SIEMENS

Supplements to system manual

System Manual

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

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The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be adhered to. The information in the relevant documentation must be observed.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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System Expansions

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## 1.1 AS-i Power24V and data decoupling units

1.1.1 Overview

AS-i Power24V is an enhancement of the AS-Interface specification. This enhancement specifies that an AS-Interface network can alternatively also be supplied with the nominal voltage of 24 V DC instead of the nominal voltage of 30 V DC that is typical for AS-i power supply units. This makes it possible to use a standard 24 V power supply unit for supplying an AS-Interface network.

AS-i Power24V is not a new bus system. The data communication remains the same so that all AS-i components work the same at operating voltages of 30 V and 24 V if they are approved for the respective voltage.

The basic change in AS-i Power24V relates to the power supply unit:
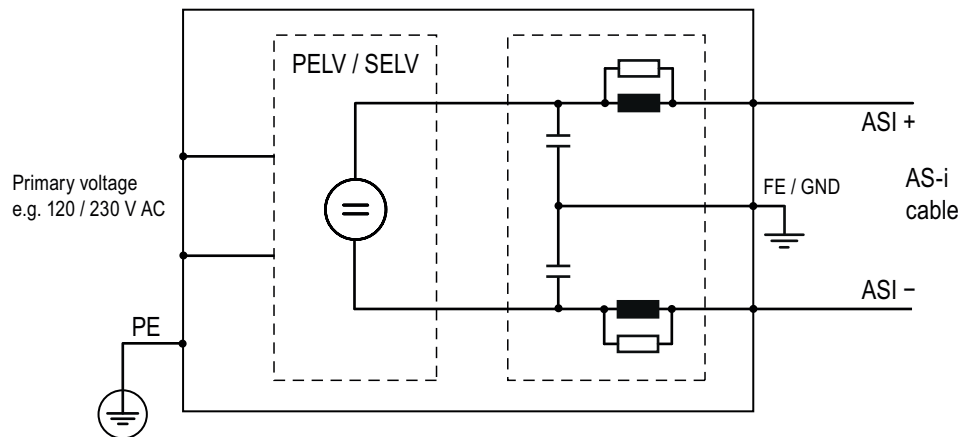
In addition to DC power generation, an AS-i power supply unit contains a data decoupling circuit, which is absolutely necessary for data communication.

As is evident from the picture, all of the operating current of the AS-Interface power supply flows through the data decoupling unit, which needs to be sized for the required current.

In an AS-i power supply unit with integrated data decoupling, the nominal currents of the DC power generation and data decoupling need to be harmonized.

The following picture shows a typical network structure with an AS-i power supply unit:

AS-i power supply unit

S7-300 with CP 343-2 / CP 343-2 P

Supply of the AS-i cable via AS-i power supply unit
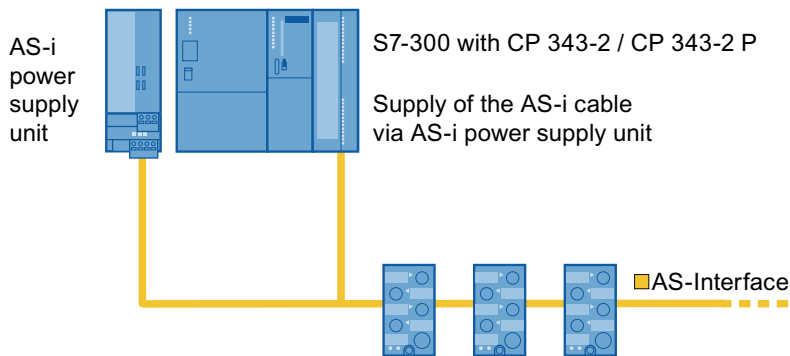
☐ AS-Interface

If an AS-i power supply unit is replaced with a standard power supply, the data decoupling needs to be looped into the AS-i cable as a separate device:

S7-300 with CP 343-2 / CP 343-2 P

Supply of the AS-i cable via standard 24 V DC power supply unit
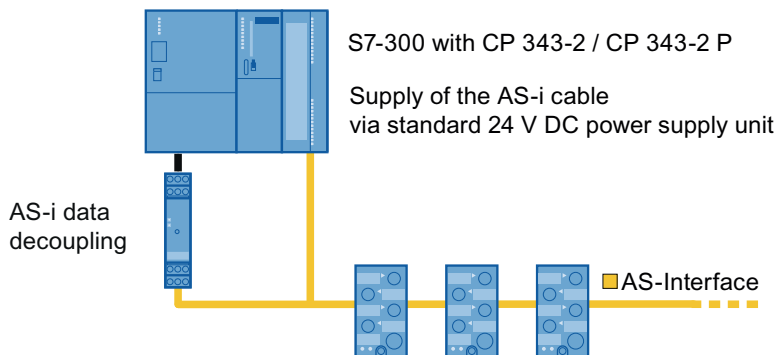
AS-i data decoupling

☐ AS-Interface

The possibility of using an existing 24 V power supply unit reduces costs and enables AS-Interface to be employed also for small applications. As a result, the advantages of AS-Interface are also of benefit for these applications.

The AS-i data quality is equally high in both operating modes. Up to 31 standard slaves or 62 A/B slaves can be connected to each, including safe slaves.

As is the case with all voltage supplies, it must be ensured that the voltage at the location of the load is high enough, i.e. the voltage drop on the AS-I cable needs to be considered. Therefore, in AS-i Power24V, the AS-i cable length is limited to 50 m.

The AS-i master, the AS-i slaves and the sensors or actuators must be suitable for low voltage.

1.1.2 The AS-Interface cable for AS-i Power24V

Shaped cable

- For AS-i Power24V, the same yellow AS-i shaped cable is used as in standard AS-i.

- The shaped cable transmits data and power.
  As with standard AS-i, the data are transported over the cable as an alternating-current component (alternating pulse modulation with 167 kHz sin² pulses), the power as a direct-current component.
  The user does not need to perform any settings for this functionality.

Number of nodes

- Up to 62 slaves, one master, and up to four additional passive nodes (without their own AS-i address) can be connected to a network.

Cable length

- The total length of the AS-i cable is limited to 50 m for AS-i Power24V.
  This limitation was set in order to limit the voltage drop on the cable so that even at the lower feed voltage a sufficiently high DC voltage level is applied to slaves and sensors.

Transmission quality

- The quality of the data signal is equally high in AS-i Power24V and standard AS-i.
  The amplitude of the alternating-current component on the cable and the transmission procedure are identical in the two versions.

Other cables

- If a round cable is used instead of the AS-i shaped cable, then in AS-i Power24V a correction factor is normally not needed for the cable length.

  The data signal (i.e. the alternating-current component) is normally high enough with a maximum cable length of 50 m.

  However, when the core cross-section is small, a greater voltage drop involving the direct current component must be taken into account.

Expansion options

- Repeater and extension plug cannot be used with AS-i Power24V.

  For the enlargement of the network span, an AS-i Power24V network structure can in principle be updated to a standard AS-i network (with nominal voltage 30 V DC) by replacing the power supply unit.

1.1.3 Voltage level on AS-i module and sensor

The voltage supplied by the power supply unit runs through several sections until it arrives at the sensor. The supply voltage level to be expected at the sensor is shown below.
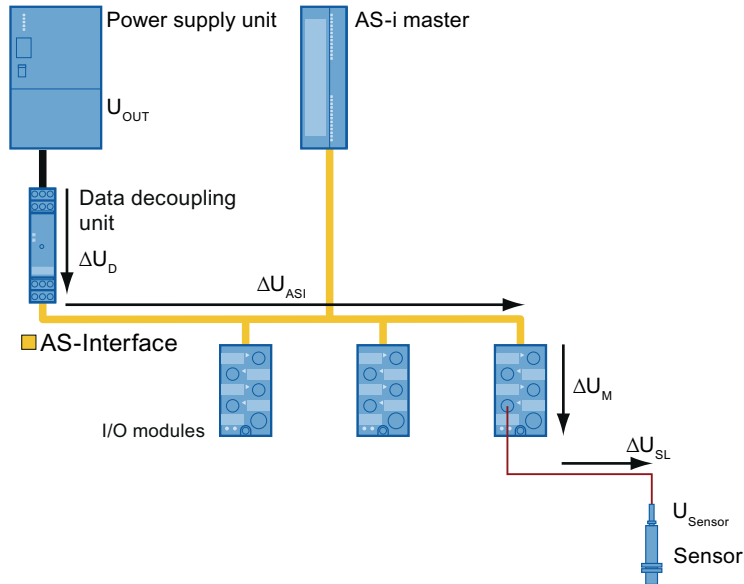

Figure 1-1   Voltage level on AS-i module and sensor

1.1.3.1 Voltage drop due to the data decoupling

The data decoupling circuit downstream from the DC power supply unit reduces the voltage fed into the AS-i cable by a maximum of 0.5 V (at maximum current):

$$\Delta U_D \approx 0,5 \text{ V}$$

ΔU_D Voltage drop of the data decoupling

1.1.3.2 Voltage drop on the AS-i shaped cable

The resistance of the AS-i shaped cable (2 x 1.5 mm²) is 0.025 Ω/m (incl. return wire).

The formula for the voltage drop ΔU on the AS-i cable generally reads:

$$\Delta U = I \times 0,025 \text{ } \Omega/\text{m} \times \ell$$

ΔU Voltage drop
I Current
ℓ Cable length

The voltage drop at a current of 1 A and a cable length of 10 m is therefore calculated to be 0.25 V.

Because the slaves are normally arranged in a spatially distributed manner along the AS-i cable, the current at the beginning of the cable (infeed) is higher than at the end of the cable (at the most distant slave). The actual voltage drop is therefore less than the value that is determined in a single calculation with total current and total cable length using the aforementioned formula.

If the slaves are evenly distributed over the linear cable and the current drain of any slave is equally high, the following formula can be used for the voltage drop ΔU_{ASI}:

$$\Delta U_{ASI} = (n+1) \text{ x } 0{,}0125 \text{ V x } \frac{I_M}{100 \text{ mA}} \text{ x } \frac{\ell_{ASI}}{10 \text{ m}}$$

ΔU_{ASI} Voltage drop at the end of the AS-i cable

n   no. of slaves

I_M current per slave module (including station service of a slave ≈ 50 mA)

ℓ_{ASI} total cable length of the AS-i cable

A network having 20 slaves equally distributed over the 50 m cable length with 150 mA current per slave therefore has a voltage drop of 21 x 0.0125 V x 1.5 x 5 ≈ 2 V on the AS-i cable.

1.1.3.3 Voltage reduction in the slave module

The AS-i module provides the supply voltage for the connected sensors. This supply voltage is drawn from the AS-i cable. For circuitry design reasons, the voltage is reduced here by approximately 4 V.

The voltage difference ΔU_M between AS-i cable and sensor supply depends on the module type and on the sensor current.

The voltage difference ΔU_M in the slave can be calculated as follows:

Module	Slave type	Voltage difference ΔU_M (type)
K45 module	Standard slave	$2{,}7 \text{ V} + (1{,}4 \text{ V x } \frac{I_{SM}}{100 \text{ mA}})$
Other module	Standard slave	$2{,}0 \text{ V} + (1{,}4 \text{ V x } \frac{I_{SM}}{100 \text{ mA}})$
K45 module	A/B slave	$2{,}7 \text{ V} + (2{,}7 \text{ V x } \frac{I_{SM}}{100 \text{ mA}})$
Other module	A/B slave	$2{,}0 \text{ V} + (2{,}7 \text{ V x } \frac{I_{SM}}{100 \text{ mA}})$

I_{SM}: Sensor current (total) of all sensors that are supplied by the module

Thus, a voltage difference of 2.7 V + 1.4 V ≈ 4 V can be estimated for a K45 module type standard slave at 100 mA aggregate sensor current.

1.1.3.4 Voltage drop on the sensor cable

The resistance of a conventional sensor cable (2 x 0.34 mm²) is 0.11 Ω/m (incl. return wire).

The following formula yields the voltage drop ΔU_{SL} on the sensor cable:

$$\Delta U_{SL} = 0{,}011 \text{ V x } \frac{I_S}{10 \text{ mA}} \text{ x } \frac{\ell_{SL}}{10 \text{ m}}$$

ΔU_{SL} Voltage drop of the sensor cable

I_S Supply current of the individual sensor

ℓ_{SL} Length of sensor supply cable

The voltage drop on the sensor cable at 25 mA current and at a sensor cable length of 10 m is therefore calculated to be $\Delta U_{SL} \approx 0.03$ V and is therefore for the most part negligible.

1.1.3.5 Voltage across the sensor

The value of the DC voltage U_{Sensor}, with which the "last sensor" is supplied results from the supplied output voltage U_{Out} of the power supply unit minus all voltage differences between power supply unit and sensor:

$$U_{Sensor} = U_{Out} - \Delta U_D - \Delta U_{ASI} - \Delta U_M - \Delta U_{SL}$$

U_{Out} Voltage supplied by the power supply unit

ΔU_D Voltage drop of the data decoupling

ΔU_{ASI} Voltage drop at the end of the AS-i cable

ΔU_M Voltage difference in the slave

ΔU_{SL} Voltage drop of the sensor cable

The voltage drop due to contact resistance is disregarded here.

1.1.3.6 Calculation examples

Example 1:

10 AS-i slaves (K45 modules type A/B slave) are installed equally distributed over the 50 m cable. 150 mA are needed for each slave (including approx. 100 mA sensor supply). The 24 V power supply unit is located at the beginning of the cable.

Approximate calculation:

Total current from the power supply unit at the beginning of the cable: 1.5 A (plus power consumption of the AS-i master, with CP343-2 max. 100 mA)

Total voltage drop at the end of the AS-i cable:	approximately 0.5 V + 1.0 V = 1.5 V
Voltage across the last slave:	24.0 V – 1.5 V = 22.5 V
Voltage across the last sensor:	22.5 V – 5.4 V = 17.1 V

Example 2:

20 slaves (K45 modules type A/B slave) are installed equally distributed over the 50 m cable. 150 mA are needed for each slave (including approx. 100 mA sensor supply). The 24 V power supply unit is located at the beginning of the cable.

Approximate calculation:

Total current from the power supply unit at the beginning of the cable: 3.0 A (plus power consumption of the AS-i master, with CP343-2 max. 100 mA)

Voltage drop at the end of the cable:	approximately 0.5 V + 2.0 V = 2.5 V
Voltage across the last slave:	24.0 V – 2.5 V = 21.5 V
Voltage across the last sensor:	21.5 V – 5.4 V = 16.1 V

Example 3:

30 slaves (K45 modules type A/B slave) are installed equally distributed over the 50 m cable. 120 mA are needed for each slave (including approx. 70 mA sensor supply). The 24 V power supply unit is located at the beginning of the cable.

Approximate calculation:

Total current from the power supply unit at the beginning of the cable: 3.6 A (plus power consumption of the AS-i master, with CP343-2 max. 100 mA)

Voltage drop at the end of the cable:	approximately 0.5 V + 2.3 V = 2.8 V
Voltage across the last slave:	24.0 V – 2.8 V = 21.2 V
Voltage across the last sensor:	21.2 V – 4.6 V = 16.6 V

1.1.3.7 Practical tips

- The sensors must be selected in such a way that the real sensor voltage is within the acceptable range of the sensor operating voltage. In practice, sensors with the standard voltage range of 10 to 30 V can be used.

- With many power supplies, the output voltage can be set slightly higher than the nominal voltage of 24 V DC, so that the voltage drop on the cable can be compensated. This setting option can also be used for AS-i Power24V.

- All AS-i Power24V components function within the overall voltage range between the nominal voltages of 24 V and 30 V. (Any exceptions are explained in the operating instructions.)

- The AS-i voltage on the Power24V-capable slave must be at least 18 V.

1.1.4   Masters and links for AS-i Power24V

The current list of masters and links that are suitable for AS-i Power24V are available in the Internet (http://support.automation.siemens.com/WW/view/en/42806066).

The following properties are important for the AS-i masters and links:

If the voltage on the AS-Interface is less than 22.5 V (+/-1 V)

● and voltage monitoring is active (delivery condition), the master generates the message "AS-i POWER FAIL" (APF) and

● stops the operation of the AS-Interface network

The slaves on the AS-Interface network switch off automatically if there is an undervoltage.

In order to ensure flawless operation of the AS-i master in an AS-i Power24V network, the voltage monitoring of the master must be deactivated.

In the delivery condition, the voltage monitoring is activated and the master is thereby preset for operation at a 30 V supply voltage.

1.1.4.1   AS-i Power24V operation of the AS-i master CP 343-2 / CP 343-2P

The modules

● CP 343−2 (6GK7 343-2AH01-0XA0) and

● CP 343−2 P (6GK7 343-2AH11-0XA0)

are released for operation with 24 V DC and 30 V DC starting with product version 02.

Voltage monitoring of the AS-i master must be deactivated for operation in an AS-i Power24V network.

The procedure is as follows:

Deactivation of the voltage monitoring on the CP 343−2 / CP 343−2 P:
(only with 6GK7 343-2AH01-0XA0 and 6GK7 343-2AH11-0XA0 with product version 02)

Step	Action	Meaning
1	Install the CP as described in the CP 343−2 / CP 343−2 P manual.	
2	Switch the power supply to the SIMATIC station off and then on again.	The CP performs a self-test when it powers up. All the LEDs on the CP light up while it is powering up. Then the LEDs go out.
3	Check the status of the voltage monitoring by the LED indicators.	There are two different cases: • Voltage monitoring is activated (delivery condition): The LEDs immediately show the operating state according to the CP 343−2 / CP 343−2 P manual • Voltage monitoring is deactivated (for AS-i Power24V operation): The two LEDs **APF** and **0** flash for approximately 2 s; then the LEDs indicate the normal operating state.
4	Keep the **SET** button depressed (approx. 5 s), until the **APF** LED flashes. **Note**: This action is only possible within 30 seconds of switching on the SIMATIC station.	Pushbutton operation detected. The device is in setting mode.
5	Release the **SET** button.	The **APF** LED flashes. Voltage monitoring status indication: • LED **1** lights up: Voltage monitoring is activated (delivery condition): • LED **0** lights up: Voltage monitoring is deactivated (AS-i Power24V mode):
6	Press the SET button briefly to change the monitoring setting (several possibilities).	The APF LED flashes. Voltage monitoring switchover: • LED **1** lights up: Voltage monitoring activated • LED **0** lights up: Voltage monitoring deactivated
7	Keep the **SET** button depressed (approx. 5 s), until the **APF** LED goes out. Heed the safety information at the end of the table.	The setting of the voltage monitoring was stored in non-volatile memory in the CP.
8	Transition to normal operation	—

NOTICE

Note regarding step 2: Canceling the power-up by pressing the SET button:

While the CP is powering up, do **not** press the **SET** button; if you press the **SET** button, the CP switches into an internal special state: A running light is started (LED **SF** - **PWR** - **APF** - **CER** - **AUP** - **CM**). Normal operation is not possible in this special state.

To cancel this special state, you must switch off the power supply of the SIMATIC station.

NOTICE
Note regarding step 7 (storing the setting in memory):
If you would like to cancel the setting of the voltage monitoring without saving it, you must shut off the SIMATIC station power supply instead of performing step 7.

NOTICE
Note regarding steps 4 to 8:
Perform steps 4 to 8 only if you would like to change the setting of the voltage monitoring.

The CP is ready for immediate operation after powering up (normal operation).
After power-up, the CP briefly indicates the setting for voltage monitoring:

Checking the setting for voltage monitoring on the CP 343−2 / CP 343−2 P:
(only with 6GK7 343-2AH01-0XA0 and 6GK7 343-2AH11-0XA0 with product version 02)

Step	Action	Meaning
1	Install the CP as described in the CP 343−2 / CP 343−2 P manual.	
2	Switch the power supply to the SIMATIC station off and then on again.	The CP performs a self-test when it powers up. All the LEDs on the CP light up while it is powering up. Then the LEDs go out.
3	Check the status of the voltage monitoring by the LED indicators.	There are two different cases: • Voltage monitoring is activated (delivery condition): The LEDs immediately indicate the operating state • Voltage monitoring is deactivated (for AS-i Power24V operation): The two LEDs **APF** and **0** flash for approximately 2 s; then the LEDs indicate the normal operating state according to CP 343−2 / CP 343−2 P manual.

Manual CP 343−2 / CP 343−2 P AS−Interface Master

The manual for the AS−Interface Master CP 343−2 / CP 343−2 P is available in the Internet: (http://support.automation.siemens.com/WW/view/en/5581657).

1.1.5　　　Slaves for AS-i Power24V

The current list of slaves that are suitable for AS-i Power24V are available in the Internet (http://support.automation.siemens.com/WW/view/en/42806066).

Here you can obtain additional information (FAQ) about the compatibility of AS-i Power24V.

No settings need to be made on the slaves with regard to AS-i Power24V.

All the Power24V slaves need to be supplied with at least 18 V AS-i voltage.

1.2 AS-i data decoupling units

1.2.1 Function overview

Using the data decoupling units

In order to supply AS-Interface from a standard power supply unit, a data decoupling unit must be connected between the voltage supply and AS-i network.

The data decoupling generates the specific signal shape of the AS-i data signals and prevents the AC voltage pulses of the data signals from being short-circuited by the DC voltage supply.

A DC voltage supply can feed several data decoupling units so that multiple AS-i networks can be operated on a single DC voltage supply.

A single data decoupling unit contains a data decoupling circuit for operating **one** AS-i network.
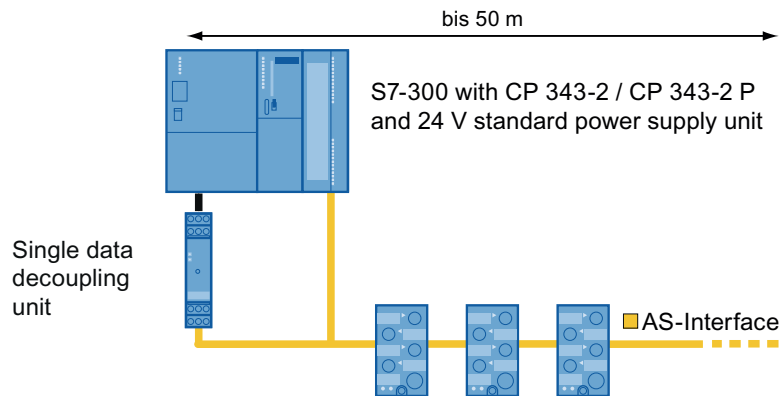

Figure 1-2   AS-i Power24V single network

A double decoupling unit contains two data decoupling circuits for the operation of **two** AS-i networks:
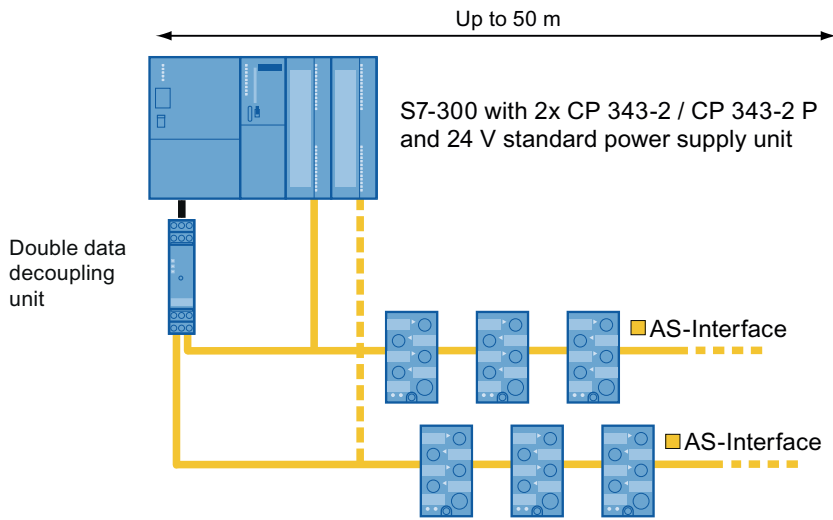

Figure 1-3   AS-i Power24V double network

As many data decoupling units as desired can be connected in parallel to a DC voltage supply in order to operate a corresponding number of AS-i networks.

The input side of the data decoupling unit is typically connected to a standard power supply with a nominal voltage of 24 V or 30 V.

Operation of the AS-Interface network on a 24 V DC voltage supply falls within the AS-i Power24V category. Because a standard 24 V power supply unit does not include a data decoupling circuit, with Power24V an additional data decoupling unit is absolutely necessary. The DC voltage supply can simultaneously supply the 24 V control voltage for the system controller (PLC) or the entire system. Obviously, the DC voltage supply must be large enough to supply all connected AS-i networks and other loads with power.

For an AS-i network with unlimited AS-i properties, a 30 V DC voltage supply must be used. This is especially necessary if the voltage level of the sensor supply is insufficient due to a voltage drop on a (longer) AS-i cable, or slaves and other AS-i components are used that are not suitable for AS-i Power24V. An AS-i power supply unit supplies a voltage of 30 V and simultaneously includes integrated data decoupling. A standard 30 V power supply requires an additional data decoupling.

If the data decoupling unit is connected to an AS-i power supply (i.e. 30 V DC voltage supply with integrated data decoupling), the data decoupling circuit integrated in the AS-i power supply becomes inactive. It is not technically possible to produce a second AS-i network by connecting a single data decoupling unit to an existing AS-i network. If a double data decoupling unit is connected to an AS-i power supply unit, two AS-i networks can be operated separately from each other on the two outputs of the double data decoupling unit.

Requirements of the DC voltage supply

The DC voltage supply needs to produce an extra low voltage according to **PELV** Standard (Protective Extra Low Voltage) or **SELV** Standard (Safety Extra Low Voltage).

The nominal voltage must be within the **24 … 30 V DC** range.

For trouble-free communication in the AS-i network, it is necessary for the DC voltage supply to have a low residual ripple:

Residual ripple $V_{ppnoise}$ < 250 mV

Modern switched mode power supplies can easily satisfy this requirement; check the residual ripple in the power supply data sheet.

Industrial power supplies from the Siemens SITOP product range are recommended.

Note

If high spurious peaks due to switching operations on the control voltage are expected, a separate power supply unit should be provided to supply the AS-i networks.

Grounded and ungrounded DC voltage

The relevant standard (EN 60204 part 1, DIN VDE 0113) prescribes a grounding or corresponding measures for control voltages (e.g. ground fault detection) to prevent dangerous movements etc. when a ground fault occurs.

Therefore, the 24 V control voltage is normally grounded, i.e., the negative pole of the DC voltage supply is connected to the system ground.

Although an AS-i network cannot have any connection to the system ground, a grounded DC voltage can be used for AS-i Power24V. This can be explained as follows:

The data decoupling separates the DC voltage from the communication signal. For fault-tolerant communication, the communication signal is transmitted symmetrically, i.e. the AC voltage signal is transmitted both to the positive pole and as a reversed-polarity signal to the negative lead. Any noise is injected equally on both conductor wires. By calculating the difference in the two transmitted signals, the desired communication signal is recaptured while the interference signals cancel each other out.

The "FE" terminal represents the reference potential for both transmitted AC voltage signals and must be connected to the system's ground in order to obtain an optimal symmetry of the AC voltage signals. An additional grounding of the supplying DC voltage, does not effect the symmetry - provided that this grounding occurs on the supply side of the data decoupling unit (terminals L+ / M). A grounding on the side of the AS-i network (terminals ASI1+ / ASI1- and ASI2+ / ASI2-) subtly disturbs the symmetry and must not be carried out.

Reverse polarity and undervoltage protection

If supply voltage (L+ / M) is connected with reversed polarity or if the supply voltage is too low (below 21 V), both outputs ASI1 and ASI2 are switched off (only with the double data decoupling unit). A supply voltage connected with reversed polarity is not transmitted to the outputs.

If the input voltage is correct, the outputs are automatically switched on.

The two outputs of the double data decoupling unit switch on with a 200 ms time differential in order to reduce the starting current for the supplying power supply.

Overload and short-circuit protection

The data decoupling unit limits the current in the AS-i network and is short-circuit proof.

When there is a short circuit or overload on an AS-i cable, the involved output ASI1 or ASI2 is switched off (electronic transistor output) and is thereby decoupled from the power source (selectivity). In the double data decoupling unit, a short circuit on one AS-i network has no effect on the other AS-i network, if the supplying power supply unit has sufficient capacity reserves.

The restart occurs automatically after about 5 seconds.

The absence of the AS-i voltage can be detected and signaled by the connected AS-i master.

The signaling contacts are not affected by a short circuit/overload.

The overload current value can be set in four stages: 2.5 A – 3.0 A – 3.5 A – 4.0 A. (with a tolerance of approx. +0.1 A). The maximum value on delivery is preset at 4.0 A. The reduction of the overload current value is only required if the supplying power supply does not yield the required output for the maximum total current of the module.

Example:

Use of a double data decoupling unit on a 24 V power supply with a nominal current of 10 A. The AS-i networks on ASI1 and ASI2 each require a maximum of 3 A, the remaining controller a max. of 4 A.

The overload current value is set by the user at 2 x 3 A for ASI1 and ASI2. When there is an overload on an AS-i cable, the supplying power supply is not overloaded, so the rest of the system continues to operate.

The shutdown in the event of an overload occurs after a delay of up to 3 s, in order to take into account starting currents. Starting at 130 % overload, the shutdown comes after just 500 ms; in the event of a short circuit, it comes after approx. 100 ms.

The supplying power supply must have corresponding reserve capacity.

Integrated ground fault detection with error log

The AC voltage signal of the data communication is symmetrically aligned with the system ground, so that interference pulses (e.g. due to switching operations) have an equal effect on the positive cable and the negative cable and as a result are automatically compensated. This noise suppression functions in principle only under the following assumptions:

● The ground terminal on the data decoupling unit must be connected to the system ground. This connection produces the required balancing.

● The AS-i cable must not be connected at any point to the system ground. Because the sensor supply is transferred from the AS-i cable, the sensor cable also must not be connected to the system ground. A capacitive connection (capacitor for the ground) is not allowed.

If any of these assumptions is not satisfied, the AS-Interface system becomes susceptible to disturbances. Depending on the impedance of a ground fault, sporadic communication faults or complete failure can occur on an AS-i cable or a sensor cable.

Note

The functionality described above regarding the system ground also applies analogously for AS-i networks that are operated with a conventional AS-i power supply (with integrated data decoupling): The ground terminal (GND) on the AS-i power supply unit must be connected to the system ground in order to suppress faults.

In order to reliably detect a ground fault, the data decoupling unit has an integrated ground fault detection. If a ground fault is detected, an internal error log is set and a relay signaling contact is closed, which is routed to the outside via terminals. The status LED on the module indicates via a yellow flashing light that the error log is set. A yellow continuous light indicates that the ground fault is currently still present. Short-term ground faults which occur, for example, when the cable insulation gets crushed, are also recorded via the error log.

The error log must be reset by the user after the ground fault has been eliminated. After the reset, the relay contact is opened again. Resetting is not possible when the ground fault is still present. Resetting can be done by pressing the button (RESET/TEST) on the module or via potential-free terminal input (Y1, Y2).

The ground fault detection of the data decoupling unit functions both with an ungrounded voltage and if the DC voltage supply of the data decoupling unit (terminals L+ and M) is grounded. The detection circuit detects only ground faults on the wiring system that is connected to the ASI terminals. Because the ground fault detection evaluates the communication signals, it is absolutely necessary for the function of the ground fault detection that an AS-i master be connected and turned on.

In order to ensure the availability of the system, a ground fault should be eliminated immediately.

By appropriate external wiring of the signaling contacts, the supply of the AS-i network can be interrupted in the event of a ground fault. The provisions of the relevant standard are to be heeded here; see for instance EN 60204 part 1, DIN VDE 0113:
"Ground faults in any control circuit must not lead to inadvertent start-up or potentially hazardous movements or prevent the stoppage of the machine."

Note

The ground fault detection module 3RK1408-8KE00-0AA2 or 3RK1408-8KG00-0AA2 that is still provided can only be used in AS-i networks with ungrounded DC voltage supply. For AS-i Power24V, this separate ground fault detection module is not necessary because the data decoupling unit has integrated ground fault detection.

Setting the AS-i address

The AS-i data decoupling unit does not have an AS-i address.

1.2.2   Order numbers

Data decoupling unit

Version	Order number
Single data decoupling unit, screw-type connection, 1 x 4 A	3RK1901-1DE12-1AA0
Single data decoupling unit, spring-loaded connection, 1 x 4 A	3RK1901-1DG12-1AA0
Double data decoupling unit, screw-type connection, 2 x 4 A	3RK1901-1DE22-1AA0
Double data decoupling unit, spring-loaded connection, 2 x 4 A	3RK1901-1DG22-1AA0

Accessories

Designation	Order number
Plug-in lugs for screw mounting	3RP1903

1.2.3   Connecting

Terminal assignment of the data decoupling unit

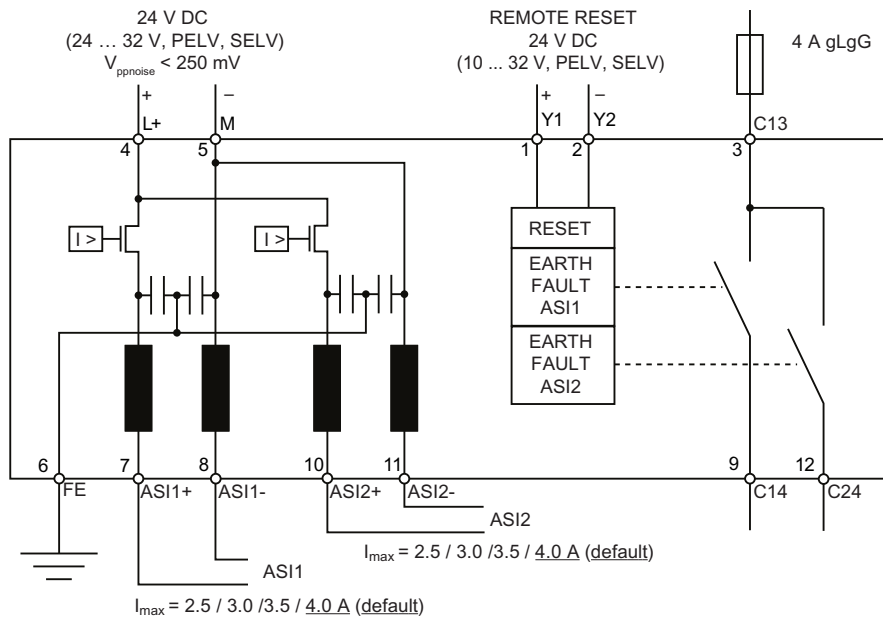| Order number		Connections		
3RK1901-1DE12-1AA0 3RK1901-1DG12-1AA0	3RK1901-1DE22-1AA0 3RK1901-1DG22-1AA0	Screw Spring- loaded		Designation
		4	L+	Supply voltage 24 V DC (24 … 32 V, PELV, SELV, $V_{ppnoise}$ < 250 mV)
		5	M	
		1	Y1	Remote Reset Y1 = +, Y2 = –
		2	Y2	
		7	ASI1+	AS-Interface network1 terminal
		8	ASI1–	
		10	ASI2+	AS-Interface network 2 terminal (only with double data decoupling unit 3RK1901-1D.22)
		11	ASI2–	
		3	C13	Ground fault detection signaling contact: C13-C14 for AS-Interface network 1 C13-C24 for AS-Interface network 2 (closed contact = ground fault detected)
		9	C14	
		12	C24	
		6	FE	Terminal for system ground

Note

The connection of the "FE" terminal to the system ground is absolutely necessary for trouble-free operation.

## Wiring of the single data decoupling unit

I_{max} = 2.5 / 3.0 / 3.5 / 4.0 A (default)
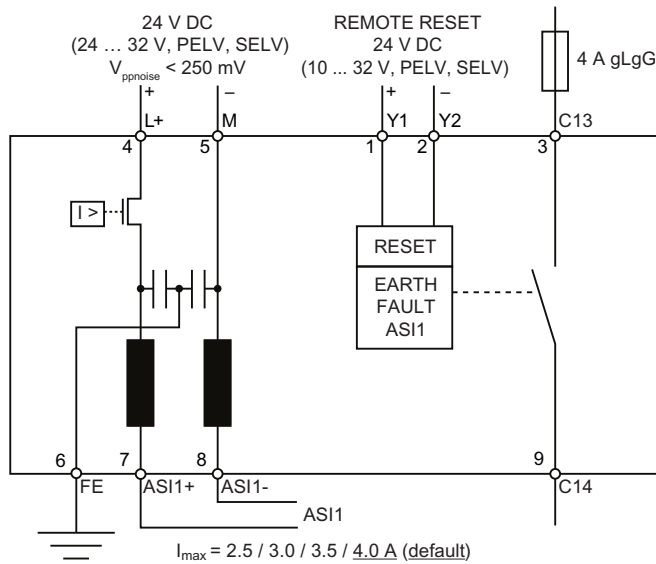
Wiring of the double data decoupling unit

I_{max} = 2.5 / 3.0 /3.5 / 4.0 A (default)
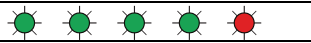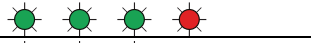
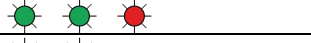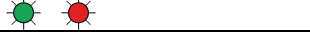I_{max} = 2.5 / 3.0 /3.5 / 4.0 A (default)

1.2.4 Configuration and operation

Overload current value setting

The set overload current value can only be changed when the supply voltage is turned on. Carry out the following steps:
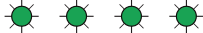
Step	Action / Reaction
1	Activate setting mode by holding down the button (⬜ approximately 3 … 5 seconds) while the voltage L+ is switching on; the **PWR** LED rapidly flashes green (4 Hz)
2	LED **ASI1** flashes green one to four times, then once red. This sequence is continuously repeated. The number of green flashing signals represents the current value according to the table below.
3	Change the current value by pressing the button (∥ approximately 0.5 s) briefly: 4.0 A → 3.5 A → 3.0 A → 2.5 A → 4.0 A etc.
4	Save the new current value for ASI1 by pressing and holding down the button (⬜ approximately 3 … 5 s).
In the double data decoupling unit, the LED **ASI2** then begins to flash, and you can set the new current value for ASI2 as described in steps 2 to 4.	
Completion	Then the program exits setting mode and normal operation is started.

Flashing sequence STATUS ASI1 / ASI2		I_{max} for ASI1 or ASI2
🟢 🟢 🟢 🟢 🔴	green/red	**4.0 A** (delivery condition)
🟢 🟢 🟢 🔴	green/red	3.5 A
🟢 🟢 🔴	green/red	3.0 A
🟢 🔴	green/red	2.5 A

Checking the set overload current value

Checking the set overload current value is possible during operation. Proceed as follows:

Step	Action / Reaction
1	Make sure that there are no ground fault signals (no yellow LED indications; see Diagnostics below. Press the button briefly (∥ approximately 0.5 s) during operation to activate display mode:
2	Observe the flashing behavior of the LEDs: LED **ASI1** flashes green 1 to 4 times. The number of green flashing signals represents the current value according to the table below
In the double data decoupling unit, the LED **ASI2** then begins to flash, and you can read the current value for ASI2 as described under step 2.	
Completion	Then the program exits display mode. If necessary, the setting can be checked again; see step 1.

Flashing sequence STATUS ASI1 / ASI2		Imax for ASI1 or ASI2
🟢 🟢 🟢 🟢	Green	**4.0 A** (delivery condition)
🟢 🟢 🟢	Green	3.5 A
🟢 🟢	Green	3.0 A
🟢	Green	2.5 A

Testing the signaling contacts

The relay contacts C13 / C14 and C13 / C24 (only with double data decoupling unit) can be switched on manually for testing the external wiring.
To do this press the button in normal operation (after powering up) and keep it pressed for 3 to 5 s ⌐⌐. Inside the device, a ground fault is simulated on an AS-i network and the error log is set. The AS-i network itself is **not** grounded here. Just like after a real ground fault, the status LED flashes yellow and the signaling contact is closed.

To reset the error log, the button must be pressed briefly ⌐ or a remote reset is activated. If a real ground fault is present, the error log cannot be reset.

In the double data decoupling unit, the button must be pressed a second time and held down ⌐⌐ in order to also simulate a ground fault on the second AS-i network. The associated status LED flashes yellow, and the associated signaling contact is closed. The status of the other error log or signaling contact is irrelevant here. The signaling contacts in this context can be switched on individually (by interim reset) or else together.

Remote reset

In addition to the button on the device, the error log can be reset via a pulse on the remote reset input (terminals Y1 / Y2).

The remote reset pulse must be present as a HIGH signal for at least 100 ms in order to execute a reset. In order to be able to trigger a new remote reset, a LOW signal must be present on the remote reset input for at least 100 ms.

1.2.5 Diagnostics

LED indication: PWR

PWR	Possible cause	Possible remedial measures
Green	Normal operation, input voltage OK	—
Flashing green (1 Hz)	Input voltage at L+ / M too low, AS-i outputs switched off	Check input voltage
Rapidly flashing green (4 Hz)	Mode for current setting active, (activation only possible while powering up)	Terminate setting mode and switch to normal operation
Off	No voltage at L+ / M, voltage at L+ / M with reversed polarity	Switch on, correctly connect input voltage

Display LEDs: STATUS ASI 1,
STATUS ASI 2 (only 3RK1901-1DE22-1AA0, 3RK1901-1DG22-1AA0)

STATUS ASI 1 STATUS ASI 2	Signaling contact switch position C13 / C14 or C13 / C24	Possible cause	Possible remedial measures
Off	Signaling contact open	Normal operation, everything OK	—
Yellow	Signaling contact closed	Ground fault is present	Check wiring, check insulation of the AS-i- and sensor cables for damage
Flashing yellow (1 Hz)	Signaling contact closed	Ground fault eliminated, memory has not yet been reset	Briefly press **TEST / RESET** button (approx. 0.5 s) or activate remote reset
Red	Signaling contact open	Overload / short circuit on AS-i cable AS-i output switched off, (automatic restarting)	Check power requirement of the modules and sensors; Check AS-i cable for short circuit
Flashing red/yellow (1 Hz)	Signaling contact closed	Overload/short circuit and ground fault stored	Check power requirement of the modules and sensors. Check AS-i cable for short circuit. Briefly press **TEST / RESET** button (approx. 0.5 s) or activate remote reset.

Table applies only for normal operation (LED **PWR** continuous lit green)

Signaling contacts

The single data decoupling unit has a relay contact (terminals C13 / C14) in order to signal a ground fault on the AS-i network.

The double data decoupling unit has two relay contacts (terminals C13 / C14 for ASI1 and C13 / C24 for ASI2) for separate signaling of a ground fault on the respective AS-i network. The contacts (C13) have a common root.

The signaling contact is closed if a ground fault has been identified.

The signaling contact is only reopened once the ground fault is no longer present and the button has been briefly pressed (resetting the error log) or the supply voltage has been switched off.

The button acts on both signaling contacts or error logs.

TEST/RESET button

Pressing briefly (approx. 0.5 s) in normal operation

With ground fault signal (status LED yellow):
- stored ground fault is reset (only possible if ground fault is no longer present)

Without ground fault signal:
- check of the set overload current values (see above)

Pressing and holding (approx. 3 ... 5 s)

- simulation of a ground fault signal, separately for ASI1 and ASI2 (sequentially by pressing repeatedly), no physical ground fault is produced on AS-i here (see above)

During power-up:
- setting the overload current values (see above)

1.2.6   Technical data

Order number	3RK1901-1DE12-1AA0	3RK1901-1DG12-1AA0	3RK1901-1DE22-1AA0	3RK1901-1DG22-1AA0
Version	Single data decoupling unit		Double data decoupling unit	
Type of connection	Screw-type connection	Spring-loaded connection	Screw-type connection	Spring-loaded connection
Enclosure design	SlimLine 22.5			
Electrical data				
Input voltage (L+, M) Voltage range Residual ripple $V_{ppnoise}$	24 V DC PELV, SELV 24 … 32 V < 250 mV			
Load current I_{max} (per AS-i network), adjustable	2.5 / 3.0 /3.5 / 4.0 A (default)			
Signaling contacts: External fuse max.	4 A gL/gG			
Signaling contacts: Switching capacity I_e at U_e DC-13 AC-15	24 V 1.0 A 3.0 A			
Overload protection (ASI1, ASI2)	✓			
Short-circuit protection (ASI1, ASI2)	✓			
Polarity reversal protection (L+, M)	✓			
Undervoltage protection (L+, M)	✓			

Derating curve
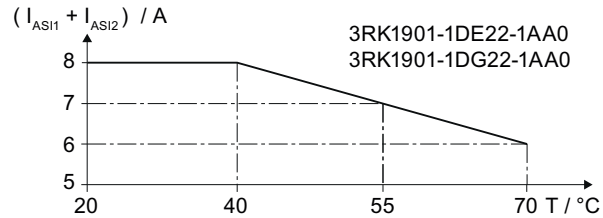
$(I_{ASI1} + I_{ASI2})$ / A

3RK1901-1DE22-1AA0
3RK1901-1DG22-1AA0

Order number	3RK1901-1DE12-1AA0	3RK1901-1DG12-1AA0	3RK1901-1DE22-1AA0	3RK1901-1DG22-1AA0
Mechanical data				
Degree of protection	IP20			
Dimensions (WxHxD) in mm	22.5 x 101.3 x 116.1	22.5 x 104.9 x 116.1	22.5 x 101.3 x 116.1	22.5 x 104.9 x 116.1
Shock stressing (IEC 60068-2-6)	15 g / 11 ms			
Shock stressing (IEC 60068-2-27)	5 ... 500 Hz 5 ... 26 Hz: 0.75 mm amplitude 26 ... 500 Hz: 2 g			
Rated temperature T_a	25 °C			
Ambient temperature T_a	-25 ... +70 °C			
Storage temperature T_s	-40 ... +85 °C			
Ground connection	✓			
Approvals	CE: available soon UL, CSA			

For information on additional properties, please refer to the current data sheet which is available in the Internet:

| Order No.: |
|---|
| 3RK1901-1DE12-1AA0 (http://support.automation.siemens.com/WW/view/en/3RK1901-1DE12-1AA0/td) |
| 3RK1901-1DG12-1AA0 (http://support.automation.siemens.com/WW/view/en/3RK1901-1DG12-1AA0/td) |
| 3RK1901-1DE22-1AA0 (http://support.automation.siemens.com/WW/view/en/3RK1901-1DG12-1AA0/td) |
| 3RK1901-1DG22-1AA0 (http://support.automation.siemens.com/WW/view/en/3RK1901-1DG22-1AA0/td) |

1.2.7 Dimension drawings

Dimensions of the data decoupling unit with screw-type connection
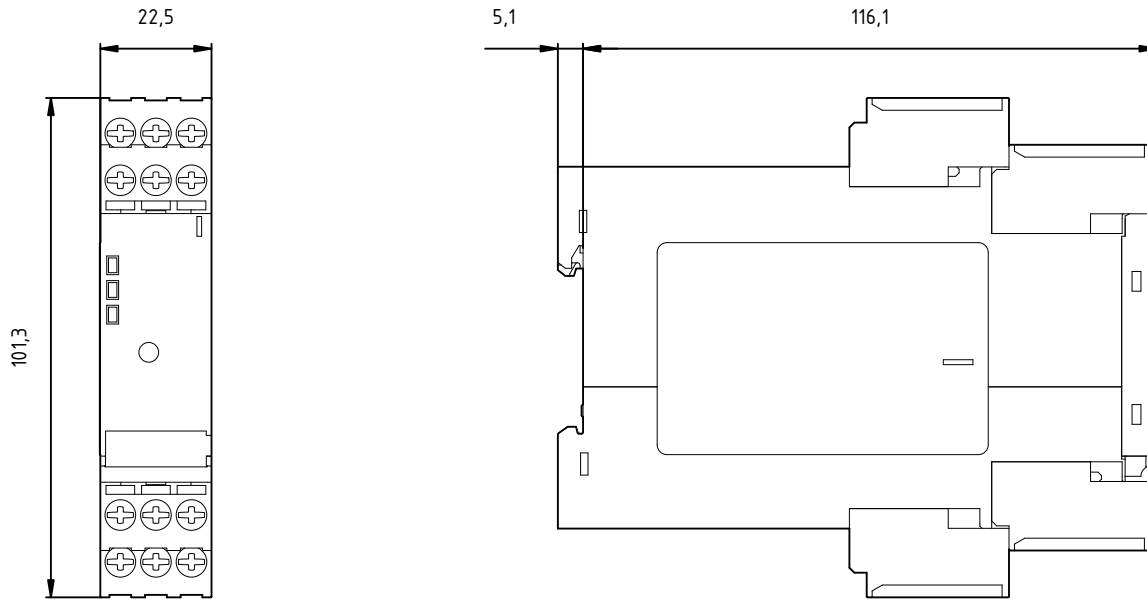
Dimensions of the data decoupling unit with screw-loaded connection
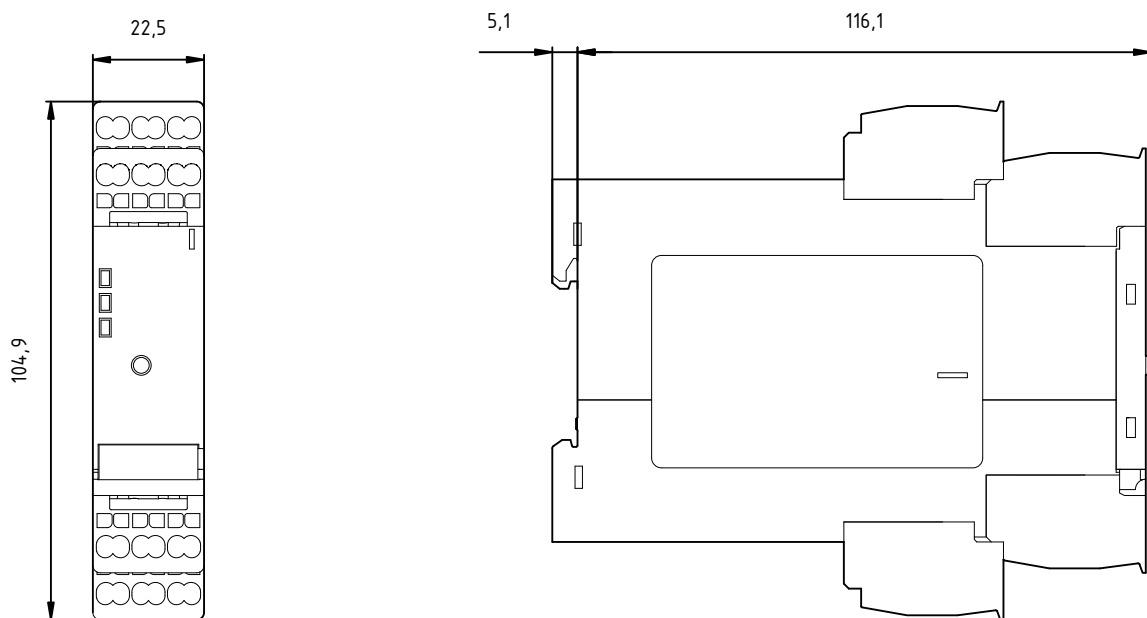
ASIsafe: Safe AS-i outputs

<div align="right">

2

</div>

2.1 Safe SlimLine module S45F

The ASIsafe concept enables the integration of safety-oriented components like EMERGENCY STOP operator panels, protective door switches or safety light arrays in an AS-Interface network. These are fully compatible with the standard AS-Interface components (master, slaves, power supply unit, repeater, etc.) in accordance with IEC 62062/EN 50295 and are operated together on the yellow AS-Interface cable. The technology of the safe AS-i outputs enhances ASIsafe.

In addition to the acquisition and evaluation of safe signals, now a safety-oriented decentralized shutdown is possible directly via AS-Interface.

A fail-safe controller or special master is not required. The evaluation of the safe signals is performed in the AS-i safety monitor. The master treats safety slaves like all the other slaves and receives safety data for information purposes only. This means that all existing AS-Interface networks can also be enhanced. ASIsafe ensures that a maximum response time of 40 ms can be achieved. This is the time between the signal being applied to the input of the safe slave and the output on the safety monitor being switched off. In decentralized shutdown via a safe AS-i output, the response time is extended by the time that the safe AS-i output needs in addition to the shutdown. The maximum response time is then at 70 ms.

Tested safety

The system has been tested and approved for use by TÜV (Germany), NRTL (USA), and INRS (France). The transmission procedure for safety-oriented signals is designed in such a way that the applications up to Category 4 in accordance with EN 954-1, up to PL e in accordance with EN ISO 13849-1 and up to SIL 3 in accordance with IEC 61508 can be implemented.

Configuration

The configuration of safety technology is identical to the installation of AS-Interface that is known today. The family of the safe AS-Interface products consists of the safety monitor, which monitors or shuts down the safe nodes. The spectrum of safe nodes consists of the safe modules and the safety-oriented sensors with integrated interface. Sensors, monitors and safe AS-i outputs can be connected at any points of the AS-Interface network. More than one monitor can also be used in a network.

The components ASIsafe

Standard PLC and Standard AS-i master:
The centralized configuration on the PLC as well as distributed configuration via DP-AS-i links is possible.

Safety monitor:
The safety monitor evaluates all safe inputs on the AS-i bus and provides for safe shutdown.

Safe input slave:
Safe signals are made available for evaluation via the safe slaves and, for example, the safety monitor.

Safe AS-i outputs:
The shutdown signal, e.g. of the safety monitor can be used via ASIsafe for safety-oriented shutdown of distributed safe AS-i output**s.**

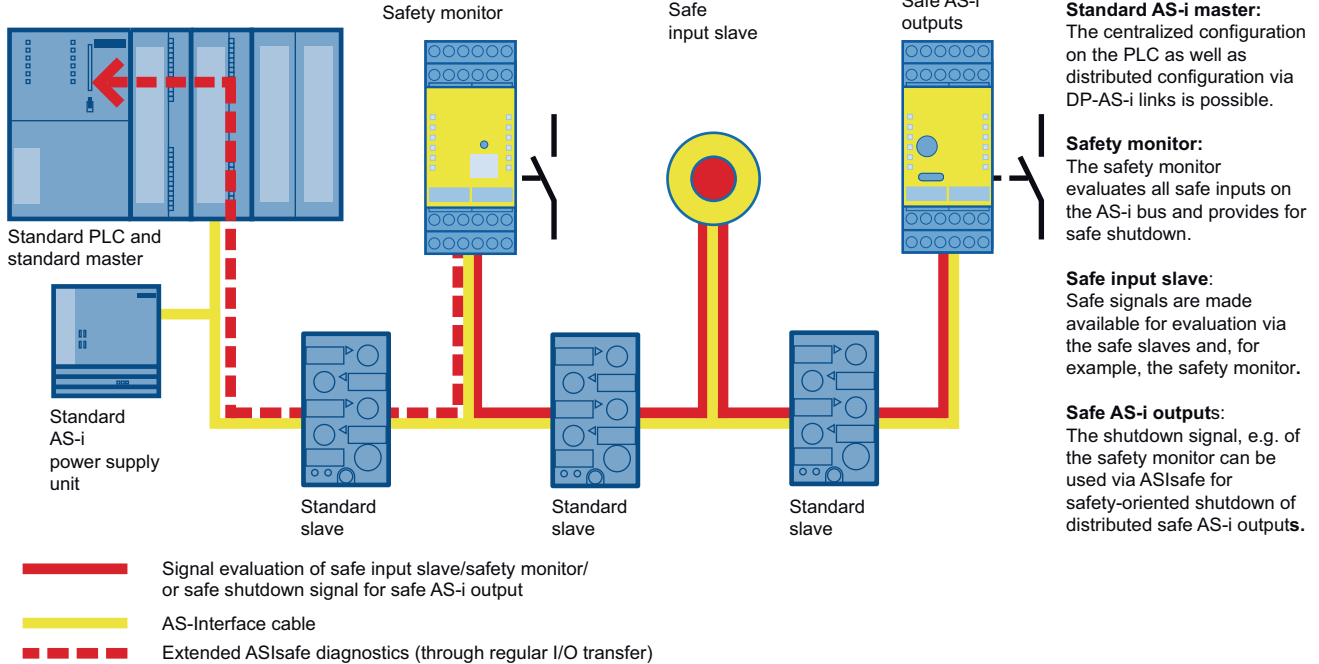|	Signal evaluation of safe input slave/safety monitor/ or safe shutdown signal for safe AS-i output
	AS-Interface cable
	Extended ASIsafe diagnostics (through regular I/O transfer)

Figure 2-1   The ASIsafe components and their signal flows

Function

The safe nodes transmit their information according to the master call, like the standard nodes, to the master. The safety monitor monitors this transmission from the safe nodes to the master and switches into the safe state or transmits a shutdown signal to one or more decentralized safe AS-i outputs, which on their part switch into the safe state. The safety monitor enables various functions, such as OR logic, AND logic, timer functions, buffers, etc.

Software

With the ASIMON configuration software, the safety-oriented applications can be configured and transferred to the monitor. The configuration consists of the input signals of the safe nodes, the internal functions of the safety monitor as well as the assignment of the address for the control of a safe decentralized output. The software also supports online diagnostics.

Integration

For the integration of the safety technology into AS-Interface, the existing infrastructure, like the master and the power supply unit, can still be used. For the safety technology, the safety monitor is integrated as a monitoring element and the safe nodes as an interface between the safe sensors and the system. The safe sensors can be used as before. With ready-to-use function blocks that are supplied with the ASIMON configuration software, a detailed diagnosis of all parameterized blocks is possible. To do this, an AS-i address needs to be assigned to the safety monitor via the configuration software. The evaluation is done via function blocks in the PLC. Using preconfigured WinCC flexible blocks, this evaluation can then be visualized on a system-wide basis on existing HMI devices (starting with OP/TP 270).
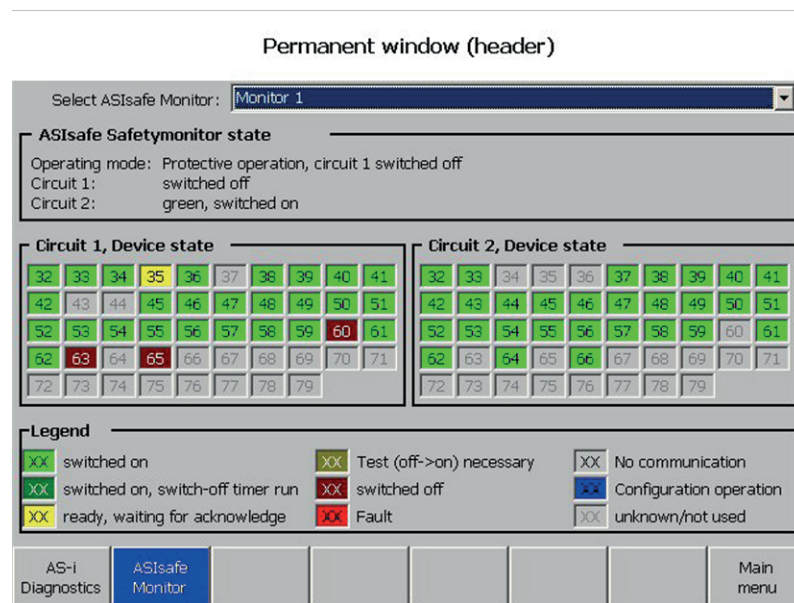

Figure 2-2   Diagnostics interface for ASIsafe components via S7-200 or S7-300

2.1.1 Functional principle

The basis for the safe switching of an actuator is the safety monitor. The functional principle of the safety monitor is described in the AS-Interface System Manual, Edition 11/2008 Chapter 9.1. You can view or download the system manual here (http://support.automation.siemens.com/WW/view/en/26250840).

The functional principle for safe switching of an actuator via a decentralized AS-i output comprises four steps:

1. Acquisition of the safe signals via a safe input slave (e.g. Emergency Stop):

   The safe slave transmits a safe code sequence (8x4 bit). For a safety-oriented transmission of information, each safe input slave has a unique code sequence, which is saved (by teaching) in the safety monitor during commissioning.

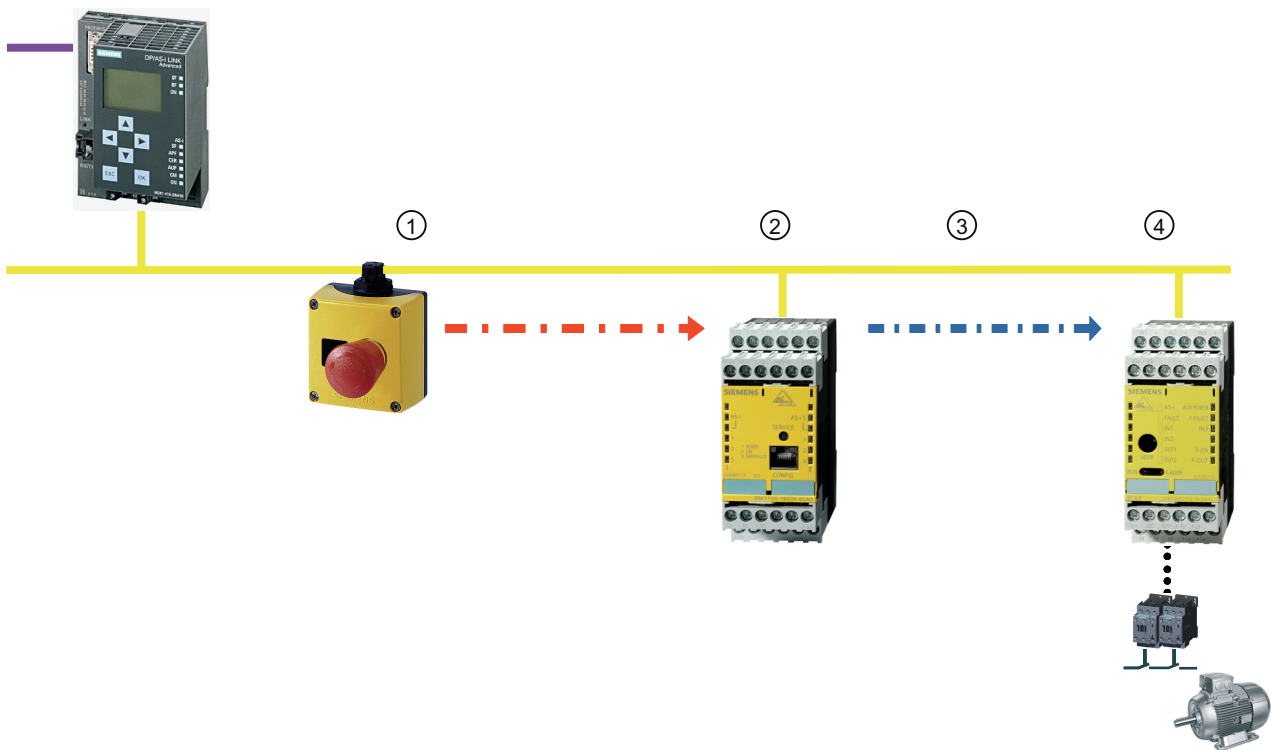2. Evaluation of the safe signals by the safety monitor:

   The function of the safety monitor is parameterized using the ASIMON configuration software. During operation, the safety monitor compares the actual state of the received code tables of all assigned safe input slaves with the stored desired state. According to the evaluation of this safety information, the safety monitor switches its enabling circuit on or off in a safety-oriented manner.

3. Forwarding the enabling or shutdown information to a decentralized safe output:

   The enhanced safety monitor with integrated safe slave 3RK1105-1BE04-4CA0 or 3RK1105-1BG04-4CA0 is required for the forwarding of the enabling or shutdown information. This optionally controls a safe AS-i output according to the switching state of its second enabling circuit. For this purpose, the safety monitor emulates a safe slave, which transmits a specific code sequence (7x4 bit) as a function of the state of the second enabling circuit. In contrast to the code sequences of the safe input slaves, which differ for each slave, the 7x4 bit code sequence for controlling a decentralized safe output depends exclusively on the address assigned to the emulated slave. Teaching of the code sequences as in the case of the safe input slaves is thus not necessary for safe outputs.

4. Decentralized switching of the actuators via safe output slave:

   The safe output slave evaluates as a passive listener the 7x4 bit code sequence which the slave emulated in the safety monitor transmits. The address of the slave emulated in the safety monitor is set in the safe output slave. This ensures a unique assignment between safe output slave and safety monitor. If the safety monitor has enabled the second enabling circuit, the safe output slave receives this information via the 7x4 bit code sequence. If it is correctly received, the safe output slave activates the connected actuator via its safe output. Thus, the safe output slave always assumes the same state as the second enabling circuit of the assigned safety monitor.

1	Acquisition of the safe signals via a safe input slave (e.g. Emergency Stop)
2	Evaluation of the safe signals by the safety monitor
3	Forwarding the enabling or shutdown information to a decentralized safe output
4	Decentralized switching of the actuators via safe output slave

Figure 2-3   Functional principle ASIsafe with safe output slave

Behavior during communication faults

If, as a result of a communication fault, the enabling signal does not arrive or does not arrive correctly at the safe output slave, it shuts down its output as a safety measure. A fault tolerance provided in the system thereby prevents the shutdown of the output during very brief faults. After a fault, the user needs to acknowledge the fault for safety reasons.

In order to signal a shutdown after a fault to the user, the safe output slave also has an integrated A/B slave. Via this slave, the waiting for an acknowledgment after a shutdown because of a fault is communicated over the bus. If the user does the acknowledgment, the safety monitor produces acknowledgment signals (help signals 1 and 2), which are transmitted by specific modification of the 7x4 bit code sequence to the safe output slave. It switches the actuator back on after receipt of the acknowledgment.

## Generating the acknowledgment signals

For the acknowledgment after a communication fault, two different help signals are available. In this context, a distinction is made according to the duration of the communication fault:

- Communication faults >140 ms require help signal 1 (reset of error condition) as an acknowledgment

- Brief communication faults <140 ms require help signal 2 (restart) as an acknowledgment

This distinction enables the auto-acknowledgment of brief faults, because help signal 2 (restart) can also be transmitted continuously during operation. The conditions for transmitting the help signals are parameterized in the ASIMON configuration software.

Configuration examples

With an enhanced safety monitor with integrated safe slave, a safe output slave can be activated. In addition, the two relay outputs of the safety monitor can be used for local shutdown.
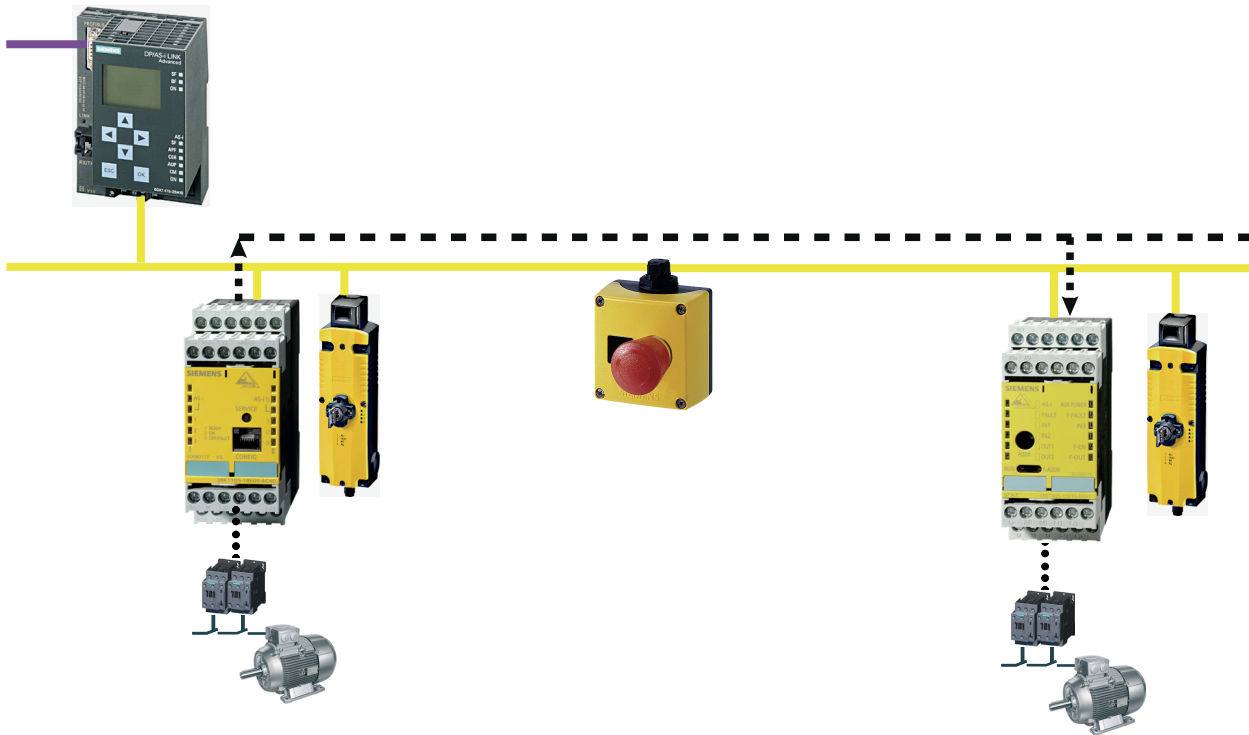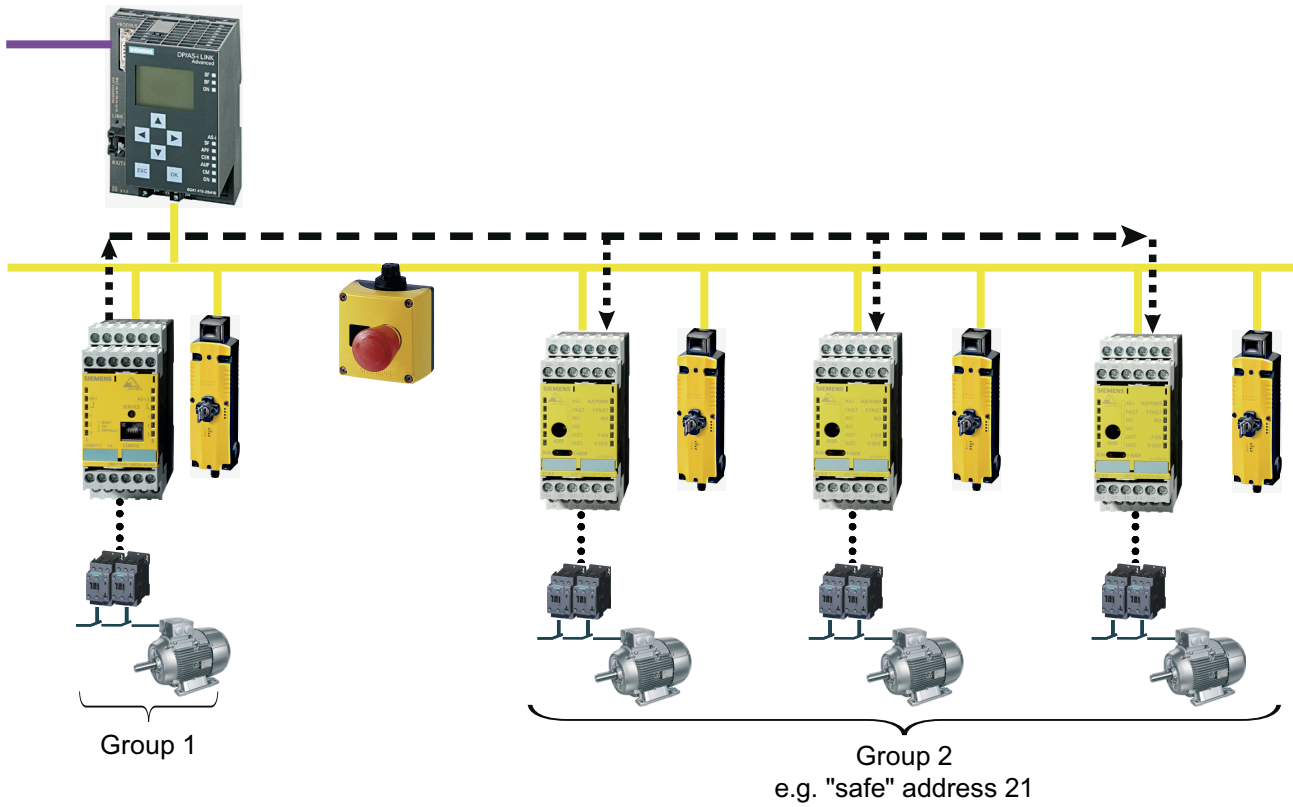

OSSD 1: local shutdown

OSSD 2: decentralized shutdown via safe output and/or local shutdown

Figure 2-4   Activation of a safe output slave with a safety monitor

To be sure any safety monitor can transmit only one shutdown or enabling signal for decentralized safe shutdown. However, multiple safe output modules can also evaluate this information together. Therefore, a safety monitor can jointly switch a group of safe output slaves.
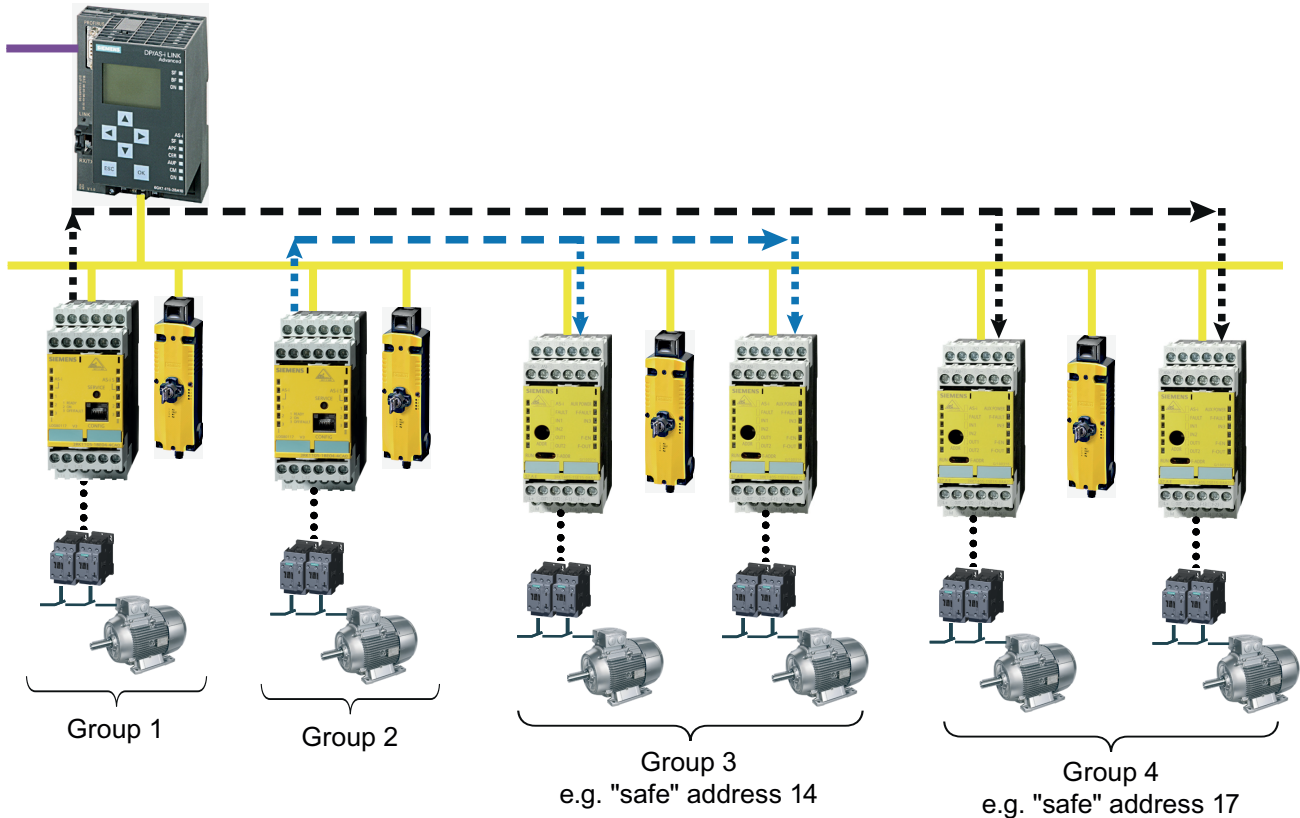

OSSD 1: local shutdown

OSSD 2: decentralized shutdown of all safe outputs together and/or local shutdown

Figure 2-5   Activation of a group of safe output slaves with a safety monitor

If two or more safe output slaves are to be controlled independently of each other, two or more safety monitors are needed. This applies accordingly for groups of safe output slaves.

OSSD 1: local shutdown for each (groups 1 and 2)

Monitor 1 OSSD 2: decentralized shutdown of safe outputs group 3

Monitor 2 OSSD 2: decentralized shutdown of safe outputs group 4

Figure 2-6   Activation of two groups of safe output slaves with two safety monitors

2.1.2   Overview
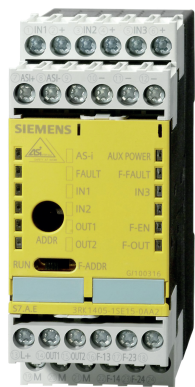
The safe ASIsafe SlimLine module S45F is used for safe switching of an actuator. For this purpose, the device has a 2-channel safe output with which a safety-oriented shutdown up to Category 4, SIL3 or PLe can be achieved. The device receives the enabling or shutdown signal from the enhanced safety monitor with integrated slave. It simulates a safe slave, which transmits a corresponding code sequence independently of the state of its enabling circuit 2. The safe ASIsafe module S45F evaluates this code information and switches the safe output accordingly.

In addition, the module has an integrated A/B slave. In addition to the diagnostics feedback, this slave enables the functional switching of the enabling circuit and beyond that provides 3 digital inputs and 2 digital outputs.

2.1.3 Function

2 addresses are assigned to the S45F ASIsafe module for its operation. The safety-related address is used for the assignment of the simulated slave of the safety monitor to which the enabling circuit of the module is to react. The second address is needed for the standard inputs and outputs, for the functional switching and for the device diagnostics. The address is set according to the following sequence:

1. Setting the safety-related address. For this purpose set the switch on the front of the device to **F-ADDR**.

2. Set the desired safety-related address via AS-i addressing device or AS-i master.

3. Check the set safety-related address:

   – Read the profile via AS-i addressing device or AS-i master.

   – The ID code must be "F".

   – The ID1 code must correspond to the tens digit of the address.

   – The ID2 code must correspond to the units digit of the address.

   – The IO code must be "7".

     Example: Address 24 is set as a safety-related address.
     The profile that is read must then be as follows:

     ID-Code = F, ID1-Code = 2, ID2-Code = 4, IO-Code = 7

4. If the codes do not match, repeat steps 2 and 3. If the codes again do not match, replace the device.

5. Set the device switch on **RUN**

6. Set the standard address (switch in position **RUN**):

   – Set the desired address via AS-i addressing device or AS-i master. No checking of the set address is required.

The safety function is parameterized via the safety monitor using the ASIMON configuration software. The ASIsafe module S45F always switches the enabling circuit identically to the state of the enabling circuit OSSD 2 of the safety monitor. The S45F ASIsafe module is assigned to the safety monitor via setting of the safety-related address. The response time of the entire system (from the moment of the shutdown request on the safe input to the moment at which the output has switched off) is at a max. of 70 ms (worst case). For the assignment of the S45F ASIsafe module to the respective safety monitor, the same safety-related address is set via the ASIMON configuration software in the safety monitor.
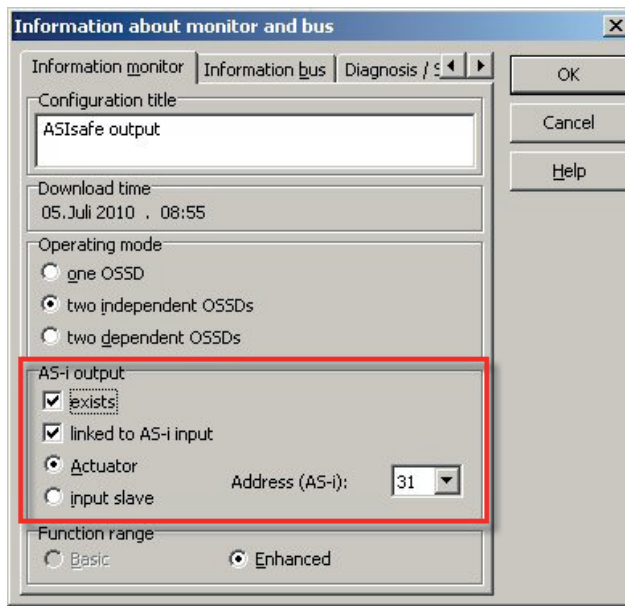
Figure 2-7   Setting the safety-related address (F-Addr.) in the ASIMON configuration software

In addition, the enabling circuit of the S45F module can also be switched during operation. The functional switching is activated via the parameter bit P1. Where:

- P1 = 0 functional switching activated

- P1 = 1 functional switching deactivated
  (Default = deactivated)

If functional switching is activated, the enabling circuit via the output OUT3 of the integrated A/B slave can be controlled via the AS-i master (the requirement is that the safe enabling information from the safety monitor is correctly received).

If the transmission of the enabling information is disrupted by the safety monitor, the module safely shuts down the output. For a restart, a corresponding help signal is needed independent of the duration of the communication fault. The following is applicable:

- Duration of a communication fault >140 ms requires help signal 1 ("reset of error condition")
- Duration of a communication fault <140 ms requires help signal 2 ("restart")

The help signals are transmitted via the safety monitor using the code sequence of the simulated safe slave. The conditions for transmitting the help signals are set during the parameterization of the safety monitor in the ASIMON configuration software. In so doing, it is possible to transmit the help signal 1 ("restart") continuously. Therefore, communication faults up to 140 ms in duration can be automatically acknowledged.
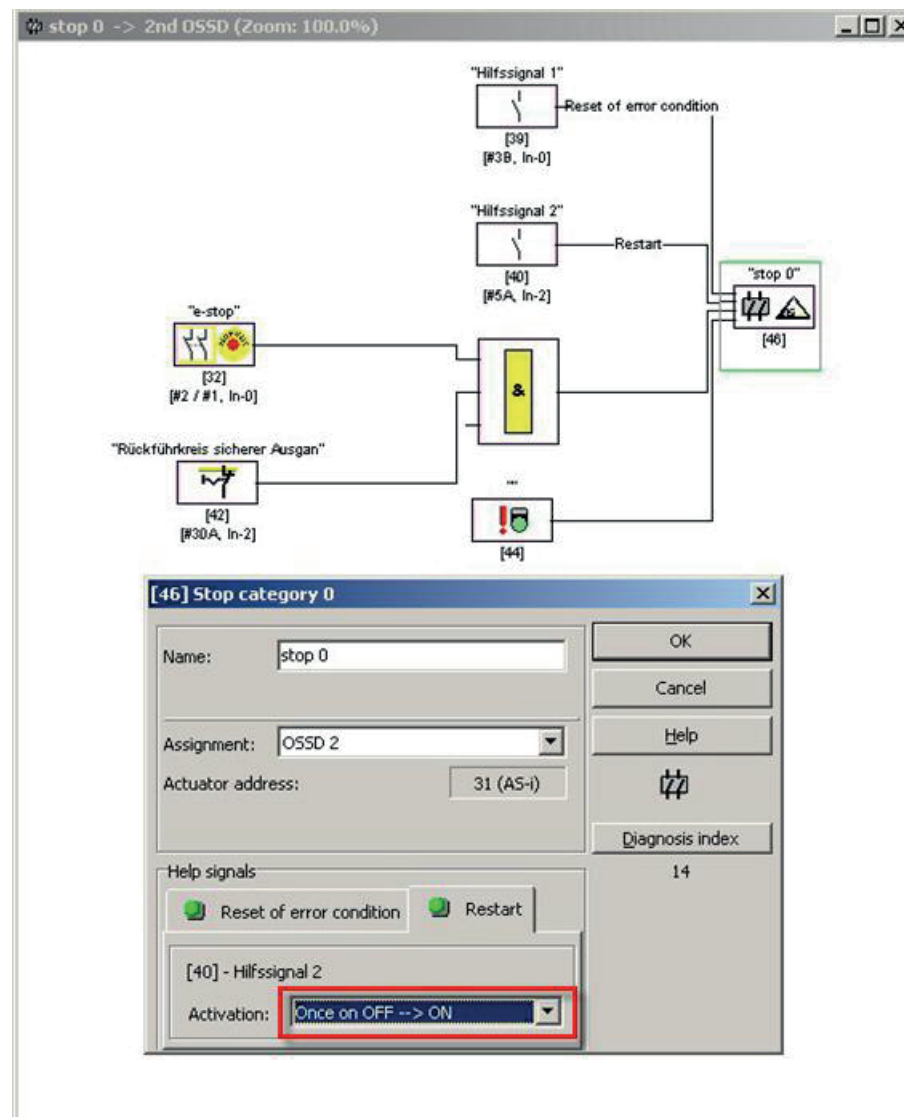

Figure 2-8   Setting the conditions for the acknowledgment signals using the ASIMON configuration software

The safe S45F SlimLine module has in addition to the safe output another 3 digital standard inputs and 2 digital standard outputs. Mechanical contact elements and both 2- and 3-conductor sensors can be connected to the digital inputs. One of the standard inputs can be used for monitoring the protective feedback circuit. Actuators can be controlled independently of the safety function via the digital standard outputs. The standard inputs and standard outputs are controlled via the integrated A/B slave.

Note

In an AS-Interface network, which is controlled by the DP/AS-i F-Link 3RK3141.CD10, the use of the S45F ASIsafe module is not permissible.

2.1.4 Order numbers

S45F ASI safe module

Connection	I/O type	U$_{AUX}$	Order number
Screw-type connection	1F-RO / 3DI / 2DO	✓	3RK1405-1SE15-0AA2
Spring-loaded connection	1F-RO / 3DI / 2DO	✓	3RK1405-1SG15-0AA2

Accessories

Designation	Order number
Plug-in lug for screw mounting	3RP1903

2.1.5 Connecting

Connection and terminal assignment

Figure 2-9   Connections of the safe S45F SlimLine module
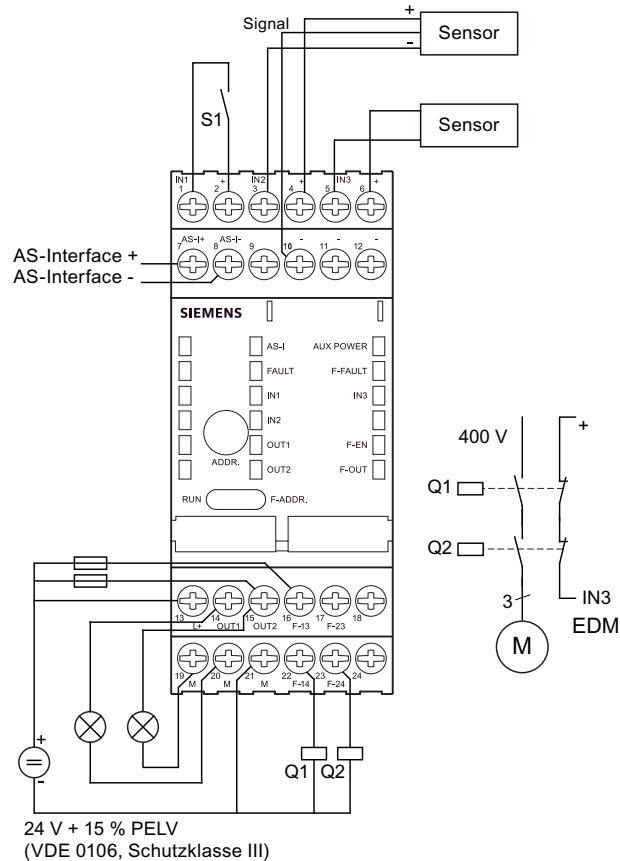
AS-I + , AS-I –	AS-Interface - connection
IN1, IN2, IN3	Standard inputs
L+	+24 V DC / supply voltage
M	GND / ground reference
F-13, F-14	Switching output relay contact 1
F-23, F-24	Switching output relay contact 2
OUT1, OUT2	Standard outputs

Connection example of safe reversing starter
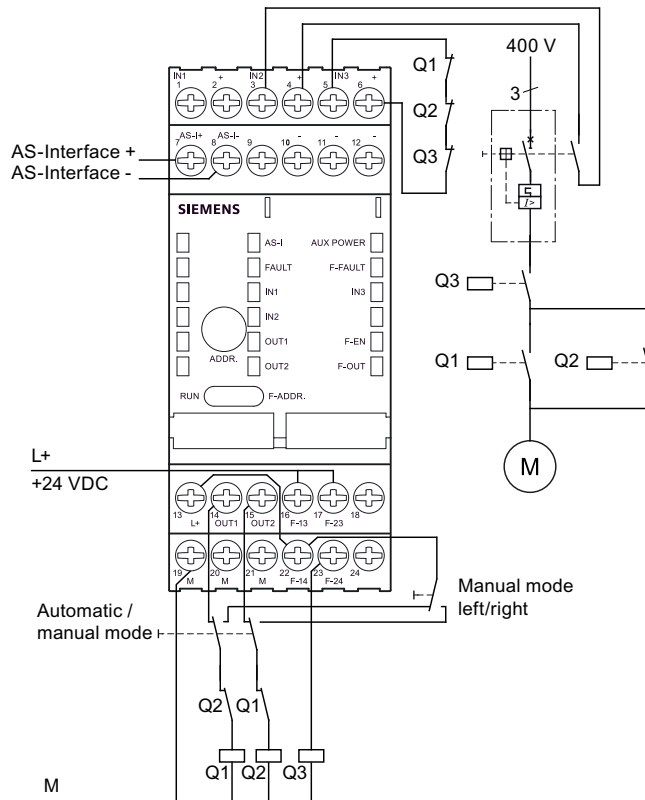
2.1.6 Diagnostics

The safe S45F SlimLine module provides the following diagnostic information:

- Local diagnostic information via LED on the device
- AS-i diagnostics of the integrated A/B slave
- Diagnostic bit IN4 (DI3)
- Online diagnostics in ASIMON configuration software
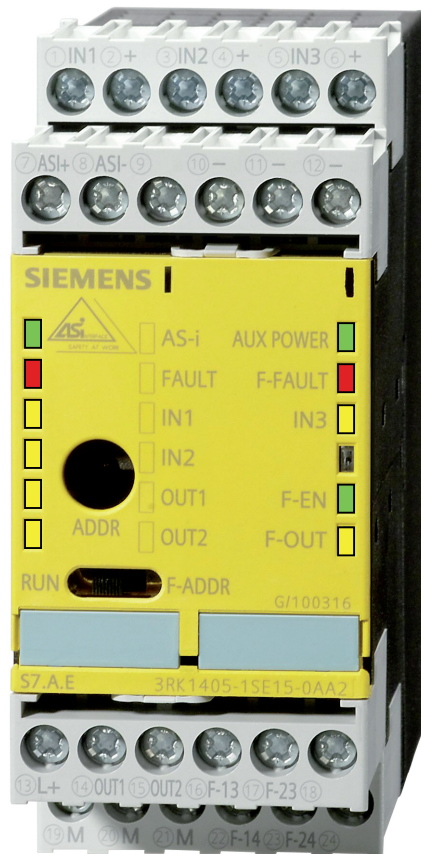
2.1.6.1 Local diagnostics via LED on the device

Figure 2-10   Arrangement of the LEDs

LED indicator for AS-i communication: AS-i FAULT

AS-i	FAULT	Possible cause	Possible remedial measures
Green	Off	Normal operation, AS-i communication OK	—
Green	Red	No AS-i communication: • The master is switched off or offline. • The slave is not configured in the master. • The incorrect slave type is connected. • The slave has the wrong address.	Ensure AS-i communication: • Switch on the master or switch it to online mode. • Reconfigure the master. • Connect the correct module. • Check/correct the slave address.
Green	Flashing red	Sensor supply overload and/or overload of the outputs	Unplug the sensor/actuator cables, use sensors with a lower overall current consumption, check the sensors/actuators and cables.
Flashing green	Red	Standard address is set for address 0 (delivery condition)	Assign an address that is not 0.
		Output overload (the slave switches off all the outputs)	Unplug the actuator cables from the output sockets, check the actuators and cables.
Off	Off	• No AS-Interface supply, • AS-i voltage connected with incorrect polarity, • AS-i voltage too low	• Check the cable connections. • Check the AS-Interface power supply unit. • Measure AS-i voltage

Display LED for the 24 V DC auxiliary voltage: AUX POWER

AUX POWER	Possible cause	Possible remedial measures
Green	Normal operation, 24 V DC auxiliary voltage OK	—
Off	• No auxiliary voltage • Auxiliary voltage connected with incorrect polarity • Auxiliary voltage too low	• Activate 24 V DC auxiliary voltage, • Connect it properly • Measure the auxiliary voltage (approx. 24 V DC)

LED indicator for the switching state of the standard inputs: INx

INx	Meaning
Yellow	Standard input on
Off	Standard input off

LED indicator for the switching state of the standard outputs: OUTx

INx	Meaning
Yellow	Standard output on
Off	Standard output off

LED indicator for ASIsafe communication: F-FAULT, F-EN, F-OUT

F-FAULT	F-EN	F-OUT	Possible cause	Possible remedial measures
Off	Green	Yellow	Normal ASIsafe operation, safety-oriented enable by the safety monitor is correctly received, F-OUT output is enabled	—
Off	Green	Off	Normal ASIsafe operation, safety-oriented enable by the safety monitor is correctly received, but F-OUT output is not connected during operation	• Set output OUT3 to switch on **F-OUT** during normal operation • If necessary, deactivate functional switching (set parameter bit P1 to 1)
Off	Off	Off	Normal ASIsafe operation, no enable or incorrect safety-oriented enable of safety monitor received	• Bring safe slaves into the state so that safety monitor enable is sent • check correct assignment to the safety-related address (**F-ADDR**.)
Red	Off	Off	F-Out switched off, communication fault must be acknowledged	Send acknowledgment by help signals (reset of error condition, restart) via safety monitor
Flashing red	Flashing green	Flashing yellow	Address switch not in the RUN position	Move address switch to the RUN position
(running light)				
Flashing red	Flashing green	Flashing yellow	Device error	Restart or replace defective device
(rapid flashing in unison)				

2.1.6.2 AS-i diagnostics of the integrated A/B slave

When there is an overload on the standard outputs and/or when there is an overload of the sensor current supply of the standard inputs, the module sets the I/O error bit.

The safe S45 SlimLine module also maintains communication in the event of a sensor power supply overload. In the event of a sensor overload, the substitute value zero is transmitted for the inputs.

Note

This behavior ensures that an overload of the sensor power supply for the standard inputs has no effect on the safety function of the device. Therefore, this is a departure from the normal behavior of AS-i slaves, which revert to the reset state and then no longer communicate via AS-Interface when there is an overload of the sensor power supply.

2.1.6.3 Diagnostic bit IN4 (DI3)

If the safe S45F SlimLine module has shut down the enabling circuit because of a communication fault and is waiting for an acknowledgment in order to restart (help signal 1 or 2), the fourth input (input bit D3) of the integrated A/B slave assumes state 1. The request for the acknowledgment signal is thereby transmitted to the controller and the safety monitor.

2.1.6.4 Diagnostics via ASIMON configuration software

In the ASIMON configuration software, the state of the safe output module can be displayed in the online diagnostics via the "actuator diagnostics" diagnostics device. For this purpose, a corresponding diagnostics device needs to be added in the ASIMON configuration for each safe output module. The address of the integrated A/B slave of the safe S45F SlimLine module as well as the diagnostics type need to be entered in it. Diagnostics type 4 is to be selected for the safe S45F SlimLine module.
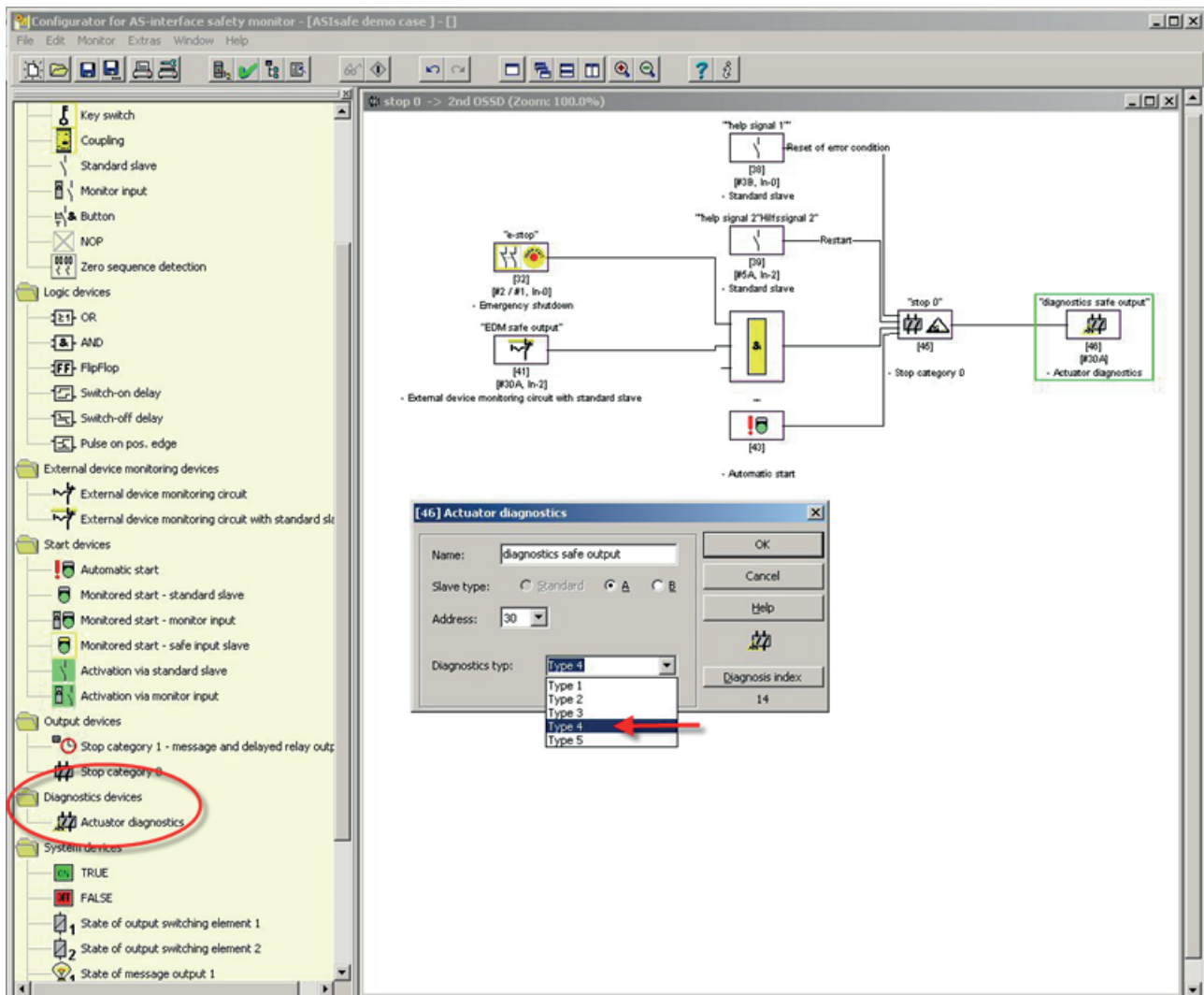

Figure 2-11   Selecting ASIMON diagnostics device

2.1.7   Technical data

Order number	3RK1405-1SE15-0AA2	3RK1405-1SG15-0AA2
Type of connection	Screw-type connection	Spring-loaded connection
Slave type	Standard slave	
Suitable for AS-i Master acc. to spec. ... (or higher)	AS-i Spec. 2.1	
AS-i slave profile IO.ID.ID2	S-7.A.E (ID1 is variable, default setting: 7_{hex})	
PFH value	$2.14 \times 10\text{-}8$ [1/h]	
No. of inputs/outputs	1 safe output / 3 inputs digital / 2 outputs digital	
Electrical data		
Total power consumption	≤ 200 mA	
Reverse polarity protection	Integrated	
Total system response time (from the moment of the shutdown request to the moment at which the output has switched off)	< 70 ms	
On-delay time (Power On)	< 3 s	
Digital inputs		
For signal "0" I_{in}	≤ 1.5 mA	
For signal "1" U_{in}, I_{in}	≥ 10 V, ≥ 5 mA	
Digital outputs (short-circuit-proof, with induction protection)		
Operating voltage U_{AUX} (PELV)	24 V ± 15 %	
Current-carrying capacity per output I_{out}	≤ 0.7 A, short-circuit-proof and overload-proof	
Voltage drop Δ U_{type}	0.8 V	
Safe output		
Max. contact load	24 V DC, 3 A	
Protection	external with 4 A MT, max.	
Mechanical data		
Degree of protection	IP20	
Rated temperature T_a	25 °C	
Ambient temperature T_a	-25 ... +70 °C	
Storage temperature T_s	-40 ... +85 °C	
Approvals	UL, CSA applied for	

For information on additional properties, please refer to the current data sheet which is available in the Internet:

| Order No.: |
|---|
| 3RK1405-1SE15-0AA2 (http://support.automation.siemens.com/WW/view/en/3RK1405-1SE15-0AA2/td) |
| 3RK1405-1SG15-0AA2 (http://support.automation.siemens.com/WW/view/en/3RK1405-1SG15-0AA2/td) |

Assignment of inputs and outputs

Bit	AS-i Input
DI 0	IN 1
DI 1	IN 2
DI 2	IN 3 (EDM)

DI 3	Diagnostics
	0: ok
	1: Error
	    HS1 or HS2 required
	    (HS = help signal) or fatal error

Bit	AS-i output	
DO 0	OUT 1	
DO 1	OUT 2	
DO 2	P1 = 1: Functional switching deactivated; F-OUT OFF, if no safety-oriented enable F-OUT ON, if safety-oriented enable	P1 = 0: Functional switching activated; 0: F-OUT OFF 1: F-OUT ON, if safety-oriented enable received
DO 3	—	—

2.1.8   Dimension drawings

Safe S45F SlimLine module, screw-type connection
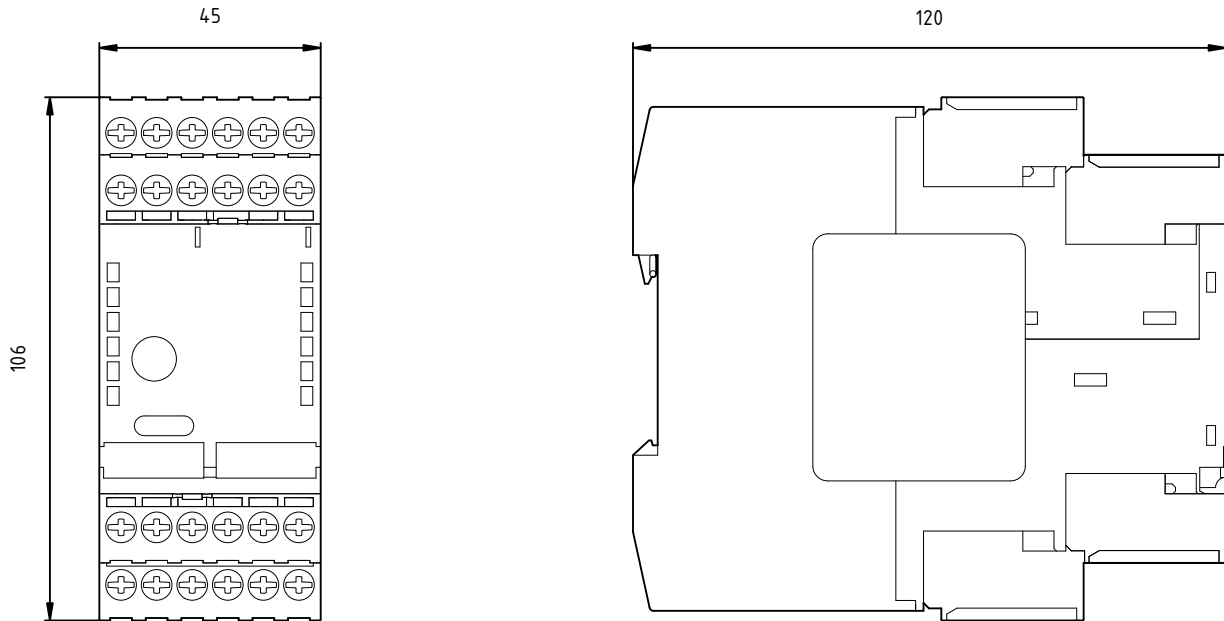
Safe S45F SlimLine module, spring-type connection