ifm electronic

AS-Interface manual

Tips and tricks for users

Edition 2.2

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1 On this manual

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Nobody is perfect. Send us your suggestions for improvements to this manual and you will receive a little gift from us to thank you.

1.1 Preface

6274

This installation manual is intended for those using ifm AS-Interface products in practice (users, installers, ...).

This manual is intended to provide the user with basic information about the different **ifm** AS-i product families.

* * *

Everyone has probably experienced it already: during setup, the red LED [FAULT] is suddenly lit on the AS-i module and you are not sure if the module is faulty or if maybe it still has the slave address 0?

Or: how can I extend the AS-i system to 500 m?

Why do the input LED and the periphery fault indication flash on the analogue module?

Can the AirBox also be operated with lubricated compressed air? And, if so, at what minimum pressure?

* * *

We have tried to integrate as much information and experience as possible in this AS-Interface manual - e.g. from service interventions, presentations, customer training, but also from the installation instructions and device manuals.

Even if this is no complete list of all data and devices, e.g. for "Safety at Work" or ATEX, we have tried to provide the user with a useful reference document.

For the current rating, voltage values etc. of the different AS-i components please refer to the corresponding data sheets and installation instructions.

The actual data sheet you will find on the ifm homepage:
→ www.ifm.com > select your country > [data sheet search] > (article no.)

For corrections and additions to existing documentation please refer to ifm's website:
→ www.ifm.com > select your country > [data sheet search] > (article no.) > [Additional data]

1.2 What do the symbols and formats mean?

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The following symbols or pictograms depict different kinds of remarks in our manuals:

⚠ WARNING

Death or serious irreversible injuries are possible.

⚠ CAUTION

Slight reversible injuries are possible.

NOTICE

Property damage is to be expected or possible.

	Important notes on faults and errors
	Further hints
► ...	Required action
> ...	Response, effect
→ ...	"see"
abc	Cross references (links)
[...]	Designations of keys, buttons or display

1.3 How is this documentation structured?

6758

This documentation is a combination of different types of manuals. It is for beginners and also a reference for advanced users.

How to use this documentation:

- Refer to the table of contents to select a specific subject.
- Using the index you can also quickly find a term you are looking for.
- At the beginning of a chapter we will give you a brief overview of its contents.
- Abbreviations and technical terms are listed in the glossary.

In case of malfunctions or uncertainties please contact the manufacturer at:
→ www.ifm.com > select your country > [Contact].

We want to become even better! Each separate section has an identification number in the top right corner. If you want to inform us about any inconsistencies, please indicate this number with the title and the language of this documentation. Thank you for your support.

We reserve the right to make alterations which can result in a change of contents of the documentation. You can find the current version on **ifm's** website at:
DE → https://www.ifm.com/ifmde/web/asi-download.htm
UK → https://www.ifm.com/ifmgb/web/asi-download.htm
FR → https://www.ifm.com/ifmfr/web/asi-download.htm

1.4 History of the instructions

11452

What has been changed in this manual? An overview:

Issue	Topic
2nd edition	• new: intermediate tables of contents • new: section ident numbers • new: Flat cable AC4007 + AC4008 (→ page 21)
	• revised: Device description ControllerE, gateways (AC13nn) (→ page 29)
	• new: Device description AS-i gateways (AC14nn) (→ page 43) • new: Device description AS-i power supplies (AC1220, AC1221) (→ page 71) • new: Device description AS-i power supplies (AC1236, AC1244) (→ page 73)
	• Device description control cabinet modules SmartLine (AC22nn) (→ page 75) supplemented by "Measuring range" tables and supplemented by a note about the addressing socket • Device description universal modules (AC20nn, AC26nn) (→ page 91) supplemented by "Measuring range" tables • Device description field modules ClassicLine (screw mounting, AC25nn) (→ page 103) supplemented by "Measuring range" tables • Device description field modules ClassicLine (quick mounting, AC52nn) (→ page 116) supplemented by the table "Differences AC5222 / AC5223" and supplemented by a note about the addressing socket • Device description field modules AirBox (screw mounting, AC25nn) (→ page 131) supplemented by a note about the addressing socket • Device description field modules AirBox (quick mounting, AC52nn) (→ page 137) supplemented by a note about the addressing socket
	• revised: Device description field modules CompactLine (AC24nn, to June 2010) (→ page 148)
	• new: Device description field modules CompactLine (AC24nn, as from 06.2010) (→ page 152) • new: Device description IP 67 splitter (→ page 171) (E70381, E7048n, E70498, E70499) • new: Device description addressing units (→ page 193) (AC1154)
Edition 2.1	• Download source of e-learning changed
Edition 2.2	• Mistakes corrected

2 Safety instructions

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What previous knowledge is required? 12
Tampering with the unit 12

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2.1 Important!

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No characteristics are warranted with the information, notes and examples provided in this manual. The drawings, representations and examples imply no responsibility for the system and no application-specific particularities.

The manufacturer of the machine/equipment is responsible for the safety of the machine/equipment.

⚠ WARNING

Property damage or bodily injury are possible when the notes in this manual are not adhered to!
ifm electronic gmbh does not assume any liability in this regard.

- ► The acting person must have read and understood the safety instructions and the corresponding chapters of this manual before performing any work on or with this device.
- ► The acting person must be authorised to work on the machine/equipment.
- ► Adhere to the technical data of the devices!
  You can find the current data sheet on **ifm's** homepage at:
  → www.ifm.com > select your country > [Data sheet search] > (Article no.) > [Technical data in PDF format]
- ► Note the installation and wiring information as well as the functions and features of the devices!
  → supplied installation instructions or on **ifm's** homepage:
  → www.ifm.com > select your country > [Data sheet search] > (Article no.) > [Operating instructions]

NOTICE

The driver module of the serial interface can be damaged!

Disconnecting the serial interface while live can cause undefined states which damage the driver module.

- ► Do not disconnect the serial interface while live.

Start-up behaviour of the controller

The manufacturer of the machine/equipment must ensure with his application program that when the controller starts or restarts no dangerous movements can be triggered.

A restart can, for example, be caused by:

- voltage restoration after power failure
- reset after watchdog response because of too long a cycle time

2.2 What previous knowledge is required?

215

This document is intended for people with knowledge of control technology and PLC programming with IEC 61131-3.

If this device contains a PLC, in addition these persons should know the CoDeSys® software.

The document is intended for specialists. These specialists are people who are qualified by their training and their experience to see risks and to avoid possible hazards that may be caused during operation or maintenance of a product. The document contains information about the correct handling of the product.

Read this document before use to familiarise yourself with operating conditions, installation and operation. Keep the document during the entire duration of use of the device.

Adhere to the safety instructions.

2.3 Tampering with the unit

11242

⚠ WARNING

Tampering with the units can affect the safety of operators and machinery!

Tampering with the units is not allowed.
In case of non-compliance our liability and warranty expire.

- ► Do not open the devices!
- ► Do not insert any objects into the devices!
- ► Prevent metal foreign bodies from penetrating!

3 System description

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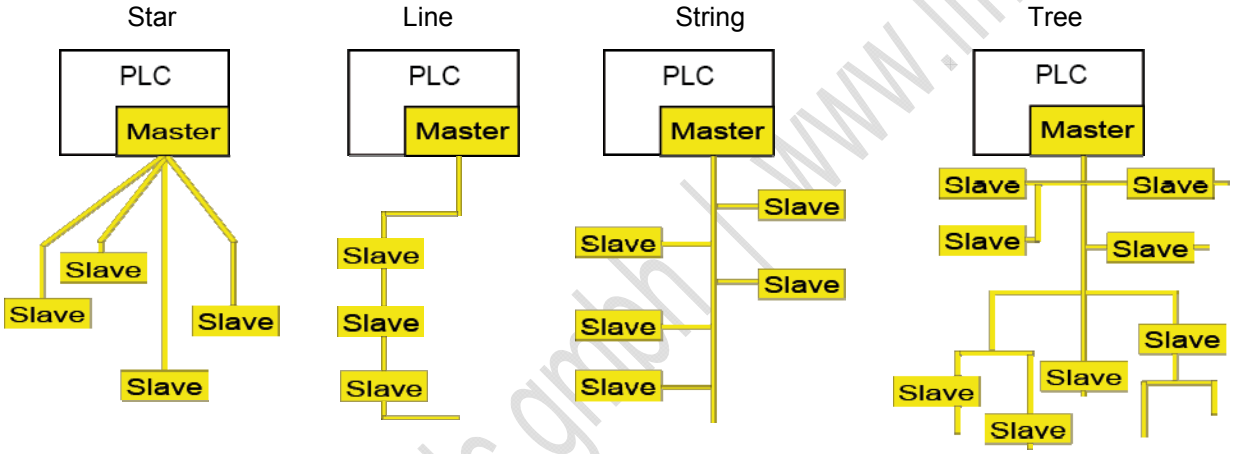
3.1 AS-i topology

6478

Several topologies are allowed in AS-i, also mixed topologies:



NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

- The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).
- Up to 31 single slaves can be connected to each AS-i master.

As from AS-i specification 2.11:

- Up to 31 single slaves or up to 31 A slaves and 31 B slaves can be connected to each AS-i master.
- A mixed connection of single slaves and A/B slaves to the same master is possible.

3.2 AS-i flat cable overview

Contents

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Flat cable AC4001 + AC4006....17
Flat cable AC4003 + AC4004....19
Flat cable AC4007 + AC4008....21

6479

Flat cable yellow	Flat cable black	Material
AC4000	AC4002	EPDM
AC4001	AC4006	PUR
AC4003	AC4004	TPE
AC4007	AC4008	TPE+PVC

3.2.1 Flat cable AC4000 + AC4002

11243

Characteristics

11244

Material	EPDM
free from halogen	yes
external sheath silicone-free	yes
flame-retardant, self-extinguishing	no
free from asbestos, PCB, CFC	yes
suitable for drag chains	no

Resistance to environmental influences

11245

ozone	no cracks (to EN 60811-2-1)
water, hot water, steam	yes
sea water	yes
ammonia	yes
mineral oils	conditionally resistant
animal and vegetable oils and fats (e.g. olive oil)	conditionally resistant to not resistant
butter, coconut oil, castor oil, soybean oil	conditionally resistant to not resistant
dry chlorine	conditionally resistant
wet chlorine, bromine, iodine	yes
methanol, ethanol, butanol	yes
propanol	yes
ethylene glycol	yes
glycerine	yes
aromatic hydrocarbons (e.g. benzene, toluene, tetralin, naphthalene	no
regular petrol	no
diesel	no
hydrochloric acid	yes, up to 37 %
sulphuric acid	yes, up to 75 %
nitric acid	yes, up to 30 %
sodium hydroxide solution	yes, up to 10 %
polar solvents, acetone	yes

Temperature characteristics

11246

Limit temperature for operation, installation, transport and storage:

on the wire during operation	+ 90 °C
on the wire in case of short circuit	+ 200 °C
on the surface, cable firmly laid	-40...+85 °C
moving, upon laying	-25...+85 °C

3.2.2 Flat cable AC4001 + AC4006

11247

Characteristics

11248

Material	PUR
free from halogen	yes
external sheath silicone-free	yes
flame-retardant, self-extinguishing	good
free from asbestos, PCB, CFC	yes
suitable for drag chains	conditionally resistant acc. to DIN VDE 0472 part 603

Resistance to environmental influences

11249

ozone	yes
water, hot water, steam	yes, up to 100 °C *)
sea water	yes
ammonia	yes
mineral oils	yes
animal and vegetable oils and fats (e.g. olive oil)	no data
butter, coconut oil, castor oil, soybean oil	no data
dry chlorine	no data
wet chlorine, bromine, iodine	no data
methanol, ethanol, butanol	yes
propanol	no data
ethylene glycol	no data
glycerine	no data
aromatic hydrocarbons (e.g. benzene, toluene, tetralin, naphthalene	benzene: conditionally resistant; toluene: no; other: no data
regular petrol	yes
diesel	yes
hydrochloric acid	yes, up to 20 %
sulphuric acid	yes, up to 30 %
nitric acid	yes, up to 10 %
sodium hydroxide solution	yes, up to 10 %
polar solvents, acetone	fades easily, becomes softer

*) short-time cleaning and disinfection

Temperature characteristics

11250

Limit temperature for operation, installation, transport and storage:

on the wire during operation	---
on the wire in case of short circuit	---
on the surface, cable firmly laid	-40...+85 °C
moving, upon laying	-30...+85 °C

3.2.3 Flat cable AC4003 + AC4004

11251

Characteristics

11252

Material	TPE
free from halogen	no
external sheath silicone-free	yes
flame-retardant, self-extinguishing	good
free from asbestos, PCB, CFC	yes
suitable for drag chains	conditionally resistant acc. to DIN VDE 0472 part 603

Resistance to environmental influences

11253

ozone	yes
water, hot water, steam	yes, up to 100 °C
sea water	yes, up to 70 °C
ammonia	no data, probably conditionally resistant
mineral oils	yes, up to 70 °C
animal and vegetable oils and fats (e.g. olive oil)	yes
butter, coconut oil, castor oil, soybean oil	yes
dry chlorine	no data
wet chlorine, bromine, iodine	no data
methanol, ethanol, butanol	yes
propanol	no data
ethylene glycol	yes
glycerine	probably weak to mild influence
aromatic hydrocarbons (e.g. benzene, toluene, tetralin, naphthalene	benzene + toluene: strong influence; otherwise probably the same (no data)
regular petrol	fades easily
diesel	yes
hydrochloric acid	yes, up to 37 %
sulphuric acid	yes, up to 30 %
nitric acid	yes, up to 10 %
sodium hydroxide solution	yes, up to 10 %
polar solvents, acetone	fades easily, becomes harder

Temperature characteristics

11254

Limit temperature for operation, installation, transport and storage:

on the wire during operation	---
on the wire in case of short circuit	---
on the surface, cable firmly laid	-40...+105 °C
moving, upon laying	-30...+105 °C

3.2.4 Flat cable AC4007 + AC4008

11255

Characteristics

11256

Material	TPE+PVC
free from halogen	no
external sheath silicone-free	yes
flame-retardant, self-extinguishing	good
free from asbestos, PCB, CFC	yes
suitable for drag chains	conditionally resistant acc. to DIN VDE 0472 part 603

Resistance to environmental influences

11257

ozone	yes
water, hot water, steam	yes, up to 100 °C
sea water	yes, up to 70 °C
ammonia	no data, probably conditionally resistant
mineral oils	yes, up to 70 °C
animal and vegetable oils and fats (e.g. olive oil)	yes
butter, coconut oil, castor oil, soybean oil	yes
dry chlorine	no data
wet chlorine, bromine, iodine	no data
methanol, ethanol, butanol	yes
propanol	no data
ethylene glycol	yes
glycerine	probably weak to mild influence
aromatic hydrocarbons (e.g. benzene, toluene, tetralin, naphthalene	benzene + toluene: strong influence; otherwise probably the same (no data)
regular petrol	fades easily
diesel	yes
hydrochloric acid	yes, up to 37 %
sulphuric acid	yes, up to 30 %
nitric acid	yes, up to 10 %
sodium hydroxide solution	yes, up to 10 %
polar solvents, acetone	fades easily, becomes harder
additional cleaning agents	yes **)

**) alkaline containing surfactants; highly alkaline containing surfactants; foam cleaning with active chlorine; TFC procedure (Thin Film Cleaning);
acid foam cleaning agents (with or without organic acids); peracetic acid-containing disinfectant

Temperature characteristics

11258

Limit temperature for operation, installation, transport and storage:

on the wire during operation	---
on the wire in case of short circuit	---
on the surface, cable firmly laid	-40...+105 °C
moving, upon laying	-30...+105 °C

3.3 Sealing the AS-i flat cable end

6646

► Protect the flat cable end against moisture and direct machine contact to avoid short circuits.

Several methods of sealing the cable are available for AS-i flat cables:

E70113	heat-shrink cap for sealing the flat cable ends (closed on one side)	
E70413	flat cable connection IP 67 housing material = ULTRAMID sealing material = NBR	
	application examples E70113 / E70413	
AC5000 +AC3000	FC lower part and cover	

3.4 Information about AS-i

6278

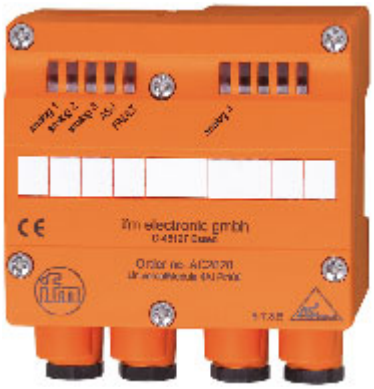
Here you will find further information to understand AS-Interface better in general.

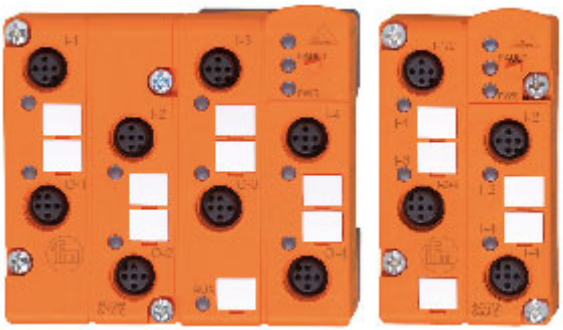
- Online training in the ifm download area:
  DE → https://www.ifm.com/ifmde/web/asi-download.htm
  UK → https://www.ifm.com/ifmgb/web/asi-download.htm
  FR → https://www.ifm.com/ifmfr/web/asi-download.htm
  > [AS-i Animations] > E-learning
- Literature: www.as-interface.net > [THE SYSTEM] > [Publications]

3.5 Overview of the ifm AS-i device families

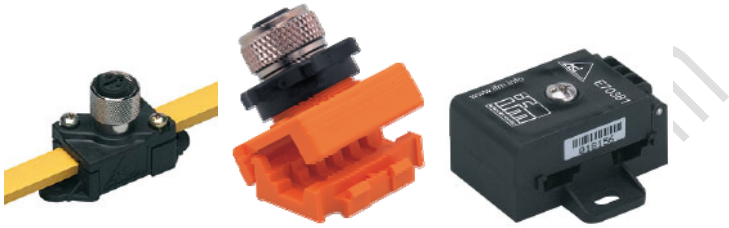
6277

Device family	Sample units
ControllerE and gateways (AC13nn) → **Device description ControllerE, gateways (AC13nn)** (→ page 29)	
AS-i gateways (AC14nn) → **Device description AS-i gateways (AC14nn)** (→ page 43)	
AS-i power supplies (AC1216, AC1218, AC1223, AC1224, AC1226) → **Device description AS-i power supplies (AC1216, AC1218, AC1223, AC1224, AC1226)** (→ page 67)	
AS-i power supplies (AC1220, AC1221) → **Device description AS-i power supplies (AC1220, AC1221)** (→ page 71)	

Device family	Sample units
AS-i power supplies (AC1236, AC1244) → **Device description AS-i power supplies (AC1236, AC1244)** (→ page 73)	
Control cabinet modules SmartLine (AC22nn) → **Device description control cabinet modules SmartLine (AC22nn)** (→ page 75)	
Cabinet modules (AC27nn) → **Device description cabinet modules** (→ page 89)	
Universal modules (AC20nn, AC26nn) → **Device description universal modules *(AC20nn, AC26nn)*** (→ page 91)	

Device family	Sample units
Field modules ClassicLine (screw mounting, AC25nn) → **Device description field modules ClassicLine (screw mounting, AC25nn)** (→ page 103)	
Field modules ClassicLine (quick mounting, AC52nn) → **Device description field modules ClassicLine (quick mounting, AC52nn)** (→ page 116)	
Field modules AirBox (screw mounting, AC20nn) → **Device description field modules AirBox (screw mounting, AC20nn)** (→ page 131)	
Field modules AirBox (quick mounting, AC52nn) → **Device description field modules AirBox (quick mounting)** (→ page 137)	

Device family	Sample units
Field modules CompactLine (to June 2010) (AC24nn) → **Device description field modules CompactLine** (→ page 148)	
Field modules CompactLine (as from June 2010) (AC24nn) → **Device description field modules CompactLine (as from June 2010)** (→ page 152)	
Field modules ProcessLine (AC29nn) → **Device description field modules ProcessLine** (→ page 158)	

Device family	Sample units
ProcessLine IP 69K splitter (E70nnn) → **Device description ProcessLine splitter** (→ page 166)	
IP 67 splitter (AC5005, E70nnn) → **Device description IP 67 splitter** (→ page 171)	
Repeater (AC2225), Tuner (AC1146), Bus termination (AC1147) → **Device description repeater, tuner, bus termination** (→ page 181)	
Earth fault and insulation fault monitors (AC2211, AC2212) → **Earth fault / insulation fault monitoring** (→ page 251)	
Addressing unit (AC1154) → **Addressing unit AC1154** (→ page 194)	

4 Device descriptions

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6300

4.1 Device description ControllerE, gateways (AC13nn)

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6302

Example:

AC13nn

4.1.1 Operating conditions, installation

6303

- Protection IP 20.

► Installation only in a condensation-free environment.

► Avoid excessive dust, vibration and shock.

► The air circulation through the vents must not be impeded.
Minimum distance above and below the device 30 mm.

► Avoid installation in the direct vicinity of frequency inverters.

4.1.2 Electrical connection

6304

► Disconnect the installation from power.

► The national and international regulations for the installation of electrical equipment must be adhered to.

► Connect the device as indicated on the terminals.

► Never connect the minus potentials to each other, e.g.:
AS-i- to 0 V of the 24 V DC supply or
AS-i- to FE (functional earth), etc.

► FE serves for **F**unctional **E**arth, **not for protective earth**.

The FE terminal is internally connected to the housing and the DIN rail fixing. This internal connection is only useful if an electrical connection to the machine ground exists.

► Connect the FE terminal (= functional earth) of the device to the machine ground, if an ungrounded supply voltage (24 V DC) is used.

► Do not use the FE terminal of the device when there is a supply voltage of 24 V DC (0 V grounded).

4.1.3 LED behaviour (AC13nn)

6306

The three diagnostic LEDs on the device inform about the status of the AS-i master and the connected systems:

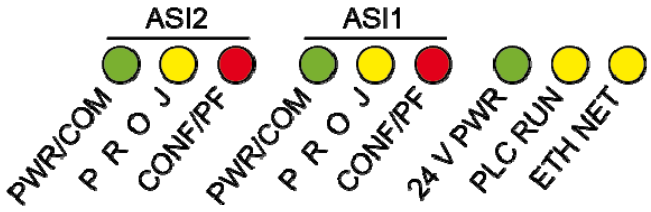


Figure: Diagnostic LEDs on the ControllerE with 2 AS-i masters and Ethernet programming interface

The LEDs [ASI2] including their labelling are an option for the second AS-i master.

LEDs [PWR/COM], [PROJ], [CONF/PF], [24V PWR]

11455

Diagnostic LEDs	LED colour	LED off	LED lit	LED flashes
ASI1 [PWR/COM] AS-i bus 1: **P**ower **Com**munication	green	no supply for AS-i bus 1	AS-i supply is available; at least 1 slave on the bus was recognised	AS-i supply is available; no slave on the bus was recognised
ASI1 [PROJ] AS-i bus 1: **Proj**ection	yellow	AS-i master in protected mode	AS-i master in projection mode; configuration monitoring is deactivated	projection mode active; changeover to protected mode not possible because a slave with the address 0 is connected
ASI1 [CONF/PF] AS-i bus 1: **Conf**iguration **P**eriphery **F**ault	red	configuration and periphery ok	projected and current configuration do not match	periphery fault detected
ASI2 [PWR/COM] AS-i bus 2: **P**ower **Com**munication	green	no supply for AS-i bus 2	AS-i supply is available; at least 1 slave on the bus was recognised	AS-i supply is available; no slave on the bus was recognised
ASI2 [PROJ] AS-i bus 2: **Proj**ection	yellow	AS-i master in protected mode	AS-i master in projection mode; configuration monitoring is deactivated	projection mode active; changeover to protected mode not possible because a slave with the address 0 is connected
ASI2 [CONF/PF] AS-i bus 2: **Conf**iguration **P**eriphery **F**ault	red	configuration and periphery ok	projected and current configuration do not match	periphery fault detected
[24V PWR]	green	no 24 V operating voltage	24 V operating voltage available	---

LED [PLC RUN]

11456

The LED [PLC RUN] is optional for the PLC in the ControllerE including its labelling:

Diagnostic LEDs	LED colour	LED off	LED lit	LED flashes
[PLC RUN]	yellow	Profibus device: ControllerE operates as gateway	The PLC program in the ControllerE is running Fieldbus device (no Profibus): Gateway function is active	The PLC program in the ControllerE is stopped

LED [ETH NET]

11457

The LED [ETH NET] is optional for the Ethernet programming interface including its labelling:

Diagnostic LEDs	LED colour	LED off	LED lit	LED flashes
[ETH NET]	yellow	no communication in the Ethernet	LED flashes for each data package (only for access via CoDeSys Ethernet protocols)	

LED [BUS FAIL]

11458

The LED [Bus Failure] is optional for the Profibus interface including its labelling:

Diagnostic LEDs	LED colour	LED off	LED lit	LED flashes
[BUS FAIL]	red	when response monitoring (watchdog) active: Profibus connection ok OR: master switched off OR: response monitoring (watchdog) deactivated	when response monitoring (watchdog) active: no Profibus connection	device error → message text in text/graphics display

LEDs fieldbus interface

11459
4539

4 status LEDs on the ControllerE inform about the status of the fieldbus interface and the systems connected to it:

Module State	O	O	Net State
Link to Fieldbus	O	O	Transmission Activity

Graphics: status LEDs on the network connection

The colours and meanings of these 4 LEDs depend on the type of interface, e.g.:

CANopen	AC1331, AC1332
DeviceNet	AC1308, AC1314, AC1318, AC1324
EtherCAT	AC1391, AC1392
Ethernet/IP	AC1307, AC1317, AC1327, AC1337

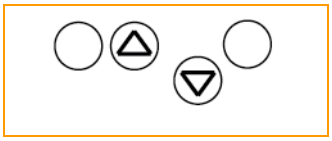
→ corresponding device manual

4.1.4 Operating and display elements

11288

Key functions

5460



The four keys on the device enable quick and easy handling of the menu:

The [▲] und [▼] keys are used for selecting the menu or for changing the displayed values. Menus with more than three options are adapted automatically. If it is possible to move upwards and downwards in the menu, this is indicated by means of small arrows in the middle of the lowest line of the display (→ **Menu screen** (→ page 34)).

The two outer keys are function keys. Their function depends on the menu screen and is indicated in the lowest row of the display by means of inverted texts.

Example:

- Here the left key is used for the function [OK], i.e. to confirm the selected menu item.
- The right key is used for the function [ESC], i.e. to return to the previous menu level.

Display (presentation, language, contrast/brightness)

Contents

What is what in the text/graphics display? 34
Text/graphics display: Switch language 36
Text/graphics display: Set contrast/brightness 37

5447

Using the text/graphics display on the device enables a more detailed system diagnosis. With the four keys the device is easy to use. The bilingual structure of the menus and messages simplifies worldwide use of this device family. An intelligent message management generates priority-based diagnostic and error messages and supports the user during set-up.

The respective function of the keys is displayed dynamically above the keys.

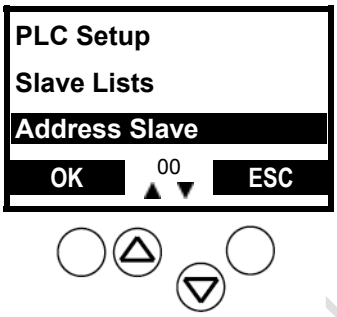
After power-on of the gateway the device displays either a start screen with the ifm logo (AC1376) or with the headline "AS-i DP Gateway" (AC1375) or – if available – a list of the errors in the connected AS-i systems. In any case, the system menu can be accessed by pressing the left [MENU] button.

What is what in the text/graphics display?

5449

Menu screen

5450



> Usually the menu shows 3 to 5 lines similar to those on the left.

> One menu line is inverted:
This shows the active or selected entry. By pressing on [OK] the device changes to the respective menu screen.

> 00:
Number of the menu screen.

> Triangles [▲] or [▼]:
note which arrow keys can be used to scroll in the menus (or: to move the line marking).

► Press [▲] or [▼] to scroll through the menu or the values:
[▲] = scroll through the menu points or increment the value,
[▼] = scroll through the menu points or decrement the value.

► Press [OK] to select marked menu item.

► Press [ESC] to quit this menu to go to the previous menu level.

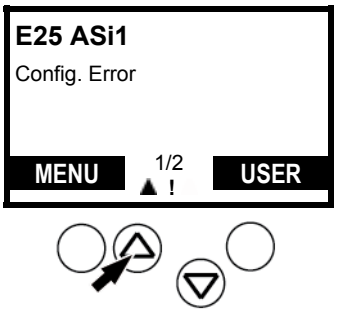
In this documentation we show the menu version for the device AC1376 (2 AS-i master).

Some menus are slightly different and / or have other menu screen numbers for the device AC1375 (1 AS-i master). We indicate the deviations.

Error screen

5452

In case of a configuration error or failure the start screen of the text/graphics display will provide information as shown in the following screen:



Display of an error when the start screen was active:

> E25 = error number, → chapter **Troubleshooting ControllerE and gateways (AC13nn)** (→ page 207).

> ASi1 = concerned AS-i master channel number.

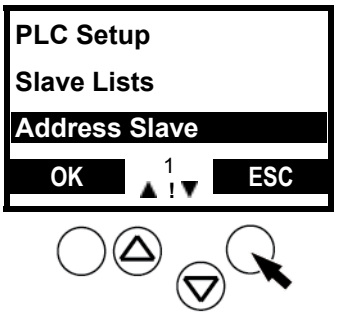
> Config. Error:
There is a configuration error.

> 1/2:
First page of 2 with troubleshooting.

> Flashing "**!**":
There is an error message.

> LED [CONF/PF] lights.

> Triangles [▲] / [▼]
note which arrow keys can be used to scroll.



Display of an error when any menu screen is active:

> Flashing "**!**":
There is an error message.

> LED [CONF/PF] lights.

> Triangles [▲] / [▼]
note which arrow keys can be used to scroll.

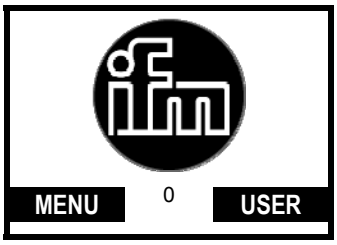
► Return to the start screen with [ESC].

> An error screen as described above appears.

Text/graphics display: Switch language

5454

There are 2 languages stored for the text/graphics display in the device. You can change between the languages at any time.

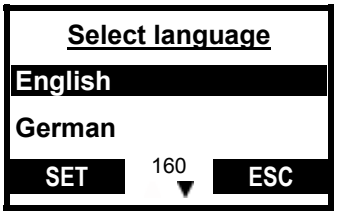


simultaneously!

Step 1:

> **Example:** current language = English.

► [▲] and [▼] pressed simultaneously for about 2 seconds.

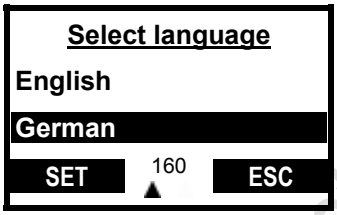


Step 2:

> Text/graphics display is reinitialised.

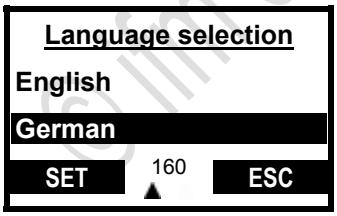
> Indication of the current language (here: English).

► Move to the requested language with [▲] or [▼].



Step 3:

► Select the requested language with [SET].



Step 4:

> Display changes to the requested language.

► Quit language selection with [ESC].

> That's it!

English is always available and is set as default language on delivery. The other language depends on the device version (→ AS-i catalogue). Therefore, the menus shown in this manual are only in English.

Text/graphics display: Set contrast/brightness

5456

If the text/graphics display is difficult to read, the contrast can be set:

> **The display is too bright / too pale:**	
 **simultaneously!**	► Press these buttons simultaneously. > Contrast is increased / screen becomes darker.
> **The display is too dark:**	
 **simultaneously!**	► Press these buttons simultaneously. > Contrast is decreased / screen becomes brighter.
> **The text/graphics display indicates nothing any more (only background illumination active). All other functions of the device are not affected.**	
 **simultaneously!**	► [▲] and [▼] pressed simultaneously for about 2 seconds. > Text/graphics display is reinitialised. > Language selection is active. ► Quit language selection with [ESC].

The device automatically stores the last setting.

Menu navigation

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Master Setup 39
Fieldbus Setup 39
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Slave Setup 40
System Setup 40
System Info 40

6310

Quick Setup

6313

Summary of the menu items required for a basic configuration:

- Reading of the current AS-i configuration (config all).
- Setting of the fieldbus connection (optional).

PLC Setup

6316

Menu only for ControllerE. Using the integrated PLC is optional.

- Activate (= no PLC used) or deactivate the gateway mode.
- Start or stop the PLC in the ControllerE (if used).

Slave Lists

6311

Checking of the addresses of the AS-i slaves connected to the AS-i master:

- List of detected AS-i slaves (LDS).
- List of projected AS-i slaves (LPS).
- List of activated AS-i slaves (LAS).
- List of AS-i slaves with periphery fault (LPF).

Address Slaves

6312

Programming of the correct addresses in the connected AS-i slaves:

- Readdressing of an AS-i slave connected to the device.
- Automatic addressing of new AS-i slaves to the next free address (easy start-up).

Diagnostics

6319

Display of error counters and AS-i cycle time:

- Display of the number of cases of undervoltage on the AS-i bus.
- Display of the number of detected configuration errors since the last reset.
- Display of faulty AS-i telegrams in percent of the sent telegrams.
- Display of the number of active slaves.
- Display of the number of AS-i cycles per second.
- Display of the number of disturbed telegrams of each active slave.
- Reset of the error counter.
- Display of the longest AS-i cycle time after last reset.
- Reset of the previous test series and start of a new test series.

Master Setup

6318

Set operating modes master:

- In the operating mode "Config all": reading of the current AS-i configuration (config all)
- Changing the operating mode:
  - Operating mode "protected": standard mode (the master monitors the configuration) Changes to the slaves are detected. Slaves with a different projected profile are not activated.
  - Operating mode "Config all": Changes to the slaves are detected. All connected slaves are active.
- Automatic addressing of AS-i slaves ON / OFF:
  - Automatic addressing ON:
    Permits the replaced slave (with the same profile!) to be assigned the address of the old slave in the protected mode (default).
  - Automatic addressing OFF:
    The replaced slave must be manually set to the right address.
- AS-i reset when leaving the projection mode ON / OFF:
  - Slave reset ON:
    After switching the master to the protected mode the device briefly sets all slave outputs to "0" (default).
  - Slave reset OFF:
    The status of the slave outputs remains unchanged when switching to another operating mode.

Fieldbus Setup

6320

The different fieldbus interfaces are optional.

- Input of the slave address of the device as projected in the higher-level fieldbus master.
- Further inputs depending on the higher-level fieldbus.

Slave Info

6321

Displaying status information of individual active slaves:

- Data of the digital inputs and outputs (binary + hexadecimal).
- Data of the analogue channels (decimal).
- Entries in the lists of active / detected / projected slaves / slaves with periphery fault.
- Slave profile configuration.
- Slave parameters.
- Number of telegram errors.

Slave Setup

6322

Displaying or changing output data or parameters of individual slaves:

- Digital and analogue outputs of the connected AS-i slaves.
- Current and projected parameters of the connected AS-i slaves.
- Current and projected I/O and ID codes of the connected AS-i slaves.

System Setup

6314

Central device settings:

- Baud rate of the serial programming interface.
- IP address of the Ethernet programming interface (optional).
- Input of the password to enable changes in the system configuration.
- Update of the firmware of the device (special programming software required).
- Reset of the device to the factory setting.
- History memory of the last system errors which had to be acknowledged.

System Info

6315

Display of all system parameters:

- Hardware and firmware version numbers of the device.
- Serial number of the device.
- Current / maximum PLC cycle time.

4.1.5 Changing slave parameter data

6834

NOTE

The parameter data are only stored in the AS-i master.

Changes to the slave parameter data with an addressing unit (e.g. AC1145 or AC1154) are NOT possible.

Devices with Profibus DP interface

6504

For devices with Profibus DP interface (e.g. AC1355/56, AC1365/66, AC1375/76) the adaptation of AS-i slave parameters is preferably carried out via the Profibus DP configuration.

Example: Siemens S7 with AS-i gateway AC1376:

(3) ASI-DP-Controller e

Slot	DP ID	Order Number / Designation	I Address	Q Address	Comment
1	119	1: all (A)Slaves AS-i Master 1	256...271	256...271	
2	0	2: No (A)Slaves AS-i Master 2			
3	113	3: Sl. 1B..7B AS-i Master 1	272...275	272...275	
4	0	4: No B-Slaves AS-i Master 2			
5	2AX	5: 2 word AS-i Analog MUX IN	276...279	276...279	
6	2AX	6: 2 word AS-i Analog MUX OUT	280...283	280...283	
7	179	7: 4 byte AS-i command channel	284...287	284...287	
8	2AI	8: 2 word PLC IN	288...291		
9	4AO	9: 4 word PLC OUT		288...295	
10	8AI	10: 8 word = 2 Sl. Analog IN	292...307		
11	12AO	11: 12 word = 3 Sl. Analog OUT		296...319	
12	Ext. Command channel				

To do so, change the initial values of the A/B slaves from 0xF to 0x7 if necessary.

Setting slave parameters via the device display in the AS-i master

6505

For ControllerE units with RTS > 2 and SmartLink with RTS > 1.4 the slave parameters can also be set via the device display in the AS-i master:

[Menu] > [Slave Setup] > select master > parameter value

NOTE

The change made is NOT non-volatile.

► To permanently save the parameter setting, reconfigure the AS-i master after the parameter change:
[Menu] > [Quick Setup] > [Config all]

Change of parameter data via command channels

6835

Depending on the device type and version, up to 2 different command channels are available, by means of which the AS-i slave parameters can be adapted with the specific commands.
Details → device manual

4.2 Device description AS-i gateways (AC14nn)

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11261

Example:

AC14nn

4.2.1 Operating conditions, installation

6303

- Protection IP 20.

► Installation only in a condensation-free environment.

► Avoid excessive dust, vibration and shock.

► The air circulation through the vents must not be impeded.
Minimum distance above and below the device 30 mm.

► Avoid installation in the direct vicinity of frequency inverters.

4.2.2 Electrical connection

11264

- ► Disconnect the installation from power.
- ► The national and international regulations for the installation of electrical equipment must be adhered to.
- ► Connect the device as indicated on the terminals.
- ► Do never connect the minus potentials to each other, e.g.:
  AS-i – with 0 V or 24 V DC supply or
  AS-i – with FE (functional earth) etc.
- ► FE serves for **F**unctional **E**arth, **not for protective earth**.

The FE terminal is internally connected to the housing and the DIN rail fixing. This internal connection is only useful if an electrical connection to the machine ground exists.

- ► Connect the FE terminal (= functional earth) of the device to the machine ground.

4.2.3 Power supply concepts

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11266

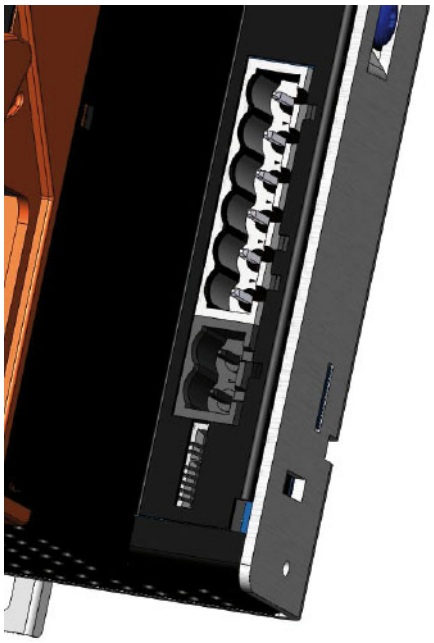


Figure: supply connections on the device

top: X1 plug, 6 poles:
for AS-i 1, AS-i 2 and FE

pin 1 AS-i 2 +
pin 2 AS-i 2 –
pin 3 AS-i 1 +
pin 4 AS-i 1 –
pin 5 FE
pin 6 n.c.

bottom: X2 plug, 2 poles

pin 1 AUX + 24 V
pin 2 AUX 0 V

below: AUX jumper

General conditions

8680

→ Adhere to the installation instructions!

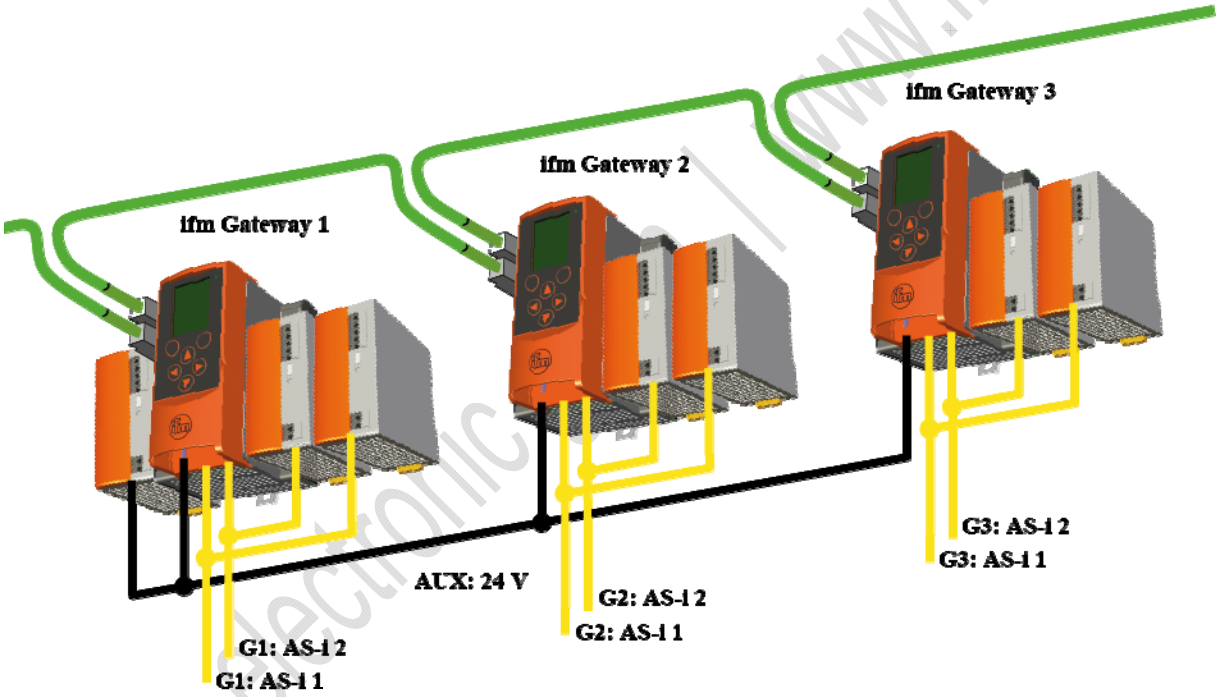
- AUX and AS-i are safely generated, touchable extra-low DC SELV voltages
- AUX is in the range 18.0...32.0 V DC
- AUX can be grounded (SELV ⇒ PELV)

Supply concept 1

6941

- Device supply via AUX.
- AS-i master 1 and AS-i master 2 are supplied via separate AS-i power supplies.

► AUX jumper must not be connected!



Example: Supply concept 1

Supply concept 2

6946

- Device supply via AS-i 1.
- AS-i 1 and AS-i 2 are supplied via separate AS-i power supplies.
- The AUX jumper (supplied with the device) must be connected!
- The AUX jumper covers the AUX connection of the device and thus prevents a simultaneous application of a voltage to the X2 plug.

Photo: AUX jumper

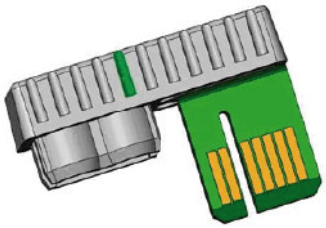
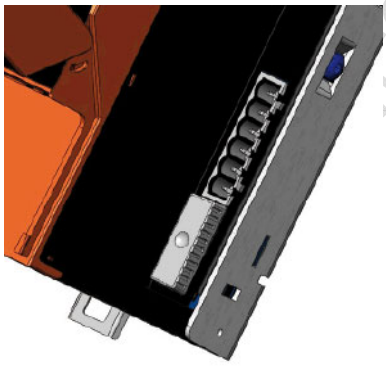
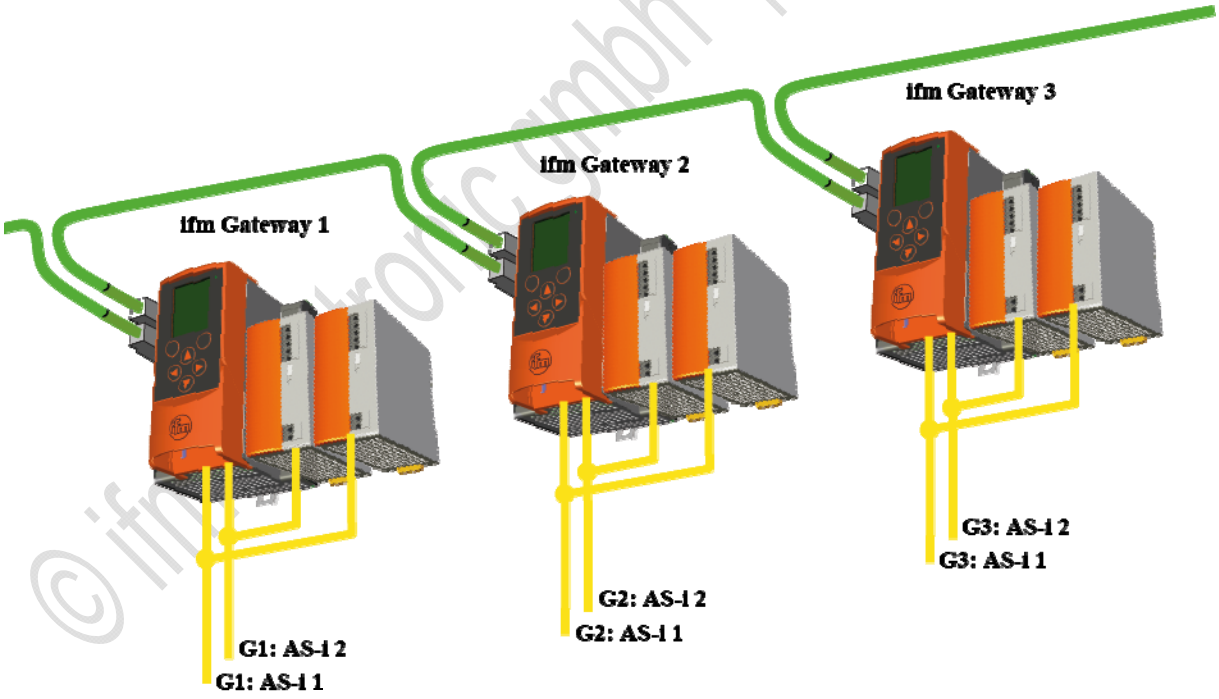


Photo: AUX jumper, inserted in the device





Example: Supply concept 2

Supply concept 3

6943

- Total supply (gateway, AS-i 1, AS-i 2) via one single voltage source:
  - 21.0...31.6 V at option (grounded or ungrounded)
  - or an AS-i power supply.
- The AC1250 data decoupling module (accessory) must be connected!

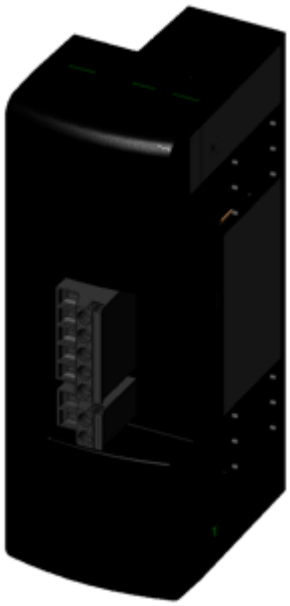


Photo: AC1250 data decoupling module (accessory)

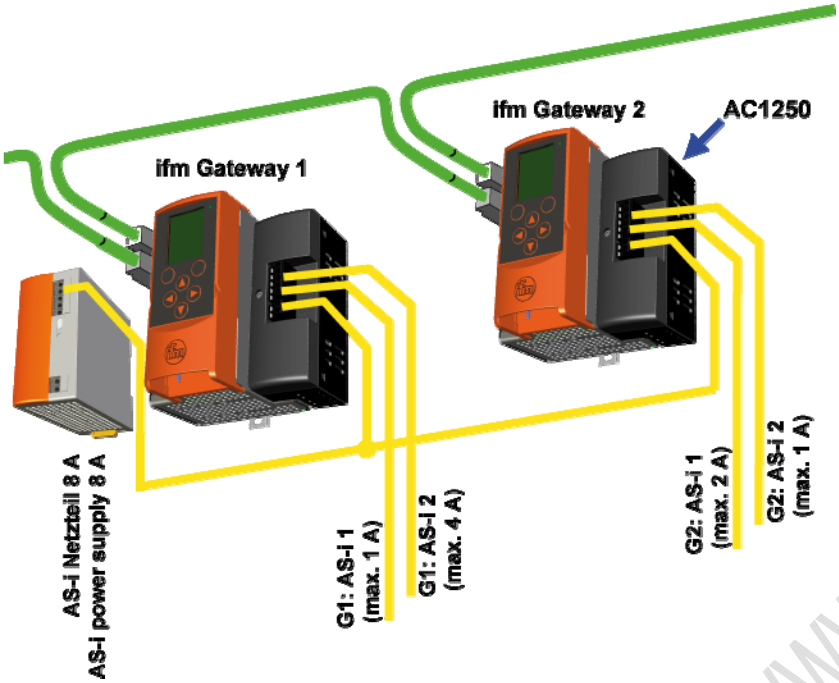
An external AC1250 data coupling module that is fixed to the device is absolutely required.

The data decoupling module has the following tasks:

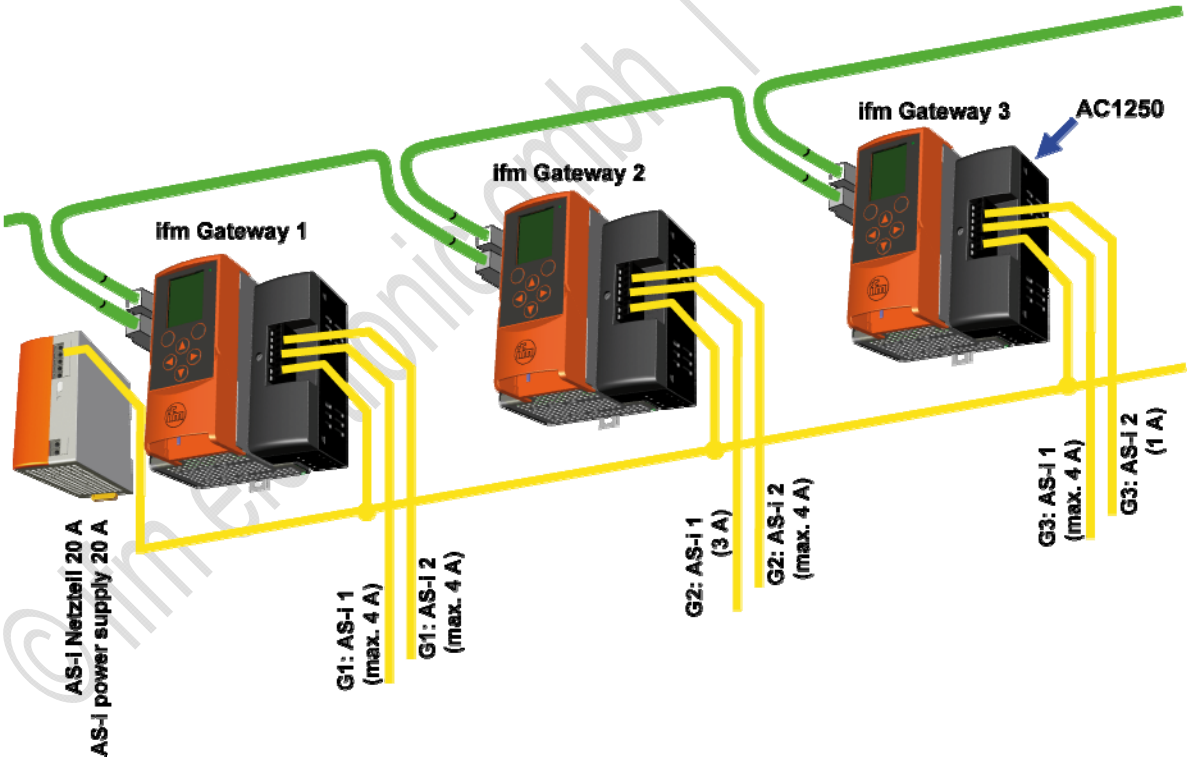
- The module supplies the device with voltage.
- The module generates a special AS-i voltage (data decoupled) for two AS-i networks beginning on the device, i.e.:
  - from a standard 24 V DC power supply
  - or from a 30 V DC power supply
  - or from a conventional AS-i power supply.

The max. current per AS-i network is 4 A.

Voltage U at the AUX+ and AUX- terminals of the data decoupling module	Result
21.5 V DC ≤ U < 30.0 V DC	Power24 (not recommended) limited AS-i cable length ≤ 50 m only AS-i slaves with special Power24 capability are allowed
30.0 V DC ≤ U ≤ 31.6 V DC or an AS-i power supply	standard AS-i (recommended)



Example 1: Supply concept 3: here: supply of 2 devices via the AS-i power supply 8 A



Example 2: Supply concept 3: here: supply of 3 devices via the AS-i power supply 20 A

The power of the AS-i power supply can be distributed to the single AS-i lines as requested, provided that max. 4 A are applied to a single AS-i line.

4.2.4 LED behaviour (AC14nn)

11268

Diagnostic LED: Basic device

6950

Diagnostic LED			Description
H1	green	lights	device has been started. There is no warning or error message.
	yellow	flashes 0.5 Hz	there is a warning but not an error message
	red	flashes 2 Hz	there is an error message

Diagnostic LED: Fieldbus Profinet

6951

Diagnostic LED			Description
H2	yellow	flashes	receipt of data
H3	green	lights	physical connection OK
H4	yellow	flashes	receipt of data
H5	green	lights	physical connection OK

4.2.5 Operating and display elements

11269
8700

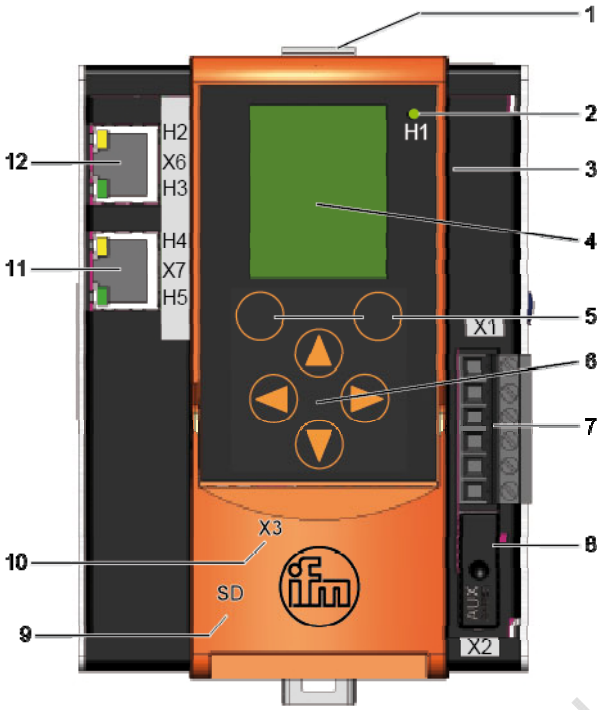


Photo: Overview AS-i Profinet gateway

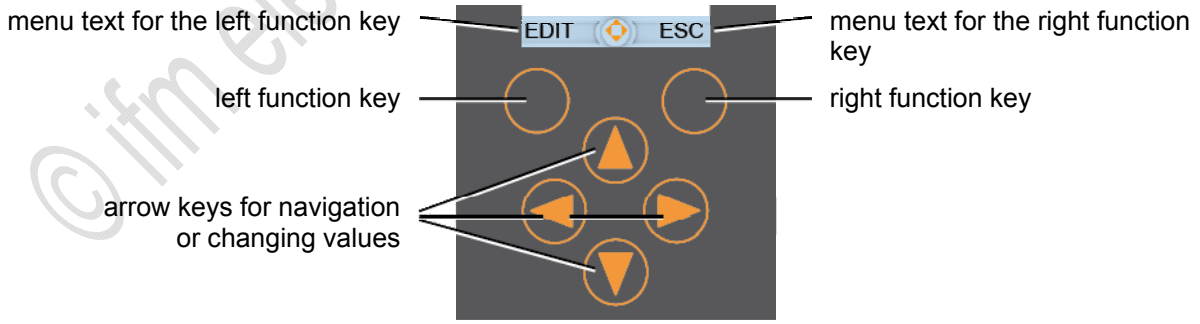
Legend:

1. unlocking key for detaching the unit from a DIN rail
2. H1 status LED
3. IP20 metal housing
4. text/graphics display
5. 2 function keys
6. 4 arrow keys
7. X1 connector for AS-i 1, AS-i 2, functional earth
8. X2 connector for AUX (here with AUX jumper)
9. slot for SD card (behind the front flap)
10. X3 Ethernet configuration interface (behind the front flap)
11. X7 Profinet interface 1 H4, H5: status LED
12. X6 Profinet interface 2 H2, H3: status LED

Key functions

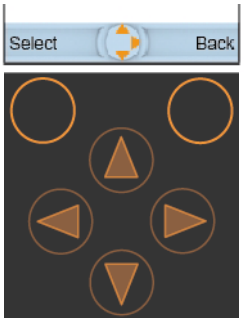
6930

There are 6 membrane keys on the user interface of the device below the display:



Function keys

7090



2 function keys directly below the display are used for selecting functions, menu items or display levels.

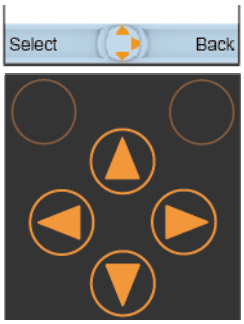
The labelling of the function keys in the navigation bar of the display shows the current meaning. If the function keys are not labelled, it has no function in the current situation.

Example:

- With the left function key [Select] you start the edit mode of the element marked in the display, e.g. to change a value.
- With the right function key [Back] you leave the current screen. The screen active before is displayed again.

Arrow keys

7091



4 arrow keys are used for navigation or for changing values.

Which keys can be activated in the current situation is shown in the navigation compass in the centre of the navigation bar.

- With the [▲] key you navigate step by step upwards in the displayed menu.
  Or: The value to be edited is increased step by step.
- With the [▼] key you navigate step by step downwards in the displayed menu.
  Or: The value to be edited is decreased step by step.
- With the [◀] key you navigate step by step to the left in the displayed menu.
- With the [▶] key you navigate step by step to the left in the displayed menu.

Switch language

9137

Sequence from the start screen:

►  >  > tab [System settings] > group [Language]

Detailed description:

1.		► Use [▶] or [◀] to switch to the symbol [System].
2.		► Use [▼] > [◀] to switch to the symbol [Settings].
3.	[System settings]	► Use the function key [Select] to go to tab [System settings]. > The menu screen [System settings] is displayed. > Focus is on the tab [System settings] .
4.	[Language] [English] [▼]	► Use several times [▼] to go to the group [Language] button. > Focus is on the listbox [Language]. > The listbox shows the current language.
5.	[Select]	► Use the function key [Select] to open the listbox [Language]. > A list of the possible languages opens. The focus shows the current language.
6.		► Use [▲] or [▼] to mark the requested language. ► Use the function key [Select] to select the new language. > The listbox shows the newly set language.
7.	[Accept selection]	► Use [▼] to mark the button [Accept selection]. ► Use the function key [Select] to activate the new language.
8.	[Back]	> The change is immediately effective. ► Use several times the function key [Back] to go to the start screen. > That's it!

Display

11271
6954

The layout of the display contains the following basic elements (→ following illustration):

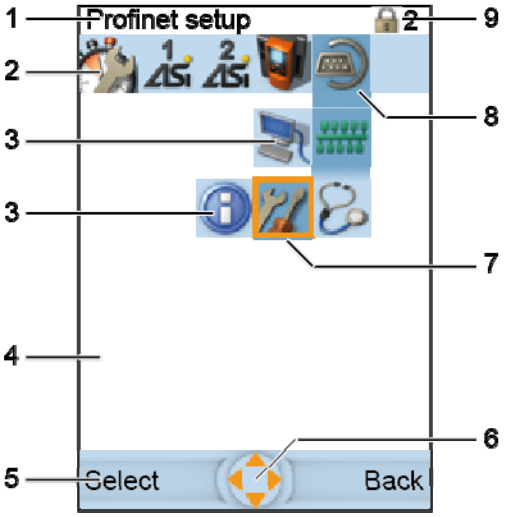


Figure: Areas in the display (example: Profinet setup)

1 = info bar
2 = main navigation bar
3 = subnavigation bars
4 = working area
5 = navigation status bar
6 = navigation compass
7 = focus
8 = starting point navigation

The position and sizes of the info bar, main navigation bar, working area and navigation status line elements cannot be changed.

Main navigation bar

6957

The main navigation bar is always visible. It is used for navigation via symbols.

> The following symbols are displayed from left to right (if the respective option is available):

Symbol		Meaning
	quick setup	This is a container for the primary device functions: • automatic adoption of the slave configuration → Project all • setting the operating modes • setting the fieldbus • setting the configuration interface • address the AS-i slaves
	AS-i 1	AS-i line 1: - master - diagnosis - slaves
	AS-i 2 (optional)	AS-i line 2: - master - diagnosis - slaves
	system	system: - information - diagnosis - settings
	interfaces	interfaces: - configuration interface - fieldbus

> All pictograms used are always displayed left-aligned within the main navigation bar and in the sequence shown above.

> When the system has been started, the main navigation bar is displayed without focus.

> The first click on any key sets the focus to the first left symbol.
Exception: in the basic screen with the function key [Support] the device changes to the page **Online support center (OSC)** (→ page 241).

> The focus can always be only on one single symbol.

► Navigate within the main navigation bar using the [◀] / [▶] arrow keys.

> Navigation is not scrolling. If a border symbol has the focus, it is not possible to navigate beyond the border to get to the opposite border symbol.

Focus

6977

The focus is used for representing the navigation through the menus and pages.

	The focus frames the marked symbol or control element which the current operation of the device refers to. top: the symbol [AS-i 1] bottom: the button [Accept selection]

► The focus is moved via the arrow keys.

> During navigation only ONE symbol or control element can have the focus.

Navigation trail

6981

Each navigation step between the main navigation bar and the tab control element of a page is marked by a navigation trail.

To recognise the navigation path there are two versions of each symbol.

	symbol without navigation trail (light background) this navigation element is not part of the navigation path
	symbol with navigation trail (dark background) this navigation element is part of the active navigation path

The starting point is the initial point of the navigation trail. The user is thus shown the navigation path to a page.

Example:

	symbol [AS-i 2] with navigation trail (dark background) becomes the starting point of navigation in the main navigation bar. The distance block connects the main navigation and subnavigation bars. Here the symbol [master settings] in the subnavigation bar has the focus.

Subnavigation bars

6965

The subnavigation bars have the following features:

- The subnavigation bar 1 is always displayed when the focus is on it or on a symbol of the main navigation bar for which a submenu has been defined.
- The subnavigation bar 2 is always displayed when the focus is on it or on a symbol of the subnavigation bar 1 for which a submenu has been defined.
- The subnavigation bars partially cover the working area.
- Navigation is made via the symbols by means of the arrow keys.
- The subnavigation bars change dynamically depending on the current menu structure.

► Navigate within the subnavigation bar using the [◀] / [▶] arrow keys.

> Navigation is not scrolling. If a border symbol has the focus, it is not possible to navigate beyond the border to reach the opposite border symbol.

Symbols in the subnavigation bars

6966

Below an overview of the symbols in the subnavigation bars:

Symbol		Meaning
	AS-i master	AS-i master settings
	AS-i slaves	AS-i slaves
	information	show information
	settings	make settings
	diagnosis	show diagnosis
	configuration interface	configuration interface settings
	fieldbus interface	Profinet interface settings
	fieldbus interface	Profibus interface settings

4.2.6 Quick setup

Contents

Project all....58
Set operating mode....59
Profibus settings....60
Profinet settings....61
Set the configuration interface....63
Change addresses of individual AS-i slaves....65

7273

Symbol		Meaning
	quick setup	This is a container for the primary device functions: • automatic adoption of the slave configuration → Project all • setting the operating modes • setting the fieldbus • setting the configuration interface • address the AS-i slaves

Project all

8973

The AS-i master always works with only those AS-i slaves that are in its list of projected slaves. As soon as there are deviations, the AS-i master excludes this slave address from processing. Added slaves are recognised but not integrated in the program sequence.

With [Project all] the AS-i master accepts the configuration of all AS-i slaves currently found in the bus into its memory. This function is useful as soon as a change has been made in the AS-i network, e.g.:
- AS-i slave replaced with another profile than before
- dynamic change of attachments with own AS-i slaves
- static restructuring of the machine/plant

Sequence from the start screen:

►  > [Project all]

Detailed description:

1.		► Use [▶] or [◀] to switch to the symbol [Quick setup].
2.	[Project all]	► Use [▼] to go to the tab [Project all] .
3.	 AS-i master 1	► Use [▼] to go to the check box [AS-i master 1] . ► Use the function key [Select] to activate the check box to select this master.
4.	(Option)  AS-i master 2	► Use [▼] to go to the check box [AS-i master 2] ► Use the function key [Select] to activate the check box to select this master.
5.	[Start projection process]	► Use [▼] to go to button [Start projection process] . ► Use the function key [Select] to start projecting.
6.		> AS-i master accepts the found slaves (LDS) in the list of the projected slaves (LPS).
7.	[Back]	► Use several times the function key [Back] to go to the start screen. > That's it!

Set operating mode

8974

Sequence from the start screen

►  > tab [Operation modes]

Detailed description:

1.		► Use [▶] or [◀] to switch to the symbol [Quick setup].
2.	[Project all]	► Use [▼] to go to the tab [Project all] .
3.	[Operation modes]	► Use [▶] to go to the tab [Operation modes] .
4.		> Display of the following groups: ▪ group [AS-i master 1] ▪ group [AS-i master 2] (Option) ▪ group [Output access]
5.	[AS-i master 1]	► Use [▼] to go to the group [AS-i master 1] . ► Mark the requested parameter with [▼] / [▲]. ► Activate or deactivate the parameter with function key [Select] . > The change is immediately effective.
6.	☐ Projection mode	☑ = Projection mode The configuration in the AS-i network can be projected. ☐ = Protected mode Normal mode; no projection is possible.
7.	☐ No slave reset	☑ = operating mode change without slave reset After changing the operationg mode the AS-i slaves go on working. ☐ = operating mode change with slave reset After changing the operationg mode the AS-i slaves make a reset before they go on working.
8.	[AS-i master 2]	(option) ditto for AS-i master 2
9.	[Output access] [Gateway] [▼]	Choose from a list which instance is responsible to power the outputs of the AS-i slaves, e.g.: [Gateway] = fieldbus master [manual] = HMI ► Use [▼] to go to the group [Output access] . > Focus is on the listbox [Output access] . > The listbox shows the current responsibility. Example: [Gateway]
10.		► Use the button [Select] to open the listbox [Output access] . > List of the possible responsibilities opens. The focus shows the current responsibility.

11.		► Use [▲] or [▼] to mark the requested responsibility. ► Use the function key [Select] to select new responsibility. > The listbox shows the reset responsibility.
12.	[Accept selection]	► Use [▼] to mark the button [Accept selection] . ► Activate the new responsibility with function key [Select] .
13.	[Back]	> The change is immediately effective. ► Use several times the function key [Back] to go to the start screen. > That's it!

Profibus settings

10917

Here you set the parameters of the Profibus fieldbus interface.

Sequence from the start screen:

►  > tab [Profibus]

Detailed description:

1.		► Use [▶] or [◀] to switch to the symbol [Quick setup].
2.	[Project all]	► Use [▼] to go to tab [Project all] .
3.	[Profibus]	► Go to the tab [Profibus] with 2 times [▶].
4.		> Displays the following groups: ▪ group [Profibus address]
5.		► Use [▼] to select the requested page.
6.	[Profibus address] Address: 3	> Displays the Profibus address of the AS-i master.
7.	[Select]	► Use the function key [Select] to start the editing mode.
8.		► Use [▲] / [▼] to set the requested value. Permissible values: 3...126
9.	[Select]	► Use the function key [Select] to accept the change. OR: Use the function key [Back] to discard the change. In both cases: exit the editing mode.
10.	[Accept]	► Use [▼] to go to the button [Accept] . ► Use function key [Select] to activate the changes.
11.	[Back]	► Use several times the function key [Back] to go to the start screen. > That's it!

Profinet settings

8976

Here you set the parameters of the fieldbus interface Profinet.

Sequence from the start screen:

►  > tab [Profinet]

Detailed description:

1.		► Use [▶] or [◀] to switch to the symbol [Quick setup].
2.	[Project all]	► Use [▼] to go to the tab [Project all] .
3.	[Profinet]	► Go to the tab [Profinet] with 2 times [▶].
4.		> Display of the following pages: ▪ group [IP address] ▪ group [Subnet mask] ▪ group [Gateway address]
5.		► Use [▼] to select the requested page.
6.	[IP address]	IP address of the AS-I master
7.	[Subnet mask]	Subnet mask → below
8.	[Gateway address]	IP address of the router
9.	[Accept]	► Use [▼] to go to the button [Accept] . ► Activate the change with the function key [Select] .
10.	[Back]	► Use several times the function key [Back] to go to the start screen. > That's it!

Notes on the Ethernet rules

NOTE

In the Ethernet network every IP address MUST be unique.

The following IP addresses, however, are reserved for network-internal purposes and are therefore not allowed as addresses for participants: nnn.nnn.nnn.0 and nnn.nnn.nnn.255.

Only network participants whose subnet mask is identical and whose IP addresses are identical with respect to the subnet mask can communicate with each other.

Rule:
If part of the subnet mask = 255, the corresponding IP address parts must be identical.
If part of the subnet mask = 0, the corresponding IP address parts must be different.

If the subnet mask = 255.255.255.0, 254 participants communicating with each other are possible in the network.
If the subnet mask = 255.255.0.0, 256x254 = 65 024 participants communicating with each other are possible in the network.

In the same physical network different subnet masks of the participants are allowed. They form different groups of participants which cannot communicate with groups of participants having other subnet masks.

In case of doubt or problems please contact your system administrator.

Examples:

Participant A IP address	Participant A Subnet mask	Participant B IP address	Participant B Subnet mask	Communication of participants possible?
192.168.82.247	255.255.255.0	192.168.82.10	255.255.255.0	yes, 254 participants possible
192.168.82.**247**	255.255.255.0	192.168.82.**247**	255.255.255.0	no (same IP address)
192.168.82.247	255.255.**255**.0	192.168.82.10	255.255.**0**.0	no (different subnet mask)
192.168.**82**.247	255.255.255.0	192.168.**116**.10	255.255.255.0	no (different IP address range: 82 ≠ 116)
192.168.222.213	255.255.0.0	192.168.222.123	255.255.0.0	yes, 65 024 participants possible
192.168.111.213	255.255.0.0	192.168.222.123	255.255.0.0	yes, 65 024 participants possible
192.168.82.247	255.255.255.0	192.168.82.**0**	255.255.255.0	no, the whole network is disturbed because the IP address nnn.nnn.nnn.0 is not allowed

Set the configuration interface

8991

Here you set the parameters of the Ethernet configuration interface (X3 port).

Sequence from the start screen:

 > tab [Configuration interface]

Detailed description:

1.		► Use [▶] or [◀] to switch to the symbol [Quick setup].
2.	[Project all]	► Use [▼] to switch to the tab [Project all].
3.	[Configuration interface]	► Use [▶] several times to switch to the tab [Configuration interface].
4.		> Display of the following groups: ▪ group [IP address] ▪ group [Subnet mask] ▪ group [Gateway address]
5.		► Use [▼] to select the requested page.
6.	[IP address] ☑ Optain IP address autom.	> check box [Optain IP address autom.]: Display of the current setting. ▪ ☐ = IP address indicated below is valid. ▪ If a valid DHCP IP address has been indicated: ☑ = The device will obtain the IP address from the DHCP server. ▪ If no DHCP server has been found: ☑ = The IP address will be generated from the following address range: 192.168.nnn.nnn Subnet mask for this = 255.255.0.0 ► Activate or deactivate the parameter with function key [Select] . ► The change is immediately effective.
7.	IP status: Statisch	> Display status of the IP connection: ▪ "DHCP" = DHCP = **D**ynamic **H**ost **C**onfiguration **P**rotocol The device will obtain the IP address from the DHCP server. ▪ "Zeroconf" = (Zero Configuration Networking) The IP address will be generated from the following address range: 192.168.nnn.nnn ▪ "Static" = The IP address is not obtained automatically. The device statically uses the following IP address.

8.	[IP address] 169 . 254 . 198 . 31	IP address of the AS-i master (change value → **IP address control element**, only possible if [Optain IP address autom.] = ☐)
9.	[Subnet mask] 255 . 255 . 0 . 0	Subnetzmaske (change value → **IP address control element**, only possible if [Optain IP address autom.] = ☐) 🛈 → below
10.	[Gateway address] 0 . 0 . 0 . 0	IP-Adresse of the DHCP server (change value → **IP address control element**)
11.	[Accept]	► Use [▼] to go to button [Accept] . ► Use [Select] to activate the changes.
12.	[Back]	► Use several times the function key [Back] to go to the start screen. > That's it!

Notes on the Ethernet rules

🛈 NOTE

In the Ethernet network every IP address MUST be unique.

The following IP addresses, however, are reserved for network-internal purposes and are therefore not allowed as addresses for participants: nnn.nnn.nnn.0 and nnn.nnn.nnn.255.

Only network participants whose subnet mask is identical and whose IP addresses are identical with respect to the subnet mask can communicate with each other.

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If part of the subnet mask = 255, the corresponding IP address parts must be identical.
If part of the subnet mask = 0, the corresponding IP address parts must be different.

If the subnet mask = 255.255.255.0, 254 participants communicating with each other are possible in the network.
If the subnet mask = 255.255.0.0, 256x254 = 65 024 participants communicating with each other are possible in the network.

In the same physical network different subnet masks of the participants are allowed. They form different groups of participants which cannot communicate with groups of participants having other subnet masks.

🛈 In case of doubt or problems please contact your system administrator.

Examples:

Participant A IP address	Participant A Subnet mask	Participant B IP address	Participant B Subnet mask	Communication of participants possible?
192.168.82.247	255.255.255.0	192.168.82.10	255.255.255.0	yes, 254 participants possible
192.168.82.**247**	255.255.255.0	192.168.82.**247**	255.255.255.0	no (same IP address)
192.168.82.247	255.255.**255**.0	192.168.82.10	255.255.**0**.0	no (different subnet mask)
192.168.**82**.247	255.255.255.0	192.168.**116**.10	255.255.255.0	no (different IP address range: 82 ≠ 116)
192.168.222.213	255.255.0.0	192.168.222.123	255.255.0.0	yes, 65 024 participants possible
192.168.111.213	255.255.0.0	192.168.222.123	255.255.0.0	yes, 65 024 participants possible
192.168.82.247	255.255.255.0	192.168.82.**0**	255.255.255.0	no, the whole network is disturbed because the IP address nnn.nnn.nnn.0 is not allowed

Change addresses of individual AS-i slaves

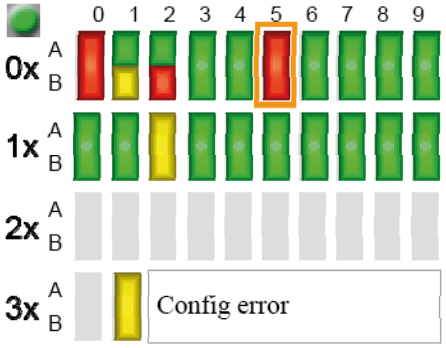
8992

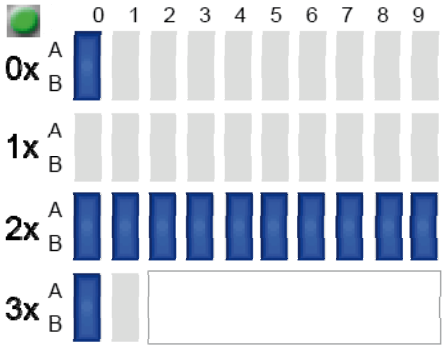
Here you can change the addresses of individual AS-i slaves.

Sequence from the start screen:

►  > tab [Addressing AS-i 1] or [Addressing AS-i 2]

Detailed description:

1.		► Use [▶] or [◀] to switch to the symbol [Quick setup].
2,	[Project all]	► Use [▼] to go to the tab [Project all].
3.	[Addressing AS-i 1]	► Use [▶] several times to go to the tab [Addressing AS-i 1] or [Addressing AS-i 2] (option).
4.	[Overview slave status]	> Display the [Overview slave status] page:  > Display AS-i master operating mode: = AS-i master in protected mode = AS-i master in projection mode ► Mark the slave address to be changed with [▶] / [▼]. ► Select this slave with function key [Select].

5.	[Overview free slave addresses]	> Display the [Overview free slave addresses] page:  > Display AS-i master operating mode: = AS-i master in protected mode = AS-i master in projection mode ► Use [▶] / [▼] to mark the requested target address to which the AS-i slave is to be changed. ► Use the function key [Select] to accept the new address.
6.		> Display of safety query. ► Confirm the change with function key [OK]. OR: Cancel the change with function key [Cancel].
7.	[Cancel]	After function key [Cancel] : > The [Overview free slave addresses] page is displayed to select another address. ► Continue with step 5 OR:
8.	[OK]	After function key [OK] : > The [Overview slave status] page is displayed. If as a consequence of this measure the current configuration does no longer correspond to the saved configuration: > Error message "Configuration error" appears.
9.	[Back]	► Use several times the function key [Back] to go to the start screen. > That's it!

4.3 Device description AS-i power supplies (AC1216, AC1218, AC1223, AC1224, AC1226)

Contents

Operating conditions, installation 67
Electrical connection (AC1216...) 68
LED behaviour (AC12nn) 70

6317

Examples:

AC1216

AC1218

4.3.1 Operating conditions, installation

6324

- Protection IP 20.

► Installation only in a condensation-free environment.

► Avoid excessive dust, vibration and shock.

► The air circulation through the vents must not be impeded. Recommended clear space:
Left / right: 15 mm in each direction,
Top / bottom: 25 mm in each direction.

► Avoid installation in the direct vicinity of frequency inverters.

4.3.2 Electrical connection (AC1216...)

6325

Size of the back-up fuse (line protection) → data sheet.

The AS-i power supplies have an integrated fuse serving exclusively for device protection. If this internal fuse triggers, the device must be sent to the manufacturer for repair for security reasons.

- ► If single wires are used for the AS-i connection in the control cabinet:
  lay the wires as a twisted parallel pair to avoid e.g. current loops.
- ► Connect the protective wire to the PE terminal (protective earth!). Do not operate the device without protective wire! The PE terminal on the primary side of the AS-i power supply is internally connected to the earthing screw and the housing.
- ► The screws on the housing serve for internal earthing. Do not remove! Do not connect any cables to them!
- ► Connect Shield/Ground (GND) on the AS-i power supply to the machine ground so that the AS-i system is symmetrically operated against this machine ground. This improves noise sensitivity in case of symmetrical interference on the AS-i cable.
- ► Check the voltage range of the network selection switch:
  - 115 V AC (range 85...132 V AC)
  - 230 V AC (range 184...264 V AC)

Fault: The power supply does not start up, the back-up fuse (line protection) triggers.	**Cause:** The inrush current limitation is often implemented by an NTC resistor. If a power supply operating under load is briefly (a couple of seconds) switched off and on again, the NTC is still of low resistance and so the starting inrush current is almost indefinitely high.

Link for IR addressing

6326

Link at position 2-3 interrupts the AS-i data communication, IR addressing can be carried out.

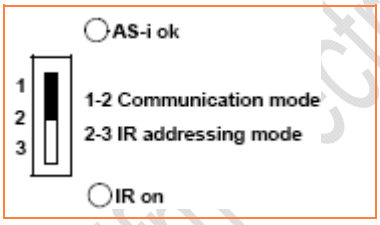


Figure: Link on the AS-i power supply

1. Switch off the AS-i power supply upon first setup of the AS-i slaves with IR interface (preset address 0).
2. Reposition the link to position 2-3.
3. Switch the power supply on again and address the slaves.
4. Reposition the link to position 1-2 for regular data communication.

IR addressing of the slaves → chapter **Infrared addressing** (→ page 105)

Integrated earth fault monitor (optional)

6327

Detection of asymmetrical earth faults, e.g. AS-i+ or AS-i- against Shield.

Relay output (GF ok) as normally closed contact
($V_{switching}$ = 25 V AC or 60 V DC, max. 0.5 A).

Button [Test-Reset]:
pressed < 2 s = earth fault simulation,
pressed > 2 s = reset of the earth fault monitor.

Fuse mode (optional)

6328

Electronic fuse on the output.

Triggering in case of overload, short circuit and excess temperature.

Device switches off after 2...5 s.

Restart via reset button on the front.

Power supply for 8 A

6329

For use of an 8 A AS-i power supply please note the following:

- The voltage drop along the AS-i line increases.
  For orientation: If 2 A are transmitted via a 100 m long cable with 1.5 mm² wire cross section, the voltage drop is about 5 V.
- When distributing the AS-i voltage (branch), note the current rating of the contacts for the insulation displacement technology. Examples:
  AC5000 flat cable lower part: 2 A
  E70377 flat cable splitter: 8 A
  E70381 flat cable splitter: 8 A

Core cross sections

11283

Type of cable	Max. core cross section [mm²]	AWG
massive	0.5…6	20…10
flexible	0.5…4	20…12

4.3.3 LED behaviour (AC12nn)

6330

Diagnostic LEDs	LED colour	LED off	LED lit	LED flashes
AS-i ok	green	AS-i overload	AS-i ok	---
COM off	red	---	IR addressing	---
Overload *)	red	---	---	fuse mode switches off the output
Ground Fault *)	red	---	earth fault	---

*) Option

4.4 Device description AS-i power supplies (AC1220, AC1221)

11276

Example:

AC1220

4.4.1 Operating conditions, installation

11277

- Protection IP 20.
- ► Installation only in a condensation-free environment.
- ► Avoid excessive dust, vibration and shock.
- ► The air circulation through the vents must not be impeded. Recommended clear space:
  Left / right: 30 mm in each direction,
  Top / bottom: 30 mm in each direction.
- ► Avoid installation in the direct vicinity of frequency inverters.

4.4.2 Electrical connection

11279

Back-up fuse (line protection): external, 10 A, characteristic B.

The AS-i power supplies have an integrated fuse serving exclusively for device protection. If this internal fuse triggers, the device must be sent to the manufacturer for repair for security reasons.

- ► If single wires are used for the AS-i connection in the control cabinet:
  lay the wires as a twisted parallel pair to avoid e.g. current loops.
- ► Connect Shield/Ground (GND) on the AS-i power supply to the machine ground so that the AS-i system is symmetrically operated against this machine ground. This improves noise sensitivity in case of symmetrical interference on the AS-i cable.

Wide-range input: 100...240 V AC ± 10 %

Fault: The power supply does not start up, the back-up fuse (line protection) triggers.	**Cause:** The inrush current limitation is often implemented by an NTC resistor. If a power supply operating under load is briefly (a couple of seconds) switched off and on again, the NTC is still of low resistance and so the starting inrush current is almost indefinitely high.

Core cross sections

11281

Type of wire	Max. core cross section [mm²]	AWG
massive	1.5	16
flexible	1.5 (with wire end ferrule)	---

4.4.3 Output response

11284

In case of short-circuit or overload of the output the output voltage is regulated down at constant maximum current.

4.5 Device description AS-i power supplies (AC1236, AC1244)

11275

Example:

AC1236

4.5.1 Operating conditions, installation

11273

- Protection IP 20.
- ► Installation only in a condensation-free environment.
- ► Avoid excessive dust, vibration and shock.
- ► The air circulation through the vents must not be impeded. Recommended clear space:
  Left / right: 20 mm in each direction,
  Top / bottom: 20 mm in each direction.
- ► Avoid installation in the direct vicinity of frequency inverters.

4.5.2 Electrical connection

11280

Back-up fuse (line protection): external, 10 A, characteristic B.

The AS-i power supplies have an integrated fuse serving exclusively for device protection. If this internal fuse triggers, the device must be sent to the manufacturer for repair for security reasons.

- ► If single wires are used for the AS-i connection in the control cabinet:
  lay the wires as a twisted parallel pair to avoid e.g. current loops.
- ► Connect the protective wire to the PE terminal (protective earth!). Do not operate the device without protective wire! The PE terminal on the primary side of the AS-i power supply is internally connected to the earthing screw and the housing.
- ► The screw on the housing serves for internal earthing. Do not remove! Do not connect any cables to it!
- ► Connect Shield/Ground (GND) on the AS-i power supply to the machine ground so that the AS-i system is symmetrically operated against this machine ground. This improves noise sensitivity in case of symmetrical interference on the AS-i cable.

► Do not use unmarked terminals.

► Tightening torque for all terminals 0.5...0.6 Nm.

Wide-range input: 100...240 V AC ± 10 %

Fault: The power supply does not start up, the back-up fuse (line protection) triggers.	**Cause:** The inrush current limitation is often implemented by an NTC resistor. If a power supply operating under load is briefly (a couple of seconds) switched off and on again, the NTC is still of low resistance and so the starting inrush current is almost indefinitely high.

Core cross sections

11282

Connection	Type of wire	Max. core cross section [mm²]	AWG
AC	massive	0.2…6	24…10
AC	flexible	0.2…4 with wire end ferrule: 0.25…4	---
DC	massive	0.2…6	24…10
DC	flexible	0.2…4 with wire end ferrule: 0.25…4	---

4.5.3 Output response

11284

In case of short-circuit or overload of the output the output voltage is regulated down at constant maximum current.

4.6 Device description control cabinet modules SmartLine (AC22nn)

Contents

Operating conditions, installation 75
Electrical connection 76
Addressing 76
Connecting analogue periphery (AC2216...AC2220).....77
Fehler! Verweisquelle konnte nicht gefunden werden...... **Fehler! Textmarke nicht definiert.**

6332

Examples:

AC2250

AC2258

4.6.1 Operating conditions, installation

6335

- Protection IP 20.

► Installation only in a condensation-free environment.

► Avoid excessive dust, vibration and shock.

► Avoid installation in the direct vicinity of frequency inverters or inductive loads.

4.6.2 Electrical connection

6342

► Disconnect the installation from power before connecting the modules to the periphery.

► Supply all the outputs (relays) with the same voltage (e.g. 240 V AC or 24 V DC).
Exception for AC2258 and AC2259:
Supply the outputs (relays) O1 and O2 as well as O3 and O4 in pairs with the same voltage (e.g. 2x 240 V AC or 2x 24 V DC).

► Do **not** connect the inputs to an external potential when these are supplied from the AS-i voltage.

Device	The connections are internally connected	External connection	Note
AC2251, AC2252, AC2267	E- to O-	not useful	---
AC2254, AC2255, AC2259	E- to I-	not useful	The sensors must be supplied via an external PELV voltage source.
AC2257, AC2267	E- to I- and O-	not useful	The sensors must be supplied via an external PELV voltage source.
AC2264	E- to O-	not useful	---

4.6.3 Addressing

6343

When mounted and wired, the module can be addressed with the addressing cable E70213 via the integrated addressing interface.

NOTICE

A connector other than the ifm jack plug E70213 can destroy the addressing socket!

Non ifm connectors (other than ifm article E70213) can cause short-circuits or irreparable deformations of the socket contacts, resulting in a damaged addressing socket. As a consequence the device can no longer communicate since it is permanently separated from the AS-i bus.

► For addressing only use the ifm jack plug E70213!

If a slave is used with the ID code "A" (extended address mode enabled) combined with a master of the 1st generation (version 2.0) then:

- Set parameter P3=1.
  Set output bit D3=0.
  The output bit D3 must not be used.
- Assign an address of 1A...31A to this slave.

4.6.4 Connecting analogue periphery (AC2216...AC2220)

Contents

Analogue inputs 4...20 mA (AC2216)....78
Analogue inputs 0...10 V (AC2217)....79
Parameter setting (AC2216, AC2217)....80
Measuring range (AC2216)....80
Measuring range (AC2217)....80
Analogue temperature measurement Pt100 (AC2220)....81
Parameter setting (AC2220)....82
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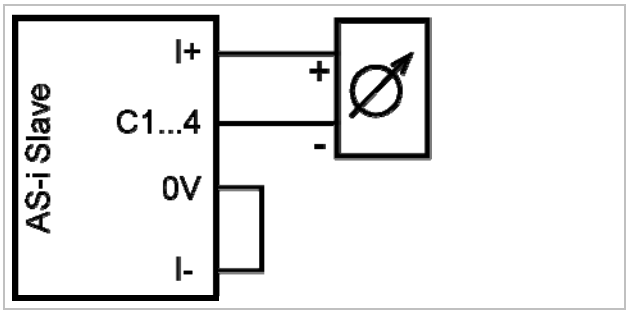
Analogue outputs 0...20 mA (AC2218)....83
Analogue outputs 0...10 V (AC2219)....84
Parameter setting (AC2218, AC2219)....85
Measuring range (AC2218)....85
Measuring range (AC2219)....85

6485

Analogue inputs 4...20 mA (AC2216)

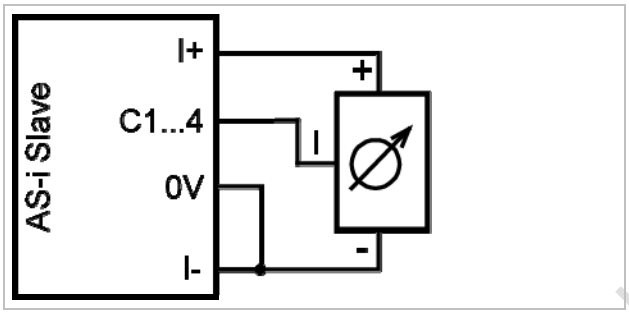
6568

Wiring 2-wire sensor without own supply



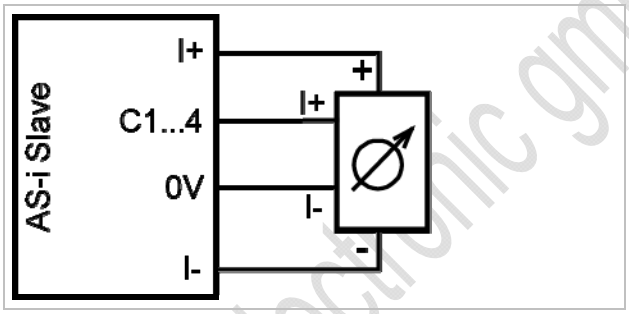
► Connect the terminals I- and 0V to each other via an external link.

Wiring 3-wire sensor without own supply

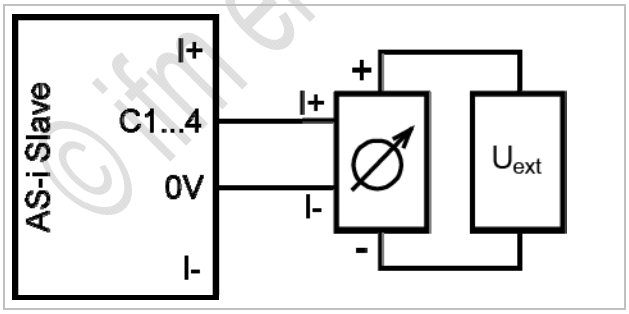


► Connect the terminals I- and 0V to each other via an external link.

Wiring 4-wire sensor without own supply



Wiring analogue sensor with own supply

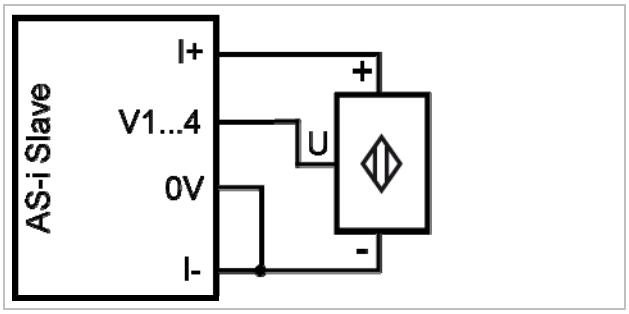


External supply PELV ungrounded

Analogue inputs 0...10 V (AC2217)

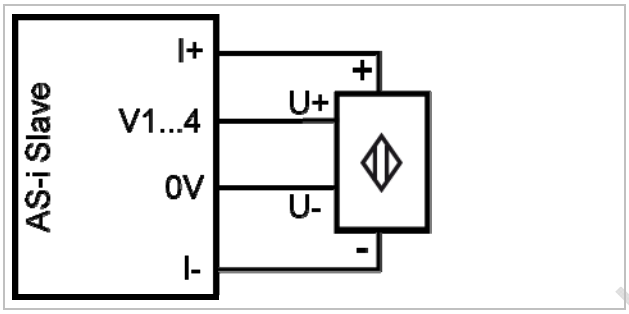
6569

Wiring 3-wire sensor without own supply

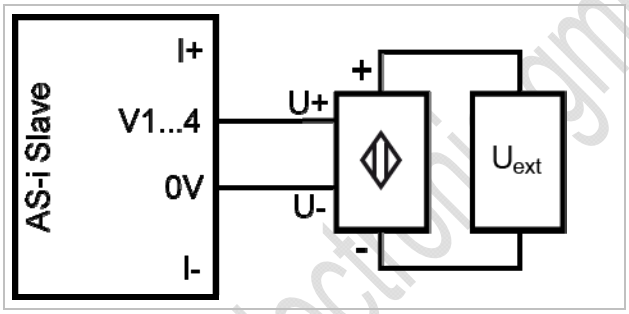


► Connect the terminals I- and 0V to each other via an external link.

Wiring 4-wire sensor without own supply



Wiring analogue sensor with own supply



External supply PELV ungrounded

Parameter setting (AC2216, AC2217)

6478

Parameter bit	Designation	Description					
P0	filter for A/D converter	0 = 60 Hz filter is active 1 = 50 Hz filter is active (for the whole of Europe)					
P1, P2	channel activation	**P1**	**P2**	**channel 1**	**channel 2**	**channel 3**	**channel 4**
		0	0	on	off	off	off
		0	1	on	on	off	off
		1	0	on	on	on	off
		1	1	on	on	on	on
P3	indication of periphery faults	0 = periphery fault indication is not active 1 = periphery fault indication is active					

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2216)

11289

Analogue input module, nominal range = 4...20 mA

Range [mA]	Units [dec]	Units [hex]	LED yellow I1…I4	Meaning
< 1	32767	7FFF	flashes	wire break
1…3.999	1000…3999	03E8…0F9F	lights	below nominal range
4…20	4000…20000	0FA0…4E20	lights	nominal range
20.001…23	20001…23000	4E21…59D8	lights	overcontrol
> 23	32767	7FFF	flashes	overflow

Measuring range (AC2217)

11290

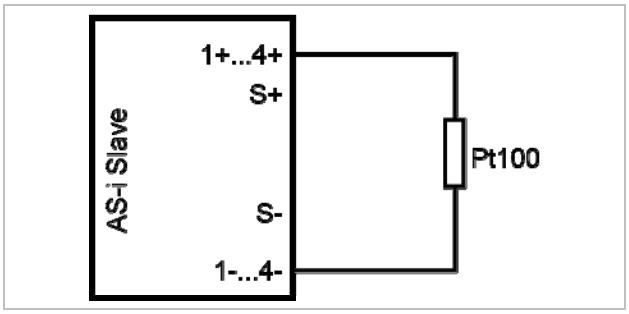
Analogue input module, nominal range = 0...10 V

Range [V]	Units [dec]	Units [hex]	LED yellow I1…I4	Meaning
< 0	0	0000	lights	outside range
0…10	0…10000	0000…2710	lights	nominal range
10.001…11.5	10001…11500	2711…2CEC	lights	overcontrol
> 11.5	32767	7FFF	flashes	overflow

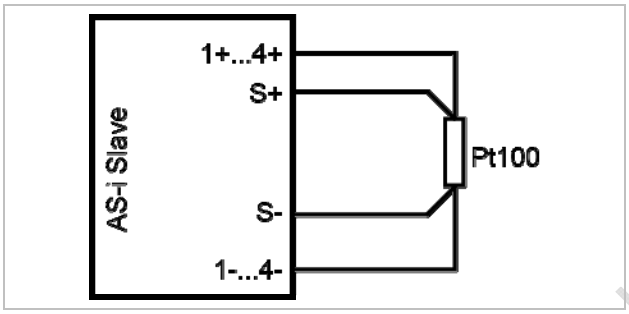
Analogue temperature measurement Pt100 (AC2220)

6588

Wiring 2-wire Pt100 sensor



Wiring 4-wire Pt100 sensor



► For modules with Pt100 inputs:
Connect at least one Pt100 sensor prior to switching on the AS-i slave, to start the A/D converter. Otherwise there will be an error message: LEDs I1...I4 flashing at 5 Hz.

Important notes on Pt100 measurements

- With the Pt100 measuring method, very low currents flow into the measuring electronics.
- 4-wire Pt100 sensors provide more precise results than 2-wire sensors. For 2-wire measurement, all contact resistances and connection resistances add up by measurement and can massively falsify the measurement result.

► The changeover between 2- wire and 4-wire sensors is made via the parameter bit P3.

► Avoid additional resistance (conductors, contact and transfer resistance, loose contacts, etc.) in the measuring circuit! This ensures a precise measurement.

► Use high-quality connectors for the AS-i Pt100 module. Prefer prewired and potted connectors with gold-plated contacts.

Parameter setting (AC2220)

6551

Parameter bit	Designation	Description					
P0	filter for A/D converter	0 = 60 Hz filter is active 1 = 50 Hz filter is active (for the whole of Europe)					
P1, P2	periphery fault is detected by channel...	**P1**	**P2**	**channel 1**	**channel 2**	**channel 3**	**channel 4**
		0	0	yes	no	no	no
		0	1	yes	yes	no	no
		1	0	yes	yes	yes	no
		1	1	yes	yes	yes	yes
P3	Pt100 sensor type	0 = 4-wire mode 1 = 2-wire mode					

The parameter bits P1 and P2 define which measuring channels can trigger a periphery fault message. But irrespective of the defined parameters all 4 channels are always transferred via the AS-Interface.

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2220)

11291

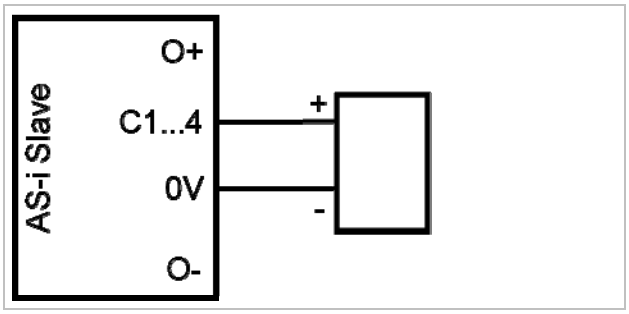
Pt100 module, nominal range = -200...+850 °C

Range [°C]	Units [dec]	Units [hex]	LED yellow I1…I4	Meaning
< -219.4	32767	7FFF	flashes	short circuit
-219.4…-200.1	-2194…-2001	F76E…F82F	lights	below nominal range
-200…+850	-2000…8500	F830…2134	lights	nominal range
+850.1…+883.6	8501…8836	2135…2284	lights	overcontrol
> +883.6	32767	7FFF	out	wire break

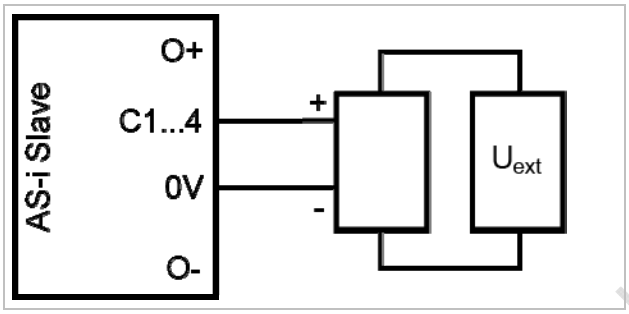
Analogue outputs 0...20 mA (AC2218)

6579

Wiring actuator without separate voltage supply

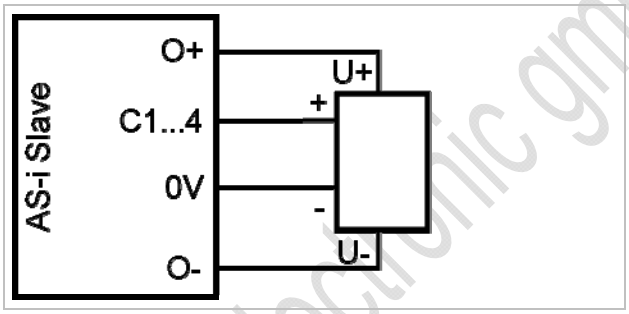


Wiring actuator with own voltage supply



External supply PELV ungrounded

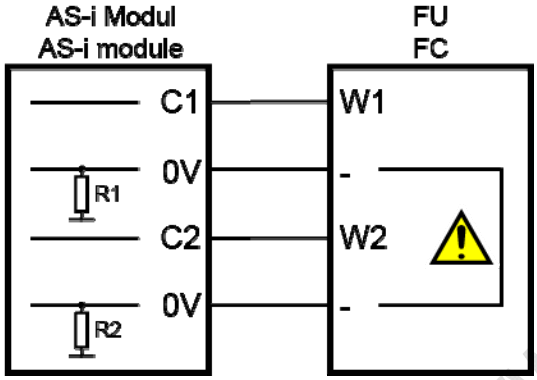
Wiring actuator with separate voltage supply



Additional note for the current output AC2nn8:

► Do not connect the terminal [analogue output 0V] of the respective channels of the current output module to each other!
The connection can e.g. also be made when connecting a multi-channel frequency inverter.

> This connection leads to faulty current signals. Reason: A parallel connection of the internal resistances is established by connecting the terminal [analogue output 0V]:



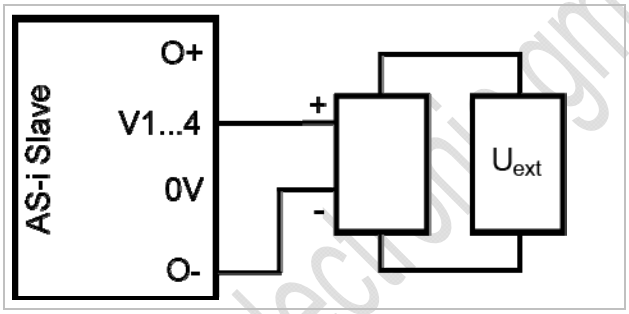
► Solution: Use of **two** current output modules.

When using voltage output modules the 0V terminals can be connected.

Analogue outputs 0...10 V (AC2219)

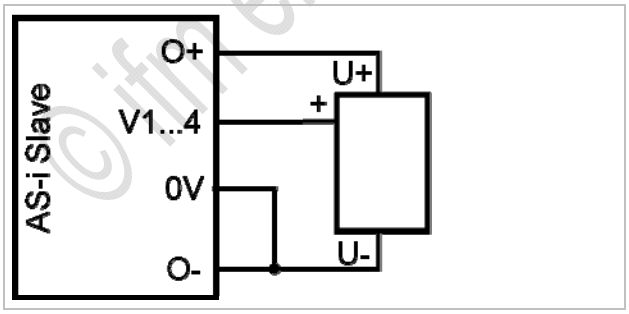
6580

Wiring actuator with own voltage supply



External supply PELV ungrounded

Wiring actuator with own voltage supply



Connect the terminals O- and 0V to each other via an external link.

Parameter setting (AC2218, AC2219)

6586

Parameter bit	Designation	Description
P0	not used	reserved
P1	not used	reserved
P2	periphery fault	0 = periphery fault not active 1 = periphery fault active
P3	not used	reserved

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2218)

11292

Analogue output module, nominal range = 0...20 mA

Range [mA]	Units [dec]	Units [hex]	LED yellow O1…O4	Meaning
0…20	0…20000	0000…4E20	lights	nominal range
20.001…23	20001…23000	4E21…59D8	lights	overcontrol
> 23	> 23000	> 59D8	flashes	overflow

Measuring range (AC2219)

11293

Analogue output module, nominal range = 0...10 V

Range [V]	Units [dec]	Units [hex]	LED yellow O1…O4	Meaning
0…10	0…10000	0000…2710	lights	nominal range
10.001…11.5	10001…11500	2711...2CEC	lights	overcontrol
> 11.5	> 11500	> 2CEC	flashes	overflow

4.6.5 LED behaviour (AC2216...AC2220)

6786

LED behaviour of the digital modules

6808

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[I1]...[I4] [O1]...[O4]	yellow	lights	binary input/output is switched on
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- Lacking auxiliary voltage (only where the inputs of the modules are supplied via AUX)
- Overload etc.

LED behaviour (AC2216, AC2217)

6419

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[DIAG]	yellow	off	internal diagnosis: fault (replace module)
		lights	internal diagnosis: no fault
		flashes	internal diagnosis: fault (replace module)

LED behaviour (AC2216)

6778

Diagnostic LED			Description
[I-1]...[I-4]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range (overflow), no sensor connected or wire break
[I-2]...[I-4]	yellow	off	no sensor connected (at least one LED flashes, because not all channels can be deactivated via the parameter bit P1/P2 (channel activation) (channel 1 is always activated))
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- Nothing connected to at least one analogue channel, although the respective channel is activated.
- There is a wire break.

LED behaviour (AC2217)

6783

Diagnostic LED			Description
[I-1]...[I-4]	yellow	lights	the respective channel is activated analogue signal in the measuring range or no sensor connected (it cannot be differentiated whether the 0 V signal is applied or whether no sensor is connected)
		flashes	analogue signal outside the measuring range (outside range)
[I-2]...[I-4]	yellow	off	the respective channel is not activated (channel 1 is always activated)
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.

LED behaviour (AC2220)

6788

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[I1]...[I4]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range
		off	no sensor connected
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- Nothing connected to at least one analogue channel, although the respective channel is activated.

LED behaviour (AC2218, AC2219)

6787

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[DIAG]	yellow	off	internal diagnosis: fault (replace module)
		lights	internal diagnosis: no fault
		flashes	internal diagnosis: fault (replace module)
[O1]...[O4]	yellow	lights	analogue signal within the measuring range or no actuator connected it cannot be differentiated whether the 0V/0mA signal is applied or whether no actuator is connected
		flashes	analogue signal outside the measuring range (outside range)
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.

4.7 Device description cabinet modules

6447

Example:

AC2704

4.7.1 Operating conditions, installation

6335

- Protection IP 20.

► Installation only in a condensation-free environment.

► Avoid excessive dust, vibration and shock.

► Avoid installation in the direct vicinity of frequency inverters or inductive loads.

4.7.2 Electrical connection

6469

► Disconnect the installation from power before connecting the modules to the periphery.

► Digital modules: Do NOT connect the inputs to an external potential, when the inputs are supplied from the AS-i voltage.

► For the outputs O1...O4 the external potential must be a PELV voltage.

4.7.3 Addressing

6691

For modules with addressing plug (jumper):

► Connect the module to the addressing unit via the terminals A+ and A-. Pull the plug prior to addressing and place the plug on only one pin (= parking position) after carrying out the addressing.

► Automatic addressing of several modules via the ControllerE or the gateway (to do so, activate [Address Slave] > [Easy Startup] in the menu):
Pull the addressing plug on the first module, then on the second module, etc.
The modules are addressed in ascending order.

If a slave is used with the ID code "A" (extended address mode enabled) combined with a master of the 1st generation (version 2.0) then:

- Set parameter P3=1.
  Set output bit D3=0.
  The output bit D3 must not be used.
- Assign an address of 1A...31A to this slave.

4.7.4 LED behaviour (AC27nn)

6455

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[I1]...[I4] [O1]...[O4]	yellow	lights	binary input/output is switched on
[ERR]	red	lights	short circuit or overload the output switches off reset (after rectification of the fault) by switching the external voltage supply for the actuators off and on again
[AUX]	green	lights	external voltage supply present 24 V DC

4.8 Device description universal modules (AC20nn, AC26nn)

Contents

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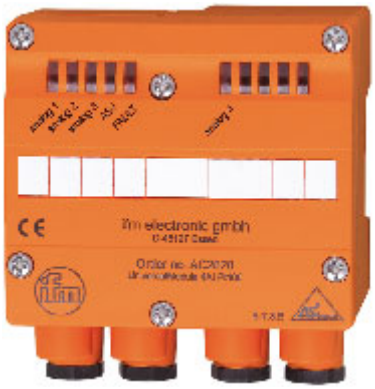
Addressing 92
Connecting analogue periphery (AC2616...AC2620)....92
LED behaviour (AC2032, AC2035, AC2616...AC2620)....101

6452

Example:



AC2620

4.8.1 Operating conditions, installation

6471

- Protection IP 65

► Mount the module on a wired module lower part of the AS-i network, tightening torque 0.8 Nm.

► Avoid installation in the direct vicinity of frequency inverters.

► Use an FC-E lower part (article no. AC5003, AC5011) if supply is to be made from the external 24 V supply.

4.8.2 Electrical connection

6473

► Disconnect the installation from power before connecting the modules to the periphery.

► Use an FC-E lower part (article no. AC5003, AC5011) if supply is to be made from the external 24 V supply.

Digital modules:

► Do NOT connect the inputs to an external potential, because the inputs are supplied from the AS-i voltage.

4.8.3 Addressing

6476

- ► When you use module lower parts without an addressing socket (AC5000 or AC5003) first address the module by placing it onto an addressing unit (AC1144) and assign a free address between 1 and 31.
- ► When you use module lower parts with an addressing socket (AC5010, AC5011) the modules can be addressed with the addressing adapter E70213 later on.

4.8.4 Connecting analogue periphery (AC2616...AC2620)

Contents

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6489

- ► Disconnect the installation from power before connecting the modules to the periphery.
- ► If a total of over 90 mA is needed for the sensor supply, the supply must be from an external 24 V PELV voltage source.
- ► Use an FC-E lower part (article no. AC5003, AC5011) if supply is to be made from the external 24 V supply.
- ► Select the type of supply via links inside the module:
  - To select the voltage supply the position of the links may only be changed when the module is disconnected!
  - Switch off the module supply and open the module by removing the screws. Remove the module cover. The links for the supply selection are now freely accessible.
  - Place the links as follows:

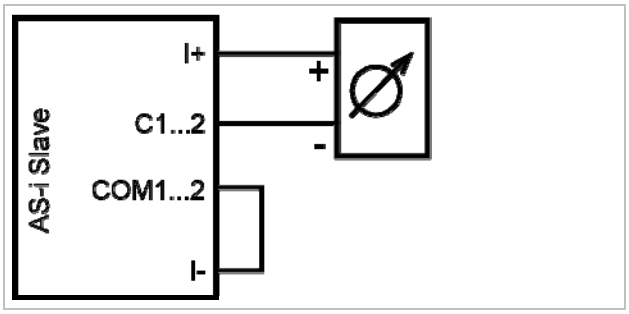
	Periphery supply from AS-i OR:
	Periphery supply from an external 24 V PELV voltage source

Analogue inputs 4...20 mA (AC2616)

6592

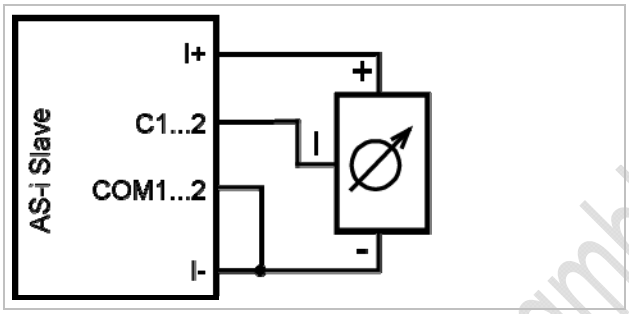
On delivery, the analogue input module with 2 current inputs is equipped with a resistor between the terminals I+ and C2 and with a link between the terminals I- and COM2. Due to this, no error message is displayed by the module when it is set up with only one connected sensor.

Wiring 2-wire sensor without own supply



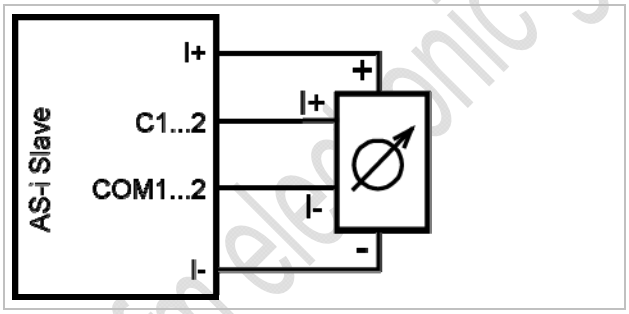
► Connect the terminals I- and COM1/COM2 to each other via an external link.

Wiring 3-wire sensor without own supply

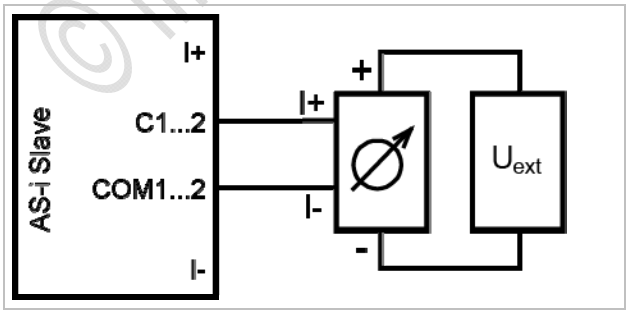


► Connect the terminals I- and COM1/COM2 to each other via an external link.

Wiring 4-wire sensor without own supply



Wiring analogue sensor with own supply

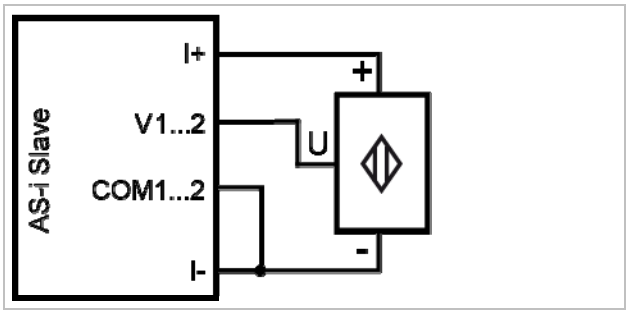


External supply PELV ungrounded

Analogue inputs 0...10 V (AC2617)

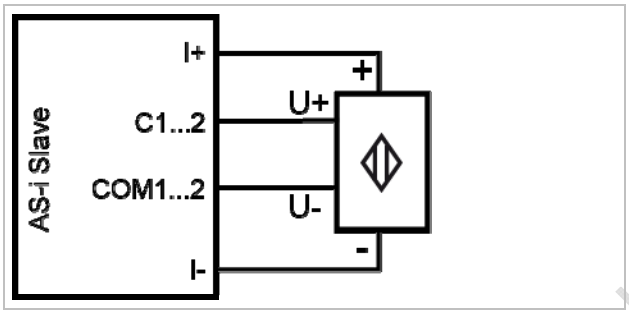
6597

Wiring 3-wire sensor without own supply

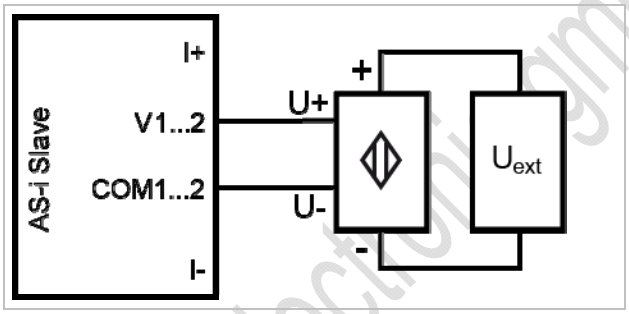


► Connect the terminals I- and COM1/COM2 to each other via an external link.

Wiring 4-wire sensor without own supply



Wiring analogue sensor with own supply



External supply PELV ungrounded

Parameter setting (AC2616, AC2617)

6567

Parameter bit	Designation	Description
P0	filter for A/D converter	0 = 60 Hz filter is active 1 = 50 Hz filter is active (for the whole of Europe)
P1	activate channel 2 *)	0 = channel 2 not activated 1 = channel 2 activated
P2	indication of periphery faults	0 = periphery fault indication is not active 1 = periphery fault indication is active
P3	not used	reserved

*) Configuration has an effect on the conversion time in the AS-i slave, the transmission via the AS-Interface, the LED function and the periphery fault messages.
By disabling channel 2 the conversion time in the slave can be reduced considerably. LED indication and periphery fault messages are then no longer influenced by this channel.

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2616)

11294

Analogue input module, nominal range = 4...20 mA

Range [mA]	Units [dec]	Units [hex]	LED yellow I1…I4	Meaning
< 1	32767	7FFF	out	wire break
1…3.999	1000…3999	03E8…0F9F	lights	below nominal range
4…20	4000…20000	0FA0…4E20	lights	nominal range
20.001…23	20001…23000	4E21…59D8	lights	overcontrol
> 23	32767	7FFF	flashes	overflow

Measuring range (AC2617)

11295
11290

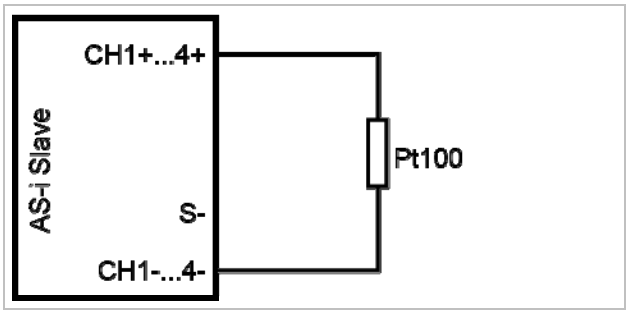
Analogue input module, nominal range = 0...10 V

Range [V]	Units [dec]	Units [hex]	LED yellow I1…I4	Meaning
< 0	0	0000	lights	outside range
0…10	0…10000	0000…2710	lights	nominal range
10.001…11.5	10001…11500	2711…2CEC	lights	overcontrol
> 11.5	32767	7FFF	flashes	overflow

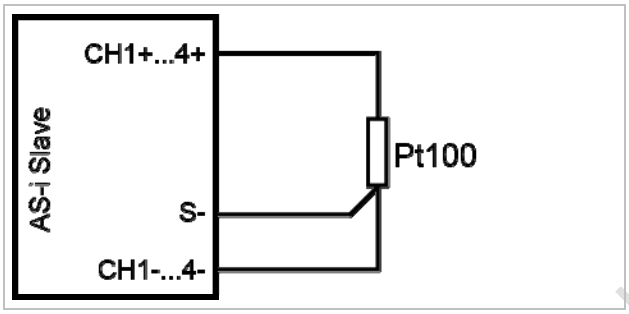
Analogue temperature measurement Pt100 (AC2620)

6609

Wiring 2-wire Pt100 sensor



Wiring 3-wire Pt100 sensor



► For modules with Pt100 inputs:
Connect at least one Pt100 sensor prior to switching on the AS-i slave, to start the A/D converter. Otherwise there will be an error message: LEDs I1...I4 flashing at 5 Hz.

Important notes on Pt100 measurements

- The terminals CH1+...CH4+ are interconnected in the module.
- On delivery, an external resistor is placed between the terminals Ch2+ and Ch2-, Ch3+ and Ch3- as well as Ch4+ and Ch4- so that no error message is indicated by the module when it is operated with only one sensor being connected.
- With the Pt100 measuring method, very low currents flow into the measuring electronics.
- 3-wire Pt100 sensors supply more exact results than 2-wire sensors provided that the wire resistance is the same. For 2-wire measurement, all contact resistances and connection resistances add up by measurement and can massively falsify the measurement result.

► The changeover between 2-wire and 3-wire sensors is made via the parameter bit P3.

► Avoid additional resistance (conductors, contact and transfer resistance, loose contacts, etc.) in the measuring circuit! This ensures a precise measurement.

Parameter setting (AC2620)

6793

Parameter bit	Designation	Description					
P0	filter for A/D converter	0 = 60 Hz filter is active 1 = 50 Hz filter is active (for the whole of Europe)					
P1, P2	periphery fault is detected by channel...	**P1**	**P2**	**channel 1**	**channel 2**	**channel 3**	**channel 4**
		0	0	yes	no	no	no
		0	1	yes	yes	no	no
		1	0	yes	yes	yes	no
		1	1	yes	yes	yes	yes
P3	Pt100 sensor type	0 = 3-wire mode 1 = 2-wire mode					

The parameter bits P1 and P2 define which measuring channels can trigger a periphery fault message. But irrespective of the defined parameters all 4 channels are always transferred via the AS-Interface.

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2620)

11296
11291

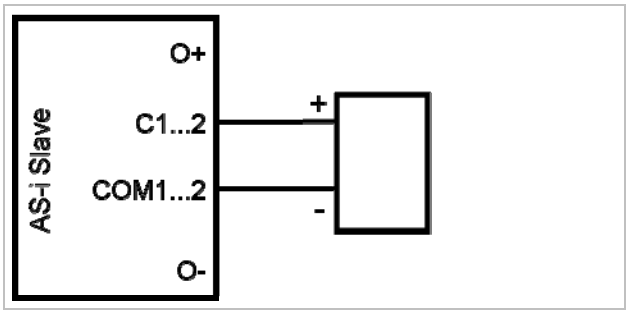
Pt100 module, nominal range = -200...+850 °C

Range [°C]	Units [dec]	Units [hex]	LED yellow I1…I4	Meaning
< -219.4	32767	7FFF	flashes	short circuit
-219.4…-200.1	-2194…-2001	F76E…F82F	lights	below nominal range
-200…+850	-2000…8500	F830…2134	lights	nominal range
+850.1…+883.6	8501…8836	2135…2284	lights	overcontrol
> +883.6	32767	7FFF	out	wire break

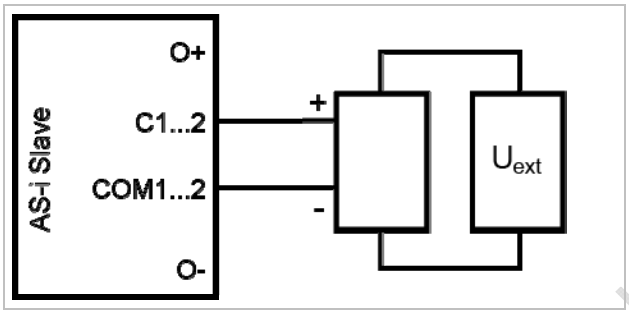
Analogue outputs 0...20 mA (AC2618)

6602

Wiring actuator without separate voltage supply

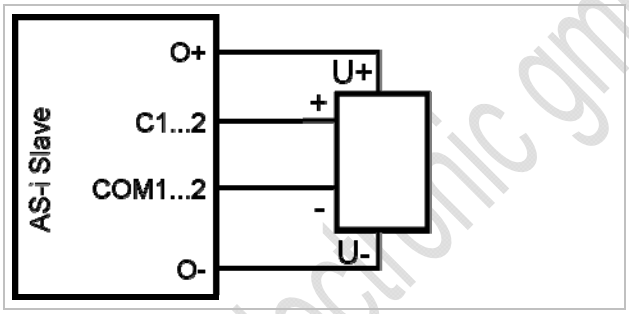


Wiring actuator with own voltage supply



External supply PELV ungrounded

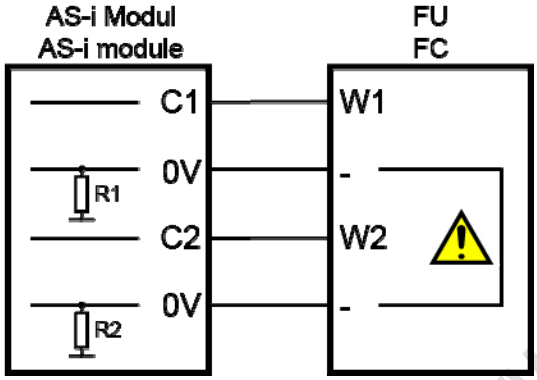
Wiring actuator with separate voltage supply



Additional note for the current output AC2nn8:

► Do not connect the terminal [analogue output 0V] of the respective channels of the current output module to each other!
The connection can e.g. also be made when connecting a multi-channel frequency inverter.

> This connection leads to faulty current signals. Reason: A parallel connection of the internal resistances is established by connecting the terminal [analogue output 0V]:



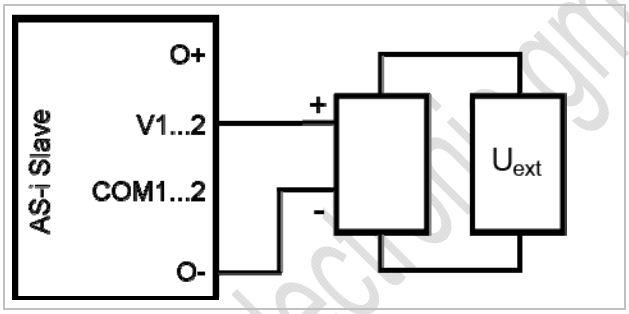
► Solution: Use of **two** current output modules.

When using voltage output modules the 0V terminals can be connected.

Analogue outputs 0...10 V (AC2619)

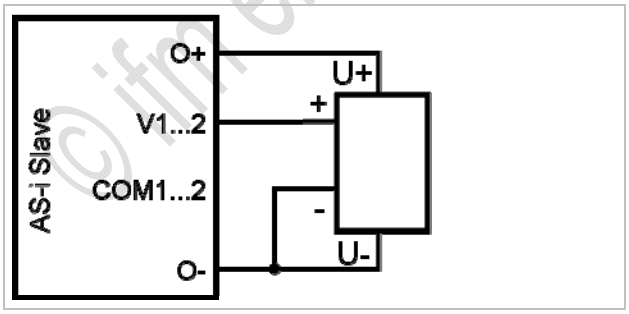
6606

Wiring actuator with own voltage supply



External supply PELV ungrounded

Wiring actuator with separate voltage supply



Parameter setting (AC2618, AC2619)

6586

Parameter bit	Designation	Description
P0	not used	reserved
P1	not used	reserved
P2	periphery fault	0 = periphery fault not active 1 = periphery fault active
P3	not used	reserved

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2218)

11297

Analogue output module, nominal range = 0...20 mA

Range [mA]	Units [dec]	Units [hex]	LED yellow O1…O4	Meaning
< 0	< 0	< 0000	flashes	outside range
0…20	0…20000	0000…4E20	lights	nominal range
20.001…23	20001…23000	4E21…59D8	lights	overcontrol
> 23	> 23000	> 59D8	flashes	overflow

Measuring range (AC2619)

11298

Analogue output module, nominal range = 0...10 V

Range [V]	Units [dec]	Units [hex]	LED yellow O1…O4	Meaning
< 0	< 0	< 0000	flashes	outside range
0…10	0…10000	0000…2710	lights	nominal range
10.001…11.5	10001…11500	2711...2CEC	lights	overcontrol
> 11.5	> 11500	> 2CEC	flashes	overflow

4.8.5 LED behaviour (AC2032, AC2035, AC2616...AC2620)

6460

LED behaviour (AC2032)

6795

Diagnostic LED			Description
[1]...[4]	yellow	lights	binary input/output is switched on
[PWR / ERR]	green	lights	AS-i voltage supply present
	red	lights	AS-i communication error, e.g. slave address = 0
	red / green	flashes alternately	periphery fault, e.g. sensor supply overloaded or shorted

LED behaviour (AC2035)

6796

Diagnostic LED			Description
[AE]	green	lights	external voltage supply present
[1]...[4]	yellow	lights	binary input/output is switched on
[PWR / ERR]	green	lights	AS-i voltage supply present
	red	lights	AS-i communication error, e.g. slave address = 0
	red / green	flashes alternately	periphery fault, e.g. sensor supply overloaded or shorted

LED behaviour (AC2616, AC2617)

6797

Diagnostic LED			Description
[Analog 1] / [Analog 2]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range
		off	no sensor connected or wire break
[AD-Power]	green	lights	supply voltage for the A/D converter present *)
[AS-i]	green	lights	AS-i voltage supply present
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

*) The LED signals the status of the voltage from which the actuator is supplied, i.e. it depends on the selected link position.

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- Nothing connected to at least one analogue channel, although the respective channel is activated.

LED behaviour (AC2618, AC2619)

6798

Diagnostic LED			Description
[Analog 1] / [Analog 2]	yellow	lights	analogue signal in the nominal range
		flashes	analogue signal outside the nominal range
[AD-Power]	green	lights	supply voltage for the A/D converter present *)
[AS-i]	green	lights	AS-i voltage supply present
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

*) The LED signals the status of the voltage from which the actuator is supplied, i.e. it depends on the selected link position.

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.

LED behaviour (AC2620)

6799

Diagnostic LED			Description
[Analog 1]... [Analog 4]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range
[AS-i]	green	lights	AS-i voltage supply present
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- There is nothing connected to at least one analogue channel.

4.9 Device description field modules ClassicLine (screw mounting, AC25nn)

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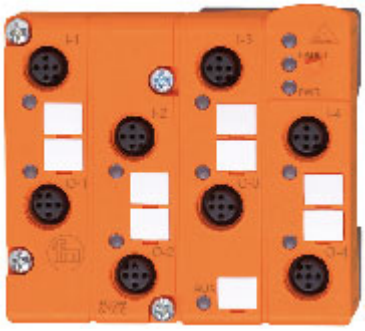
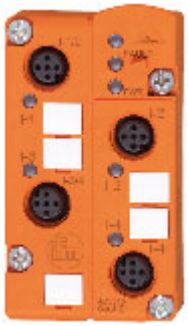
6345

Examples:



AC2509



AC2515

4.9.1 Operating conditions, installation

6347

- Protection IP 67

► When installing the module on a wired FC lower part:
Tighten the screws crosswise with a tightening torque of 0.8 Nm.

► To ensure the protection rating:
- Cover the unused M12 sockets using the protective caps E73004!
- Permissible tightening torque of the protective caps = 0.6...0.8 Nm.

► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.

► Use the enclosed seals for sealing the lower part if the AS-i flat cable ends in the FC lower part.

► If modules with **stainless steel** screws are used, the corresponding FC lower parts with **stainless steel** threaded inserts must be used (e.g. AC5014, AC5015).

4.9.2 Electrical connection

6381

► Disconnect the installation from power before connecting the modules to the periphery.

► Connect the module to AS-Interface either:
- via the flat cable lower part AC5000 or AC5010 (for supply from AS-i) OR:
- via the flat cable lower part AC5003 or AC5011 (for supply from an ext. 24 V PELV voltage source).

► Digital modules: Do NOT connect the inputs to an external potential, when the inputs are supplied from the AS-i voltage.

► Analogue modules: If a total of over 100 mA is needed for the sensor supply, the supply must be from an external 24 V PELV voltage source. The supply is automatically changed when the external 24 V voltage is applied.

4.9.3 Addressing

6349

Address the module...

- either with the addressing unit prior to installation,
- or in conjunction with the FC lower part with integrated addressing socket when mounted and wired.
- with the IR addressing adapter E70211 (→ **Infrared addressing** (→ page 105)).

If a slave is used with the ID code "A" (extended address mode enabled) combined with a master of the 1st generation (version 2.0) then:

- Set parameter P3=1.
  Set output bit D3=0.
  The output bit D3 must not be used.
- Assign an address of 1A...31A to this slave.

Infrared addressing

6350

The AS-i module also offers the option of infrared addressing with the addressing unit AC1154 and the addressing cable E70211.

Addressing the module

- ► Switch off the AS-i power supply
- ► Disconnect the AS-i master or use the jumper on the ifm AS-i power supply to interrupt communication
- ► Switch on the AS-i power supply
- ► Connect the infrared addressing cable to the module
- ► Select an address and remove the addressing cable
- ► Switch off the AS-i power supply
- ► Connect the AS-i master again or use the jumper on the ifm AS-i power supply to start communication again
- ► Switch on the AS-i power supply

When the AS-i power supply is switched on and off, the module is reset.

4.9.4 Connecting analogue periphery (AC25nn)

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6491

- ► Do not lay the sensor cables in loops, to avoid interference.
- ► Avoid direct tractive forces on the cables.
- ► For modules with Pt100 inputs:
  Connect at least one Pt100 sensor prior to switching on the AS-i slave, to start the A/D converter.
  Otherwise there will be an error message: LEDs I1...I4 flashing at 5 Hz.

Only for analogue input modules (AC2516, AC2517, AC2566):

NOTICE

This could destroy the unit!

- ► When a combined sensor is connected (pin 2: analogue output, pin 4: 24 V output) ensure that the switching output cannot switch.
- ► To do so, set the combined sensor accordingly (e.g. by selection of a switch point which cannot be reached or by the configuration "NPN switching").

Analogue inputs 4...20 mA (AC2516, AC2566)

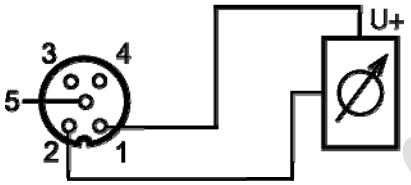
6510

► When an external link between pin 3 and pin 4 is used, the internal link can be deactivated by resetting the parameter bit P0.

► The internal link (pin 3 and pin 4) must be activated via the parameter bit P0.

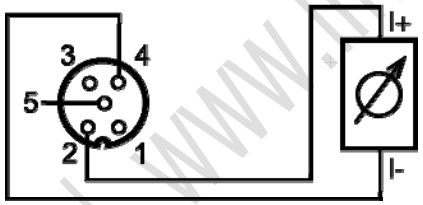
Wiring 2-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+ current
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



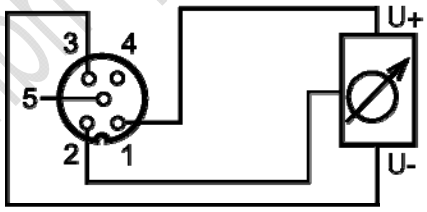
Wiring 2-wire sensor with own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+ current
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



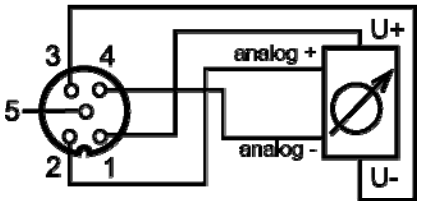
Wiring 3-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+ current
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



Wiring 4-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+ current
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



► In case of connection of a 4-wire sensor the internal link between pin 3 and pin 4 **must** be deactivated. To do so, reset parameter bit P0.

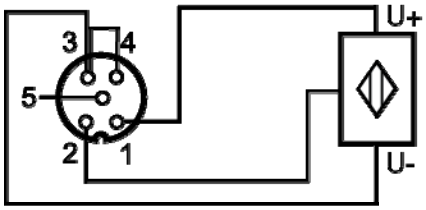
Analogue inputs 0...10 V (AC2517)

6525

The parameter bit P0 is of no importance for the AC2517!

Wiring 3-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+ voltage
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



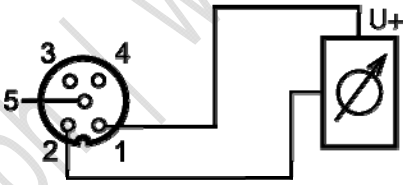
► In case of connection of a 3-wire sensor without own supply, the link must be made externally between pin 3 and pin 4!

Analogue inputs 4...20 mA (AC2526)

6681

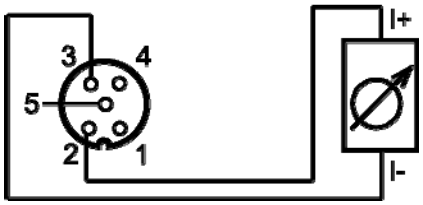
Wiring 2-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V / analogue input AI-
Pin 4 = n.c.
Pin 5 = functional earth



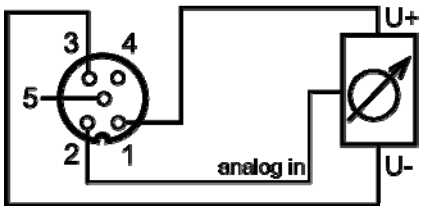
Wiring 2-wire sensor with own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+ current
Pin 3 = sensor supply 0 V
Pin 4 = n.c.
Pin 5 = functional earth



Wiring 3-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V / analogue input AI-
Pin 4 = n.c.
Pin 5 = functional earth



Parameter setting (AC2516, AC2517, AC2526, AC2566)

6528

Parameter bit	Designation	Description					
P0 *)	selection 2/3 wires / 4 wires	0 = 4-wire operation (link is inactive) (for AC2516, AC2566) 1 = 2-/3-wire operation (link is active)					
P1, P2	channel activation	**P1**	**P2**	**channel 1**	**channel 2**	**channel 3**	**channel 4**
		0	0	on	off	off	off
		0	1	on	on	off	off
		1	0	on	on	on	off
		1	1	on	on	on	on
P3	indication of periphery faults	0 = periphery fault indication is not active 1 = periphery fault indication is active					

*) not used for AC2517

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2516, AC2526, AC2566)

11299

Analogue input module, nominal range = 4...20 mA

Range [mA]	Units [dec]	Units [hex]	LED yellow AI1…AI4	Meaning
< 1	32767	7FFF	flashes	wire break
1…3.999	1000…3999	03E8…0F9F	lights	below nominal range
4…20	4000…20000	0FA0…4E20	lights	nominal range
20.001…23	20001…23000	4E21…59D8	lights	overcontrol
> 23	32767	7FFF	flashes	overflow

Measuring range (AC2517)

11300

Analogue input module, nominal range = 0...10 V

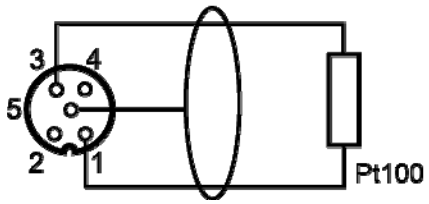
Range [V]	Units [dec]	Units [hex]	LED yellow AI1…AI4	Meaning
0…10	0…10000	0000…2710	lights	nominal range
10.001…11.5	10001…11500	2711...2CEC	lights	overcontrol
> 11.5	32767	7FFF	flashes	overflow

Analogue temperature measurement Pt100 (AC2520, AC2570)

6546

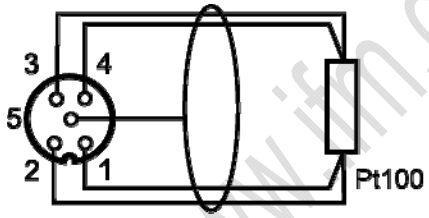
Wiring 2-wire Pt100 sensor

Pin 1 = S+
Pin 2 = AI+
Pin 3 = S-
Pin 4 = AI-
Pin 5 = functional earth (screen)



Wiring 4-wire Pt100 sensor

Pin 1 = S+
Pin 2 = AI+
Pin 3 = S-
Pin 4 = AI-
Pin 5 = functional earth (screen)



► For modules with Pt100 inputs:
Connect at least one Pt100 sensor prior to switching on the AS-i slave, to start the A/D converter. Otherwise there will be an error message: LEDs I1...I4 flashing at 5 Hz.

Important notes on Pt100 measurements

- With the Pt100 measuring method, very low currents flow into the measuring electronics.
- 4-wire Pt100 sensors provide more precise results than 2-wire sensors. For 2-wire measurement, all contact resistances and connection resistances add up by measurement and can massively falsify the measurement result.

► The changeover between 2- wire and 4-wire sensors is made via the parameter bit P3.

► Avoid additional resistance (conductors, contact and transfer resistance, loose contacts, etc.) in the measuring circuit! This ensures a precise measurement.

► Use high-quality connectors for the AS-i Pt100 module. Prefer prewired and potted connectors with gold-plated contacts.

Parameter setting (AC2520, AC2570)

6551

Parameter bit	Designation	Description					
P0	filter for A/D converter	0 = 60 Hz filter is active 1 = 50 Hz filter is active (for the whole of Europe)					
P1, P2	periphery fault is detected by channel...	**P1**	**P2**	**channel 1**	**channel 2**	**channel 3**	**channel 4**
		0	0	yes	no	no	no
		0	1	yes	yes	no	no
		1	0	yes	yes	yes	no
		1	1	yes	yes	yes	yes
P3	Pt100 sensor type	0 = 4-wire mode 1 = 2-wire mode					

The parameter bits P1 and P2 define which measuring channels can trigger a periphery fault message. But irrespective of the defined parameters all 4 channels are always transferred via the AS-Interface.

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2520, AC2570)

11301

Pt100 module, nominal range = -200...+850 °C

Range [°C]	Units [dec]	Units [hex]	LED yellow AI1…AI4	Meaning
< -219.4	32767	7FFF	flashes	short circuit
-219.4…-200.1	-2194…-2001	F76E…F82F	lights	below nominal range
-200…+850	-2000…8500	F830…2134	lights	nominal range
+850.1…+883.6	8501…8836	2135…2090	lights	overcontrol
> +883.6	32767	7FFF	out	wire break

Analogue outputs 0...20 mA (AC2518, AC2521, AC2568)

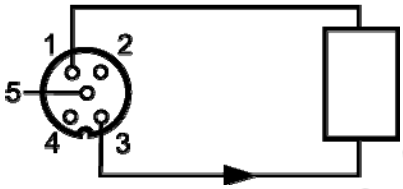
6529

► Do NOT connect the analogue outputs AO- to each other, neither directly nor indirectly (via the connected actuator)!

For AC2518, AC2568:

Wiring 2-wire actuator

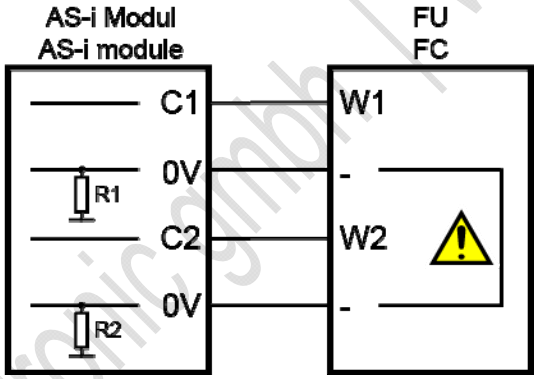
Pin 1 = analogue output AO+
Pin 2 = n.c.
Pin 3 = analogue output 0 V AO-
Pin 4 = n.c.
Pin 5 = functional earth



Additional note for the current output AC2nn8:

► Do not connect the terminal [analogue output 0V] of the respective channels of the current output module to each other!
The connection can e.g. also be made when connecting a multi-channel frequency inverter.

> This connection leads to faulty current signals. Reason: A parallel connection of the internal resistances is established by connecting the terminal [analogue output 0V]:



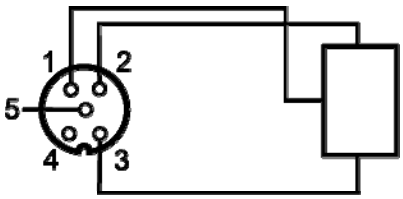
► Solution: Use of **two** current output modules.

When using voltage output modules the 0V terminals can be connected.

For AC2521:

Wiring 3-wire actuator

Pin 1 = analogue output AO+
Pin 2 = actuator supply +24 V
Pin 3 = analogue output 0 V AO-
Pin 4 = n.c.
Pin 5 = functional earth



Analogue outputs 0...10 V (AC2519)

6542

Wiring 2-wire actuator

Pin 1 = analogue output AO+
Pin 2 = n.c.
Pin 3 = analogue output 0 V AO-
Pin 4 = n.c.
Pin 5 = functional earth

Parameter setting (AC2518, AC2519, AC2521, AC2568)

6545

Parameter bit	Designation	Description
P0 *)	monitoring profile 7.3 (watchdog)	0 = not monitored 1 = monitored
P1	not used	reserved
P2	periphery fault	0 = fault indication is not active 1 = fault indication is active
P3	not used	reserved

*) not used for AC2521

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2518, AC2521, AC2568)

11302

Analogue output module, nominal range = 0...20 mA

Range [mA]	Units [dec]	Units [hex]	LED yellow AO1…AO4	Meaning
0…20	0…20000	0000…4E20	lights	nominal range
20.001…23	20001…23000	4E21…59D8	lights	overcontrol
> 23	> 23000	> 59D8	flashes	overflow

Measuring range (AC2519)

11303

Analogue output module, nominal range = 0...10 V

Range [V]	Units [dec]	Units [hex]	LED yellow AO1…AO4	Meaning
0…10	0…10000	0000…2710	lights	nominal range
10.001…11.5	10001…11500	2711...2CEC	lights	overcontrol
> 11.5	> 11500	> 2CEC	flashes	overflow

4.9.5 LED behaviour (AC25nn)

6427

LED behaviour of the digital modules

6808

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[I1]...[I4] [O1]...[O4]	yellow	lights	binary input/output is switched on
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- Lacking auxiliary voltage.
- Overload etc.

LED behaviour (AC2516, AC2526, AC2566)

6806

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[AI-1]...[AI-4]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range (overflow), no sensor connected or wire break
[AI-2]...[AI-4]	yellow	off	no sensor connected (at least one LED flashes, because not all channels can be deactivated via the parameter bit P1/P2 (channel activation) (channel 1 is always activated))
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- Nothing connected to at least one analogue channel, although the respective channel is activated.
- There is a wire break.

LED behaviour (AC2517)

6810

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[AI-1]...[AI-4]	yellow	lights	the respective channel is activated analogue signal in the measuring range or no sensor connected (it cannot be differentiated whether the 0 V signal is applied or whether no sensor is connected)
		flashes	analogue signal outside the measuring range (outside range)
[AI-2]...[AI-4]	yellow	off	the respective channel is not activated (channel 1 is always activated)
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.

LED behaviour (AC2520)

6811

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AI-1]...[AI-4]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range (overflow), no sensor connected or wire break
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- Nothing connected to at least one analogue channel, although the respective channel is activated.

LED behaviour (AC2518, AC2519, AC2521, AC2568)

6813

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[AO-1]...[AO-4]	yellow	lights	analogue signal within the measuring range or no actuator connected. It cannot be differentiated whether the 0V/0mA signal is applied or whether no actuator is connected.
		flashes	analogue signal outside the measuring range (outside range)
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.

4.10 Device description field modules ClassicLine (quick mounting, AC52nn)

Contents

Operating conditions, installation 116
Installing quick mounting modules 117
Electrical connection 123
Addressing 123
Connecting analogue periphery (AC52xx) 124
LED behaviour (AC52nn) 130

6353

Examples:

AC5215

AC5235

4.10.1 Operating conditions, installation

6354

- Protection IP 67

► To ensure the protection rating:
 - Cover the unused M12 sockets using the protective caps E73004!
 - Permissible tightening torque of the protective caps = 0.6...0.8 Nm.

► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.

► The flat cable must not end in the device and must be sealed outside of the device with the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

► The flat cable cannot be branched in the lower part.
Branching must be implemented using corresponding accessories (e.g. E70381).

► Avoid build-up of dirt and dust on the upper and lower parts so that the locking mechanism is not affected.

4.10.2 Installing quick mounting modules

Contents

Installation variants 118
Adjusting the cable guide on the lower part 119
Adjusting the cable guide on the upper part 120
Installing the device 121
Opening / uninstalling the device 122

6616

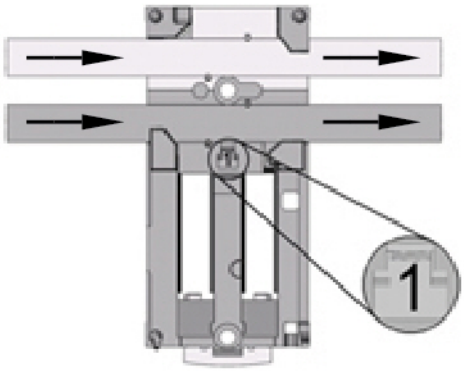
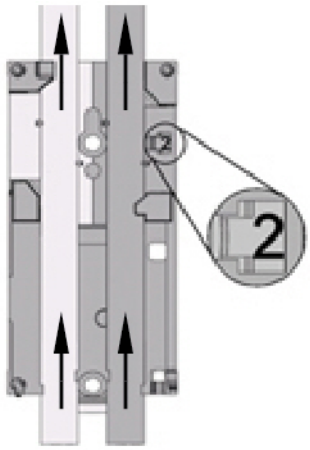
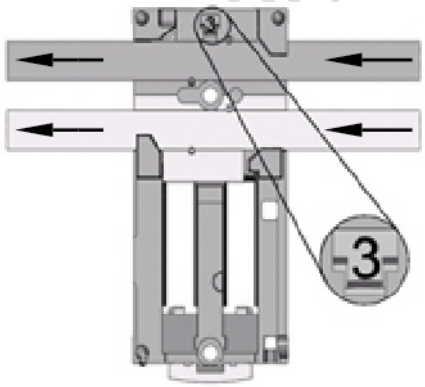
Example for quick mounting module: AC5211

In this documentation, installation is shown at the example of a slim device (45 mm) with external supply of the outputs (with black AS-i cable).

Installation variants

6634

With the supplied lower part the flat cable can be aligned in three directions.

Pos. 1		> Orientation horizontally from left to right (= factory setting). If this preset orientation is correct for the application, continue with → **Installing the device** (→ page 121)
Pos. 2		> Orientation vertically from bottom to top.
Pos. 3		> Orientation horizontally from right to left.

Adjusting the cable guide on the lower part

6635

1.		► Remove the flat cable guide (1) from the lower part. ► Turn the flat cable guide (1) according to the requested cable direction.
2.		► Insert the flat cable guide into the lower part according to the requested cable direction. > The visible position number (here: 2) indicates the selected cable direction.

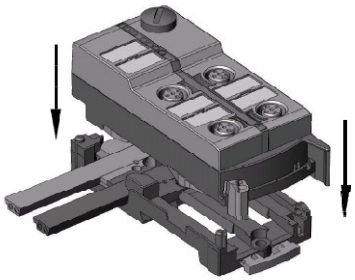
Adjusting the cable guide on the upper part

6636

a)		**Handling variant a** ► Turn the flat cable contact using a screwdriver so that the triangle (→ arrow) points towards the requested cable guide position.
b)		**Handling variant b** ► Turn the flat cable contact with the yellow-black flat cable guide (from the lower part) so that the visible position number (here: 1) corresponds to the requested cable guide position.

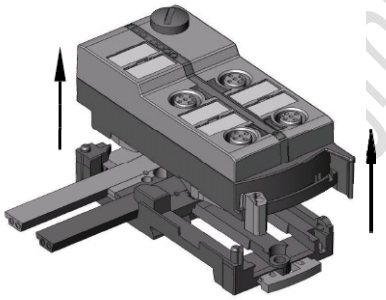
Installing the device

6637

1.		Alignment of the flat cable on delivery. ► Carefully place the yellow and optionally the black AS-i flat cable into the profile slot.
2.		► Place the upper part.
3.		► Lock the device.
4.		► Take care in laying the AS-i flat cable. The flat cable should be laid straight for about 15 cm.

Opening / uninstalling the device

6638

1.		► Unlock the device using a screwdriver.
2.		► Open the locking until the end stop.
3.		► Remove the upper part.

4.10.3 Electrical connection

6356

► Do NOT connect the inputs (M12 sockets) to an external potential when these are supplied from the AS-i voltage.

► Do not lay the sensor cables in loops, to avoid interference.

► Avoid direct tractive forces on the cables.

4.10.4 Addressing

6357

When mounted and wired, the module can be addressed with the addressing cable E70213 via the integrated addressing interface.

ATTENTION

A connector other than the ifm jack plug E70213 can destroy the addressing socket!

Non ifm connectors (other than ifm article E70213) can cause short-circuits or irreparable deformations of the socket contacts, resulting in a damaged addressing socket. As a consequence the device can no longer communicate since it is permanently separated from the AS-i bus.

► For addressing only use the ifm jack plug E70213!

If a slave is used with the ID code "A" (extended address mode enabled) combined with a master of the 1st generation (version 2.0) then:

- Set parameter P3=1.
  Set output bit D3=0.
  The output bit D3 must not be used.
- Assign an address of 1A...31A to this slave.

4.10.5 Connecting analogue periphery (AC52nn)

Contents

Analogue inputs 4...20 mA (AC5222)..... 125
Analogue inputs 4...20 mA (AC5223)..... 126
Parameter setting (AC5222, AC5223) 127
Differences AC5222 / AC5223 128

6493

- ► Draw max. 200 mA in total when the sensors are supplied from AS-i.
- ► Do not lay the sensor cables in loops, to avoid interference.
- ► Avoid direct tractive forces on the cables.

The earthing lead (2.8 x 0.5 mm) on the supplied lower part is connected to pin 5 (functional earth) of the M12 sockets.

Analogue inputs 4...20 mA (AC5222)

6652

NOTE

Sensor supply connections (pins 1, 3) and AS-i are electrically connected.

The module has NO connection option for an external supply from the black AUX flat cable.

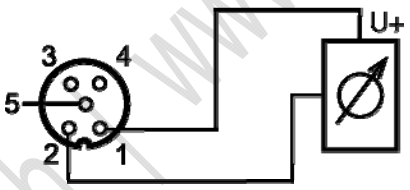
The analogue input is between pin 2 and pin 3; it is thus always electrically connected to AS-i.

2-wire and 3-wire sensors for which the provided current supply of the module from AS-i is not sufficient and which have NO electrical connection to other potentials can be connected without any problems.

If the sensor is to obtain its operating current from an external source, this source must have NO electrical connection to any other electrical network, because otherwise the AS-i connection of the module will have a forbidden electrical connection.

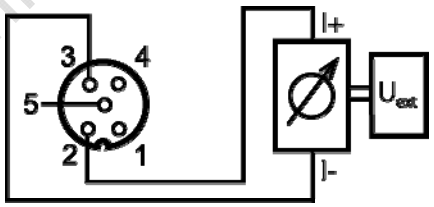
Wiring 2-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V / analogue input AI-
Pin 4 = n.c.
Pin 5 = functional earth



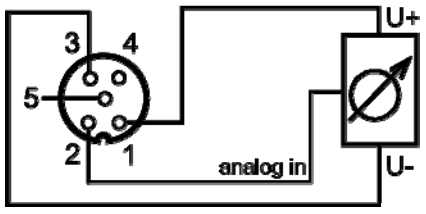
Wiring 2-wire sensor with electrically isolated and earth-free supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V / analogue input AI-
Pin 4 = n.c.
Pin 5 = functional earth



Wiring 3-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V / analogue input AI-
Pin 4 = n.c.
Pin 5 = functional earth



Analogue inputs 4...20 mA (AC5223)

6560

► For 2-wire or 3-wire sensors without own supply:
Establish an external link between pin 3 and pin 4!

NOTE

Sensor supply connections (pins 1, 3) and AS-i are electrically connected.

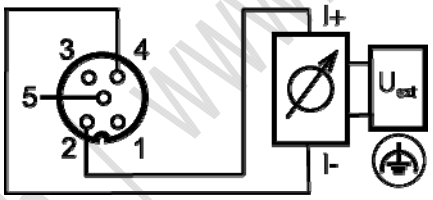
The module has NO connection option for an external supply from the black AUX flat cable.

The analogue input is between pin 2 and pin 4; it is thus electrically separated from AS-i in principle.

If only the analogue input (pins 2, 4) is used without sensor supply (pins 1, 3), the supply and electrical connection of the sensor can be made with the corresponding extra-low voltage as required. The required electrical separation from AS-i is maintained.

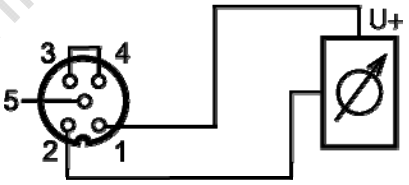
Wiring 2-wire sensor with own, grounded supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



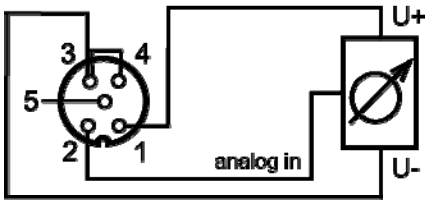
Wiring 2-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth
► Establish an external link between pin 3 and pin 4!



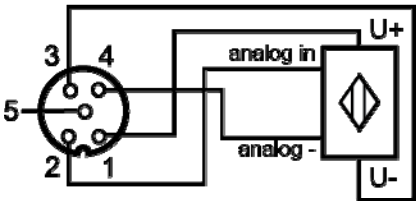
Wiring 3-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth
► Establish an external link between pin 3 and pin 4!



Wiring 4-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



Parameter setting (AC5222, AC5223)

6567

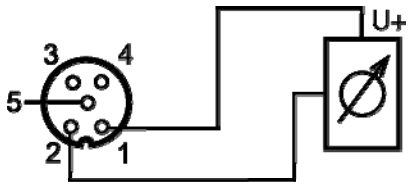
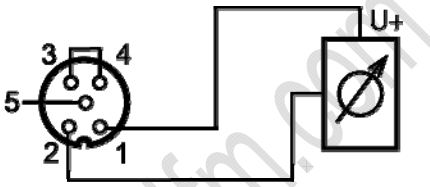
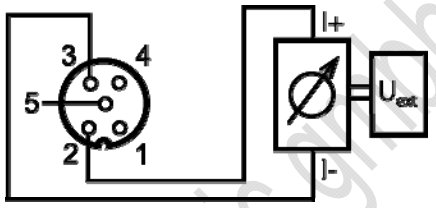
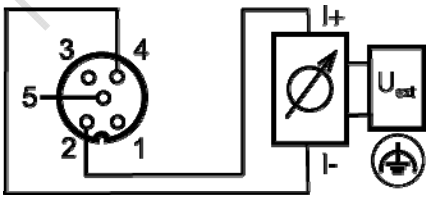
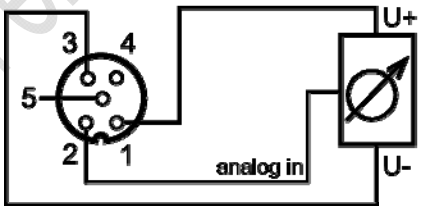
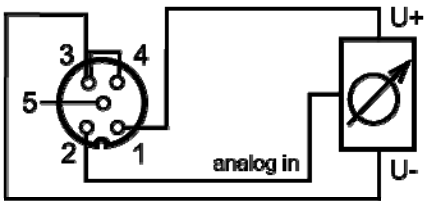
Parameter bit	Designation	Description
P0	filter for A/D converter	0 = 60 Hz filter is active 1 = 50 Hz filter is active (for the whole of Europe)
P1	activate channel 2 *)	0 = channel 2 not activated 1 = channel 2 activated
P2	indication of periphery faults	0 = periphery fault indication is not active 1 = periphery fault indication is active
P3	not used	reserved

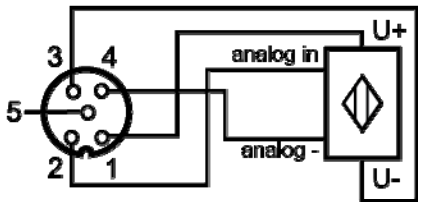
*) Configuration has an effect on the conversion time in the AS-i slave, the transmission via the AS-Interface, the LED function and the periphery fault messages.
By disabling channel 2 the conversion time in the slave can be reduced considerably. LED indication and periphery fault messages are then no longer influenced by this channel.

→ **Changing slave parameter data** (→ page 41)

Differences AC5222 / AC5223

11304

Parameter	AC5222	AC5223
Sensor supply	from AS-i, max. 200 mA	from AS-i, max. 200 mA
Connection of	2- and 3-wire sensors	2- and 3- and 4-wire sensors
Particularities	electrical connection between the sensor connection and AS-i	electrical separation between the sensor connection and AS-i if the sensor is NOT supplied via the module (AS-i)
2-wire sensor (supply via the module)	wiring 2-wire sensor without own supply  Pin 1 = sensor supply +24 V Pin 2 = analogue input AI+ Pin 3 = sensor supply 0 V / analogue input AI- Pin 4 = n.c. Pin 5 = functional earth	wiring 2-wire sensor without own supply  Pin 1 = sensor supply +24 V Pin 2 = analogue input AI+ Pin 3 = sensor supply 0 V Pin 4 = analogue input AI- Pin 5 = functional earth ► Establish an external link between pin 3 and pin 4!
2-wire sensor	wiring 2-wire sensor with electrically separated and earth-free supply  Pin 1 = sensor supply +24 V Pin 2 = analogue input AI+ Pin 3 = sensor supply 0 V / analogue input AI- Pin 4 = n.c. Pin 5 = functional earth The sensor is not supplied via the module but via an own **earth-free** supply.	wiring 2-wire sensor with own, earthed supply  Pin 1 = sensor supply +24 V Pin 2 = analogue input AI+ Pin 3 = sensor supply 0 V Pin 4 = analogue input AI- Pin 5 = functional earth The sensor is not supplied via the module but via an own **earthed** supply.
3-wire sensor (supply via the module)	wiring 3-wire sensor without own supply  Pin 1 = sensor supply +24 V Pin 2 = analogue input AI+ Pin 3 = sensor supply 0 V / analogue input AI- Pin 4 = n.c. Pin 5 = functional earth	wiring 3-wire sensor without own supply  Pin 1 = sensor supply +24 V Pin 2 = analogue input AI+ Pin 3 = sensor supply 0 V Pin 4 = analogue input AI- Pin 5 = functional earth ► Establish an external link between pin 3 and pin 4!

Parameter	AC5222	AC5223
4-wire sensor	---	wiring 4-wire sensor without own supply  Pin 1 = sensor supply +24 V Pin 2 = analogue input AI+ Pin 3 = sensor supply 0 V Pin 4 = analogue input AI- Pin 5 = functional earth
AS-i profile	S-7.3.D	S-7.3.D
Accessories (supplied)	lower part	lower part
Accessories (optional)	analogue connector E75222 M12 protective cap E73004	analogue connector E75222 M12 protective cap E73004

4.10.6 LED behaviour (AC52nn)

6840

LED behaviour of the digital modules

6808

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[I1]...[I4] [O1]...[O4]	yellow	lights	binary input/output is switched on
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- Lacking auxiliary voltage.
- Overload etc.

LED behaviour (AC5222, AC5223)

6817

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AI-1]...[AI-2]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range or: no sensor connected
		off	sensor input is deactivated (→ parameter bit P1)
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- Nothing connected to at least one analogue channel, although the respective channel is activated.
- In case of overload or short circuit of the sensor supply.

LED display of the logic PLC outputs

6845

For the ClassicLine modules (quick mounting), additional LEDs below the [FAULT] indication signal the logic state of the PLC outputs.

The LEDs [O1]...[O4] represent the data bits D0...D3.

4.11 Device description field modules AirBox (screw mounting, AC20nn)

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LED behaviour AirBox (AC20nn) 136

6359

Examples:

AC2046

AC2055

4.11.1 Operating conditions, installation

6361

- ► Protection rating of the devices depending on the version IP 65 (filter version) and IP 67 with common exhaust (tube connection to lead the exhaust air of the AirBox away e.g. from the wet area).
- ► In dusty environments the AirBox can be installed with the filter facing downwards.
- ► When installing the module on a wired FC lower part:
  Tighten the screws crosswise with a tightening torque of 0.8 Nm.
- ► Use the enclosed seals for sealing the lower part if the AS-i flat cable ends in the FC lower part.
- ► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).
- ► To ensure the protection rating:
  - Cover the unused M12 sockets using the protective caps E73004!
  - Permissible tightening torque of the protective caps = 0.6...0.8 Nm.
- ► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.

4.11.2 Electrical connection

6430

► Do NOT connect the inputs to an external potential, because the inputs are supplied from the AS-i voltage.

► Do not lay the sensor cables in loops, to avoid interference.

► Avoid direct tractive forces on the cables.

4.11.3 Addressing

6383

Address the module...

- either with the addressing unit prior to installation,
- or in conjunction with the FC lower part (e.g. AC5011) with integrated addressing socket when mounted and wired.

For the FC lower part AC5011 the following applies:

When mounted and wired, the module can be addressed with the addressing cable E70213 via the integrated addressing interface.

ATTENTION

A connector other than the ifm jack plug E70213 can destroy the addressing socket!

Non ifm connectors (other than ifm article E70213) can cause short-circuits or irreparable deformations of the socket contacts, resulting in a damaged addressing socket. As a consequence the device can no longer communicate since it is permanently separated from the AS-i bus.

► For addressing only use the ifm jack plug E70213!

4.11.4 Pneumatics

6373

AirBox	Operating pressure	Flow (at 6/5 bar)
2x3/2-way AirBox	2…8 bar	350 Nl/min
4/2-way AirBox	3…8 bar	500 Nl/min

A combination of slide and seat valve is used in the AirBox, which is NOT free from overlapping.

- ► Connect the AirBox to the actuator in the shortest possible way, to avoid pressure losses and to achieve faster switching times.
- ► Connect the AirBox with the pneumatic system via tube fittings, outside calibration according to CETOP standard RP 54 P.
  To remove the tubes press on the clamping ring and pull out the tube at the same time.
- ► The pneumatic output can be activated manually using the manual override: by pressing/releasing or pressing/turning/locking depending on the version.
  The electrical control has priority over the mechanical control (manual override).
- ► The reduction of the tube diameter (e.g. from 8 mm to 6 mm) reduces among others the flow rate

NOTICE

Risk of permanent leaks or irreparable damage to the pneumatic components! Risk of malfunctions!

- ► Operate the device only within the indicated operating pressure range (→ table above).
- ► Prepare the compressed air properly.

Operating pressure: maximum 8 bar, minimum (depending on the device) 2 bar or 3 bar. The minimum pressure is required for a complete switching of the main valve. If this minimum pressure is not applied, leakage occurs via the exhaust connection [3] of the AirBox. This is the characteristic behaviour of a valve which is not free from overlapping.

NOTE

- ► Provide all pneumatic connections of the AirBox either with suitable cover plugs or tube them immediately upon installation. This prevents the ingress of moisture and dirt into the AirBox.
- ► Once the AirBox has been operated with lubricated compressed air, it must continue to be operated with lubricated air because the oil has removed the initial lubrication.

Auxiliary air

6374

The 4/2-way AirBox has an external auxiliary air connection (4 mm). External auxiliary air is required:

- when pressures < 3 bar are to be switched,
- when vacuum is to be switched,
- in case of parallel connection of valves, if a considerable pressure drop is to be expected (at a high simultaneity factor).

► Apply the auxiliary air [81] with at least 3 bar to enable switching of the valve.

The connection of the auxiliary air is integrated in the module and is activated by inserting the 4 mm compressed air tube. If no tube is connected, this pneumatic input is closed (IP 67).

Switching of vacuum with 4/2-way valve

6375

The AirBox is supplied with vacuum via the 8 mm connection.

► Additionally supply the AirBox with compressed air (min. 3 bar) via the 4 mm connection [81].

Explanation:

The auxiliary air connection is required because the forces in the AirBox are "reversed" in case of vacuum operation and the switching of the valve (slide) must continue to be ensured.

► Connect the operating connection [4] of the AirBox e.g. to the suction unit, provide the operating connection [2] with a blind plug.

Purity of compressed air (specification)

6376

According to ISO 8573-1:2001 the air purity is divided into three classes:

1. The purity class of the solid particle content
2. The purity class for the humidity content
3. The purity class for the total oil content

The AirBoxes are suitable for compressed air of the purity classes: **6- 3- 4**

Meaning:

1. Solid particle content acc. to class 6: Max. particle size 5 µm, max. particle density 5 mg/m^3
2. Maximum water content acc. to class 3: **Pressure dew point** (→ page 146, → page 135) -20 °C
3. Maximum total oil content acc. to class 4: < 5 mg/m^3, this corresponds to approx. 1 oil drop per 4 000 litres of air.

Pressure dew point

6908

Air always contains water in the form of vapour. As air can be compressed, but water cannot, the water separates to form condensation during compression. The pressure dew point is the temperature to which compressed air can be cooled down without condensation occurring.

In order to be able to provide sufficiently dry air for the system the pressure dew point should be reduced to min. 10 °C below the lowest ambient temperature of the air pipe.
Example: At an operating temperature of 20 °C a pressure dew point of 10 °C should prevent further condensation.

NOTE

The indicated specification is a minimum requirement, i.e. the products may have a longer life. This can be achieved by:
- lower particle concentration
- lower humidity
- very low or no addition of oil.

Mixing of synthetic oils with mineral oils can lead to failure of moving parts due to adherence or clotting.

AirBoxes can be operated in the range of 0...55 °C.

► In case of low temperatures (< 0 °C) take additional measures to prevent freezing or solidifying of condensate, humidity etc.

Approved lubricants for lubricated compressed air

6379

If lubricated compressed air is used:

► Only use oils of the class 1 (without additives) to ISO VG10!

► The oil must not attack the materials used. This is mainly valid for the sealing materials and plastics mentioned below.
For resistance to other lubricants please contact the manufacturer.

Sealing materials and plastics used for the AirBox

6380

- NBR and FPM are used as sealing materials.
- PBT and PC are used as plastics.

4.11.5 LED behaviour AirBox (AC20nn)

6431

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[I1]...[I4] [O1]...[O2]	yellow	lights	binary input/output is switched on

4.12 Device description field modules AirBox (quick mounting, AC52nn)

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6386

Examples:

AC5228

AC5270

4.12.1 Operating conditions, installation

6397

- ► Protection rating of the devices depending on the version IP 65 (with silencer E75232) and IP 67 with common exhaust (tube connection to lead the exhaust air of the AirBox away e.g. from the wet area).
- ► In dusty environments the AirBox can be installed with the filter facing downwards.
- ► To ensure the protection rating:
  - Cover the unused M12 sockets using the protective caps E73004!
  - Permissible tightening torque of the protective caps = 0.6...0.8 Nm.
- ► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.
- ► The flat cable must not end in the device and must be sealed outside of the device with the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).
- ► The flat cable cannot be branched in the lower part.
  Branching must be implemented using corresponding accessories (e.g. E70381).
- ► Avoid build-up of dirt and dust on the upper and lower parts so that the locking mechanism is not affected.

4.12.2 Installing quick mounting modules

Contents

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Adjusting the cable guide on the upper part 141
Installing the device 142
Opening / uninstalling the device 143

6847

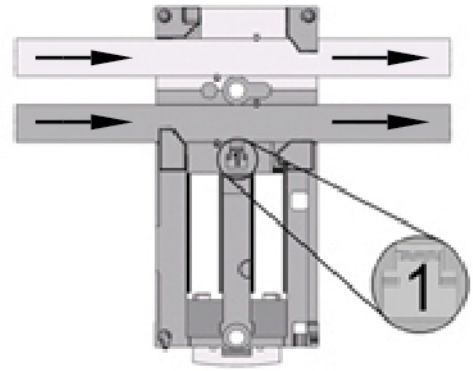
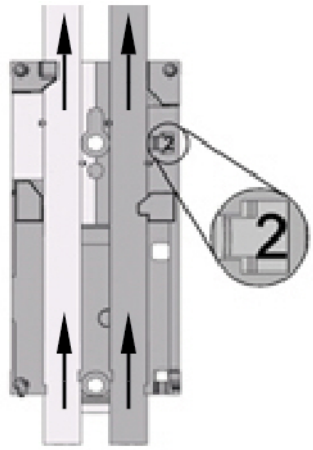
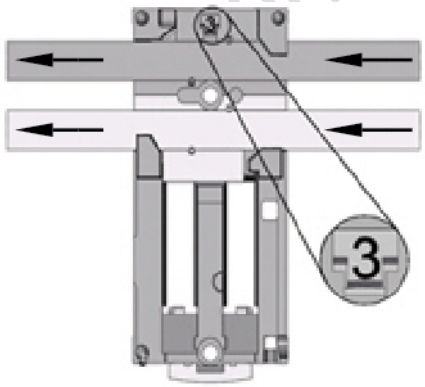
Example for quick mounting module: AC5243

In this documentation, installation is shown only with external supply of the outputs (with black AS-i cable).

Installation variants

6634

With the supplied lower part the flat cable can be aligned in three directions.

Pos. 1		> Orientation horizontally from left to right (= factory setting). If this preset orientation is correct for the application, continue with → **Installing the device** (→ page 142)
Pos. 2		> Orientation vertically from bottom to top.
Pos. 3		> Orientation horizontally from right to left.

Adjusting the cable guide on the lower part

6635

1.		► Remove the flat cable guide (1) from the lower part. ► Turn the flat cable guide (1) according to the requested cable direction.
2.		► Insert the flat cable guide into the lower part according to the requested cable direction. > The visible position number (here: 2) indicates the selected cable direction.

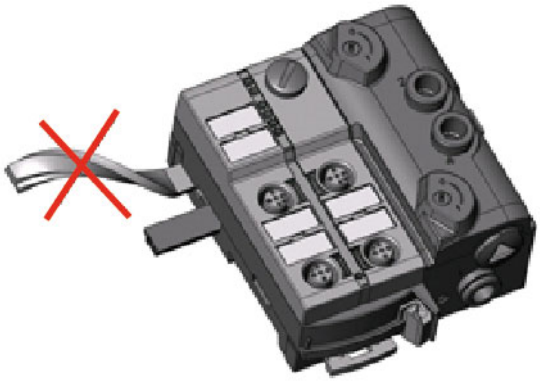
Adjusting the cable guide on the upper part

6636

a)		**Handling variant a** ► Turn the flat cable contact using a screwdriver so that the triangle (→ arrow) points towards the requested cable guide position.
b)		**Handling variant b** ► Turn the flat cable contact with the yellow-black flat cable guide (from the lower part) so that the visible position number (here: 1) corresponds to the requested cable guide position.

Installing the device

6849

1.		Alignment of the flat cable on delivery. ► Carefully place the yellow and optionally the black AS-i flat cable into the profile slot.
2.		► Place the upper part.
3.		► Lock the device.
4.		► Take care in laying the AS-i flat cable. The flat cable should be laid straight for about 15 cm.

Opening / uninstalling the device

6853

1.		► Unlock the device using a screwdriver.
2.		► Open the locking until the end stop.
3.		► Remove the upper part.

4.12.3 Electrical connection

6430

► Do NOT connect the inputs to an external potential, because the inputs are supplied from the AS-i voltage.

► Do not lay the sensor cables in loops, to avoid interference.

► Avoid direct tractive forces on the cables.

4.12.4 Addressing

6692

When mounted and wired, the module can be addressed with the addressing cable E70213 via the integrated addressing interface.

ATTENTION

A connector other than the ifm jack plug E70213 can destroy the addressing socket!

Non ifm connectors (other than ifm article E70213) can cause short-circuits or irreparable deformations of the socket contacts, resulting in a damaged addressing socket. As a consequence the device can no longer communicate since it is permanently separated from the AS-i bus.

► For addressing only use the ifm jack plug E70213!

If a slave is used with the ID code "A" (extended address mode enabled) combined with a master of the 1st generation (version 2.0) then:

- Set parameter P3=1.
  Set output bit D3=0.
  The output bit D3 must not be used.
- Assign an address of 1A...31A to this slave.

4.12.5 Pneumatics

6401

AirBox	Operating pressure	Flow (at 6/5 bar)
2x3/2-way AirBox	2…8 bar	500 Nl/min
5/2-way AirBox	3…8 bar	500 Nl/min
5/3-way AirBox	3…8 bar	400 Nl/min

Slide valves are used in the AirBoxes, which are free from overlapping.

- ► Connect the AirBox to the actuator in the shortest possible way, to avoid pressure losses and to achieve faster switching times.
- ► Connect the AirBox with the pneumatic system via tube fittings, outside calibration according to CETOP standard RP 54 P.
  To remove the tubes press on the clamping ring and pull out the tube at the same time.
- ► The pneumatic output can be activated manually using the manual override: by pressing/releasing or pressing/turning/locking depending on the version.
  The electrical control has priority over the mechanical control (manual override).
- ► The reduction of the tube diameter (e.g. from 8 mm to 6 mm) reduces among others the flow rate

NOTICE

Risk of permanent leaks or irreparable damage to the pneumatic components! Risk of malfunctions!

- ► Operate the device only within the indicated operating pressure range (→ table above).
- ► Prepare the compressed air properly.

Operating pressure: maximum 8 bar, minimum (depending on the device) 2 bar or 3 bar.

- ► Avoid pressure peaks above the permissible operating pressure by means of approved technical measures.

NOTE

- ► Provide all pneumatic connections of the AirBox either with suitable cover plugs or tube them immediately upon installation. This prevents the ingress of moisture and dirt into the AirBox.
- ► Once the AirBox has been operated with lubricated compressed air, it must continue to be operated with lubricated air because the oil has removed the initial lubrication.

Purity of compressed air (specification)

6411

According to ISO 8573-1:2001 the air purity is divided into three classes:

1. The purity class of the solid particle content
2. The purity class for the humidity content
3. The purity class for the total oil content

The AirBoxes are suitable for non-lubricated compressed air of the purity classes: **6- 3- 1**.
The AirBoxes are suitable for lubricated compressed air of the purity classes: **6- 3- 4**

Meaning:

1. Solid particle content acc. to class 6: Max. particle size 5 µm, max. particle density 5 mg/m³
2. Maximum water content acc. to class 3: **Pressure dew point** (→ page 146, → page 135) -20 °C

Non-lubricated compressed air:
3. Maximum total oil content acc. to class 1: < 0.01 mg/m³.

Lubricated compressed air:
3. Maximum total oil content acc. to class 4: < 5 mg/m³, this corresponds to approx. 1 oil drop per 4 000 litres of air.

Pressure dew point

6377

Air always contains water in the form of vapour. As air can be compressed, but water cannot, the water separates to form condensation during compression. The pressure dew point is the temperature to which compressed air can be cooled down without condensation occurring.

In order to be able to provide sufficiently dry air for the system the pressure dew point should be reduced to min. 10 °C below the lowest ambient temperature of the air pipe.
Example: At an operating temperature of 20 °C a pressure dew point of 10 °C should prevent further condensation.

NOTE

The indicated specification is a minimum requirement, i.e. the products may have a longer life. This can be achieved by:
- lower particle concentration
- lower humidity
- very low or no addition of oil.

Mixing of synthetic oils with mineral oils can lead to failure of moving parts due to adherence or clotting.

AirBoxes can be operated in the range of -10...+55 °C.

► In case of low temperatures (< 0 °C) take additional measures to prevent freezing or solidifying of condensate, humidity etc.

Approved lubricants for lubricated compressed air

6906

If lubricated compressed air is used:

► Only use oils of the class 1 (without additives to DIN 51524 part 2!

► The oil must not attack the materials used. This is mainly valid for the sealing materials and plastics mentioned below.
For resistance to other lubricants please contact the manufacturer.

Sealing materials and plastics used for the AirBox

6482

- NBR is used as sealing material.
- PA, PC and POM are used as plastics.

4.12.6 LED behaviour (AC52nn)

6840

LED behaviour AirBox (AC52nn)

6821

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[I1]...[I4] [O1]...[O2]	yellow	lights	binary input/output is switched on
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- Lacking auxiliary voltage.
- Overload etc.

LED display of the logic PLC outputs

6858

For the AirBoxes AC52nn (quick mounting), the LEDs only signal the logic state of the PLC outputs.

> The pneumatic output status does NOT necessarily correspond to the indicated status of these LEDs.

> The pneumatic output status is NOT indicated on the device.

> The LEDs [O1]...[O4] indicate the data bits D0...D3 and additionally the attribution to the pneumatic outputs.

4.13 Device description field modules CompactLine (AC24nn, to June 2010)

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Examples:

AC2410

AC2412

4.13.1 Operating conditions, installation

6412

- Protection IP 67 (only if the AS-i flat cables AC4000 and AC4002 are used)

► Select a flat mounting surface.
The entire bottom of the module must lie flat on the mounting surface.

► Fix the lower part onto the mounting surface.

► Insert the AS-i standard cable (yellow) and, if applicable, the cable for external power supply (black). Ensure correct positioning of the cables in the profiled slot.

► The flat cable must not end in the device and must be sealed outside of the device with the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

► The flat cable cannot be branched in the lower part.
Branching must be implemented using corresponding accessories (e.g. E70381).

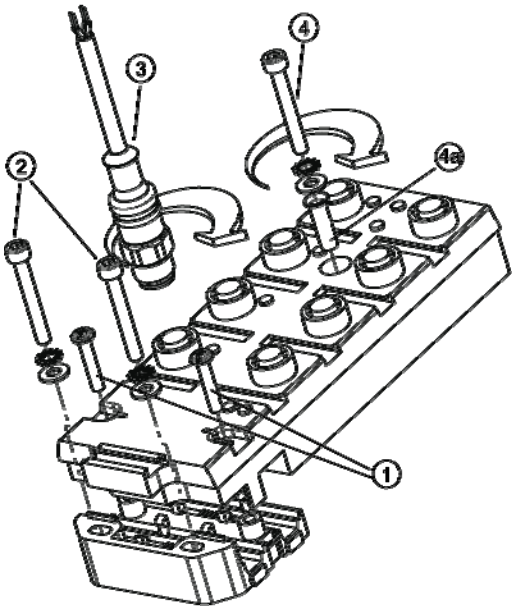
► Unused cable entries must be covered with the flat cable blank (E70399).

► To ensure the protection rating:
- Cover the unused M12 sockets using the protective caps E73004!
- Permissible tightening torque of the protective caps = 0.6...0.8 Nm.

► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.

Tightening torques

6414



Pos.	Tightening torque	For element
1	0.8...1.2 Nm	Screws for connecting the upper part to the lower part
2	2.0...2.4 Nm	Mounting screws with washers and tooth lock washers
3	0.6...0.8 Nm	M12 connector
4	max. 1.0 Nm	Mounting screw without stainless steel sleeve, with washer
4 / 4a	2.0...2.4 Nm	Mounting screw with stainless steel sleeve, washer and tooth lock washer (in case of heavy mechanical stress of the device)

4.13.2 Electrical connection

6477

► Digital modules: Do NOT connect the inputs to an external potential, when the inputs are supplied from the AS-i voltage.

► Do not lay the sensor cables in loops, to avoid interference.

► Avoid direct tractive forces on the cables.

4.13.3 Addressing

6415

Address the module with the addressing unit...

- either prior to installation with the addressing cable E70423,
- or with the IR addressing adapter E70211 (→ **Infrared addressing** (→ page 105)).

Infrared addressing

6350

The safe AS-i module also offers the option of infrared addressing with the addressing unit AC1154 and the addressing cable E70211.

Addressing the module

► Switch off the AS-i power supply

► Disconnect the AS-i master or use the jumper on the ifm AS-i power supply to interrupt communication

► Switch on the AS-i power supply

► Connect the infrared addressing cable to the module

► Select an address and remove the addressing cable

► Switch off the AS-i power supply

► Connect the AS-i master again or use the jumper on the ifm AS-i power supply to start communication again

► Switch on the AS-i power supply

When the AS-i power supply is switched on and off, the module is reset.

4.13.4 LED behaviour (AC24nn)

6432

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[I1]...[I4] [O1]...[O4]	yellow	lights	binary input/output is switched on
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- Lacking auxiliary voltage (only where the inputs of the modules are supplied via AUX)
- Overload etc.

4.14 Device description field modules CompactLine (AC24nn, as from June 2010)

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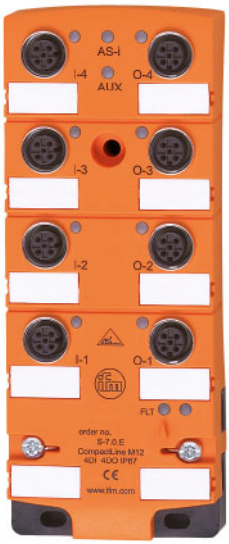
LED behaviour (AC24nn) 157

11306

Examples:

AC2410



AC2412

4.14.1 Operating conditions, installation

6412

- Protection IP 67 (only if the AS-i flat cables AC4000 and AC4002 are used)

► Select a flat mounting surface.
The entire bottom of the module must lie flat on the mounting surface.

► Fix the lower part onto the mounting surface.

► Insert the AS-i standard cable (yellow) and, if applicable, the cable for external power supply (black). Ensure correct positioning of the cables in the profiled slot.

► The flat cable must not end in the device and must be sealed outside of the device with the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

► The flat cable cannot be branched in the lower part.
Branching must be implemented using corresponding accessories (e.g. E70381).

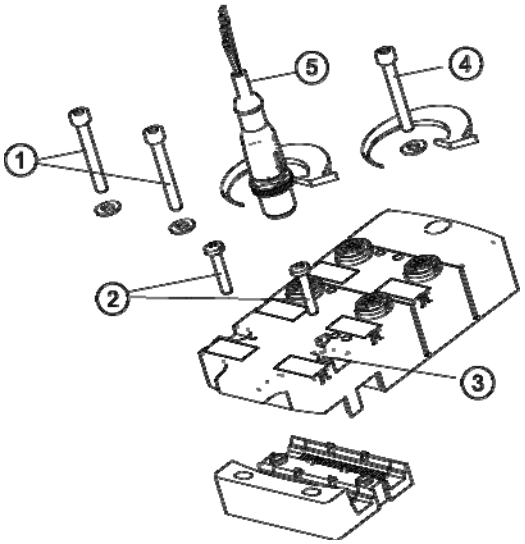
► Unused cable entries must be covered with the flat cable blank (E70399).

► To ensure the protection rating:
- Cover the unused M12 sockets using the protective caps E73004!
- Permissible tightening torque of the protective caps = 0.6...0.8 Nm.

► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.

Tightening torques, general

11308

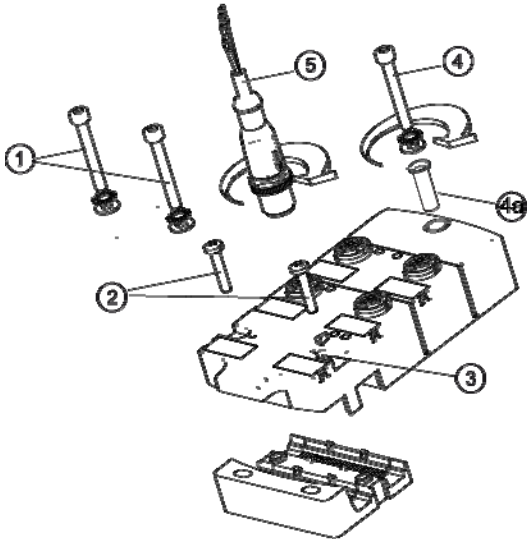


Pos.	Tightening torque	For element
1	1.8 Nm	Mounting screws, size M4, with washers
2	1.2...1.4 Nm	Connecting screws upper part with lower part, size M3.5
3		Functional earth springs
4	1.8 Nm	Mounting screw, size M4...M5, with washer
5	0.8...1.5 Nm	M12 connector

Tightening torques for AC2471, AC2474, AC2477

11310

Premounted at the factory: stainless steel sleeve (position 4a).



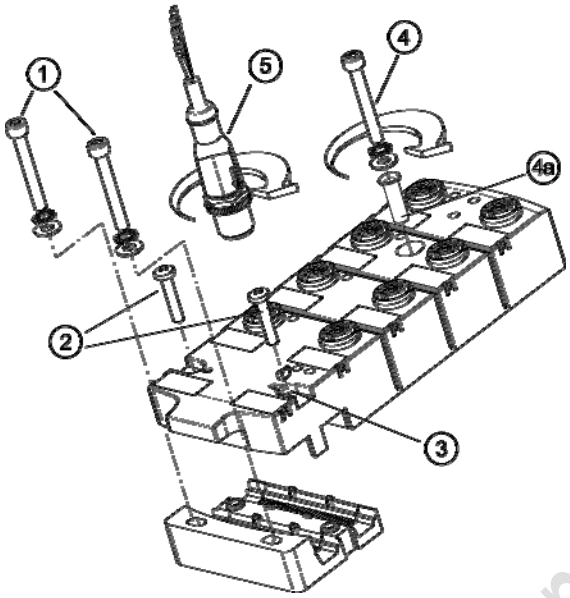
Pos.	Tightening torque	For element
1	2.0...2.4 Nm	Mounting screws, size M4, with washer and tooth lock washer
2	1.2...1.4 Nm	Connecting screws upper part with lower part, size M3,5
3		Functional earth springs
4	2.0...2.4 Nm	Mounting screw, size M4...M5, with washer and tooth lock washer
4a		Tubular rivet premounted in the mounting hole
5	0.8...1.5 Nm	M12 connector

Tightening torques for mounting set E70402

11312

Scope of delivery E70402:
10 stainless steel sleeves,
30 washers and
30 tooth lock washers
for mounting in case of high mechanical stress of the CompactLine modules

► Use one stainless steel sleeve (position 4a) per module!



Pos.	Tightening torque	For element
1	2.0...2.4 Nm	Mounting screws, size M4, with washers and tooth lock washers
2	1.2...1.4 Nm	Connecting screws upper part with lower part, size M3,5
3		Functional earth springs
4	max. 1.8 Nm	Mounting screw without stainless steel sleeve
4, 4a	2.0...2.4 Nm	Mounting screw with stainless steel sleeve, washer and tooth lock washer (in case of heavy mechanical stress of the device)
5	0.8...1.5 Nm	M12 connector

4.14.2 Electrical connection

6477

- ► Digital modules: Do NOT connect the inputs to an external potential, when the inputs are supplied from the AS-i voltage.
- ► Do not lay the sensor cables in loops, to avoid interference.
- ► Avoid direct tractive forces on the cables.

4.14.3 Addressing

6415

Address the module with the addressing unit...

- either prior to installation with the addressing cable E70423,
- or with the IR addressing adapter E70211 (→ **Infrared addressing** (→ page 105)).

Infrared addressing

6350

The safe AS-i module also offers the option of infrared addressing with the addressing unit AC1154 and the addressing cable E70211.

Addressing the module

- ► Switch off the AS-i power supply
- ► Disconnect the AS-i master or use the jumper on the ifm AS-i power supply to interrupt communication
- ► Switch on the AS-i power supply
- ► Connect the infrared addressing cable to the module
- ► Select an address and remove the addressing cable
- ► Switch off the AS-i power supply
- ► Connect the AS-i master again or use the jumper on the ifm AS-i power supply to start communication again
- ► Switch on the AS-i power supply

When the AS-i power supply is switched on and off, the module is reset.

4.14.4 LED behaviour (AC24nn)

11314

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[I1]...[I4] [O1]...[O4]	yellow	lights	binary input/output is switched on
[FLT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- Lacking auxiliary voltage
- Overload etc.

4.15 Device description field modules ProcessLine

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Connecting analogue periphery 160
LED behaviour (AC29nn) 164

6391

Example:

AC2910

4.15.1 Operating conditions, installation

6416

- Protection IP 69K
- Mount the device on a mounting surface electrically connected to the machine ground.

► To ensure the protection rating:
- The unused M12 sockets must remain closed by the E70297 protective caps!
- Permissible tightening torque of the protective caps = 0.6...0.8 Nm.

► Do not remove the installed protective cap E70297 from the M12 socket until directly before connecting the plug to the M12 socket.

► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.

The integrated end stop protects the O-ring in the M12 socket against over-tightening of the nut:

Article	As from production status
AC2900	AE
AC2904	AL
AC2910	AJ
AC2916	AE
AC2923	AE
E11775	AD
E11847	AD

4.15.2 Electrical connection

6348

- ► Digital modules: Do NOT connect the inputs to an external potential, because the inputs are supplied from the AS-i voltage.
- ► Do not lay the sensor cables in loops, to avoid interference.
- ► Avoid direct tractive forces on the cables.
- ► The round cable connected to AS-i / AUX should not be longer than 2 m.
- ► Only AC2916, AC2923:
  The device shall be supplied from an isolating transformer having a secondary listed fuse rated as noted in the following table.

Wire cross section control circuit		Maximum nominal current of the protective equipment [A]
[AWG]	[mm²]	
22	0,32	3
20	0,52	5
18	0,82	7
16	1,3	10
14	2,1	20
12	3,3	25

4.15.3 Addressing

6418

For addressing the module, a 2/4-wire jumper is connected to the M12 plug (AS-i/AUX).

AC2910: In the AS-i network the module functions as two independent A/B slaves.

In the factory setting, initially only the first slave gives a signal on address 0. It can be addressed to any address between 1A...31B. Once this slave is addressed, the second slave is automatically indicated on the display of the AC1144 with address 0 and can then also be addressed to any address between 1A...31B.

Both slaves can be assigned any A/B addresses, e.g. 3A/6A or 9A/25B. No address must be assigned twice (e.g. 3A/3A or 9B/9B).

Restore the factory setting (address both slaves to 0):
Using the addressing unit AC1144 the factory setting of the module is restored by writing a 0 to ID1 of the second slave (factory setting ID1 = 2) by the internal software.

If a slave is used with the ID code "A" (extended address mode enabled) combined with a master of the 1st generation (version 2.0) then:

- Set parameter P3=1.
  Set output bit D3=0.
  The output bit D3 must not be used.
- Assign an address of 1A...31A to this slave.

4.15.4 Connecting analogue periphery

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Analogue inputs 4...20 mA (AC2923)..... 162
Parameter setting (AC2916, AC2923) 163
Measuring range (AC2916, AC2923)..... 163

6500

- ► To ensure the protection rating:
  - The unused M12 sockets must remain closed by the E70297 protective caps!
  - Permissible tightening torque of the protective caps = 0.6...0.8 Nm.
- ► Do not remove the installed protective cap E70297 from the M12 socket until directly before connecting the plug to the M12 socket.
- ► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.
- ► Avoid direct tractive forces on the cables.

Analogue inputs 4...20 mA (AC2916)

6614

NOTE

Sensor supply connections (pins 1, 3) and AS-i are electrically connected.

The module has NO connection option for an external supply from the black AUX flat cable.

The analogue input is between pin 2 and pin 3; it is thus always electrically connected to AS-i.

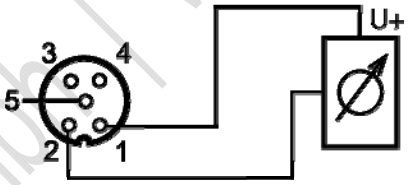
2-wire and 3-wire sensors for which the provided current supply of the module from AS-i is not sufficient and which have NO electrical connection to other potentials can be connected without any problems.

If the sensor is to obtain its operating current from an external source, this source must have NO electrical connection to any other electrical network, because otherwise the AS-i connection of the module will have a forbidden electrical connection.

- When the sensors are supplied from AS-i the load must not exceed 380 mA, the load for an individual sensor connection must not exceed 200 mA.

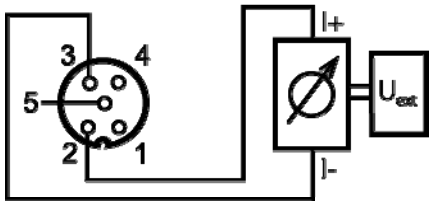
Wiring 2-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V / analogue input AI-
Pin 4 = n.c.
Pin 5 = functional earth



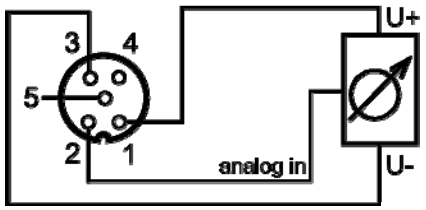
Wiring 2-wire sensor with electrically isolated and earth-free supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V / analogue input AI-
Pin 4 = n.c.
Pin 5 = functional earth



Wiring 3-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V / analogue input AI-
Pin 4 = n.c.
Pin 5 = functional earth



Analogue inputs 4...20 mA (AC2923)

6615

NOTE

Sensor supply connections (pins 1, 3) and AS-i are electrically connected.

The module has NO connection option for an external supply from the black AUX flat cable.

The analogue input is between pin 2 and pin 3; it is thus always electrically connected to AS-i.

2-wire and 3-wire sensors for which the provided current supply of the module from AS-i is not sufficient and which have NO electrical connection to other potentials can be connected without any problems.

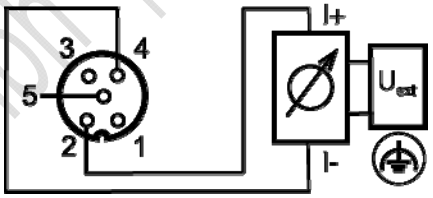
If the sensor is to obtain its operating current from an external source, this source must have NO electrical connection to any other electrical network, because otherwise the AS-i connection of the module will have a forbidden electrical connection.

► For 2-wire or 3-wire sensors without own supply:
Establish an external link between pin 3 and pin 4!

► When the sensors are supplied from AS-i the load must not exceed 380 mA, the load for an individual sensor connection must not exceed 200 mA.

Wiring 2-wire sensor with own, grounded supply

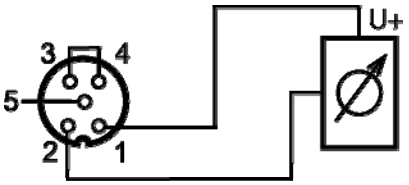
Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



Wiring 2-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth

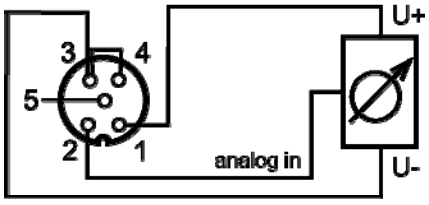
► Establish an external link between pin 3 and pin 4!



Wiring 3-wire sensor without own supply

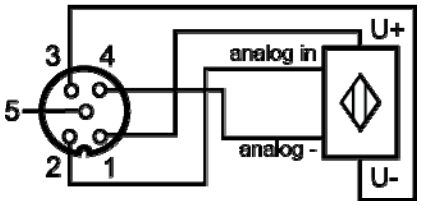
Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth

► Establish an external link between pin 3 and pin 4!



Wiring 4-wire sensor without own supply

Pin 1 = sensor supply +24 V
Pin 2 = analogue input AI+
Pin 3 = sensor supply 0 V
Pin 4 = analogue input AI-
Pin 5 = functional earth



Parameter setting (AC2916, AC2923)

6822

Parameter bit	Designation	Description					
P0	suppression 50 Hz / 60 Hz	0 = 60 Hz filter is active 1 = 50 Hz filter is active					
P1, P2	channel activation	**P1**	**P2**	**channel 1**	**channel 2**	**channel 3**	**channel 4**
		0	0	on	off	off	off
		0	1	on	on	off	off
		1	0	on	on	on	off
		1	1	on	on	on	on
P3	periphery fault when value outside measuring range	0 = periphery fault indication is not active 1 = periphery fault indication is active					

→ **Changing slave parameter data** (→ page 41)

Measuring range (AC2916, AC2923)

11316

Analogue input module, measuring range = 4...20 mA

Range [mA]	Units [dec]	Units [hex]	LED yellow AI1…AI4	Periphery fault	Meaning
< 3.4	(32768) * 32767	(8000) * 7FFF	flashes	yes ***	wire break
3.4…3.59	(3400…3599) * 32767	(0D48…0E0F) * 7FFF	flashes	no	below nominal range
3.6…22	3600…22000	0E10…55F0	lights	no	extended and nominal range **
22.01…23	(22001…23000) * 32767	(55F1…59D8) * 7FFF	flashes	no	overcontrol
> 23	32767	7FFF	flashes	yes ***	overflow

* The master replaces the transmitted value (→ value in brackets) by the preset value 32767_{10} / $7FFF_{16}$.

** The accuracy is only guaranteed in the nominal range (4...20 mA), but not in the extended nominal range.

*** only if parameter bit 3 = 1

4.15.5 LED behaviour (AC29nn)

6461

LED behaviour of the digital modules

6808

Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[AUX]	green	lights	external voltage supply present 24 V DC
[I1]...[I4] [O1]...[O4]	yellow	lights	binary input/output is switched on
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- Lacking auxiliary voltage (only where the inputs of the modules are supplied via AUX)
- Overload etc.

LED behaviour (AC2916)

6823

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AI-1]...[AI-4]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range (overflow), no sensor connected or wire break
[AI-2]...[AI-4]	yellow	off	no sensor connected (at least one LED flashes, because not all channels can be deactivated via the parameter bit P1/P2 (channel activation) (channel 1 is always activated))
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- Nothing connected to at least one analogue channel, although the respective channel is activated.
- In case of short circuit or overload of the sensor supply.

LED behaviour (AC2923)

6824

Diagnostic LED			Description
[PWR]	green	lights	AS-i voltage supply present
[AI-1]...[AI-4]	yellow	lights	analogue signal in the measuring range
		flashes	analogue signal outside the measuring range (overflow), no sensor connected or wire break
[AI-2]...[AI-4]	yellow	off	no sensor connected (at least one LED flashes, because not all channels can be deactivated via the parameter bit P1/P2 (channel activation) (channel 1 is always activated))
[FAULT]	red	lights	AS-i communication error, e.g. slave address = 0
		flashes	periphery fault **)

**) Indication periphery fault in the following cases:
- At least one of the analogue signals is outside of the value range.
- Nothing connected to at least one analogue channel, although the respective channel is activated.
- In case of short circuit or overload of the sensor supply.

4.16 Device description ProcessLine splitter

Contents

Splitter (E70354, E70377) 167
Splitter (E70454) 169

6767

Examples:

E70354

E70377

E70454

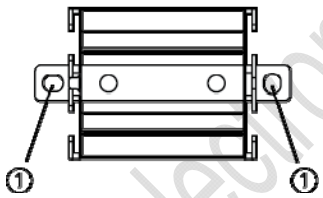
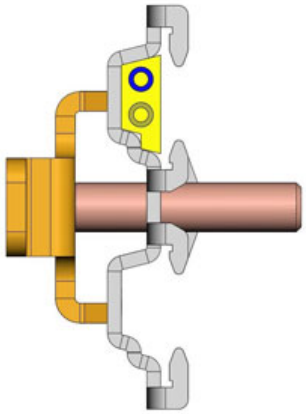
4.16.1 Splitter (E70354, E70377)

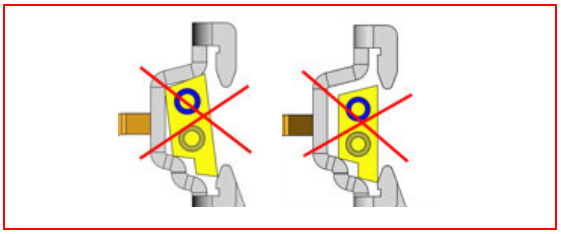
6632

	
E70354	E70377
M12 insulation displacement connector of the yellow AND black AS-i flat cable: Distribution of the AS-i voltage AND the external 24 V supply Current rating = 2 A	Flat cable branch of the yellow OR black AS-i flat cable: distribution of the AS-i voltage OR the external 24 V supply Current rating = 8 A
The two cable ducts are electrically separated.	The two cable ducts are electrically connected.

- **Material:**
  metal parts: stainless steel 316L (1.4404)
  blanks: FPM (Viton)
  O-ring: EPDM
- Protection IP 69K

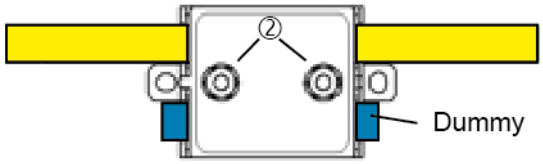
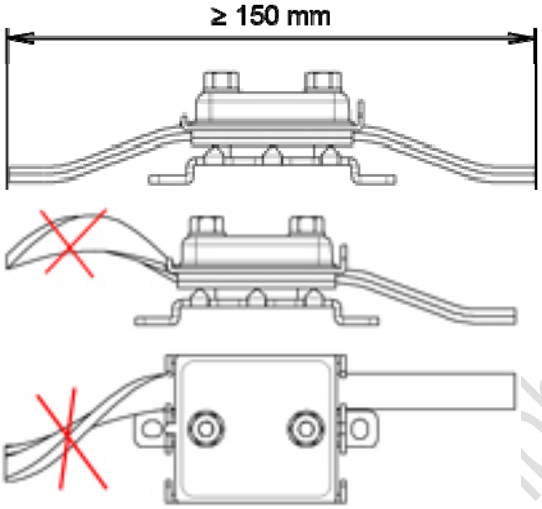
When replacing the splitter the pierced points on the AS-i flat cable must either be used exactly again or be placed within the black seal area of the splitter.

1.		► Choose a plane mounting surface. ► Fix the lower part onto the mounting surface (mounting holes ①). The mounting screws are not supplied.
2.		► E70354: Insert the AS-i flat cable (yellow) into the "AS-i" cable duct and the 24 V flat cable (black) into the other cable duct. ► E70377: Insert 2 yellow AS-i flat cables for the AS-i voltage OR 2 black cables for the external auxiliary voltage into the cable ducts. ► Ensure correct positioning of the cables in the profiled slot (→ figure).



NOT like this!

Examples for INCORRECTLY inserted flat cable

3.			► Cover the unused cable duct or cable duct entry with the supplied cable blank (blue). ► Place the upper part and tighten the nuts alternately (nuts supplied) tightening torque 2.5 Nm.
4.			► Take care in laying the AS-i flat cable. The flat cable should be laid straight for about 15 cm.
5.		Wiring M12 socket: 1 = AS-i + 2 = AUX - 3 = AS-i - 4 = AUX + 5 = n.c.	E70354: ► Do not remove the installed protective cap E70297 from the M12 socket until directly before connecting the plug to the M12 socket. ► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.

4.16.2 Splitter (E70454)

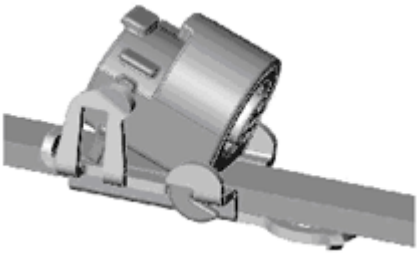
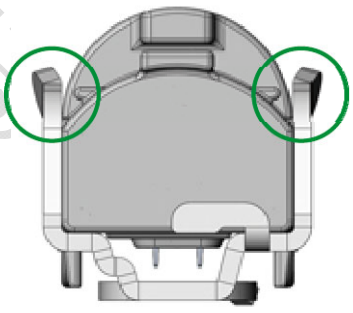
6650

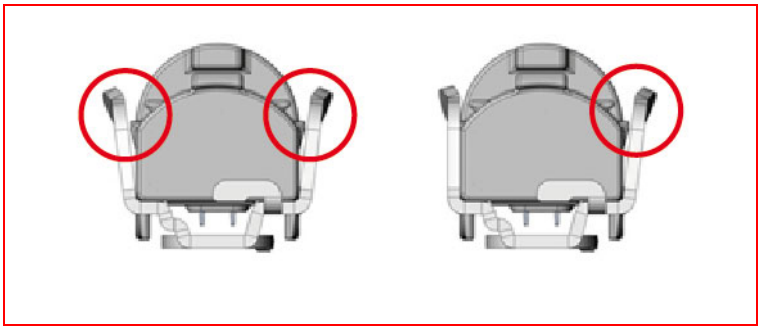
E70454

The T splitter allows tapping the AS-i voltage (yellow flat cable) via the M12 socket (current rating 2 A).

- Housing material high-grade stainless steel (316L/1.4404)
- Protection IP 69K

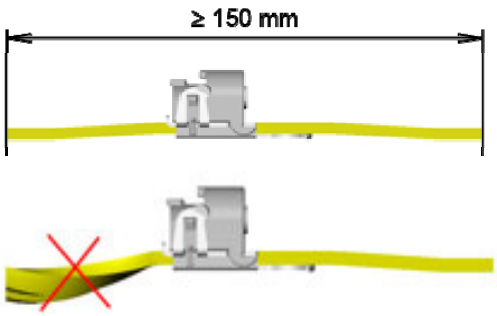
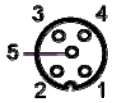
When replacing the splitter the pierced points on the AS-i flat cable must either be used exactly again or be placed within the black seal area of the splitter.

1.	► Choose a plane mounting surface. ► Screw the lower part onto the mounting surface. The mounting screw is not supplied.	
2.		► Insert the AS-i flat cable (yellow) into the cable duct. Place the cable correctly in the profile slot. ► Place the upper part (→ figure on the left).
3.		► Press the upper part against the lower part. ► Insert the upper part into the locking on both sides using a screwdriver (→ figure). OR: Push the upper part into the locking on both sides using a suitably large pipe wrench.
4.		> The upper part is correctly snapped in place (→ figure).



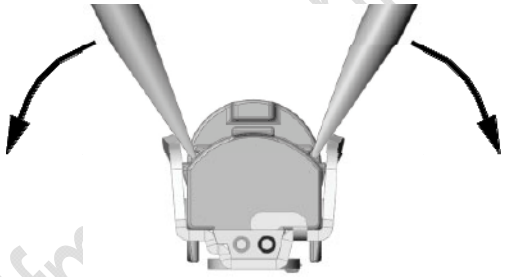
NOT like this!

Examples for INCORRECTLY mounted splitter

5.				► Take care in laying the AS-i flat cable. The flat cable should be laid straight for about 15 cm.
6.		yellow flat cable: 1 = AS-i + 2 = n.c. 3 = AS-i - 4 = n.c. 5 = n.c.	black flat cable: 1 = + 24 V 2 = n.c. 3 = 0 V 4 = n.c. 5 = n.c.	► Do not remove the installed protective cap E70297 from the M12 socket until directly before connecting the plug to the M12 socket. ► Permissible tightening torque of the M12 connectors = 0.6…0.8 Nm.

Unlocking / uninstalling the upper part

6826

1.		► Place two screwdrivers on the housing and push evenly towards the bottom.
2.		► Remove the upper part.

4.17 Device description IP 67 splitter

Contents

FC insulation displacement connector AC5005 172
FC insulation displacement connector E70096 173
FC insulation displacement connector E70381 174
FC insulation displacement connector E70481 175
FC insulation displacement connector E70483 176
FC insulation displacement connector, E70485, E70486 177
FC insulation displacement connector E70487 178
FC insulation displacement connector E70498, E70499 179
Mounting (e.g. E70381) 180

6770

4.17.1 FC insulation displacement connector AC5005

11318

M12 insulation displacement connector of the yellow OR black AS-i flat cable:
distribution of the AS-i voltage OR the external 24 V supply

- Ambient temperature: -25...70 °C
- **Materials:**
  Housing: PA 6-GF-FR
  Metal parts : nickel-plated brass
- Current rating = 2 A

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

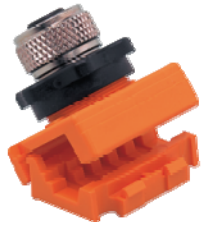
Wiring:

	Yellow flat cable: 1 = AS-i + 2 = n.c. 3 = AS-i - 4 = n.c.	Black flat cable: 1 = AUX + 2 = n.c. 3 = AUX - 4 = n.c.

4.17.2 FC insulation displacement connector E70096

11317

M12 insulation displacement connector of the yellow OR black AS-i flat cable:
distribution of the AS-i voltage OR the external 24 V supply



- Ambient temperature: -25...75 °C
- **Materials:**
  Housing: PA
- Current rating = 2 A

Installation instructions:

► First separate the fixture (orange) from the insulation displacement connector.

► Insert the cable in the fixture and close the fixture.

► Screw the fixture back on the insulation displacement connector.

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

Wiring:

	Yellow flat cable:	Black flat cable:
	1 = AS-i + 2 = n.c. 3 = AS-i - 4 = n.c.	1 = AUX + 2 = n.c. 3 = AUX - 4 = n.c.

4.17.3 FC insulation displacement connector E70381

11319

Flat cable branch of the yellow OR black AS-i flat cable:
distribution of the AS-i voltage OR the external 24 V supply

- Ambient temperature: -25...75 °C
- **Materials:**
  Housing: PA 6 GF35 Grivory
- Tightening torque upper part to lower part: 1.65 Nm
- Current rating = 8 A

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

4.17.4 FC insulation displacement connector E70481

11320

M12 insulation displacement connector of the yellow AND black AS-i flat cable:
Distribution of the AS-i voltage AND the external 24 V supply

- Ambient temperature: -25...75 °C
- **Materials:**
  Housing: PA 6 GF35 Grivory
  Socket: PUR
- Tightening torque upper part to lower part: 1.65 Nm
- Current rating = 4 A
- Cable length =1 m

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

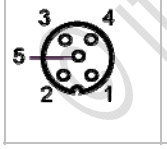
NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

Wiring:



1 = AS-i +
2 = AUX -
3 = AS-i -
4 = AUX +
5 = n.c.

4.17.5 FC insulation displacement connector E70483

11321

M12 insulation displacement connector of the yellow AS-i flat cable: Distribution of the AS-i voltage

- Ambient temperature: -25...75 °C
- **Materials:**
  Housing: PA66 - GF25
- Tightening torque upper part to lower part: 1.65 Nm
- Current rating = 4 A
- Cable length = 0.6 m

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

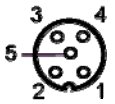
NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

Wiring:



1 = AS-i +
2 = n.c.
3 = AS-i -
4 = n.c.
5 = n.c.

4.17.6 FC insulation displacement connector, E70485, E70486

11322

M12 insulation displacement connector of the yellow AS-i flat cable: Distribution of the AS-i voltage

E70485

E70486

The units differ in the orientation of the M12 socket (keyway).

- Ambient temperature: -25...75 °C
- **Materials:**
  Housing: PA66 - GF25
- Tightening torque upper part to lower part: 1.65 Nm
- Current rating = 4 A

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

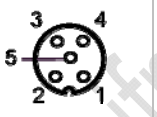
NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

Wiring:



1 = AS-i +
2 = n.c.
3 = AS-i -
4 = n.c.
5 = n.c.

4.17.7 FC insulation displacement connector E70487

11330

M12 insulation displacement connector of the yellow AND black AS-i flat cable:
Distribution of the AS-i voltage AND the external 24 V supply

- Ambient temperature: -25...75 °C
- **Materials:**
  Housing: PA66 - GF25
- Tightening torque upper part to lower part: 1.65 Nm
- Current rating = 4 A

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

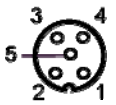
NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

Wiring:



1 = AS-i +
2 = AUX -
3 = AS-i -
4 = AUX +
5 = n.c.

4.17.8 FC insulation displacement connector E70498, E70499

11323

Flat cable insulation displacement connector of the yellow OR black AS-i flat cable:
distribution of the AS-i voltage OR the external 24 V supply
Adapter flat cable to round cable

- Ambient temperature: -25...75 °C
- **Materials:**
  Housing: PA 6 GF35 Grivory
  Round cable: PUR
  Core insulation: PVC
- Tightening torque upper part to lower part: 1.65 Nm
- Current rating = 4 A

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

- Cable length:
  E70498: 2 m
  E70499: 5 m

NOTE

The longest distance (total cable length) from the master must be max. 100 m. Greater distances require special measures, → chapter **Extension of the AS-i cable length** (→ page 182).

► Take into account the connection cables (spurs) when calculating the cable length!

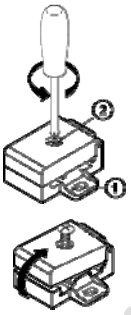
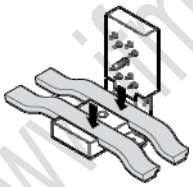
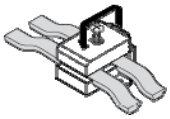
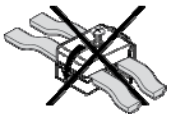
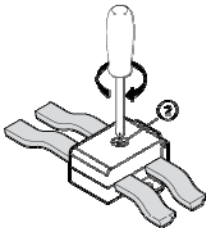
The maximum possible cable length might be reduced in case of a reduced cable cross section or when other cable types are used.

Wiring:
(+) brown
(-) blue

4.17.9 Mounting (e.g. E70381)

11336

► Disconnect the installation from power.

► Choose a flat mounting surface and fix the splitter on it (mounting hole pos. (1)). The mounting screw is not supplied. ► Loosen screw 2 (supplied with the unit) and open the passive splitter. Legend: (1) mounting hole (2) screw (tightening torque 1.65 Nm)	
► Insert the AS-i flat cable into the flat cable ducts. ► Place the cables correctly in the profile slot.	
► Close upper part. To do so, first lift the upper part, then place it parallel to the lower part so that the upper part is not jammed. This is the only way to ensure that the contacts pierce the flat cable vertically.	**Only mount this way:**  **Do NOT mount as this:** 
► Press the upper part against the lower part and firmly tighten the screw (2). Tightening torque = 1.65 Nm	

► To guarantee the protection rating: if the AS-i flat cable ends outside of the device, use the flat cable seal E70413 (IP 67) or the heat-shrink cap E70113 (→ **Sealing the AS-i flat cable end** (→ page 23)).

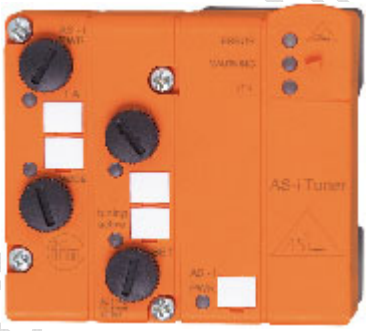
4.18 Device description repeater, tuner, bus termination

Contents

Extension of the AS-i cable length 182
Device description repeater 185
Device description tuner 188
Device description passive bus termination 191

6394

Examples:

Repeater	 AC2225
Tuner as active bus termination	 AC1146
Passive bus termination	 AC1147

4.18.1 Extension of the AS-i cable length

6675

The longest distance (total cable length) from the master must be max. 100 m. There are several solutions for an extension by a further 100 m:

1. Repeater
2. Dual master in the centre of the machine
3. Bus termination at the end of the long cable
4. Tuner

Repeater

6862

Repeaters allow a cable extension by a further 100 m in AS-Interface. The number of possible participants remains unchanged. Each repeater has an electrical separation which divides the network into two segments. Each segment has its own voltage supply. The master segment can thus be supplied with voltage via AS-i power supply 1 and the area behind the repeater via AS-i power supply 2. This principle allows an increase in total current per AS-i network and improves the voltage drop.

A repeater can also be used for safety reasons. A repeater is used to ensure that a short circuit on the secondary circuit has no influence on the primary circuit. AS-i networks can thus be divided into electrically isolated areas.

Each repeater has an internal propagation time which adds for series connection. This limits the number of repeaters to be used, see comparison below.

Dual master in the centre of the machine

6863

Dual masters in the centre of the machine allow an extension of the AS-i cable by a further 100 m in opposite directions. Distances of 200 m can thus be linked. One side effect is that twice the number of AS-i participants can be connected.

Bus termination at the end of the long cable

6864

The passive bus termination minimises reflections on the end of the cable and must therefore be connected to the end of the cable. The main effect of the bus termination is the improvement of the AS-i telegram quality for long cables and the use of Safety at Work components.

- ► In a branched network, the bus termination should be connected to the end of the cable that is the furthest away from the AS-i power supply.
- ► Only ONE bus termination must be installed in an AS-i network.
- ► Check the AS-i telegram quality after installation of the bus termination with the AS-i analyser AC1145.

Tuner

6865

The tuner is an active bus termination.

> During the setup, the tuner independently checks different impedances for their effectiveness as line termination.

> In the resulting operation, the tuner activates the impedance value with the best telegram quality and maintains this value constant.

An extension of the AS-i cable up to 200 m without additional repeater is possible.

► Install the tuner at the point with the greatest distance to the AS-i power supply.

Comparison of cable extension methods

6676

There are different methods of extending the AS-i cable. The specified 100 m can be extended up to 600 m in extreme cases. The following table shows the different possibilities and the different methods of cable extension.

Measure	Repeater	Dual master	Bus termination	Tuner
Extension by	100 m	100 m	100 m	100 m
Required power supplies	1x per master 1x per repeater	1x per master	1x per master	1x per master
Electrical separation	yes	yes	no	no
Voltage drop	uncritical	uncritical	critical	critical
Max. number of slaves	31 (single) 62 (A/B)	62 (single) 124 (A/B)	31 (single) 62 (A/B)	31 (single) 62 (A/B)
Cost/benefit per slave (ranking) *)	6.2 (4)	2.8 (2)	0.95 (1)	6.13 (3)
Note	≤ 2 repeaters in series	master in the centre	check voltage drop at the end of the line check telegram quality	check voltage drop at the end of the line check telegram quality

* Formula: cost/benefit = device cost / max. number of slaves

Application examples for cable extensions

6677

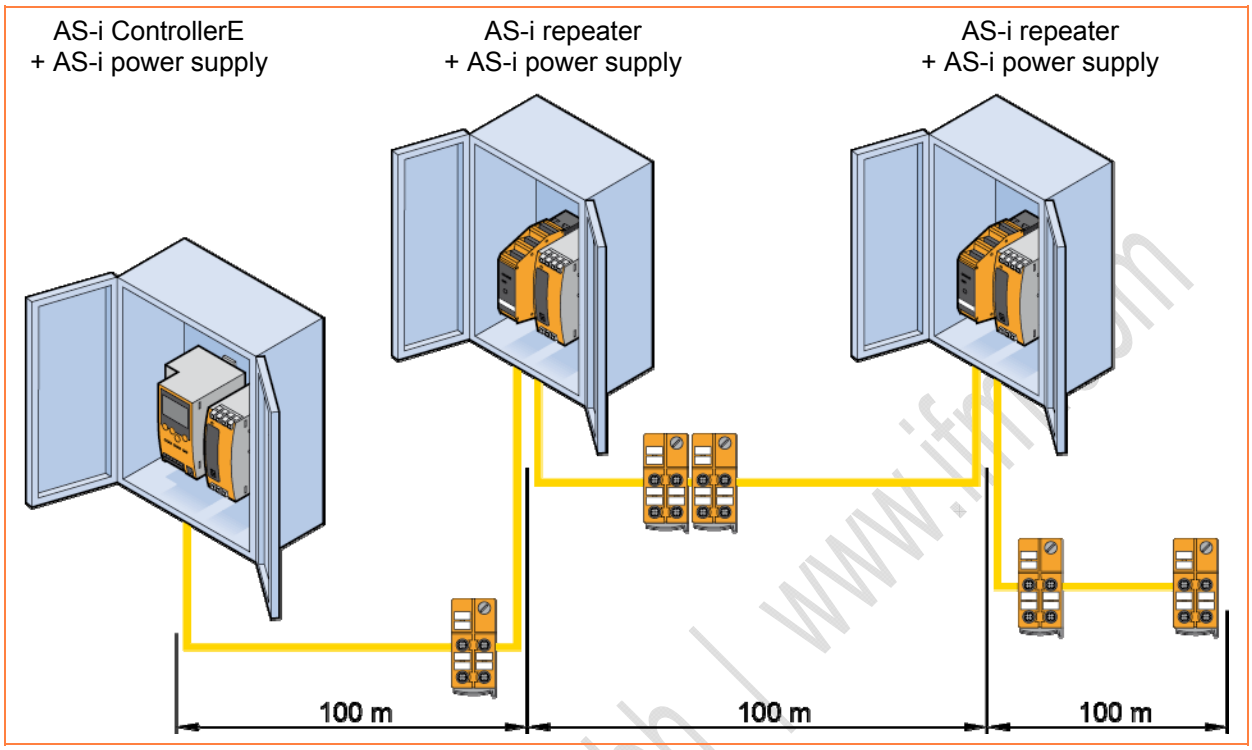


Figure: Example for AS-i cable extension with repeater

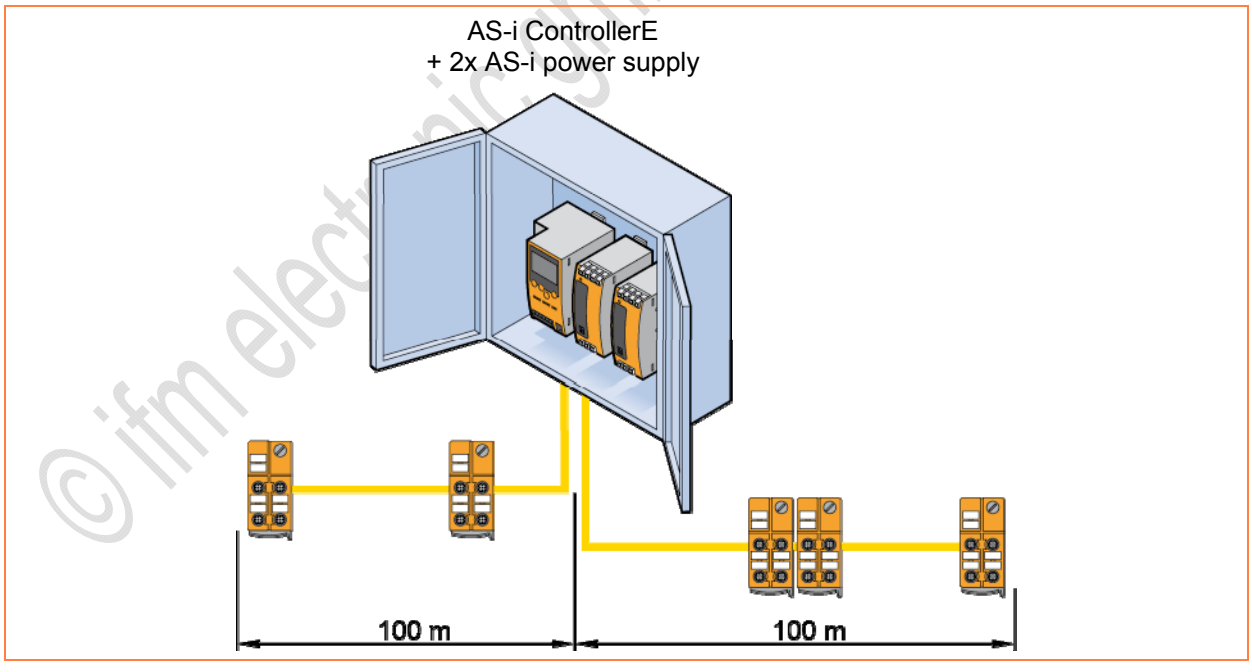


Figure: Example for AS-i cable extension with dual master

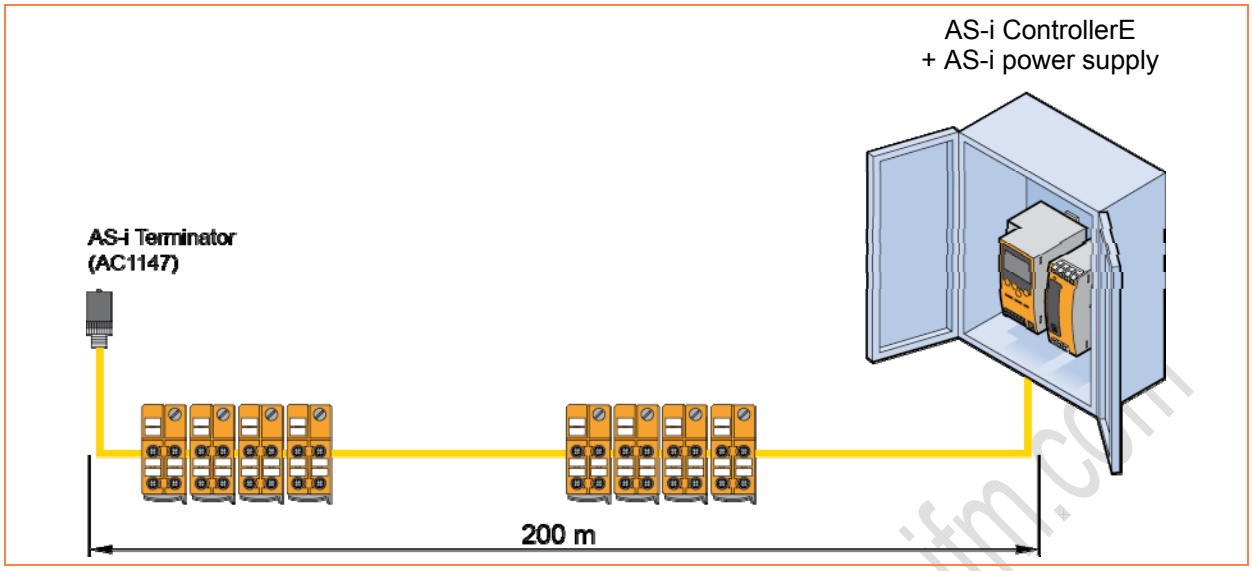


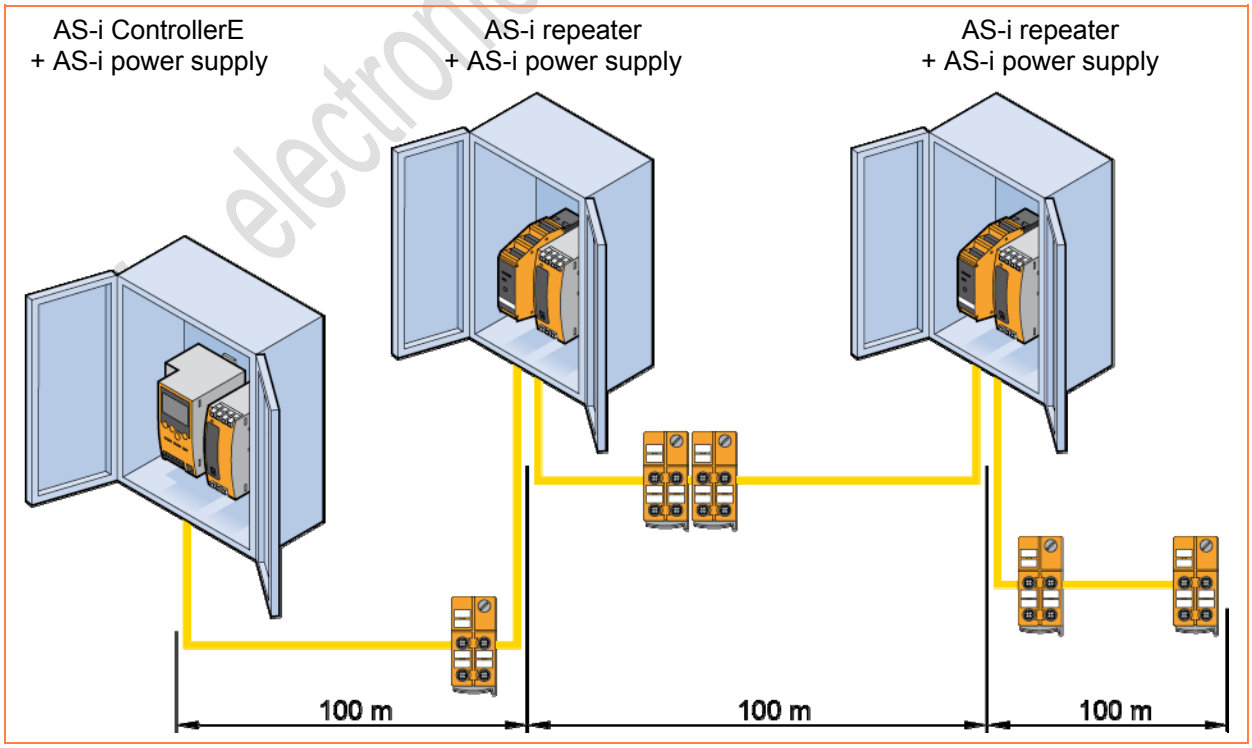
Figure: Example for AS-i cable extension with bus termination

4.18.2 Device description repeater

6683

- The AS-i repeater (AC2225) is used to extend the cable length of an AS-i network by another 100 m.
- Max. 2 repeaters must be connected in series.
- Electrical separation of the incoming AS-i line (= line 1) and of the outgoing AS-i line (= line 2).
- A separate AS-i power supply is required for the outgoing AS-i line.

Example:

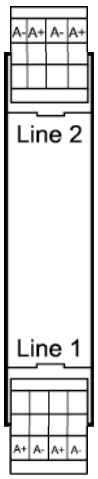


Electrical connection

6501

► Disconnect the installation from power.

► Connect the device as indicated on the terminals.



Line 1 = incoming AS-i line

Line 2 = outgoing AS-i line

Connections:

A+ = AS-i +

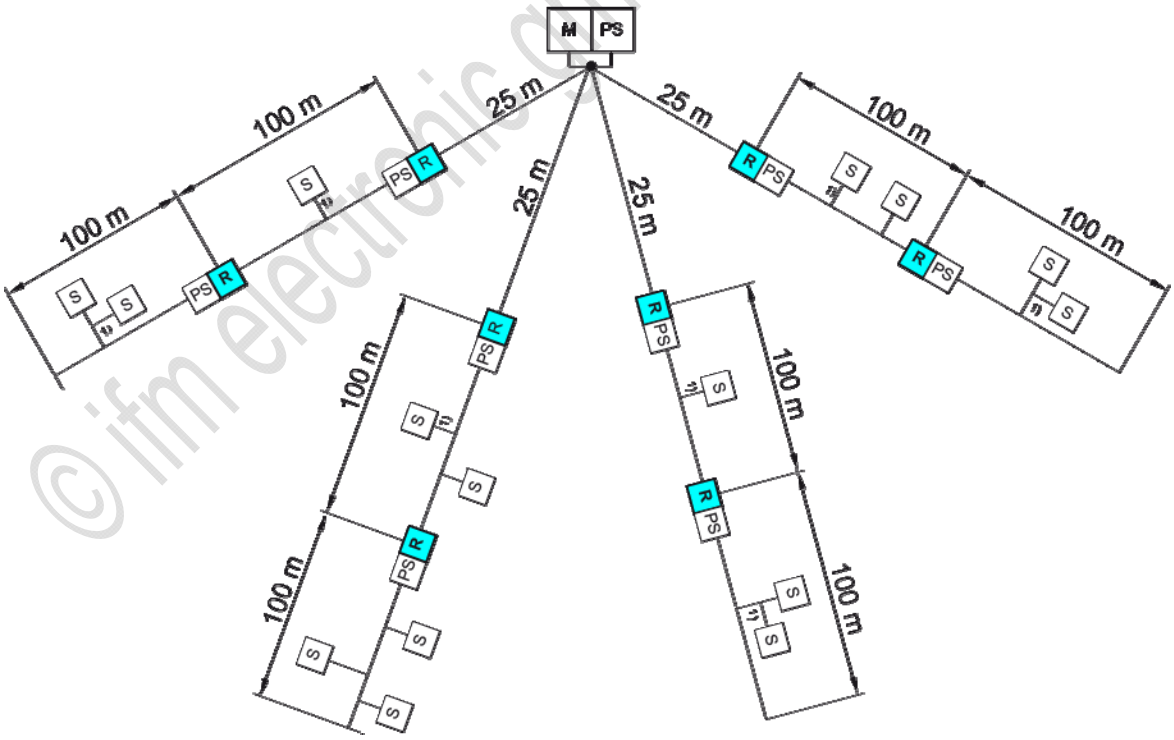
A- = AS-i -

► Consider that an additional AS-i power supply is required for the outgoing AS-i line.

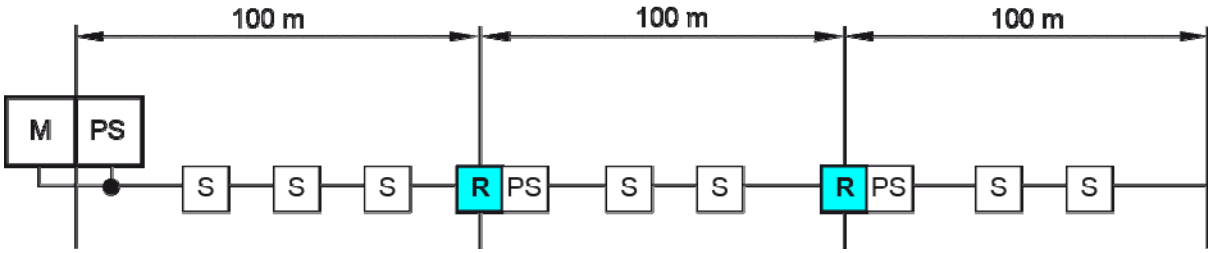
► Incoming and outgoing AS-i lines must not be connected to each other, otherwise the electrical separation of the repeater is eliminated!

Examples for cable extensions with repeaters:

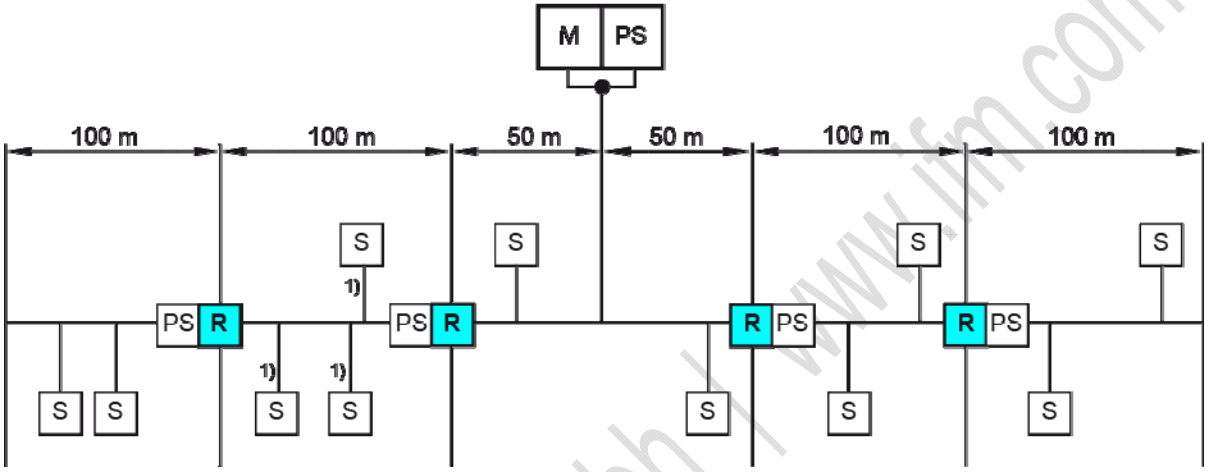
AS-i network in star topology



AS-i network in line topology



AS-i network in string topology



M = AS-i master
PS = power supply
R = repeater
S = slave

1) Take into account all branches and spurs in the calculation of the length!

LED behaviour repeater

6684

There are separate LEDs for the incoming and outgoing AS-i line.

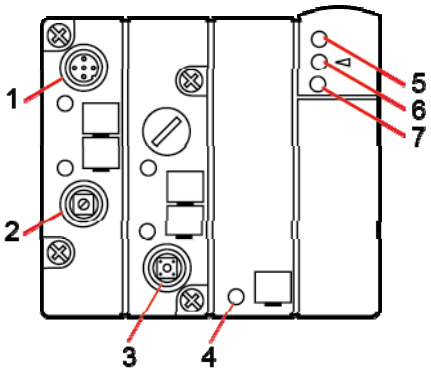
Diagnostic LED			Description
[AS-i]	green	lights	AS-i voltage supply present
[FAULT]	red	lights	no AS-i communication

4.18.3 Device description tuner

6686

- The tuner (AC1146) is an active bus termination.
- Display of critical states by "traffic light" LEDs.
- Extension of the cable to 200 m without additional repeater possible.
- Current rating AS-i distribution socket = max. 1 A.

► Install the tuner at the point with the greatest distance to the AS-i power supply.



Legend:
1 = AS-i M1 distribution socket M12
2 = rotary switch [Mode]
3 = button [Tune]
4 = LED AS-i power
5 = LED GREEN
6 = LED WARNING
7 = LED ERROR

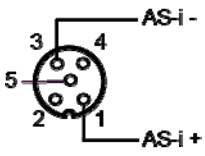
Setting the operating modes with the rotary switch [Mode]:

Pos.	Description
0	off
1	passive bus termination (function similar to AC1147)
2	tuning
3	run

All other positions have no function.

Electrical connection

6503

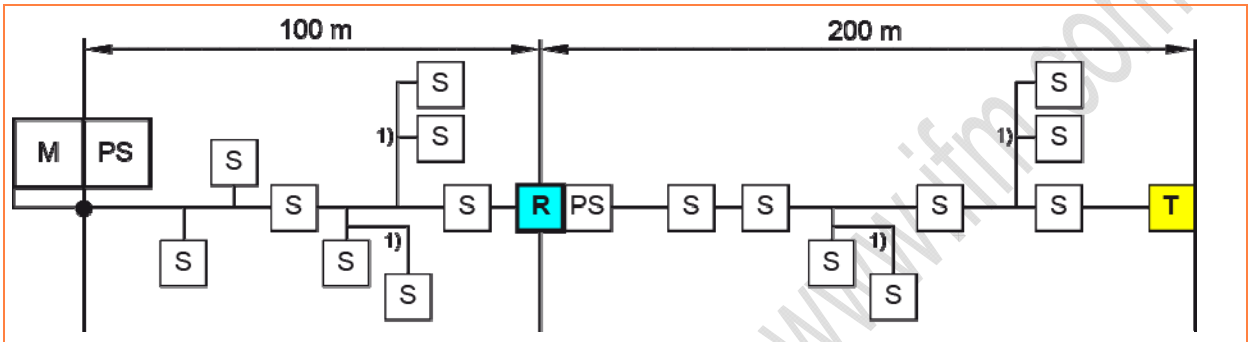


1 = AS-i + (plus)

2 = AS-i - (minus)

► Install the tuner at the point with the greatest distance to the AS-i power supply.

Example: AS-i cable extension with repeater and tuner



M = AS-i master
PS = power supply
R = repeater
S = slave
T = tuner

1) Take into account all branches and spurs in the calculation of the length!

LED behaviour tuner

6685

Diagnostic LEDs	LED colour	LED lit	LED flashes
[AS-i Power]	red	AS-i voltage ok (> 26.5 V)	AS-i voltage too low
Traffic light LEDs [GREEN]	green	normal communication: - telegram repetitions < 1 % - AS-i voltage ok - tuning active - telegram quality ok	---
Traffic light LEDs [WARNING]	yellow	occasionally disturbed communication (1...5 % telegram repetitions)	---
Traffic light LEDs [ERROR]	red	disturbed communication (as from 6 % telegram repetitions) or "Config Error"	---

> The AS-i network is checked after pressing the button [Tune] in the mode [Tuning].

> During this stage the traffic light LEDs alternately light green, yellow, red.

Set-up tuner

6693

► Turn the [Mode] selector to position 2 [Tuning] using an appropriate tool (e.g. screwdriver).

► Keep the button [Tune] pressed for more than 5 seconds.

> The tuner checks the AS-i network.

> The traffic light LEDs alternately flash red, yellow, green.

► Do not carry out any changes during this stage, until only one LED of the traffic light LEDs is lit.

► Set the rotary switch [Mode] to position 3 [Run].

NOTE

If the yellow or red LED is lit:

► Check the AS-i network for faults, e.g.:
- frequency inverter too close to cables
- power cable

► Briefly press the button [Tune] after checking the AS-i network (< 3 seconds).

> The tuner is reset (reset function) and the telegram quality is checked again.

4.18.4 Device description passive bus termination

6697

Example:

AC1147

- Advantages of the passive bus termination (AC1147):
  - improvement of the signal quality,
  - cable extension up to 200 m possible.
- Maximum current consumption < 10 mA.

► Connect maximum 2 repeaters in series if sub-networks > 100 m are installed.

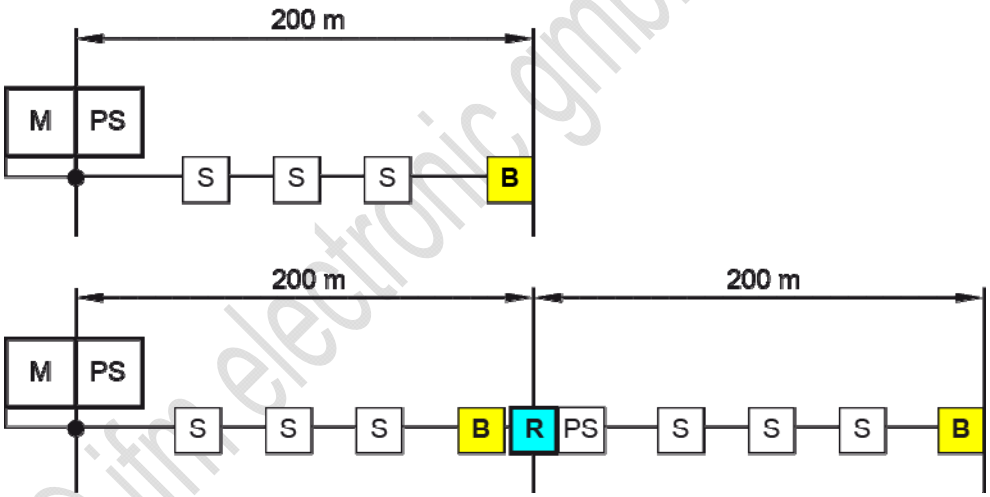
► Use maximum 1 AS-i bus termination per AS-i segment.

► Install the bus termination at the point with the greatest distance to the AS-i power supply.

► Use e.g. the FC insulation displacement connector E70096 or AC5005 for connecting AC1147.
→ **Device description IP 67 splitter** (→ page 171)

► After installation of the AC1147 test the signal quality of the AS-i network by means of the eAS-i tester AC1145 or via the diagnostic options of the controller (e.g. number of telegram errors).

Examples:



B = bus termination
M = AS-i master
PS = power supply
R = repeater
S = slave

LED behaviour passive bus termination

6687

LED lit...	Description
green	AS-i voltage ok (> 26.5 V DC)
yellow	AS-i voltage too low (> 18.5 V DC)

4.19 Device description addressing units

Contents

Addressing unit AC1154 194

11349

NOTE

The following modules cannot be addressed with the addressing unit AC1144:
- modules in the extended addressing mode (with e.g. 4 inputs + 4 outputs
- modules with safe outputs

► Address such modules with the addressing unit AC1154.

4.19.1 Addressing unit AC1154

Contents

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Structure of the addressing unit 195
Operating modes 197
Error messages 206

11350

Functions and features

11352

The protection of operating personnel and system against possible danger is not guaranteed if the sub-assembly is not operated in accordance with its intended use.

The device must be operated by qualified staff in accordance with these operating instructions.

Safety and correct functioning of the device and connected systems cannot be guaranteed if operated in any way other than that described in these operating instructions.

NOTICE

The device will be destroyed when external voltage is applied to pin 2 and 4!

Use of the pins 2 and 4 is only permitted in conjunction with the E70211 infrared addressing adapter.

The addressing unit enables the writing of identification code ID1.

► If the user has changed the ID code ID1 of a slave and uses the automatic address programming, save the correct ID code 1 in the slave before installing the new slave!

Structure of the addressing unit

11353

The adapter is used to connect the AS-interface slave to the addressing unit AC1154. Most AS-interface slaves can be connected directly to the adapter without any accessories.

This includes among other: AS-i slaves with M12 screw connections. All AS-i slaves with a 3.5 mm coaxial power connector addressing socket can be programmed using the E70213 addressing cable.

Like some AS-interface slaves the addressing unit is supplied with an infrared interface which can also be used to establish the connection to AS-interface slaves (IR addressing adapter E70211).

Wiring of the M12 socket for the IR interface:

1 = AS-i +
2 = TTL →
3 = AS-i -
4 = TTL ←
5 = +5 V

A slave with a higher current consumption than provided by the addressing unit can be powered by an external AS-i power supply.

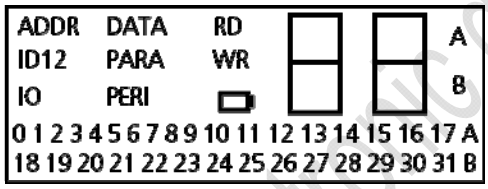
Operation with the AS-i power supply is possible but cannot be guaranteed for all topologies.
In this event:

► Switch offline or switch off the AS-i master.

► When operated with the AS-i power supply the addressing unit should be connected close to the AS-i power supply.

> All available slaves are displayed in the LC display

► The slave to be modified next can be selected using the control panel.



> The LC display shows the current operating mode in the upper left-hand corner.

Meaning and function of the individual modes
→ chapter **Operating modes** (→ page 197)

> To the right of the operating mode display is the two-digit, seven-segment display.

> In the right corner the letters 'A' or 'B' indicate whether it is an AS-Interface slave that supports the AS-i version 2.1. If not, both letters are out.

For operating the device there are 5 keys with the following meanings:

Button	Function
	• pressing once: switch on the device pressing twice: switch off the unit • search for AS-i slaves connected • activate the next higher address (in the addressing mode only) • read slave information of active slave address (not in the addressing mode)
	• program the slave address from the active address to the displayed address (in the addressing mode only) • write the displayed data to the activated slave (not in the addressing mode)
	• set the operating mode
	• set the requested address or data (counting upwards)
	• set the requested address or data (counting downwards)
 simultaneously	The function depends on the duration of actuation: • press briefly: the unit assigns the address '0' to the connected slave • press for a longer time: the internal list of the slaves used is deleted

Operating modes

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Overview of the operating modes 198
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Addressing mode 200
Read ID code or ID code 2 202
Read and write ID code 1 203
Read IO code 203
Read and write data 204
Read and write parameters 205
Read periphery fault flags 205

11360

⚠ WARNING

Serious personal injury and property damage possible!

Changing the variable values in running processes can cause serious personal injury and damage to equipment in case of malfunctioning or program errors.

Before executing the DATA or PARA functions:

► Make sure that no dangerous situations can occur.

If not yet done:

► Switch on the addressing unit with the [Read/On] button.

► Press the [MODE] button until the requested operating mode is indicated in the LC display.

> Modes of the connected slaves which are not supported are skipped.
For a slave of version 2.0 for example these are the modes ID1, ID2 and PERI.
For all slaves with address 0 the modes DATA and PARA are skipped since these are not defined according to the AS-interface specification.

► As an alternative you can change directly to the addressing mode:
Press the [MODE] button for > 2 s.

The operating modes allow reading or writing of a wide range of AS-interface data. Some of these modes are for functional tests only.

► In all operating modes, the slave to be read or written must first be activated in the addressing mode ('ADDR' is displayed).

► Use the [MODE] button to set the requested operating mode.

Overview of the operating modes

11372

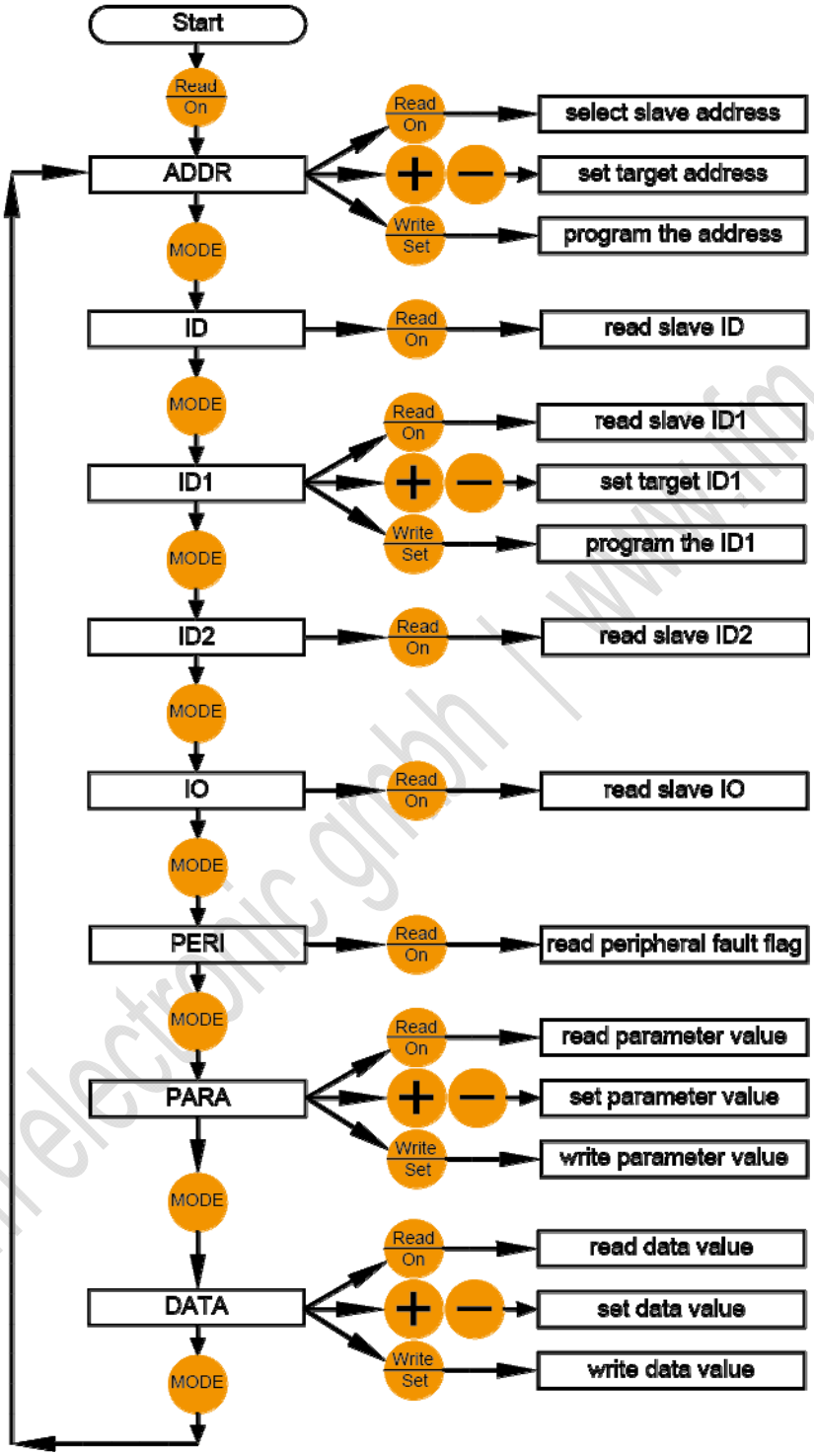
The device supports the following modes:

Display	Operating mode	Note
ADDR	addressing mode	read and write AS-i slave addresses
ID	read ID code	
ID1	read and write ID code 1	
ID 2	read ID code 2	
IO	read IO code	
PERI	read periphery fault flag	
PARA	display and write parameters	read and write AS-i slave parameters
DATA	read and write data	read and write input or output data of an AS-i slave

The modes are shown in the order in which they are displayed when the [MODE] button is pressed successively.

Structure of the operating modes

11373



Addressing mode

11362

To readdress, the slave address '0' must be free.
If an AS-interface slave having the address '0' is connected to the device, error message F5 appears.

After switching on the device (via the [Read/On] button):

> the device is automatically in the addressing mode,

> the connected participants are displayed.

If another mode was used before:

► Press the [MODE] button until 'ADDR' appears in the LC display.
As an alternative you can change directly to the addressing mode:
Press the [MODE] button for > 2 s.

After changing the operating mode:

► Press the [Read/On] button to detect the connected participants.

Display of detected slaves:

> If the addressing unit does not detect any slaves, error message F2 appears.

> All detected slaves are indicated in the lower part of the display (small numbers).
If it is a single slave, neither 'A' nor 'B' are displayed next to the address.
If slaves from version 2.1 onwards are used, an A or B next to the address indicates whether this is an A or B slave.

> If several different participants are connected to the addressing unit, the display changes every 2 seconds between single slaves, A slaves and B slaves.

> The address of the slave which is to be written next (activated slave) flashes at a frequency of 2 Hz.

► Press the [Read/On] button again to activate the next higher available address.

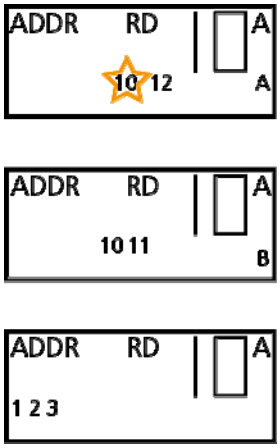
► For activating a specific slave, set the requested address in the field at the top right using the buttons [+] or [-].

> When one of the two buttons is pressed for the first time, 'RD' is no longer displayed.

> If the requested slave address is displayed, press the [Read/On] button.

> The activated address is marked by a preceding 'RD'.
The activated address in the field at the bottom flashes at 2 Hz.

The following example illustrates this behaviour:



In this example, the addressing unit detected the following slaves:

top: slave address 10A and 12A ('10' flashes quickly)

middle: slave address 10B and 11B

bottom: single slaves with the addresses 1, 2 and 3

These 3 displays run over the display one after the other.

The activated slave is reprogrammed to the address which is displayed in large text in the upper-right corner of the display (10A in the example).

► Use the [+] button to increment the value or the [-] button to decrement the value.

► If the corresponding button is pressed briefly, the display increases or decreases by 1.
If the button is held pressed, the addressing unit increments or decrements continuously.

► To address, use the [+] or [-] button to set the new requested address.

> When one of the two buttons is pressed for the first time, 'RD' preceding the address is no longer displayed. This indicates that the displayed value is not a value read from a slave.

► Use the [Write/Set] button to reprogram the activated slave (small flashing number).

> Next to the written address 'WR' is displayed. This indicates that a slave has been readdressed.
On the active, flashing address is no longer a slave.

► Press the [Read/On] button to update the display and activate the next higher address.

Address slaves with IR interface

11364

Using this addressing unit slaves with infrared interface can be addressed.
An IR addressing adapter (E70211) is required for this.

NOTE

The slave must have a watchdog function.
Slaves without a watchdog must be disconnected from the AS-i voltage for a short time after addressing so that the slaves are detected and activated again by the master.

When the slaves are put into service for the first time (address set at the factory is 0) and a SilverLine power supply from ifm is used, the shunt must be put into position 2-3 first before the power supply is switched on.

> Every action is completed by a slave reset command and thus the connected slave can communicate with the master again.

For addressing via the IR interface proceed as follows:

► Connect the IR adapter to the M12 socket of your addressing unit.

► Switch the master offline or disconnect it from the AS-i line.
For the AS-i SilverLine power supplies from ifm the communication can be deactivated by repositioning the shunt from position 1-2 to position 2-3 on the power supply.

► Address the slave in the addressing mode.

► Switch the master online again or connect it to the AS-i line.
For the new AS-i power supplies of the ifm SilverLine put the shunt back into position 1-2.

Read ID code or ID code 2

11365

► Press (several times) the [MODE] button to select the 'ID' or 'ID 2' mode.

> The display shows the corresponding ID code of the activated slave.

ID code and ID code 2 can only be read but not written.

The function 'Read ID code 2' is only supported by slaves from AS-i version 2.1 onwards.

Read and write ID code 1

11366

This function is only supported by slaves from AS-i version 2.1 onwards.

To write ID code 1, the slave address '0' must be free.
If an AS-interface slave having the address '0' is connected to the device, error message F5 appears.

► Press (several times) the [MODE] button to select the 'ID 1' mode.

> The display shows the corresponding ID code of the activated slave.

> The activated address is marked by a preceding 'RD'.
The activated address in the field at the bottom flashes at 2 Hz.

► Use the [+] or [-] button to set the requested value.

> When one of the two buttons is pressed for the first time, 'RD' is no longer displayed.

► If the requested ID1 code is displayed, the value can be stored non volatilely in the slave by pressing the [Write/Set] button.

If 'automatic addressing' is used in case of a malfunction, the new slave must have the same ID1 and ID2 codes as the slave to be exchanged.

Read IO code

11367

► Press (several times) the [MODE] button to select the 'IO' mode.

> The display shows the corresponding IO code of the activated slave.
The IO code can only be read but not written.

Read and write data

11368

This operating mode is for test purposes only.
The output data of the higher-level controller can only be read or temporarily be written.

NOTE

In this operating mode the AS-i supply voltage remains switched on after reading or writing the data.

As a result, written output data is retained until the operating mode is changed or the connection between the addressing unit and the AS-interface slave is interrupted.

This operating mode especially affects the accumulator of the addressing unit.

The addressing unit transmits data as long as the [Write/Set] or [Read/On] button is pressed.

For AS-i products with integrated watchdog:
If no AS-interface message has been received from the slave after a predefined period of time, the output is switched to the safe (power-free) state. It is thus possible that set outputs are reset when the [Write/Set] or [Read/On] button is released.

► First activate the slave to be read or written.

► To switch on the 'Read and Write Data' mode, press the [MODE] button until 'DATA' is displayed.

> When this mode is switched on, the current input data is read and displayed in the upper-right corner of the display.

> In addition, ‘RD’ is displayed, indicating that the data is read data.

► Use the [+] or [-] button to set the requested value.

> When one of the two buttons is pressed for the first time, 'RD' is no longer displayed.

► When the requested value is displayed, transmit it to the slave by holding pressed the [Write/Set] button.

> 'WR' is displayed.

> The data is transmitted to the slave until the [Write/Set] button is released.

Read and write parameters

11369

This operating mode is for test purposes only.
The parameter values in the AS-i master or AS-i slave can only be read or temporarily projected.

NOTE

In this operating mode the AS-i supply voltage remains switched on after reading or writing the parameters.

This operating mode especially affects the accumulator of the addressing unit.

► First activate the slave to be read or written.

► To switch on the 'Display and Write Parameters' mode, press the [MODE] button until 'PARA' appears in the display.

> When this mode is switched on, the default parameters are displayed in the upper-right corner. In this operating mode, the parameter values are not read from the slave. If the [Read/On] button is pressed again following the write operation to read the parameter values, this display shows the values last written.

> In addition, ‘RD’ is displayed, indicating that the data is read data.

► Use the [+] or [-] button to set the requested value.

> When one of the two buttons is pressed for the first time, 'RD' is no longer displayed.

► By holding pressed the [Write/Set] button, the displayed value is transmitted to the slave once.

> 'WR' is displayed.

> The AS-i slaves use the written parameter values as long as ...
- the activated slave is connected to the addressing unit or
- the operating mode PARA is switched on.

> If the connection is interrupted or the operating mode is changed, the values are lost.

- Due to the order of the modes, pressing the [MODE] button first switches on the 'PARA' operating mode. Press the [MODE] button again to switch on the 'DATA' operating mode. During this change the AS-i voltage remains switched on and the parameter value is kept.

Read periphery fault flags

11370

The periphery fault flag is an optional bit which indicates an error in the slave. This function is only supported by version 2.1 slaves. The addressing unit can read this bit.

► Activate the slave from which this bit is to be read.

► Press the [MODE] button until 'PERI' is displayed.

> The display '0' indicates that there is no error.
The display '1' indicates an error.

Error messages

11371

The addressing unit supports the following error messages:

Code	Meaning	Description
F1	Overload AS-Interface	Too high current consumption of the slaves connected to the addressing unit. The handheld programming unit is not able to provide sufficient supply current. ► Connect the AS-i power supply.
F2	Slave not found	No slave found at the active address.
F3	Error during programming	During programming of the address or of the extended ID code 1 the value could not be permanently stored in the EEPROM of the slave .
F4	Target address assigned	The target address to which the activated slave is to be readdressed is assigned.
F5	Address 0 assigned	When readdressing a slave or when writing the extended ID code 1, address '0' must be free. But the address '0' is assigned to a connected slave.
F6	Standard slave instead of extended slave found	The operation cannot be executed as the activated slave is not a version 2.1 slave. The error message always occurs when a standard slave is activated and you change from the addressing mode to the mode 'IO', 'PARA' or 'DATA'. These are operating modes which the standard slave does not support.
F7	Extended slave found instead of standard slave	The standard slave at the active address was exchanged for a version 2.1 slave. Error code F7 always occurs when you attempt to set a version 2.1 slave to an address when neither the extension A nor B is shown in the display.
F8	Reception error	Due to an error the response of the slave could not be received correctly.

5 AS-i system check

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5.1 Troubleshooting ControllerE and gateways (AC13nn)

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6706

In this chapter we will present a couple of error messages, their possible causes and how to remove the faults.

For further error messages of the device and detailed information → device manual:
→ www.ifm.com > select your country > [data sheet search] > (article no.) > [Additional data]

5.1.1 Boot errors – error codes B00...B11

6020

- Menu operation interrupted.
- Error message superposes the menu screen.
- Error message only disappears after the following actions:
  1. Error removed AND
  2. Error message acknowledged with the right function key.

Error message	Cause(s)	Remedy
B00	ControllerE boot error After power-on of the device, an error was found during initialisation of the individual device components. For further details please refer to the following error messages.	► Check the further error messages.
B01	Master 1 initialisation Unsuccessful initialisation of the master. Possible causes: • Unacceptable interference on the 24 V power supply. • Unacceptable interference on the AS-i power supply. • Unacceptably high electrostatic charges and electromagnetic fields in close proximity of the device.	► Ground the device via the rail. ► Connect the FE terminal to the machine ground. ► Use a switched-mode power supply to supply the device with power.
B02	Master 2 initialisation	→ B01
B03	General FAT error An error was found in the data field of the "File Allocation Table" FAT.	► Check the further error messages.
B04	Only one master detected The operating system can only detect 1 master in the device although 2 masters should be present. Possible cause: Hardware fault.	► Replace the device and project again.
B05	Two masters detected The operating system can detect 2 masters in the device although communication with only 1 master is allowed. Possible cause: Hardware fault.	→ B04
B06	Fieldbus type not detected During automatic detection of the integrated fieldbus no enabled fieldbus module could be detected. Possible cause: Hardware fault.	→ B04
B07	Number of masters not correct Invalid information was received when querying the versions of the masters. Possible cause: Hardware fault.	→ B04

Error message	Cause(s)	Remedy
B08	Exec. of PLC blocked by user (for gateway: reserved) When the device was started the automatic start of the PLC program was disabled by the user. The left function key of the device was pressed during power-on.	► Release function key during power-on. or: ► No action because this is requested.
B09	reserved	—
B10	Master 1 firmware obsolete The AS-i master firmware does not contain functions required for the RTS operating system.	► Update the AS-i master firmware to the required minimum version.
B11	Master 2 firmware obsolete	→ B10

5.1.2 AS-i system errors – error codes E10...E32

6024

- Menu operation interrupted.
- Error message superposes the menu screen.
- Error message only disappears after the following actions:
  1. Error removed AND
  2. Error message acknowledged with the right function key.

Error message	Cause(s)	Remedy
E10	Slave not activated The slave was detected in the system but not activated by the master. Detected slave profile does not correspond to the projected slave profile and the master is in the "protected mode".	► Check the slave profile: [Menu] > [Slave Info] ► Connect the slave with the right profile. ► Reproject the slaves: [Menu] > [Quick Setup]
E11	Slave not present Slave present in the "List of projected slaves" LPS but not detected on the AS-i master.	► Check the slave connections. ► Connect the slave again.
E12	Slave not projected The slave was detected on the AS-i bus but is missing in the "List of projected slaves" LPS.	► Reproject the slaves: [Menu] > [Quick Setup]
E13	Periphery fault detected Periphery fault detected on at least one connected slave.	→ **Display of the list of slaves with periphery fault (LPF)** → **Display of slave with periphery fault**
E14	Safety slave alert	Error message not active at present.
E15	Analogue protocol error	Error message not active at present.
E20	AS-i voltage error The master is in the "Protected mode" and detects that the AS-i voltage supply is not greater than 28 V. The message is only generated if at least one slave is projected.	► Check the AS-i voltage supply on the master and replace – if necessary
E21	No slave detected The master is in the "Protected mode" and detects that no slave is connected to the AS-i bus. The message is only generated if at least one slave is projected.	► Check the slave connections. ► Check the AS-i line.

Error message	Cause(s)		Remedy
E22	Slave 0 detected The master is in the "Protected mode" and detects a slave with the address 0 on the AS-i bus. This message is only generated if the profile of the missing slave on the AS-i bus is identical to the profile of the slave with the address 0.		► Switch the master to the operating mode "Projection mode": → **Set operating mode** (→ page 59)
E23	Slave 0 has wrong profile The master is in the "Protected mode" and detects a slave with the address 0 on the AS-i bus. This message is only generated if the profile of the missing slave on the AS-i bus is not identical with that of the slave with the address 0.		► Check and replace the slave. ► Reproject the slaves: [Menu] > [Quick Setup]
E24	Autoaddress not enabled The master is in the "Protected mode" and detects a slave with the address 0 on the AS-i bus. This message is only generated if the profile of the missing slave on the AS-i bus is identical with the profile of the slave with the address 0 and the "Automatic Addressing" in the master has not been activated.		► Activate "Automatic addressing" in the master
E25	Projection error The master is in the "Normal Operating Mode" and detects a projection error. Possible causes: • The profiles of the detected slaves are not identical with the projected slaves. • One or more slaves are additionally detected on the AS-i bus. • One or several slaves are missing on the AS-i bus.		► Check the detected and projected slave profile in the menu [Slave Info]. ► Check the entries of slaves in the lists LAS, LDS, LPS, LPF in the menu [Slave Lists].
E26	General periphery fault The master is in the "Normal operating mode" and detects that at least one slave on the AS-i bus signals a periphery fault.		→ **Display of the list of slaves with periphery fault (LPF)** → **Display of slave with periphery fault**
E27	Normal mode not active The master reports that it is not in the "Normal Operating Mode". Possible causes:		
	1.	The master detects an AS-i voltage lower than 22 V and therefore changes into the "Offline Mode".	► Check the AS-i voltage supply on the master and replace – if necessary
	2.	The master has received a request from the operating system to change into the "Offline Mode".	→ 1.
	3.	The master has detected a transfer error in the communication with the operating system.	► Switch the PLC off and on again ► If this does not help: Replace the device and project again.
	Other causes which can lead to the error message directly after the device has been switched on:		
	4.	Initialisation of the master after switching on the device was not successful.	→ 3.

Error message	Cause(s)		Remedy
	5.	The master has not yet received the projection nor the projected parameters from the operating system.	► Wait. ► If too long: → 4.
	6.	The master has not yet been started by the operating system.	→ 5.
E28	Status command channel The command channel has detected an invalid status. Possible causes: Overwriting of the command channel by Profibus DPV1. Profibus DP module 12, word 1.		► Check the request of command channel (1st word).
E29	Unknown MUX field identifier (for gateway: reserved) The transmission between AS-I master and PLC processor has been deranged.		► Check the data accesses via pointers into area < 4000_h of your PLC program. ► Check the electrical environment for unacceptably high electro-magnetic fields and static charging. ► Check the grounding of the device: FE terminal and rail must be connected to the machine ground!
E30	Safe slave triggered (1) For the indicated AS-i slave the opening of the contacts of the first safety circuit is detected.		no error status information of the runtime system
E31	Safe slave triggered (2) For the indicated AS-i slave the opening of the contacts of the second safety circuit is detected.		no error status information of the runtime system
E32	Safe slave triggered (1/2) Master has detected a "safe slave" on the AS-i line, whose inputs are constantly switched to LOW for a period > 64 ms.		► Bring the slave into the safe state.

5.1.3 AS-i master command errors – error codes M01...M44

6032

- Menu operation interrupted.
- Error message superposes the menu screen.
- Error message only disappears after the following actions:
  1. Error removed AND
  2. Error message acknowledged with the right function key.

Error message	Cause(s)	Remedy
M01	Command execution error An error has occurred during the execution of an AS-i command which has stopped the execution of the command. For further details please refer to the following error messages.	► Check the further error messages.
M02	Slave not found It was tried to access a slave which is not on the AS-i bus by means of an AS-i command. The slave is not in the LDS.	► Check the slave connections. ► Connect the slave again.
M03	Slave 0 found The master detects a slave with the address 0 on the AS-i bus and can therefore not execute the command. **Example:** The address of a slave is to be changed while a slave with the address 0 is present on the AS-i bus.	► Remove slave with the address 0 or address it correctly.
M04	Slave with same address found During the execution of a command the master detects that there is already a slave at the requested address on the AS-i bus. **Example:** The address of a slave is to be changed to an address which is already assigned to another slave on the AS-i bus.	► Remove one of the slaves with double address. ► Readdress the remaining slave. ► Reactivate the removed slave.
M05	Delete the old slave address The attempt to reprogram a slave to the address 0 fails. **Example:** AS-i slave has a limited number of possibilities to change the address, these are now exhausted.	► Replace slave.
M06	Reading "Extended ID Code 1" The master receives no or no valid response when reading the "Extended ID code 1". **Example:** Attempt to readdress an A/B slave to another address.	► Repeat the command.
M07	Writing to slave failed:	
	1. The attempt of the master to readdress a slave to the new target address fails.	► Repeat the command.
	2. Writing the "Extended ID Code 1" on slave 1 fails. **Example:** Attempt to readdress an A/B slave to another address.	► Repeat the command.

Error message	Cause(s)		Remedy
M08	New address only stored temporarily During the readdressing of a slave the new address could not be written to the slave because the slave is no longer detected on the AS-i bus. Possible causes:		
	1.	Double addressing.	→ M04
	2.	Major bus interference.	► Remove the cause of the interference.
M09	Extended ID1 temporarily stored While writing the "ID Code 1" to the slave the code could not be written to the slave because the slave is no longer detected on the AS-i bus. Possible causes: • Double addressing. • Major bus interference.		→ M08
M10	Slave not in LAS The master detects that a slave has not been activated. Possible causes: The slave profile in the projection data is not identical with the profile of the detected slave and the master is in the "Protected Mode".		► Switch the master to the operating mode "Projection mode": → **Set operating mode** (→ page 59) ► Check and replace slave. ► Reproject the slaves: [Menu] > [Quick Setup]
M11	Slave data invalid This error message has a multiple meaning and thus depends on the requested command:		
	1.	Readdressing of the slave Address 32 = 0B was indicated as target address.	Address 0B is not valid. ► Indicate valid address.
	2.	Write parameters The attempt has been made to write a value greater than 7_{hex} to an A/B slave, ID=A_{hex}.	► Indicate valid value.
M12	Sequence failure During the transfer according to the "7.4 slave protocol" the master detected an error in the triple sequence of the slave. Possible causes:		
	1.	Interference on the bus.	► Remove the cause of the interference.
	2.	Software error in the AS-i slave.	► Contact AS-i specialist or manufacturer.
M13	Timeout during sequence transmission (for gateway: reserved) During the transfer to the "7.4 Slave protocol" the master detected a timeout in the communication with the operating system. Possible cause: • Long PLC cycle which slows down the transfer of the individual 7.4 segments from the operating system or PLC to the master to an unacceptable degree: t > 1 sec. • If this case occurs, the master will end the 7.4 transfer started last and will again enter into normal data exchange with the respective slave.		► Shorten cycle by optimising the PLC program. ► Avoid program loops and complex arithmetic operations.

Error message	Cause(s)		Remedy
M14	Invalid address This error message has a multiple meaning and thus depends on the requested command:		
	1.	The attempt was made to write a parameter to slave 0.	► Correct the slave address to a value of $1...31_{dec}$.
	2.	During readdressing the address 0 or 0B was indicated as start and target address.	► Indicate valid address.
	3.	During the attempt to write the "Extended ID code 1" the address 0 was used.	► Indicate valid address.
M15	Slave interrupted 7.4 transfer The addressed 7.4 slave has stopped the transfer. Possible cause: Error in the 7.4 data of the PLC. Possible causes:		
	1.	Interference on the bus.	► Remove the cause of the interference.
	2.	Software error in the AS-i slave.	► Contact slave manufacturer.
M16	Slave deleted during active transfer During an active 7.4 protocol transfre the slave was deleted from the list of active slaves by the master. Possible cause: Interference on the bus.		► Remove the cause of the interference.
M17	7.4 transfer active The attempt was made to start a new 7.4 transfer during an active 7.4 protocol transfer.		► Repeat the command.
M18	7.4 host sequence failure The sequence bit was set to 1 by the host or the PLC although a value < 30_{dec} was indicated in the "Dlen" data field.		► Correct value "Dlen". or: ► Change sequence bit.
M19	Invalid 7.4 data length The indicated data length "Dlen" is not a multiple of the factor 3.		► Correct value "Dlen". A 7.4 protocol transfer always consists of several data triples.
M20	Invalid command Master received an unknown command.		► Check the cause for the wrong command and correct.
M21	Safety monitor protocol error During the processing of the safety monitor protocol a transmission error occurred. Possible cause: Interference on the bus.		► Check the cause for the wrong command and correct.
M22	Timeout command The execution of the master command exceeded the permissible execution time. The command was cancelled.		► Remove the cause of the interference. Details → command description
M23	Command requirements not met The necessary conditions for the execution of the master command to be executed are not met.		► Correction of parameters which are necessary for the execution of the AS-i master command! Details → command description
M24…M32	reserved		—

Error message	Cause(s)	Remedy
M33	Internal safety protocol error Error when processing the safety monitor protocol on the AS-i line, phase "Init A".	► Improve the transmission quality on the AS-i line. ► To do so, monitor the telegram error counter. If the counter values change: ► Check AS-i line for earth fault using earth fault monitor. ► Modify the laying of the AS-i line so that no more telegram errors occur.
M34	Internal safety protocol error Error when processing the safety monitor protocol on the AS-i line, phase "Init B".	→ M33
M35	Timeout on Safety Protocol Timeout when processing the safety monitor protocol on the AS-i line.	→ M33
M36	SubCmd invalid The sub-command entry of the command _PCS_SAFETY_MONITOR is invalid.	► Only use permitted sub-commands.
M37	Slave address has no profile S-7.F.F The slave to be added to the list "LPM" (list of projected (safety) monitors) does not have the allowed profile in the CDI data.	► Correct the slave address to the address of a slave with the profile S-7.F.
M38	Slave address outside range 1...31 The slave to be added to the list "LPM" does not have the allowed address.	► Correct the slave address to a value of $1...31_{dec}$.
M39	LPM already full The LPM list is already full so that no other entries can be added.	► Delete a superfluous slave that already is in the LPM. ► Check distribution of the slaves to the AS-i masters and modify, if necessary.
M40	Slave address already given in the LPM	► Delete wrong slave from the LPM.
M41	Slave-Adresse in der LPM unbekannt	► Slave in der LPM speichern.
M42	Monitor protocol changed The safety monitor protocol was interrupted during processing. The last received data are probably not consistent.	► Retrieve the last received data once again.
M43	HostCmd loop timeout Processing of the command "_PCS_SAFETY_MONITOR" could not be started within the permitted time.	► Check PLC command channel for cyclical use. ► Interrupt cyclical use.
M44	Internal safety protocol error During processing of the protocol of the safety monitor an error occurred in the internal "AS-i master state machine".	► Project AS-i master again.

5.1.4 RTS errors – error codes R01...R43

6040

RTS = **R**un**t**ime **S**ystem (= operating system of the device)

- Menu operation interrupted.
- Error message superposes the menu screen.
- Error message only disappears after the following actions:
  1. Error removed AND
  2. Error message acknowledged with the right function key.

Error message	Cause(s)	Remedy
R01	Unknown RTS operating mode The operating system does not recognise the set operating mode of the device ("RUN" / "STOP" / "GATEWAY"). Possible cause: Modification of the device from a gateway variant into a device with PLC support.	► Switch the device off and keep the left function key pressed during the switch-on operation.
R02	Master 1 MUX field error During the transfer of the MUX fields from the operating system the master detected an invalid field number. Possible causes:	
	1. Parts of the operating system have been overwritten by the PLC.	► Check the cause for the wrong command and correct. ► Reinstall the operating system.
	2. Unacceptable interference on the 24 V power supply.	► Ground the device via the rail. ► Connect the FE terminal to the machine ground. ► Use a switched-mode power supply to supply the device with power. ► Repeat the command.
R03	Master 2 MUX field error	→ R02
R04	Master 1 protocol error (EDET) The master has detected a protocol error during the transfer of the data fields.	→ R02
R05	Master 2 protocol error (EDET)	→ R02
R06	General RTS program failure The operating system has detected an invalid status in the process while executing the program internally. Possible cause: Operating system software error.	► Reinstall the operating system.
R07	Projection mode not active It was tried to execute an AS-i command which is only permitted in the projection mode.	► Switch the master to the operating mode "Projection mode": → **Set operating mode** (→ page 59)
R08	No PLC program loaded (for gateway: reserved) The attempt was made to start a PLC program although no program had been loaded to the ControllerE.	► Load the PLC program to the ControllerE

Error message	Cause(s)		Remedy
R09	RS-232 recognition baud rate (for gateway: reserved) The hardware of the integrated serial interface chip has found a transfer error in the RS-232 data flow. Possible causes:		
	1.	Baud rate setting in the device different from the setting in the PC.	► Adapt the baud rate
	2.	Other programs (e.g. messenger) send via the RS-232 interface of the PC.	► Exit other programs on the PC.
R10	RS-232 buffer overflow A buffer overflow was found in the serial receive buffer of the RS-232 interface. Possible causes:		
	1.	RS-232 telegram too long or baud rate too high.	► Check the driver or reduce baud rate.
	2.	Faulty connection cable between PC and RS-232 connection on the device.	► Replace the connection cable.
R11	RS-232 parity check The parity check of the serial data flow of the RS-232 interface was unsuccessful. Possible cause: Electromagnetic interference.		► Reduce interference on the RS-232 cable by means of the following measures: - Screen cable, - Reduce cable length, - Remove interfering source.
R12	ASC0 handler switched The decoding of the serial data flow was changed. Possible cause: Command for switching the device to the test mode / normal operating mode during serial data flow.		► Remove the error in the protocol driver.
R13	24 V voltage unstable During normal operation voltage drops below 1 V were found on the 24 V power supply cable.		► Permanently stabilise the 24 V supply voltage above 20 V. Better: ► Use a switched-mode power supply to supply the device with power.
R14	24 V voltage error restart The voltage failure of the 24 V power supply caused the device to start again.		► Acknowledge the message. ► The device resumes the normal operating mode. ► In future: Use a switched-mode power supply to supply the device with power.

Error message	Cause(s)		Remedy
R15	C165 Watchdog Timeout The main processor has detected a timeout. Possible causes:		
	1.	Unacceptable interference on the AS-i power supply.	► Ground the device via the rail. ► Connect the FE terminal to the machine ground. ► Use a switched-mode power supply to supply the device with power.
	2.	Unacceptably high electrostatic charges and electromagnetic fields in close proximity of the device.	→ 1.
	3.	Hardware error.	► Replace the device and project again.
	4.	Operating system software error.	► Reinstall the operating system.
R16	Software restart The main processor has detected a restart of the device which was not caused by a voltage failure.		► Find the reason, maybe also further error messages.
R17	Device waits for 24 V (for AC1375: reserved) After power-on of the device an unacceptably low 24 V power supply of < 18 V was detected.		→ R14
R18	Master 1: Host WDT error The AS-i master signals a timeout during the communication with the fieldbus master (host). During the continuous communication of the master with the operating system the master has detected a timeout. Possible causes:		
	1.	Voltage drops on the 24 V power supply cable.	► Use a switched-mode power supply to supply the device with power.
	2.	Operating system software error.	► Reinstall the operating system.
R19	Master 2: Host WDT error		→ R18
R20	Profibus DP configuration The configuration of the Profibus master for the device is not valid. Possible causes: Module lengths incorrect. Number of modules incorrect. Sum of the data lengths across all modules too large.		► Check the received data lengths in the menu [Fieldbus Setup].
R21	No ifm Profibus DP interface present A Profibus DP card is expected in the device, however, it has not been detected. Possible cause: Wrong operating system in the device: **e.g.:** AC1325 operating system software in an AC1311.		► Install a valid operating system.

Error message	Cause(s)	Remedy
R22	DP parameter invalid The parameter setting of the Profibus master for the device is not valid. Possible causes: Structure of the parameter field incorrect. Length of the parameter field incorrect. Coding of the different parameters does not correspond to the specification.	► Adopt the parameter field from the GSD file and modify it according to the specification.
R23	DP parameter download The attempt to download the current / projected parameters of the AS-i slaves via the Profibus was unsuccessful. Possible causes: The slave to which the parameter was to be written was deleted from the list of detected slaves. A timeout was found during the execution of the AS-i command "Write Parameter".	► Disconnect from the Profibus master. ► Reestablish the connection to the Profibus master. ► Download the current / projected parameters of the AS-i slaves via the Profibus.
R24	Missing pos. CPTE edge During communication with the master a change in the state of the control signal was not detected. Possible cause: Operating system software error.	► Reinstall the operating system.
R25	Master 1: Abnormal condition The master reports that it is not in the "Normal Operating Mode". Possible causes:	
	1. The master detects an AS-i voltage smaller than 22 V and therefore changes into the "Offline Mode".	► Use a switched-mode power supply to supply the device with power.
	2. The master has received a request from the operating system to change into the "Offline Mode".	► Check the cause for the wrong command and correct.
	3. The master has detected a transfer error in the communication with the operating system.	→ R15
	4. With the AS-i power supply connected the master detects that no slave is connected to the AS-i bus.	► Check and correct the wiring on the AS-i bus.
	Other causes which can lead to the error message directly after the device has been switched on:	
	5. Initialisation of the master during power on of the device was not successful.	→ **Boot errors – error codes B00...B11** (→ page 208) > error message B01
	6. The master has not yet received the projection nor the projected parameters from the operating system.	→ 5.
	7. The master has not yet been started by the operating system.	→ 5.
R26	Master 2: Abnormal condition	→ R25

Error message	Cause(s)	Remedy
R27	Profibus PLC access violation (for gateway: reserved) The PLC has tried to access the protected address range of the Profibus DP ASIC. Possible cause: A PLC project was loaded with the support of an Anybus fieldbus card.	► Remove functions from the PLC project which make use of an Anybus card.
R28	Password protected A functionality of the device was requested which is not allowed with the currently active password.	► Set a higher password level
R29	PC command unknown An unknown command was received In the "Test Mode" operating mode of the device.	► Check the cause for the wrong command and correct.
R30	PC checksum error An invalid checksum was detected in the "Test Mode" operating mode in the data flow of the device.	► Configure the data flow according to the specification.
R31	Menu not available The selected menu could not be displayed. Possible causes:	
	1. Required hardware is not available in the device.	► Check the device by means of data sheet.
	2. Required hardware was not detected by the RTS operating system.	► Switch the device off and on again.
R32	RTS checksum error The checksum of the runtime system does not correspond to the stored checksum. Possible causes:	
	1. Faulty flash memory.	► Replace the faulty device.
	2. Strong ESD fields in case of unacceptable grounding of the device.	► Minimise the ESD fields. ► Correct the grounding of the device.
R33	reserved	—
R34	Error in font data The data of the character set is not correct. Possible causes: • No data is available in the areas where font data is expected. • The expected formatting is not correct.	► Reprogram the firmware or send the device to the after-sales service.
R35	Error in menu text Possible causes: • No data is available in the areas where menu text is expected. • The expected formatting is not correct.	→ R34
R36	Error in user language Text of the user language is incorrect.	→ R34
R37	Error in text format The indicated text format is incorrect.	→ R34
R38	reserved	—

Error message	Cause(s)	Remedy
R39	reserved	—
R40	Const. data checksum error A checksum error occurred in the const. areas (character sets, system language, user language) of the runtime system.	► Reprogram the firmware or send the device to the after-sales service.
R41	reserved	—
R42	reserved	—
R43	reserved	—
R44	Invalid AS-i command	► Correct the command number to a valid value.
R45	DP module 12 illegal word access When configuring the Profibus DP modules, an invalid value (odd address) was detected for the memory to be transmitted.	► Check and correct the defined data lengths of the modules 1...11 in the GSD file.
R46	Internal DP stack error A fatal error was detected in the Profibus DP stack.	► Reprogram the firmware or send the device to the after-sales service.

5.1.5 List of errors

6044

Incorrect behaviour	Cause(s)	Remedy
Device does not display the start screen after power-on: > Text/graphics display blank or not readable. > LEDs light / flash mazily.	error in the contents of the PLC memory, e.g.: program error in the boot project	► Switch off the device. ► Press the left function key and keep it pressed. ► Switch on the device again. > The display can be read again. ► Release the function key. > Start of the boot project is disabled. > The PLC is in the operating mode "STOP". ► Check the PLC program in the PC and correct. ► Store the PLC program in the device and create it as boot project.
	electromagnetic incompatibility	The voltage supply does not correspond to the AS-i rule? ► Correct it. The grounding is not according to specifications? ► Correct it. Strong interference by neighbouring machines? ► If possible: Change the location. ► Correct or screen the interfering machines.
The text/graphics display indicates nothing any more (only background illumination active). All other functions of the device are not affected.	system errors	► Press [▲] and [▼] simultaneously for about 2 seconds. > The text/graphics display is reinitialised. > The language selection is active. ► Quit the language selection with [ESC].
The LDS slave list does not show any slave with the address 0 although such a slave has just been connected.	there is at least one other slave with the address 0 connected to the master	► Remove the last slave with the address 0 from the bus. ► Program the old slave with the address 0 to the intended address → **Change addresses of individual AS-i slaves** (→ page 65). ► Reactivate the previously removed slave. ► Reconfigure the device

Incorrect behaviour	Cause(s)	Remedy
2 identical slaves with the same address on the AS-i master.	a) slave replacement: • Slave was replaced. • The new slave did not have the address "0" before.	> The red LED on the slave is lit: the slave was not correctly addressed. > Error message on the master: "slave not present".
	b) set-up: Master in the projection mode • New slave addressed using handheld addressing unit and then connected.	> The red LED on the slave lights when the address is already occupied: the slave was not correctly addressed.
	c) set-up: Master <u>not</u> in the projection mode	> For all readdressed and connected slaves the red LEDs light: the slaves were not correctly addressed ► Reconfigure the device > In case of slaves with different profiles: the red LED on the slave is lit: the slave was not correctly addressed. > In case of slaves with the same profile: At first everything is ok, until you have different input signals. Then, the message "configuration error" is displayed.
When changing the address of A/B slaves the device sometimes freezes in the "Wait" display.	system errors	► Leave the menu item with [ESC] (= right button).
The device does not react to the button being pressed or only with a long delay. > Error messages R02...R05.	The cycle time of the PLC is > 300 ms. Other processes in the device have priority.	► Check and correct the PLC program.

5.1.6 How does the device react in case of a fault?

6045

Faults displayed during operation	Reaction
The slave is disconnected from the AS-i bus.	Slave without watchdog: Output signals remain unchanged. Slave with watchdog: Outputs switched off. AS-i master as PLC: Evaluate the slave failure in the PLC program. If necessary: Stop the machine/plant.
The AS-i master is disconnected from the fieldbus.	AS-i master as gateway: Outputs switched off. AS-i master as PLC: Input signals from the fieldbus master are reset. PLC triggers AS-i outputs with "0". Evaluate the fieldbus failure in the PLC program. If necessary: Stop the machine/plant.
The device fails as fieldbus slave.	Effect → Description of the fieldbus master (host).

5.2 Fault analysis via the controller (AC13nn)

Contents

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AS-i telegram errors on the master 230
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Reset error counter 236

6707

5.2.1 Number of AS-i voltage failures on the AS-i master

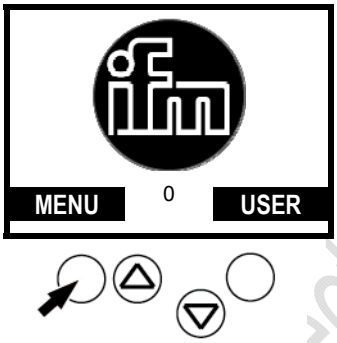
5956

How often was an inadmissible decrease or interruption of the voltage supply of the AS-i bus responsible for system failures? The device displays:

Here you cannot see in detail when which error occurred.
→ chapter **Troubleshooting ControllerE and gateways (AC13nn)** (→ page 207).

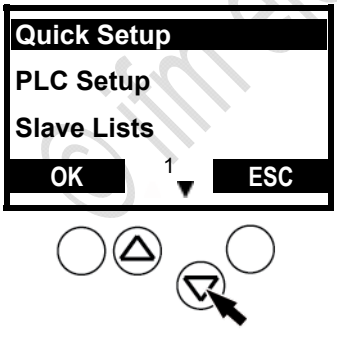
The error counter is reset...
- when the device is switched off and on again,
- with the function **Reset error counter** (→ page 236).

[MENU] > [Diagnostics] > Select master > [Voltage Disturb.]



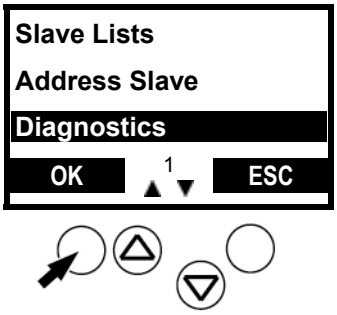
Step 1:

► Press [Menu].



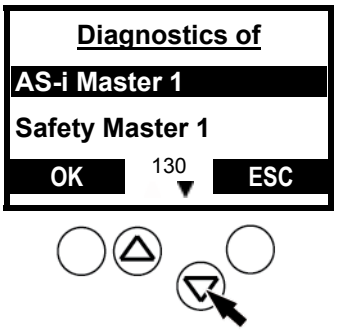
Step 2:

► Press [▼] to scroll to [Diagnostics].



Step 3:

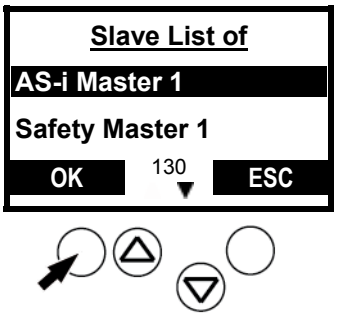
► Select [Diagnostics] with [OK].



Step 4:

AC1375: Menu screen not available.

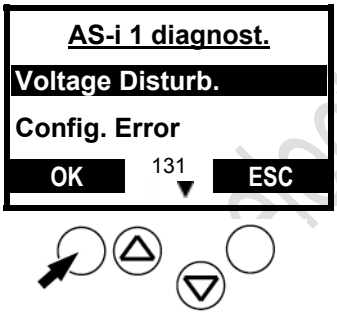
► If necessary, press [▼] to scroll to another master.



Step 5:

AC1375: Menu screen not available.

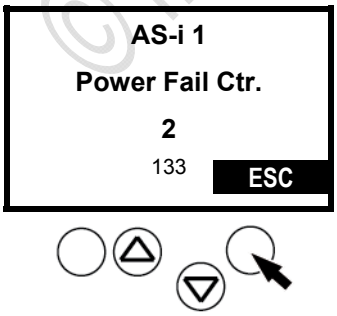
► Select AS-i master with [OK].



Step 6:

AC1375: Menu screen number = 72

► Select [Voltage Disturb.] with [OK].



Step 7:

AC1375: Menu screen number = 74

> Display of the number of failures of the AS-i supply on the master.

(**Reset error counter** (→ page 236))

► Press [ESC] to return to the start screen.

Fault analysis voltage failures

6711

Possible reasons for voltage failures:

- switch-on of big loads
- mains fluctuation
- voltage dips

5.2.2 Number of configuration errors on the master

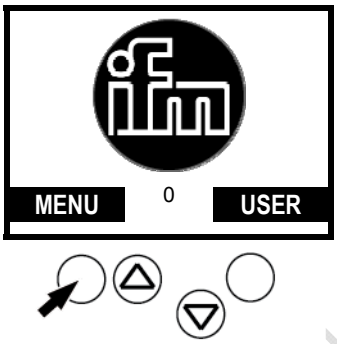
5958

Display of the number of configuration errors on the master.

Here you cannot see in detail when which error occurred.
→ chapter **Troubleshooting ControllerE and gateways (AC13nn)** (→ page 207).

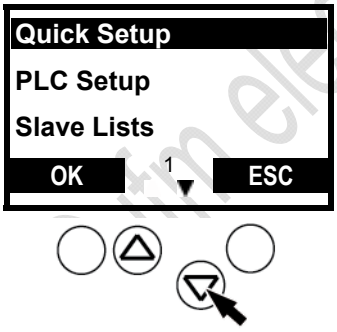
The error counter is reset...
- when the device is switched off and on again,
- with the function **Reset error counter** (→ page 236).

[MENU] > [Diagnostics] > Select master > [Config. Error]



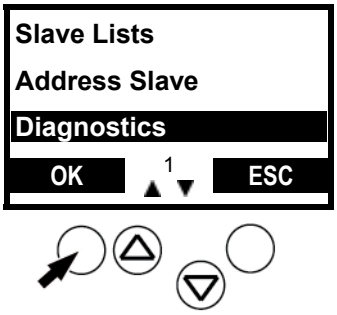
Step 1:

► Press [Menu].



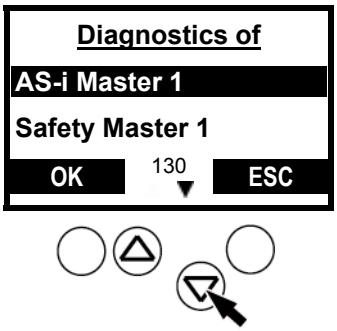
Step 2:

► Press [▼] to scroll to [Diagnostics].



Step 3:

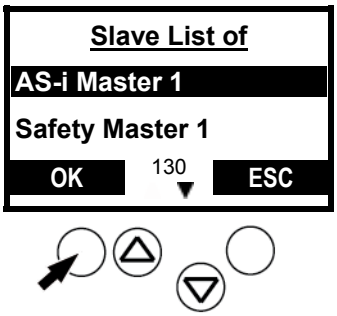
► Select [Diagnostics] with [OK].



Step 4:

AC1375: Menu screen not available.

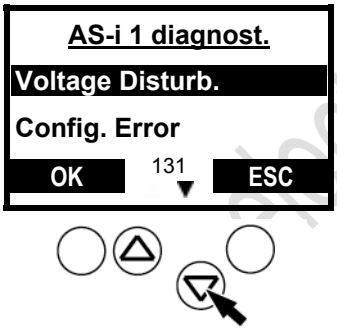
► If necessary, press [▼] to scroll to another master.



Step 5:

AC1375: Menu screen not available.

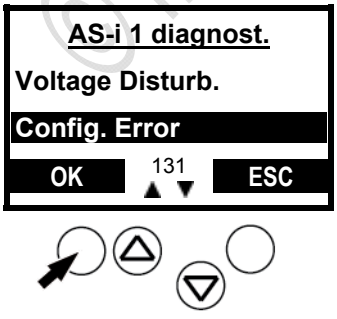
► Select AS-i master with [OK].



Step 6:

AC1375: Menu screen number = 72

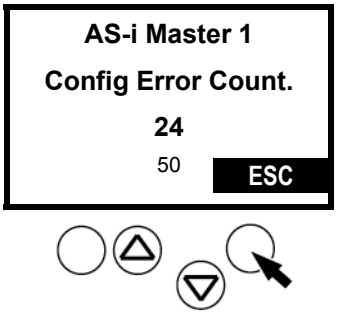
► Press [▼] to select [Config. Error].



Step 7:

AC1375: Menu screen number = 72

► Select [Config. Error] with [OK].



Step 8:

AC1375: Menu screen number = 28

> Display of the number of configuration errors on the master.

(**Reset error counter** (→ page 236))

► Press [ESC] to return to the start screen.

Fault analysis configuration errors

6712

A configuration error is given if a slave does not reply in 3 successive AS-i cycles (6 telegram repetitions = burst errors class 6).

Possible reasons for configuration errors:

- faulty slave
- slave with the address 0 in the AS-i network
- too long cable
- EMC problems, caused e.g. by electrostatic discharge, high frequency interference, etc.

5.2.3 AS-i telegram errors on the master

5960

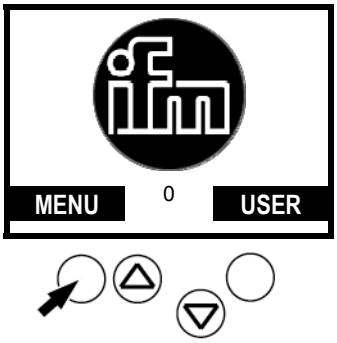
We talk of a telegram error if the expected response telegram from a slave is not received within a defined time or the signal sequences in the response telegram cannot be interpreted by the AS-i master. **Examples**:

- Due to an electrical fault the AS-i cable is used asymmetrically (one-sided earth fault). The AS-i signal is no longer clearly recognisable.
- The electrical AS-i connection to an AS-i slave is not OK.
- The electrical environment of the AS-i system (EMC) interferes with the AS-i telegrams.

Here you cannot see in detail when which error occurred.
→ chapter **Troubleshooting ControllerE and gateways (AC13nn)** (→ page 207).

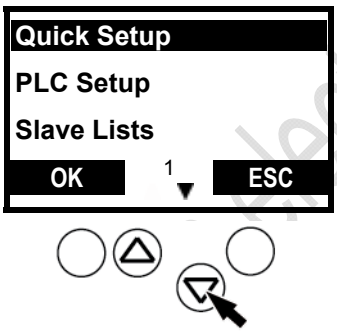
The error counter is reset...
- when the device is switched off and on again,
- with the function **Reset error counter** (→ page 236).

[MENU] > [Diagnostics] > Select master > [Telegr. Error]



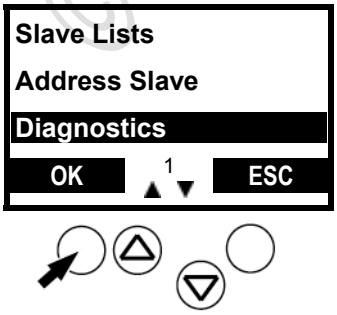
Step 1:

► Press [Menu].



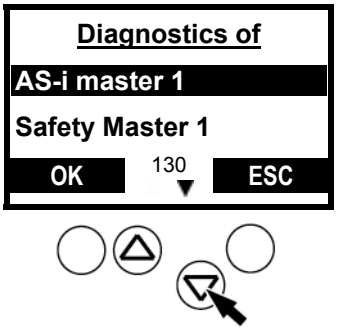
Step 2:

► Press [▼] to scroll to [Diagnostics].



Step 3:

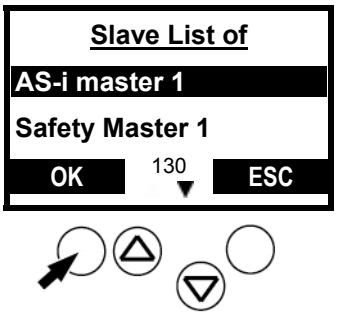
► Select [Diagnostics] with [OK].



Step 4:

AC1375: Menu screen not available.

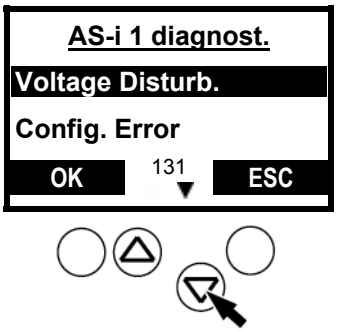
► If necessary, press [▼] to scroll to another master.



Step 5:

AC1375: Menu screen not available.

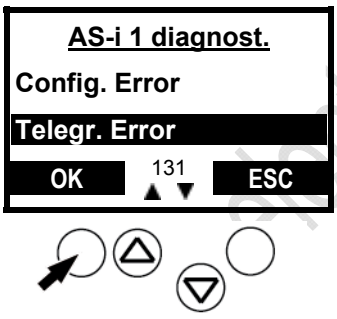
► Select AS-i master with [OK].



Step 6:

AC1375: Menu screen number = 72

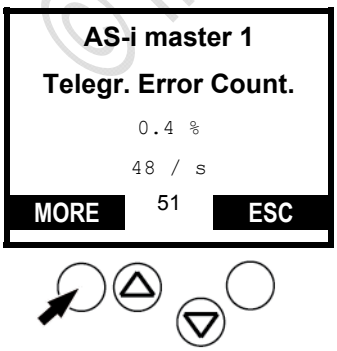
► Press [▼] to scroll to [Telegr. Error].



Step 7:

AC1375: Menu screen number = 72

► Select [Telegr. Error] with [OK].



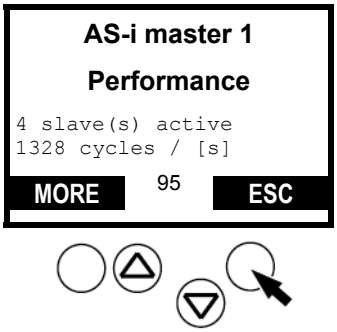
Step 8:

AC1375: Menu screen number = 29

> Dynamic display of AS-i telegram errors in per cent of the transmitted telegrams.

> Dynamic display of AS-i telegram errors per second.

► Scroll to the next screen with [MORE].



Step 9:

AC1375: Menu screen number = 49

> Dynamic display of the performance of this master:

- number of active slaves,
- number of AS-i cycles per second.

► Press [ESC] to return to the start screen.

Fault analysis AS-i telegram errors on the master

6713

In uncritical applications, telegram errors < 1 % during one second are acceptable if no configuration errors occur in the measured period.

Plant technology and safety technology potentially are two exceptions.

- In plant technology, there are applications in which standstill must be absolutely avoided. Here, it can make sense to come close to the theoretical ideal of the absence of repetitions.
- A second special case are safety-related installations to "Safety at Work". Here as well, repetitions are allowed because they are intercepted by the system and do not restrict the safety.
  In order to ensure a switch-off after maximum 40 ms, it is defined that the safety monitor is already triggered after the fourth repetition of a telegram. Therefore, a burst error class 4 already leads to the (unintended) switch-off and therefore reduced uptime of the system when using safe slaves. Here, repetitions are therefore judged more critically.

5.2.4 Number of disturbed telegrams on the master (by noisy slaves)

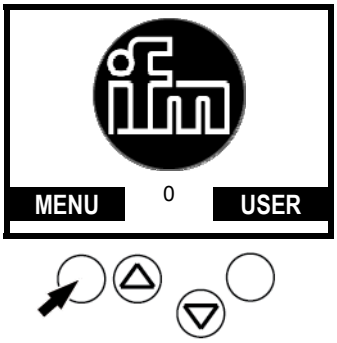
5962

You want to know how many disturbed telegrams the individual slaves have transmitted (since last [Reset error counter]? The device shows it, sorted by the number of distorted telegrams.

Here you cannot see in detail when which error occurred.
→ chapter **Troubleshooting ControllerE and gateways (AC13nn)** (→ page 207).

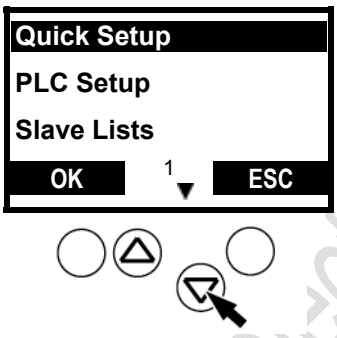
The error counter is reset...
- when the device is switched off and on again,
- with the function **Reset error counter** (→ page 236).

[MENU] > [Diagnostics] > Select master > [Noisy Slaves]



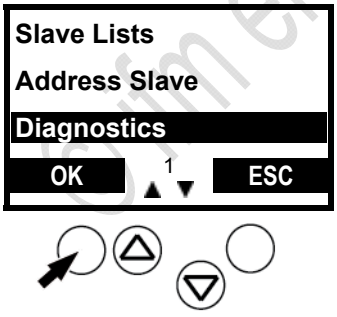
Step 1:

► Press [Menu].



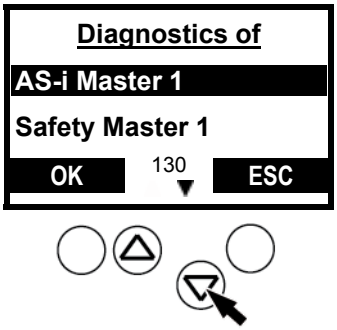
Step 2:

► Press [▼] to scroll to [Diagnostics].



Step 3:

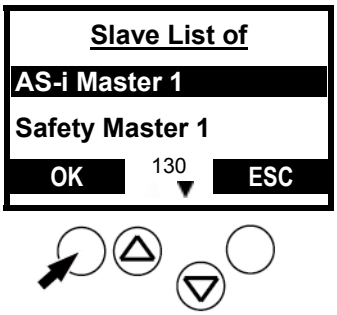
► Select [Diagnostics] with [OK].



Step 4:

AC1375: Menu screen not available.

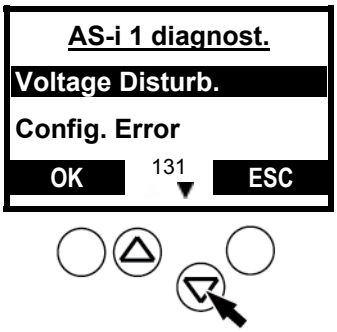
► If necessary, press [▼] to scroll to another master.



Step 5:

AC1375: Menu screen not available.

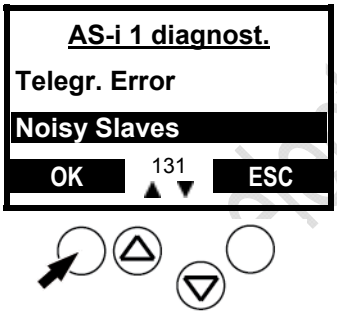
► Select AS-i master with [OK].



Step 6:

AC1375: Menu screen number = 72

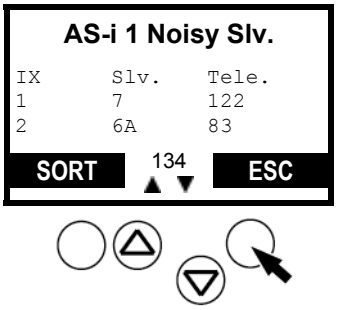
► Press [▼] to scroll to [Noisy Slaves].



Step 7:

AC1375: Menu screen number = 72

► Select [Noisy Slaves] with [OK].



Step 8:

AC1375: Menu screen number = 71

> Dynamic display of the number of disturbed telegrams of the different slaves, sorted by frequency of occurrence:

- Column "IX": Number of ranking (frequency of occurence),
- Column "Slv.": Address of the slave,
- Column "Tele.": Number of disturbed telegrams,
- only AC1375: Column "Config": Configuration error counter

► Press [SORT] for a new sorting according to the current ranking.

► ►Press [▲] or [▼] to scroll to the slaves with higher or lower rank order.

OR:

► Press [ESC] to return to the start screen.

5.2.5 Reset error counter

5964

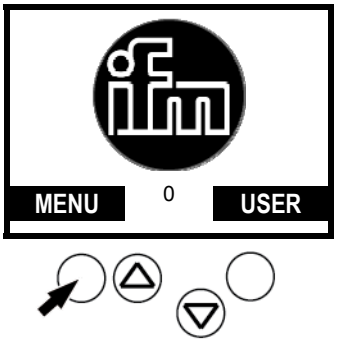
Here you will find out how you can reset the error counter of the device in the diagnostic memory.

NOTE

► Do not reset the diagnostic memory of the device **before** the analysis of the values stored so far. The reset process cannot be reversed.

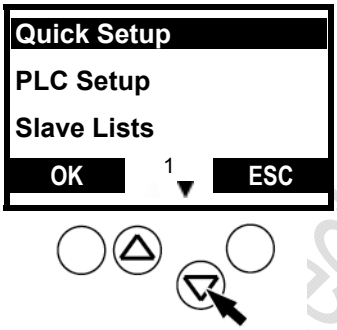
Password level 1 required: → chapter **Password setting**.

[MENU] > [Diagnostics] > Select master > [Reset Error Count.] > [OK]



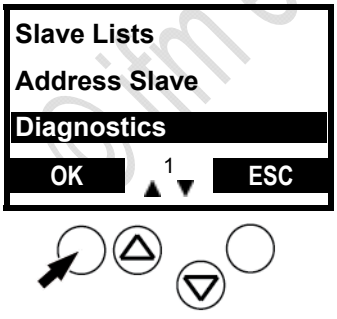
Step 1:

► Press [Menu].



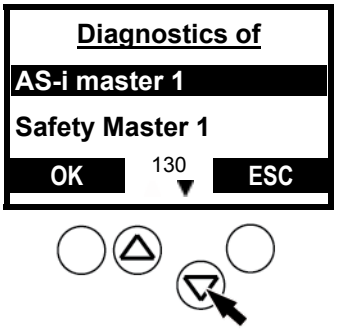
Step 2:

► Press [▼] to scroll to [Diagnostics].



Step 3:

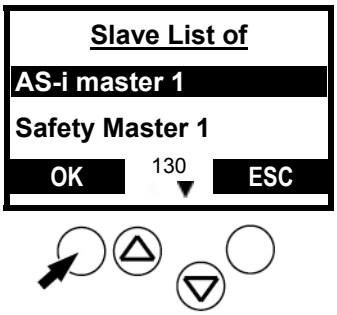
► Select [Diagnostics] with [OK].



Step 4:

AC1375: Menu screen not available.

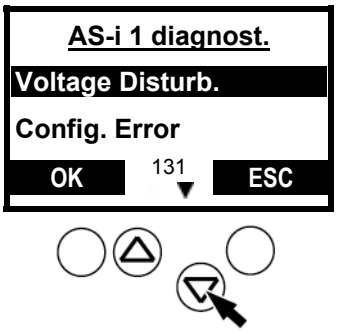
► If necessary, press [▼] to scroll to another master.



Step 5:

AC1375: Menu screen not available.

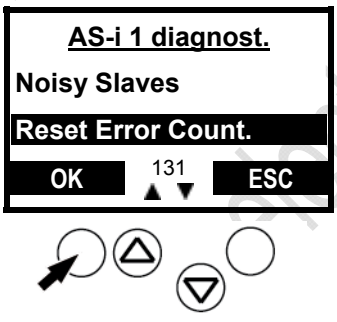
► Select AS-i master with [OK].



Step 6:

AC1375: Menu screen number = 72

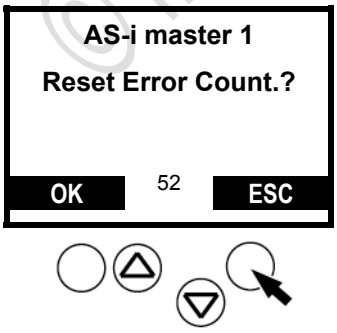
► Press [▼] to scroll to [Reset Error Count.]



Step 7:

AC1375: Menu screen number = 72

► Select [Reset Error Count.] with [OK].



Step 8:

AC1375: Menu screen number = 30

> Safety query:
"Reset Error Count.?"

► Reset all error counters with [OK].

> Return to screen (→ step 7).

Alternatively:

► Exit the screen with [ESC] without changing the error counters.

5.3 Error analysis via the gateway (AC14nn)

Contents

Show / delete error counter 238
Show error messages of the slaves 239
Show evaluation of the voltage supply 239
Show performance of the AS-i master 240
Online support center (OSC) 241

11378
9039

Sequence from the start screen:

►  or  > 

Detailed description: → following chapters

5.3.1 Show / delete error counter

9042

Sequence from the start screen:

►  or  >  > tab [Error counters]

Detailed description:

Here the device shows the counter reading of the following errors since the last reset.

► Set all counter readings to zero with button [Reset] .

> Display error counter telegrams

> Display error counter configuration

> Display error counter voltage < 22.5 V

> Display error counter voltage < 19.0 V

> Display error counter earth faults

► Use several times the function key [Back] to go to the start screen.

5.3.2 Show error messages of the slaves

9087

Sequence from the start screen:

►  or  >  > tab [Errors / slave]

Detailed description:

Here the device shows the counter reading of the telegram errors messages per slave since the last reset:

Address = address of the AS-i slave

S / A = error counter of a single or A slave on this address

B = error counter of a B slave on this address

► Use [Select] or [▼] to switch to the slave list.

► Use [▼] / [▲] to scroll in the slave list.

► Use several times the function key [Back] to go to the start screen.

5.3.3 Show evaluation of the voltage supply

9088

Sequence from the start screen:

►  or  >  > tab [Power supply]

Detailed description:

Here the device displays the status of the voltage supply:

Parameter	Meaning	Contents
Power supply:	method of the device supply → chapter **Power supply concepts** (→ page 44)	Aux = separated supply AS-i and AUX 24 V AS-i = supply only from AS-i network 1 Power24 = supply from data decoupling module
AS-i voltage:	AS-i voltage measured	value in [V]
DC earth fault:	evaluation of the network symmetry	(green) = AS-i network is symmetrical (yellow) = AS-i network is asymmetrical (red) = AS-i network has earth fault  = graphical display of the network symmetry

► Use several times the function key [Back] to go to the start screen.

5.3.4 Show performance of the AS-i master

9089

Sequence from the start screen:

►  or  >  > tab [Performance]

Detailed description:

Here the device shows the number of the active AS-i slaves and the cycle times for each AS-i master since the last reset:

> Display number of the active AS-i slaves on the AS-i master.

> Display of the shortest cycle time.

> Display of the longest cycle time.

> Display of the current cycle time.

► Use the button [Reset] to delete the shortest and longest time measurement.

► Use several times the function key [Back] to go to the start screen.

5.3.5 Online support center (OSC)

7058

OSC = **O**nline **S**upport **C**enter

The OSC summarises all fault indications and warnings in the display.

► Press the left function key [Support] in the start menu.

> Displays all fault messages
The focus is on the listbox [filter].

Example:

► Use the function key [Select] to open the listbox.

► Mark the requested parameter with [▼] / [▲].
- All
- AS-i 1
- AS-i 2 (if available)
- System

► Use the function key [Select] to accept the change.
OR:
Use the function key [Back] to discard the change.
In both cases: exit the editing mode.

> Display of the fault messages and warnings according to the filter setting.

► Use [▼] / [▲] to scroll in the messages.

► Use several times the function key [Back] to go to the start screen.

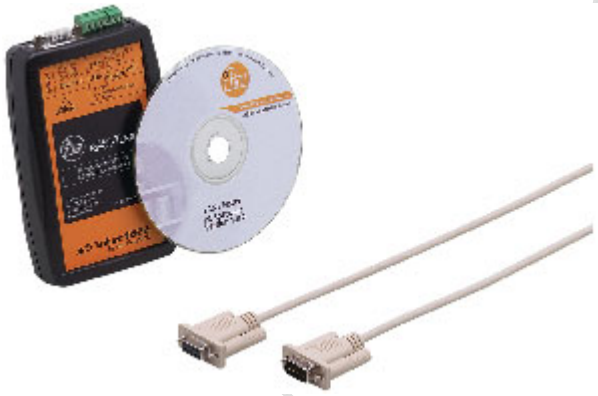
5.4 Fault analysis via the analyser

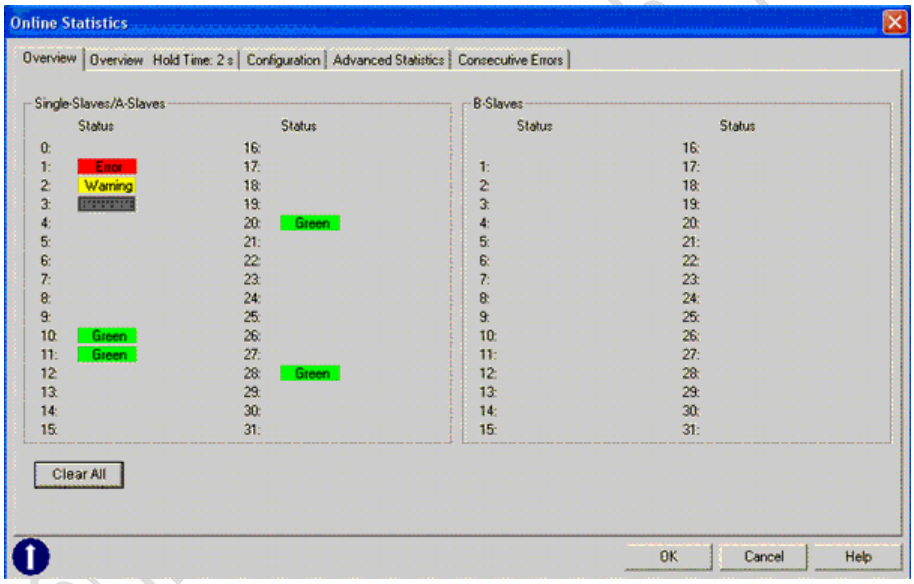
Contents

General 243
LED behaviour analyser (AC1145) 243
Online statistics (standard mode) 244
Advanced Statistics 245
Online statistics without PC 246
Data mode 247

6708

e.g. eAS-i tester AC1145:





5.4.1 General

6715

- The analyser monitors the entire telegram traffic in the AS-i network.
- The analyser requires no additional power supply and no slave address.

► Connect the terminals AS-i+ and AS-i- to the AS-i cable.

► Install the software on the PC or notebook.

- The analyser can be installed at any point in the AS-i network (preferably in the last third of the AS-i line).

More and detailed information → device manual:
→ www.ifm.com > Select your country > [Data sheet search] > (article number.) > [further information]

5.4.2 LED behaviour analyser (AC1145)

6716

The function of the analyser is signalled by 3 LEDs; their meaning depends on the operating status:

Normal operation with connected PC:

Diagnostic LEDs	LED colour	LED off	LED lit	LED flashes
[Power]	green	---	the analyser is supplied via the AS-Interface network	---
[Ser.act.]	yellow	---	active communication with the PC	---
[Test]	green	---	after trace start: trigger released	---
	red	---	after trace start: trigger not released	---

Operation without connected PC:
When operated without PC, the traffic light LEDs on the analyser roughly indicate the status of the network:

Diagnostic LEDs	LED colour	LED off	LED lit	LED flashes
[Power]	green	---	all slaves operate reliably	---
[Ser.act.]	yellow	---	warning for one or several slaves	---
[Test]	red	---	serious failure	---

5.4.3 Online statistics (standard mode)

6720

The standard mode with the creation of the online statistics is the most common application of the analyser. Here, the telegrams are evaluated mostly statistically in the analyser and transferred to the PC for presentation and addition every second. The results are very easy to access for the user, are immediately available and provide a clear overview of the function and possible faults of a network in several grades. This mode is suited for protocolling the current status as well as for long-term tests.

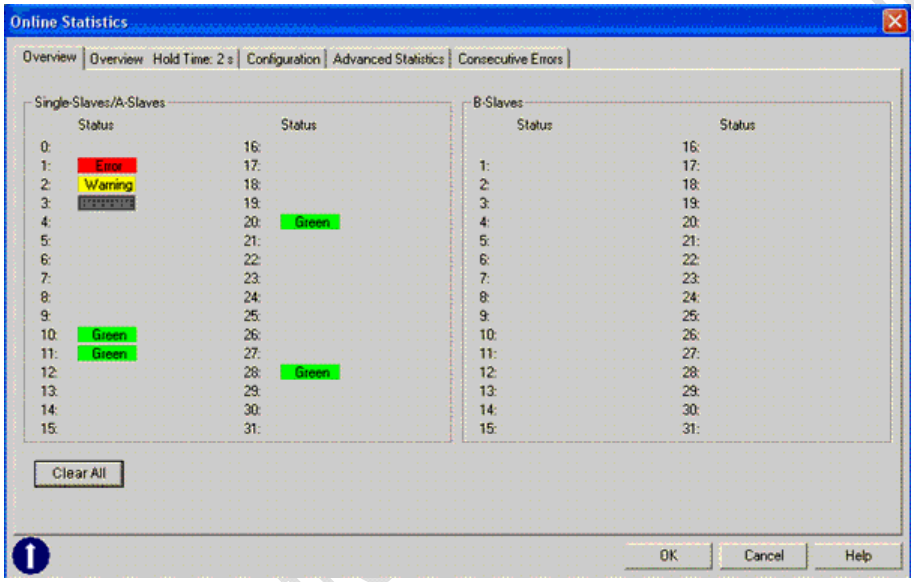
► Connect the analyser to the AS-i network.

> The analyser continuously stores the current events.

► Connect the analyser to the PC and start the analyser software there.

► Main menu [Measure] > [Online Statistics].

> Display of the current function overview of the AS-i network in the traffic lights representation (→ figure).



Example: The traffic lights representation of the online statistics shows how well or badly the slaves communicate.

Green	< 1 % telegram repetitions in one second
Warning	1...5 % telegram repetitions in one second
Error	> 5 % telegram repetitions in one second or: Config Error
	slave is present but not activated / not projected

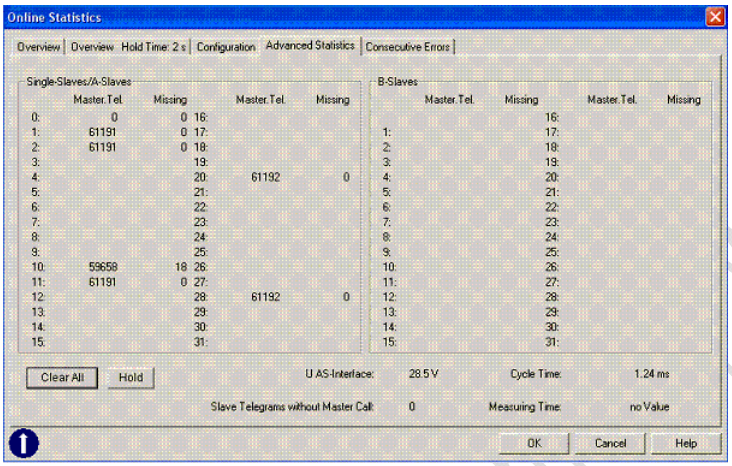
Telegram repetitions up to 1 % can be considered as not of concern in many applications and are therefore shown in green by the analyser.

5.4.4 Advanced Statistics

6721

In the "Advanced Statistics" you can see the following values (since the last reset):

- for each slave the number of data calls of the master,
- for each slave the number of missing slave replies,
- the number of slave telegrams without master call,
- the AS-i voltage at the location of the analyser,
- the cycle time,
- the measurement duration.



Example: The "advanced statistics" show quantitatively how often repetitions of the data calls were necessary.

The advanced statistics at the same time demonstrates the function of the bus and of the analyser.

- The results of the analyser are transferred to the PC once per second and displayed there in this rhythm.
- In a network without repetitions, the number of master calls must be the same for all single slaves.
- The number of calls to connected A and B slaves must be exactly half of the number of calls to single slaves.

> If a slave is suddenly removed from the system, it will be called in vain precisely 6 times and then removed from the list of activated slaves in the master: the number of calls towards him does not rise again before this slave is accepted again by the master and receives data calls.

- The button [Hold] only stops the counts in the display. Counting however continues in the background, as long as no other operating mode is activated. Pressing the button [Go] updates the display again.

> A [Stop] sign appears in the window when the statistic is stopped.

5.4.5 Online statistics without PC

6723

The online statistics can also be created without the PC and are therefore suitable for a long-term check of a network.

If the analyser is started without communication to the PC, the 3 LEDs on the analyser have a different meaning (→ **LED behaviour analyser (AC1145)** (→ page 243)).

Five restrictions are to be taken into account when working without a PC:

- Measured values are only stored in the analyser as long as it is supplied from the AS-i network. So, for evaluation the PC must be connected to the analyser on site.
- If the PC is first connected to the analyser (for example for setup) and then removed again, the data stored so far by the analyser will be deleted. The filter settings however remain unchanged!
- The indication of the duration of measurement is generated by the PC, not by the analyser. So, a duration of measurement cannot be indicated before the online statistics have been deleted at least once by the PC and restarted.
- The online statistics are also continued if the communication is temporarily interrupted by the master or the application program but the voltage is maintained in the AS-i network.
- The memory in the analyser is limited. In the continuous operation without connected PC, only the data of maximum 14 days can be stored in the statistic mode.
  When a counter reaches its maximum value, it does not continue.
  When the PC is connected, this time is extended to about 1 year.

5.4.6 Data mode

Contents

Digital values 247
Analogue data 249
Safety data 250

6725

In the data mode, not the possible faults of the telegrams but the current, valid data of the slaves are in the foreground. According to its mode of operation, the analyser adopts the current values about once per second. Data available for a shorter time may not be displayed.

Three tabs are available:

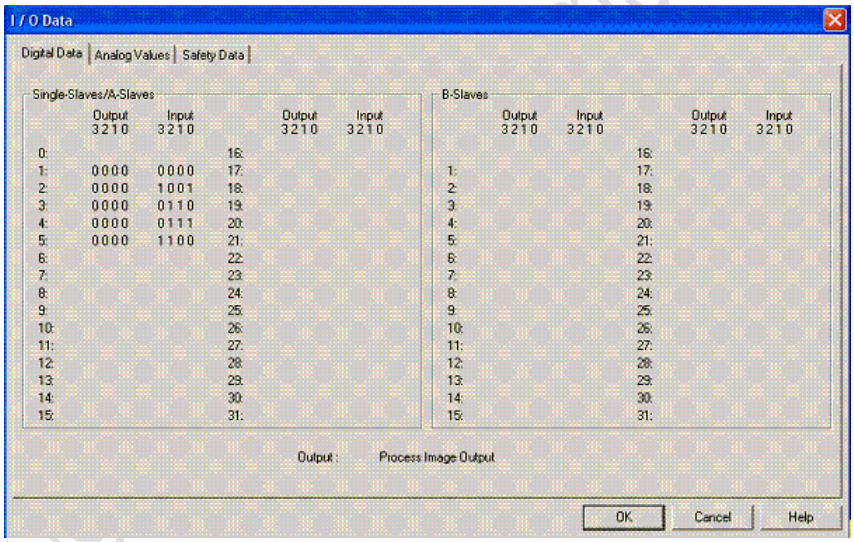
- digital values,
- analogue data,
- safety data.

Digital values

6729

Here, all I/O data currently exchanged with each individual slave are displayed in a binary way, in the following structure:

Data	Output				Input			
Bit	3	2	1	0	3	2	1	0



Example: Display digital values in the data mode

NOTES for a correct interpretation:

- According to the PLC standard EN 61131, binary output data are sent as "1" for a HIGH level, as "0" for a LOW level. This applies to communication between the controller and the master in the "process image of the outputs".
  According to the AS-Interface standards IEC 62026-2 and EN 50295, the opposite applies to the "AS-Interface level" in the AS-i network.
  Both representations are possible, so that depending on the situation the comparison with the data of the controller or within the network becomes easier:

► Select in the menu under [Options] > [Statistics] whether the outputs are to be indicated as [AS-Interface level output] or as [Process Image Output].

- In each data call, 4 bits are exchanged between the master and the slave in both directions. This also applies when individual bits are insignificant. Therefore, the analyser for example also shows 4 output bits for a pure input slave. But they do not have any significance for the application.
- For analogue slaves and safety-related slaves, the input and/or output values transferred in the network constantly change. This can be detected every second and corresponds to the function of AS-Interface. It is not possible to detect a fault with this.
- For A/B slaves according to the specification C.S.2.1 the output bit A3 of the data call is not available as a useable output value, but serves for the distinction between A and B slaves. Output bit A3 of the data call for A/B slaves therefore always has fixed values.

Analogue data

6731

Here, the data of the analogue slaves given in the network operating to the profiles S-7.3.x will be displayed. The display remains empty for digital slaves (→ figure below).

NOTE

The analyser has to convert the detected data telegrams according to the profile of the slaves.

Prerequisite for the correct display therefore is that the analyser knows the profile of the individual connected device. So, it needs to have monitored the integration of the slaves into the communication at least once, so that all 4 configuration data are recorded in the display.

In the profile, the details of the communication as well as the type and number of the channels are defined, however not the physical signification of the values. It is defined by the manufacturer, so that very different slaves can be implemented. But the user of the analyser has to convert the obtained values according to the calibration curve of the device.

If a slave indicates a value 'above range' by its overflow bit, this is displayed by an additional point in the corresponding channel.

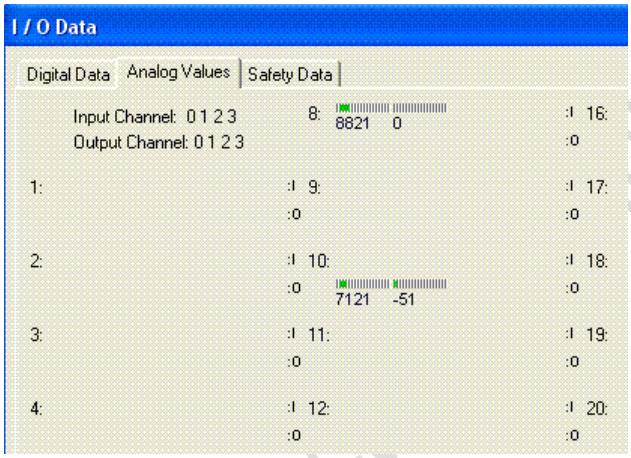


Figure: Analogue data in the data mode

Example (→ figure): There are analogue slaves at the addresses 8 and 10:

- one 2-channel input slave (on the address 8) and
- one 2-channel output slave (on the address 10).

In both cases, the value "0" corresponds to the voltage 0 V, the value 10 000 to a voltage of 10 V according to the data sheet. So, the modules have a resolution of 1 mV. The displayed values therefore result in:

input module on slave address 8	channel 0 = +8.821 V channel 1 = 0 V
output module on slave address 10	channel 0 = +7.121 V channel 1 = -0.051 V

Safety data

6732

The tab [Safety Data] shows for all safety-related slaves to "Safety at Work" whether the slave has "released" or whether the contacts are closed.

NOTE

- The display of the safety data is only valid for a short time – similar to all I/O data –, because it is updated about every second.
- Safety slaves which, after triggering, can only be enabled again by an external intervention continue to send the trigger telegrams. The display "Released" persists during that time.

5.5 Earth fault / insulation fault monitoring

Contents

What is an earth fault? 251
What does an insulation fault monitor do? 251
Symmetrical and asymmetrical earth faults 252
Earth fault monitor AC2211 253
Earth fault / insulation fault monitor AC2212 254

6709

AS-i earth fault monitor AC2211

AS-i earth fault and insulation fault monitor AC2212

5.5.1 What is an earth fault?

6870

An earth fault can occur if the AS-i voltage or sensor cables connected to it are electrically connected to earth. This is an undesired state which can reduce noise immunity as AS-i is a symmetric, earth-free system in accordance with PELV. A second earth fault can lead to earth loops which continuously supply the outputs with current.

5.5.2 What does an insulation fault monitor do?

6871

An insulation fault monitor monitors the insulation condition of an IT network (an ungrounded power network) for values below a minimum insulation resistance.

Insulation fault monitors are used where power supplies or their secondary side need to be single-fault safe, i.e. where a single fault (single-pole earth fault) must not lead to a failure of the power supply or of the respective secondary side.

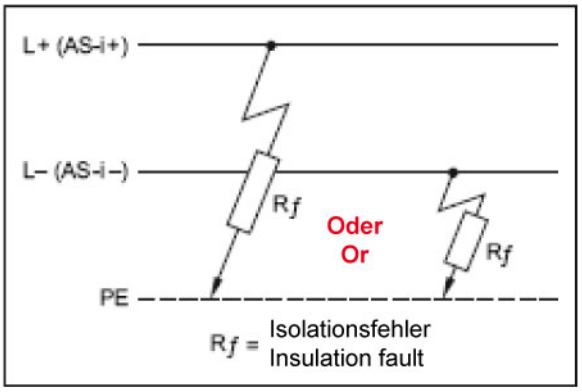
The earth fault / insulation fault monitor is a passive participant in the AS-i network and does not require a slave address.

5.5.3 Symmetrical and asymmetrical earth faults

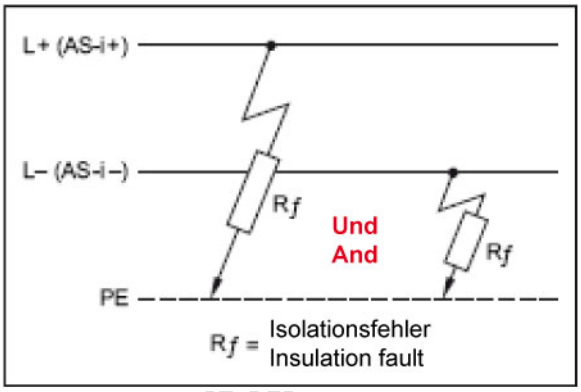
6741

Symmetrical and asymmetrical earth faults are differentiated as follows:

Asymmetrical earth fault:



Symmetrical earth fault:



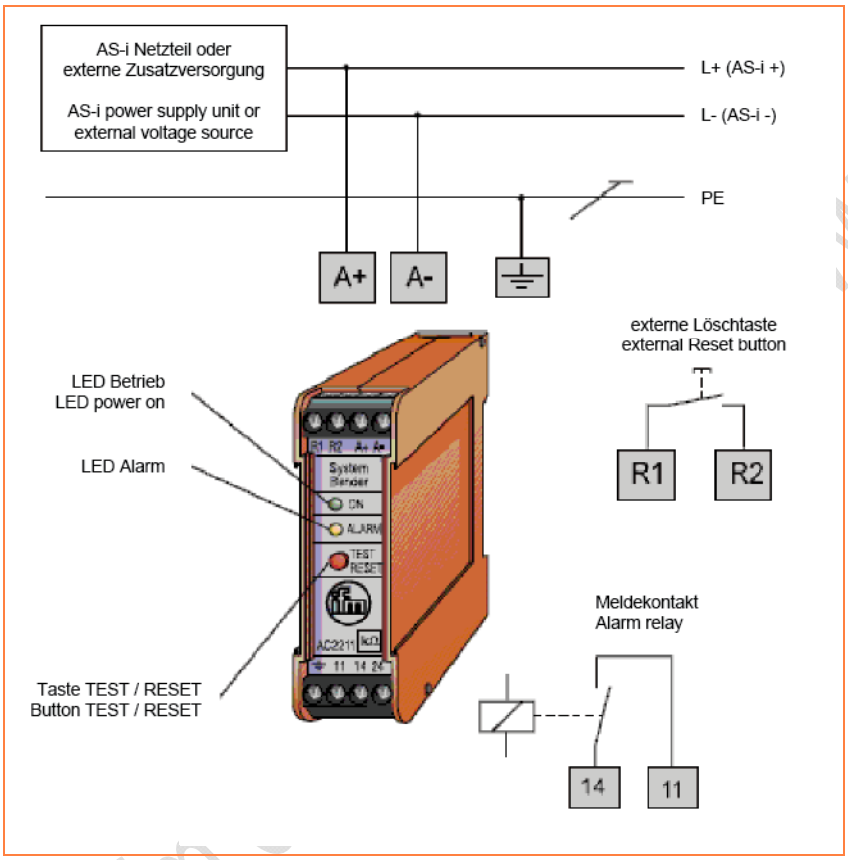
5.5.4 Earth fault monitor AC2211

6737

- Detection of asymmetrical earth faults
- Use for earth fault monitoring in ungrounded AS-i and 24 V DC systems (IT system)
- Passive asymmetrical measuring method
- 1 NO contact

Wiring and LED behaviour AC2211

6743



- Button TEST / RESET:
  Pressed briefly (< 1 s) = RESET
  Pressed for a longer time (> 2 s) = TEST
- Signal contact 11/14:
  The contact 11/14 is closed when the AS-i voltage is applied and there is no earth fault (asymmetric).
- LED Power:
  lights green = AS-i voltage applied.
- LED Alarm:
  lights yellow = asymmetrical fault.

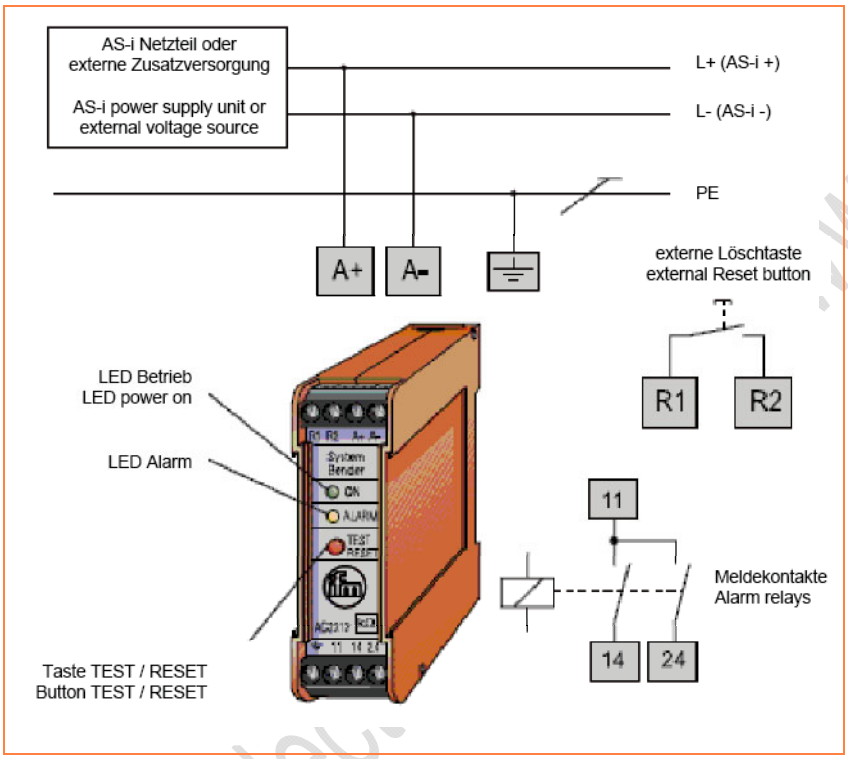
5.5.5 Earth fault / insulation fault monitor AC2212

6742

- Detection of symmetric and asymmetric insulation faults
- Use for insulation monitoring in ungrounded AS-i and 24 V DC systems (IT system)
- Active symmetrical and passive measuring method
- 2 NO contacts

Wiring and LED behaviour AC2212

6744



- Button TEST / RESET:
  Pressed briefly (< 1 s) = RESET
  Pressed for a longer time (> 2 s) = TEST
- Signal contact 11/24:
  Contact 11/24 opens in case of symmetrical faults and asymmetrical faults.
- Signal contact 11/14:
  In addition, the contact 11/14 opens in case of asymmetric faults.
- The contacts are closed when the AS-i voltage is applied and there is no fault.
- LED Power:
  lights green = AS-i voltage applied.
- LED Alarm:
  lights yellow = asymmetrical fault.
  flashes yellow = symmetrical fault.

5.6 Symmetry measurement

6710

To ensure optimum noise immunity against symmetrical interference injection, a well-balanced design of the AS-i system is required. Therefore the terminal Shield/GND of the AS-i power supply always needs to be connected to the machine ground.

Possible reasons for asymmetry (examples):

- unwanted connection between AS-i + or also AS-i - and the machine ground,
- faulty slaves,
- faulty master,
- faulty AS-i power supply,
- capacitive ground connection of metal sensors (housing) to the machine ground.

Help for EMC problems can be found at ifm on the internet:
→ www.ifm.com > select your country > [data sheet search] > (article no.) > [Additional data]

5.6.1 Check the AS-i power supply

6748

Measurement of the power supply symmetry with a voltmeter under the following conditions:

- power supply in open-circuit operation AND
- AS-i cable not connected AND
- Shield/GND not connected.

The following voltages should be measured:

between AS-i+ and Shield/GND	approx. +15 V DC	These two values must be symmetrical and should not be significantly below the value of +/- 15 V DC.
between AS-i- and Shield/GND	approx. -15 V DC	
between AS-i+ and AS-i-	approx. 30.5 V DC	

5.6.2 Check the AS-i symmetry

6749

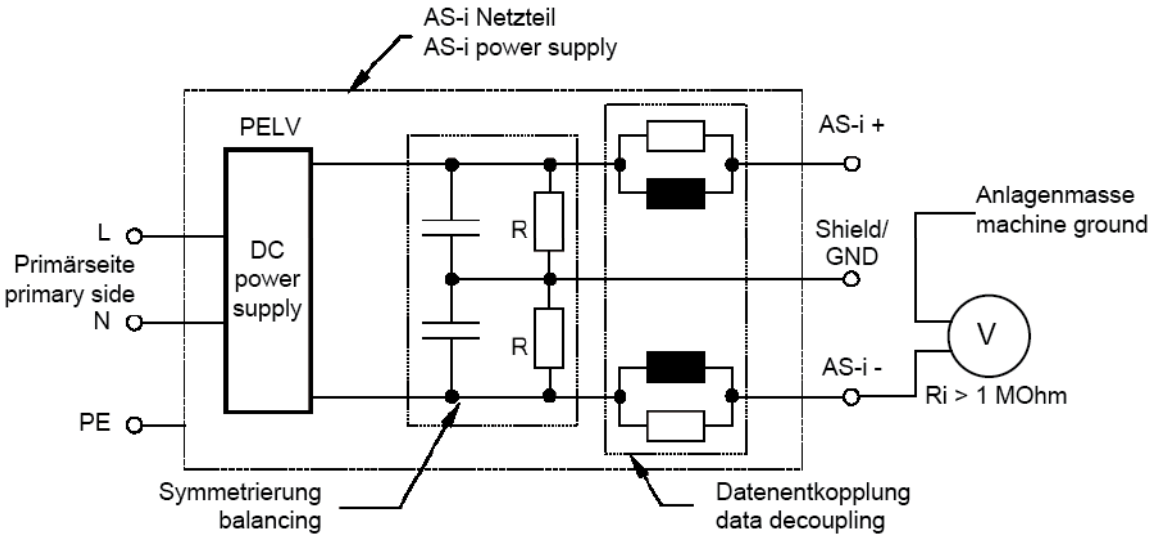
Measurement of the AS-i symmetry with a voltmeter under the following conditions:

- with connected slaves AND
- Shield/GND not connected to the power supply.

The following voltages should be measured:

between AS-i+ and machine ground	approx. +15 V DC	The difference of the two voltages must be maximum 2...3 V DC.
between AS-i- and machine ground	approx. -15 V DC	
between AS-i+ and AS-i-	approx. 30.5 V DC	

Measurement of the AS-i symmetry:



The higher the internal resistance of the measurement device, the more precise the result of measurement.

6 Glossary of Terms

A

A/B slave

AS-i slave with an A or B being appended to its address number and which may therefore be present twice on the →master.

Acyclic data transmission

Usually data are transmitted to one slave at a time by the master once per cycle (= cyclic data transmission). Data transmission only at certain events (e.g. when the device is switched on or when values have been changed) is called acyclic data transmission.

Address

This is the "name" of the bus participant. All participants need a unique address so that the signals can be exchanged without problem.

Application software

Software specific to the application, implemented by the machine manufacturer, generally containing logic sequences, limits and expressions that control the appropriate inputs, outputs, calculations and decisions

Necessary to meet the specific (→SRP/CS) requirements.
→ Programming language, safety-related

Architecture

Specific configuration of hardware and software elements in a system.

AS-i

The AS-Interface (AS-i = Actuator Sensor Interface) is a standard for fieldbus communication to EN 50295 and IEC 62026-2. It was developed for the connection of actuators and sensors with a simple wiring to replace the conventional parallel wiring.

An unscreened two-wire yellow flat cable (max. 500 m) serves for data transmission as well as for voltage supply (24...30 V DC) for the communication electronics and for participants with a low current requirement. Loads with a greater energy requirement additionally receive a separate (black) flat cable for energy supply with 24 V DC.

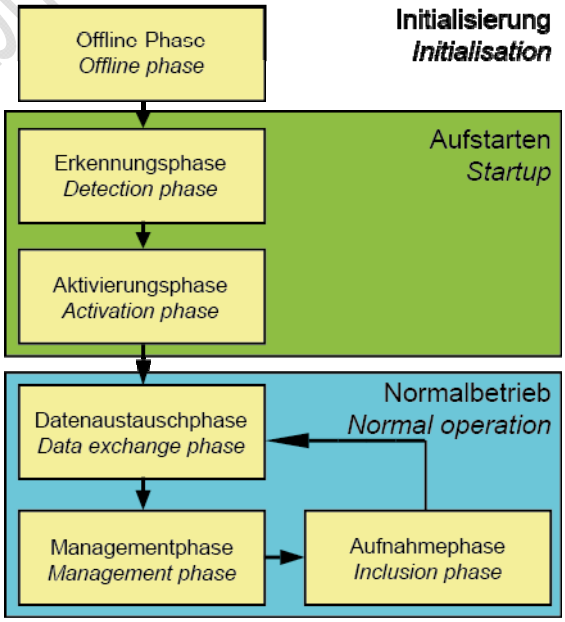
AS-Interface is a single master system. Up to 62 slaves can be connected per master. Each of these slaves needs an unambiguous address. The master cyclically polls (→polling) all projected slaves and exchanges the up to 248 input data and 186 output data with them.

→ www.as-interface.net AS-International Association (user association)

AS-i cycle

An AS-i cycle contains the data exchange of up to 31 slaves plus a telegram inclusion phase plus, if required, a telegram management phase (→ **AS-i phases (status machine)** (→ page 257)). In the case of the extended addressing mode, two AS-i cycles are required for data transfer to all A/B slaves.

AS-i phases (status machine)



- Offline phase: No AS-i data traffic takes place during initialisation.
- Detection phase: In the detection phase, the AS-i master first of all searches for existing slaves - irrespective of whether they are projected or not.
- Activation phase: In this phase, the found slaves are activated depending on the operating mode.

- Data exchange phase: The AS-i master carries out cyclical data exchange with the activated slaves.
- Management phase: At the end of a cycle the AS-i master goes into the management phase, during which the master can send a command to a specific slave (if requested).
- Inclusion phase: After this, the AS-i master goes into the inclusion phase, during which it sends a command to a free slave address to detect new slaves.

ASIsafe

The name for Safety at Work used by Siemens.

B

Baud

Baud, abbrev.: Bd = unit for the data transmission speed. Do not confuse baud with "bits per second" (bps, bits/s). Baud indicates the number of changes of state (steps, cycles) per second over a transmission length. But it is not defined how many bits per step are transmitted. The name baud can be traced back to the French inventor J. M. Baudot whose code was used for telex machines.

1 MBd = 1024 x 1024 Bd = 1 048 576 Bd

Burst errors

Burst errors are errors occurring depending on others. The class indicates the maximum permissible number of burst errors:
Class 1 = high protection,
Class 2 = lower protection etc.

Bus

Serial data transmission of several participants on the same cable.

C

CCDI

CCDI = **C**TT **C**onfiguration **D**ata **I**mage = current CTT configuration

Configuration of 7.4 and 7.5 slaves currently determined by the AS-i master:
- Manufacturer ID,
- Vendor ID,
- Device ID,
- Device Group ID.

CDI

CDI = **C**onfiguration **D**ata **I**mage = current AS-i configuration

The configuration of the connected AS-i slaves determined by the AS-i master:
LDS and AS-i profiles (IO, ID, ID1, ID2)

CoDeSys

CoDeSys® is a registered trademark of 3S – Smart Software Solutions GmbH, Germany.

"CoDeSys for Automation Alliance" associates companies of the automation industry whose hardware devices are all programmed with the widely used IEC 61131-3 development tool CoDeSys®.

Homepage → http://www.3s-software.com

ControllerE

Master in the AS-i bus system of the generation E.

CTT

e.g. CTT2 = Combined Transaction Type 2
→ **Combined transaction**

Cycle time

This is the time for one cycle. The following happens:

- PLC cycle: The PLC program performs one complete run.
- AS-i cycle: all AS-i slaves are updated (5...10 ms).
  The cycle time mainly depends on the AS-i slaves involved in the data exchange. Message errors and management phase may extend the cycle time (⇒ no constant cycle time).

Cyclic data transmission

Data are transmitted to one slave at a time by the master once per cycle.

Cyclical polling

AS-i master cyclically polls the data of all →slaves in the bus (see above). The data is updated in the →master after max. 5 ms. If A/B slaves are used, the →cycle time can be extended to 10 ms.

D

Data image (AS-i)

See →process image; sum of all digital and analogue input and output data.

As regards the time, the data image represents the current condition of each individual slave and NOT a consistent image of the entire AS-i network at an exact point in time.

DeviceNet

Fieldbus system for larger data volumes based on →CAN technology, requires special cables, complex connection technology. Can be used e.g. as a supplier for AS-i over longer distances. Corresponding →gateways are available.

DHCP

DHCP = **D**ynamic **H**ost **C**onfiguration **P**rotocol = protocol for the dynamic configuration by the →host

DHCP is a protocol that provides dynamic configuration of IP addresses and associated information. The protocol supports use of IP addresses which are only available in limited number by a centralised management of the address assignment.

The participant logs on to a server with this service when it is switched on in a network for the first time. The server assigns a local free →IP address to the participant.

Diagnosis

During the diagnosis, the "state of health" of the device is checked. It is to be found out if and what faults are given in the device.

Depending on the device, the inputs and outputs can also be monitored for their correct function.
- wire break,
- short circuit,
- value outside range.

For diagnosis, configuration and log data can be used, created during the "normal" operation of the device.

The correct start of the system components is monitored during the initialisation and start phase. Errors are recorded in the log file.

For further diagnosis, self-tests can also be carried out.

DRAM

DRAM = **D**ynamic **R**andom **A**ccess **M**emory

Technology for an electronic memory module with random access (Random Access Memory, RAM). The memory element is a capacitor which is either charged or discharged. It becomes accessible via a switching transistor and is either read or overwritten with new contents. The memory contents are volatile: the stored information is lost in case of lacking operating voltage or too late restart.

E

EMC

EMC = **E**lectro **M**agnetic **C**ompatibility

According to the EC directive (2004/108/EEC) concerning electromagnetic compatibility (in short EMC directive) requirements are made for electrical and electronic apparatus, equipment, systems or components to operate satisfactorily in the existing electromagnetic environment. The devices must not interfere with their environment and must not be adversely influenced by external electromagnetic interference.

Ethernet

Ethernet is a widely used, manufacturer-independent technology which enables data transmission in the network at a speed of 10 or 100 million bits per second (Mbps). Ethernet belongs to the family of so-called "optimum data transmission" on a non exclusive transmission medium. The concept was developed in 1972 and specified as IEEE 802.3 in 1985.

F

FC

FC = flat cable
The yellow or black AS-i cable is meant.

FE – functional earth

Functional **e**arth is a reference potential which is not connected to protective earth or only connected when special measures are taken. The functional earth serves as equalisation of potential for an ungrounded installation (e.g. →SELV).

Fieldbus

A →bus for industrial applications: mechanically extremely robust and excellent data protection.

Firmware

System software, basic program in the device, virtually the operating system.

The firmware establishes the connection between the hardware of the device and the user software. This software is provided by the manufacturer of the controller as a part of the system and cannot be changed by the user.

Flash memory

Flash ROM (or flash EPROM or flash memory) combines the advantages of semiconductor memory and hard disks. Just like every other semiconductor memory the flash memory does not require moving parts. And the data is maintained after switch-off, similar to a hard disk.

The flash ROM evolved from the EEPROM (**E**lectrical **E**rasable and **P**rogrammable **R**ead-**O**nly **M**emory). The storage function of data in the flash ROM is identical to the EEPROM. Similar to a hard disk, the data are however written and deleted blockwise in data blocks up to 64, 128, 256, 1024, ... bytes at the same time.

Advantages of flash memories

- The stored data are maintained even if there is no supply voltage.
- Due to the absence of moving parts, flash is noiseless and insensitive to shocks and magnetic fields.
- In comparison to hard disks, flash memories have a very short access time. Read and write speed are virtually constant across the entire memory area.
- The memory size that can be obtained has no upper limit, due to the simple and space-saving arrangement of the storage cells.

Disadvantages of flash memories

- A storage cell can tolerate a limited number of write and delete processes:
  - Multi-level cells: typ. 10 000 cycles
  - Single level cells: typ. 100 000 cycles
- Given that a write process writes memory blocks of between 16 and 128 Kbytes at the same time, memory cells which require no change are used as well.

FMEA

FMEA = **F**ailure **M**ode and **E**ffects **A**nalysis

Method of reliability engineering, to find potential weak points. Within the framework of quality or security management, the FMEA is used preventively to prevent faults and increase the technical reliability.

FRAM

FRAM, or also FeRAM, means **Fe**rroelectric **R**andom **A**ccess **M**emory. The storage operation and erasing operation is carried out by a polarisation change in a ferroelectric layer.

Advantages of FRAM as compared to conventional read-only memories:

- non-volatile,
- compatible with common EEPROMs, but:
- access time approx. 100 ns,
- nearly unlimited access cycles possible.

G

Gateway

Gateway = access, coupler

Gateways enable connection of completely different systems. Gateways are used when two incompatible network types are to be connected by converting the protocol of one system to the protocol of the other system.

Example: connection between AS-i and higher-level fieldbus systems such as →Ethernet DP, →DeviceNet, Interbus-S or other interfaces, e.g. RS-485. The device includes an AS-i master which is directly coupled to the →host interface (e.g. →Ethernet DP slave).

Gateway transfer time

The time that is needed for the input data in the DP-RAM of the AS-i master to be copied into the output data of the netX, and vice versa. The distance from DP-RAM to DP-RAM is decisive.

GPL

GPL = **G**eneral **P**ublic **L**icence

A licence issued by Free Software Foundation with copyleft for licensing of free software. The thus licensed program can be used for all purposes without any restriction. Commercial use is expressly permitted.

GSD

Generic **S**tation **D**escription

Describes the interface to the device to be connected to the fieldbus.

You can find the current version of the GSD file on the ifm homepage:
DE → https://www.ifm.com/ifmde/web/asi-download.htm
UK → https://www.ifm.com/ifmgb/web/asi-download.htm
FR → https://www.ifm.com/ifmfr/web/asi-download.htm
e.g. for AC1375:
→ GSD file for SmartLink AC1375
→ download the file `ifm...07E5.gsd` (... = version)

GSDML

GSDML = **G**eneric **S**tation **D**escription **M**arkup **L**anguage

Description language which can describe the characteristics of a device family across several levels. In this XML scheme, as much as possible of the semantics of the →GSD was adopted.

H

HMI

HMI = **H**uman **M**achine **I**nterface

Host

The controller in the hierarchy above the AS-i master, e.g. a PLC or a processor.

I

I&M

I&M = **I**dentification **&** **M**aintenance

→ chapter **I&M data**

→ Profibus Profile Guidelines Part 1: Identification & Maintenance Functions

ID

ID = **Id**entifier

Name to differentiate the devices / participants connected to a system or the message packets transmitted between the participants.

Instructions

Superordinate word for one of the following terms:
installation instructions, data sheet, user information, operating instructions, device manual, installation information, online help, system manual, programming manual, etc.

Intended use

Use of a product in accordance with the information provided in the instructions for use.

IO-Link

Point-to-point connection between 2 devices.
The following transmission is possible:
- binary signals or
- greater data fields for parameter setting.

→ www.io-link.com

IP address

IP = **I**nternet **P**rotocol
The IP address is a number which is necessary to clearly identify an internet participant. For the sake of clarity the number is written in 4 decimal values, e.g. 127.215.205.156.

J

Jitter

Jitter means a slight fluctuation in accuracy in the transmission cycle when transmitting digital signals. More generally, jitter in transmission technology means an abrupt and undesired change of the signal characteristics.

L

LAS

List of **A**ctive **S**laves

In this slave list the ControllerE enters the slaves detected as active for this AS-i master.

LDS

List of **D**etected **S**laves

In this slave list the controller enters the slaves detected as present for this AS-i master.

LED

LED = **L**ight **E**mitting **D**iode

Light emitting diode, also called luminescent diode, an electronic element of high coloured luminosity at small volume with negligible power loss.

LFS

List of **F**ailed **S**laves = list of slaves with configuration errors

In this slave list the controller enters the slaves with a projection error on this AS-i master.

Link

A link is a cross-reference to another part in the document or to an external document.

LKCS

LKCS = **L**ist of **K**nown **C**TT **S**laves

In this list the CTT slaves (profile 7.4 and 7.5) which are indicated in the LDS and whose CTT configuration has already been read are entered. This list is independent of the LDS, LPS, LAS and LNACS.

LNACS

LNACS = **L**ist of **N**ot **A**ctivated **C**TT **S**laves

In this list, the CTT slaves (profiles 7.4 and 7.5) which have been detected as CTT slaves but not activated are entered. As soon as the slave is entered in the LAS, it is deleted from this list. These slaves only take part in the data exchange until the CTT configuration has been read.

LPS

List of **P**rojected **S**laves

In this slave list the controller enters the slaves projected for this AS-i master.

LSB

Least **S**ignificant **B**it/Byte

M

MAC-ID

MAC = **M**anufacturer‘s **A**ddress **C**ode
= manufacturer's serial number

→ID = **Id**entifier

Every network card has a MAC address, a clearly defined worldwide unique numerical code, more or less a kind of serial number. Such a MAC address is a sequence of 6 hexadecimal numbers, e.g. "00-0C-6E-D0-02-3F".

Master

Handles the complete organisation on the bus. The master decides on the bus access time and polls the →slaves cyclically.

Master-slave communication

AS-i strictly operates to the master-slave principle. The master polls all slaves one after the other in always the same order. Only one master per network line is allowed (→cyclical polling).

MBd

MegaBaud

Baud, abbrev.: Bd = unit for the data transmission speed. Do not confuse baud with "bits per second" (bps, bits/s). Baud indicates the number of changes of state (steps, cycles) per second over a transmission length. But it is not defined how many bits per step are transmitted. The name baud can be traced back to the French inventor J. M. Baudot whose code was used for telex machines.

1 MBd = 1024 x 1024 Bd = 1 048 576 Bd

MMI

→ **HMI** (→ page 261)

Modbus

The Modbus protocol is a communication protocol based on a →master/slave architecture and was generated by Modicon in 1979 for communication with its PLCs. In the industry, Modbus has become a de facto standard.

Modbus/TCP is based on →Ethernet TCP/IP. Modbus/TCP ports the protocol defined for the serial interface to TCP. The →IP address clearly identifies each device in a network. Therefore the slave address was used to identify one of several logical units (unit IDs) in a physical device. To do so, the extended IP addressing is used.

Example: 192.168.83.28.1 means unit ID 1 on IP address 192.168.83.28.

*) Modicon passed from AEG to the group Schneider in 1994.

MRAM

MRAM means **M**agnetoresistive **R**andom **A**ccess **M**emory. The information is stored by means of magnetic storage elements. The property of certain materials is used to change their electrical resistance when exposed to magnetic fields.

Advantages of MRAM as compared to conventional RAM memories:

- non volatile (like FRAM), but:
- access time only approx. 35 ns,
- unlimited number of access cycles possible.

MSB

Most **S**ignificant **B**it/Byte

O

Operating system

Basic program in the device, establishes the connection between the hardware of the device and the user software.

OSC

OSC = **O**nline **S**upport **C**enter → **Online support center (OSC)** (→ page 241)
Help system in the device

OSSD

OSSD = **O**utput **S**ignal **S**witching **D**evice

= output signal of a switching device. Here: output signal of an AS-i safety monitor.

P

Password

In the menu [System Setup], menu item [Password] the handling can be restricted or enabled. When delivered, the device is in the user mode. By entering an invalid password

(e.g. 1000) all menu items which can change settings are blocked.

PCCD

PCCD = **P**rojected **C**TT **C**onfiguration **D**ata

Configuration data for the 7.4 and 7.5 slaves stored in the device:
- Manufacturer ID,
- Vendor ID,
- Device ID,
- Device Group ID.

PCD

PCD = **P**rojected **C**onfiguration **D**ata

Configuration data stored in the device:
LPS and AS-i profile (IO, ID, ID1, ID2)

PDM

PDM = **P**rocess and **D**ialogue **M**odule

Device for communication of the operator with the machine / plant.

PELV

PELV = **P**rotective **E**xtra **L**ow **V**oltage

Functional extra low voltage with safe separation, grounded variant of SELV.

Extra low voltage with safe separation (grounded variant of SELV). The specification as PELV system to IEC 364-4-41 covers a measure to protect against direct and indirect contact with dangerous voltages by a "safe separation" between primary and secondary side in the device (e.g. power supply to PELV specification).

For this reason no separate PE conductor is required in a PELV system. It is allowed to ground circuits and / or bodies in a PELV system.

Pictogram

Pictograms are figurative symbols which convey information by a simplified graphic representation.
→ chapter **What do the symbols and formats mean?** (→ page 8)

PLC configuration

Part of the CoDeSys user interface.

► The programmer tells the programming system which hardware is to be programmed.

> CoDeSys loads the corresponding libraries.

> Reading and writing the periphery states (inputs/outputs) is possible.

Polling

to poll = to count votes

The controller master fetches the data from every participant in the system successively:

1. Master calls participant 1.
2. Participant 1 replies with its current data (actual values).
3. Master transfers more data (target values) to participant 1, if needed.
4. Participant 1 acknowledges reception of the data.

etc. the same procedure for each further participant.

Cyclical polling: AS-i master cyclically polls the data of all →slaves in the bus (see above). The data is updated in the →master after max. 5 ms. If A/B slaves are used, the →cycle time can be extended to 10 ms.

Power-on delay time

The time required by the controller K6 from the application of the voltage supply until all of the following targets are reached:

- both AS-i networks have reached normal operation
- the master has read the configuration data of the CTTx slaves
- the field buses can use the gateway (optional)
- the PLC program was started (optional).

Process image

Process image is the status of the inputs and outputs the PLC operates with within one cycle.

- At the beginning of the cycle the PLC reads the conditions of all inputs into the process image.
  During the cycle the PLC cannot detect changes to the inputs.
- During the cycle the outputs are only changed virtually (in the process image).
- At the end of the cycle the PLC writes the virtual output states to the real outputs.

Profibus

PROFIBUS (**Pro**cess **Fi**eld **Bus**) is a standard for fieldbus communication in automation technology. There are three versions of PROFIBUS, DP being the one most widely used.

- PROFIBUS-DP (decentralised periphery) for the control of sensors and actuators by a central controller in manufacturing engineering and for networking of several controllers among each other. Data rates up to 12 Mbits/s on twisted two-wire cables and/or fibre optics are possible.
- PROFIBUS-PA (process automation) is used for the control of measurement devices by a process control system in process technology and is suited for hazardous areas (zones 0 and 1). Only a limited current flows on the bus cables in an intrinsically safe circuit so that even in case of a problem no explosive sparks can occur. A disadvantage of PROFIBUS-PA is the relatively slow data transfer rate of 31.25 Kbits/s.

→ www.profibus.com (umbrella organisation)

Profinet

PROFINET (**Pro**cess **Fi**eld **Net**work) is the open Industrial Ethernet Standard of Profibus & Profinet International (PI) for automation. Profinet uses TCP/IP and IT standards, is real-time Ethernet compatible and enables the integration of fieldbus systems.

The Profinet concept has a modular design, so that the user can choose the functionality himself. This is basically different as regards the type of data exchange, to meet the requirements regarding the speed.

For Profinet, there are the two perspectives Profinet-CBA and Profinet-IO:

- Profinet-CBA (Component Based Automation) is intended for the component-based communication via TCP/IP and the real-time communication for real-time requirements in modular plant construction. Both ways of communication can be used in parallel.
- Profinet-IO has been created for real-time (RT) and synchronous communication IRT (IRT = isochronous real-time) with the decentralised periphery. The designations RT and IRT only describe the real-time characteristics in the communication within Profinet-IO.

→ www.profibus.com (umbrella organisation)

R

Redundant

Redundancy is the presence of more than the necessary means so that a function unit performs a requested function or that data can represent information.

Several kinds of redundancy are distinguished:

- Functional redundancy aims at designing safety-related systems in multiple ways in parallel so that in the event of a failure of one component the others ensure the task.
- In addition it is tried to separate redundant systems from each other with regard to space. Thus the risk that they are affected by a common interference is minimised.
- Finally, components from different manufacturers are sometimes used to avoid that a systematic fault causes all redundant systems to fail (diverse redundancy).

The software of redundant systems should differ in the following aspects:

- specification (different teams),
- specification language,
- programming (different teams),
- programming language,
- compiler.

Remanent

Remanent data is protected against data loss in case of power failure.

The operating system for example automatically copies the remanent data to a flash memory as soon as the voltage supply falls below a critical value. If the voltage supply is available again, the operating system loads the remanent data back to the RAM memory.

The data in the RAM memory of a controller, however, is volatile and normally lost in case of power failure.

RTC

RTC = **R**eal **T**ime **C**lock

Provides (batter-backed) the current date and time. Frequent use for the storage of error message protocols.

RTS

RTS = **R**un **T**ime **S**ystem

Runtime systems are basic versions of applications. These minimum versions are supplied with certain products to meet the prerequisites for the execution of the actual product or to be able to look at or use results generated by this product on other processors: making available all routines required to execute a program in a programming language, e.g. interactions with the →operating system, memory requirements, error routines, inputs and outputs.

S

SD card

An SD memory card (short for **S**ecure **D**igital Memory Card) is a digital storage medium that operates to the principle of flash storage.

Self-test

Test program that actively tests components or devices. The program is started by the user and takes a certain time. The result is a test protocol (log file) which shows what was tested and if the result is positive or negative.

SELV

SELV = **S**afety **E**xtra **L**ow **V**oltage

Active parts of safety extra low voltage circuits must neither be connected to ground nor to protective wires of other circuits. They must be safely separated from active parts with higher voltage.

SELV circuit = secondary circuit (output voltage) which is rated and protected so that its voltages do not exceed a safe value in case of correct operation (of the power supply) or in case of a single fault (of the power supply).

SELV circuits are separated from the input voltage (mains voltage) by double or enhanced insulation. The voltage value must not exceed 60 V DC (or 42.4 V AC).

Single slave

→Slave whose address number may only occur once on the →master.

Slave

Passive participant on the bus, only replies on request of the →master. Slaves have a clearly defined and unique →address in the bus.

Slave configuration

The following terms need to be distinguished...
- AS-i projected configuration (**PCD** (→ page 264)),
- AS-i current configuration (**CDI** (→ page 258)),
- CTT projected configuration (**PCCD** (→ page 264)),
- CTT current configuration (**CCDI** (→ page 258)).

Symbols

Pictograms are figurative symbols which convey information by a simplified graphic representation.
→ chapter **What do the symbols and formats mean?** (→ page 8)

System variable

Variable to which access can be made via IEC address or symbol name from the PLC.

T

Target

The target indicates the target system where the PLC program is to run. The target contains the files (drivers and if available specific help files) required for programming and parameter setting.

TCP

The **T**ransmission **C**ontrol **P**rotocol is part of the TCP/IP protocol family. Each TCP/IP data connection has a transmitter and a receiver. This principle is a connection-oriented data transmission. In the TCP/IP protocol family the TCP as the connection-oriented protocol assumes the task of data protection, data flow control and takes measures in the event of data loss. (compare: →UDP)

U

UDP

UDP (**U**ser **D**atagram **P**rotocol) is a minimal connectionless network protocol which belongs to the transport layer of the internet protocol family. The task of UDP is to ensure that data which is transmitted via the internet is passed to the right application.

At present network variables based on CAN and UDP are implemented. The values of the variables are automatically exchanged on the basis of broadcast messages. In UDP they are implemented as broadcast messages, in CAN as PDOs. These services are not confirmed by the protocol, i.e. it is not checked whether the message is received. Exchange of network variables corresponds to a "1 to n connection" (1 transmitter to n receivers).

Unit ID

→Modbus

Use, intended

Use of a product in accordance with the information provided in the instructions for use.

W

Watchdog

In general the term watchdog is used for a component of a system which watches the function of other components. If a possible malfunction is detected, this is either signalled or suitable program branchings are activated. The signal or branchings serve as a trigger for other co-operating system components to solve the problem.

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