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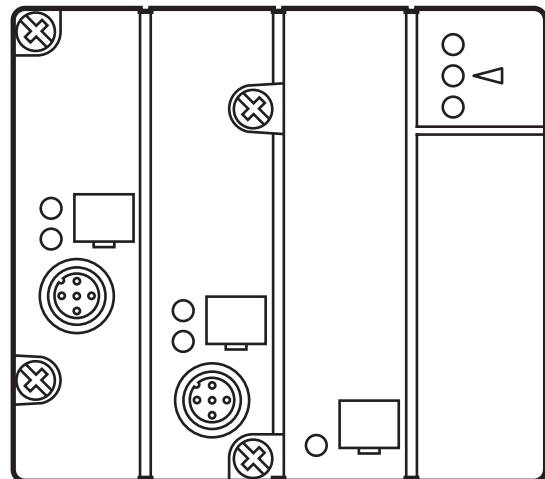
Original operating instructions  
Evaluation unit for fail-safe sensors  
with AS-interface

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**AS interface**

**AC016S**

7390512 / 02 10 / 2010



# Contents

1	Preliminary note.....	3
1.1	Explanation of symbols.....	3
2	Safety instructions .....	3
3	Installation / set-up.....	3
3.1	Applications .....	4
3.2	Function and electrical connection .....	4
4	Configuration requirements .....	5
4.1	Hardware-dependent requirements.....	5
4.2	Software-dependent requirements .....	5
5	Installation.....	6
6	Operating and display elements .....	6
7	Set-up .....	7
7.1	Electrical connection.....	7
7.2	Data bits.....	8
7.3	Addressing.....	8
7.3.1	Infrared addressing.....	8
8	Operation .....	9
8.1	Response times.....	9
8.2	Calculation of the total response time .....	9
8.3	Fault diagnosis .....	9
8.3.1	Wiring and sensor faults .....	9
8.3.2	Internal faults .....	10
8.3.3	Voltage supply .....	10
9	Safety characteristics.....	10
10	Technical data .....	12
11	Scale drawing .....	13
12	Standards .....	14
13	Approvals / Certificates .....	14

# 1 Preliminary note

## 1.1 Explanation of symbols

▶ Instructions

→ Cross-reference



Important note

Non-compliance can result in malfunction or interference.

## 2 Safety instructions

Follow the operating instructions.

Non-observance of the instructions, operation which is not in accordance with use as prescribed below, wrong installation or incorrect handling can affect the safety of operators and machinery.

For mounting and prescribed use of the product the notes in the operating instructions must be carefully observed and the applicable technical standards relevant for the application have to be considered.

In case of non-observance of notes or standards, specially when tampering with and/or modifying the product, any liability is excluded.

The unit must be installed, connected and put into operation by a qualified electrician trained in safety technology.

After installation the system has to be subjected to a complete function check.

Disconnect the unit externally before handling it. Also disconnect any independently supplied relay load circuits.

For installation the requirements according to EN60204-1 must be observed.

In case of malfunction of the unit please contact the manufacturer. Tampering with the device can seriously affect the safety of operators and machinery. This is not permitted and leads to an exclusion of liability and warranty.

## 3 Installation / set-up



The units must only be installed, connected and set up by qualified staff.

### 3.1 Applications

The evaluation unit is a redundant diverse system to process a chain of up to 8 fail-safe sensors.

The evaluation unit supplies/monitors the connected fail-safe sensors and evaluates their switching status. If all fail-safe sensors are fully operational and correctly damped, the evaluation unit transmits the safety code table to the AS-interface (8x4 bit data sequence).

The safety-related evaluation of the code table must be effected by a suitable safety monitor (e.g. AC001S ... AC004S, AC031S, AC032S). The safe state is when no code is transmitted (static 0).

When operated correctly, the system can be used in applications up to performance level e according to DIN EN ISO 13849-1 or IEC 61508/SIL 3 (→ 7.1 Electrical connection).



Depending on the safety components used the complete safety system can also be classified for a lower safety category.

### 3.2 Function and electrical connection

Please also refer to all information in the description of the configuration software (e.g. E7040S) and the operating instructions of the safety monitor. These documents provide all required instructions concerning installation, configuration, operation and maintenance of the AS-i safety system.

Information on the parameterizable safety functions of the safe AS-i module can be found in the chapter "Monitoring devices" of the configuration software manual.

## Important note:



The products described herein are designed to be components of a safety-oriented machine or control system.

A complete safety-related system normally includes sensors, evaluation units, signalling components and concepts for safe switch-off.

It is the responsibility of each manufacturer of a machine or installation to ensure a correct functioning of the whole system. The manufacturer of the safe AS-i module, his subsidiaries and affiliates are not in a position to evaluate all of the characteristics of a given machine or product not designed by him.

The manufacturer accepts no liability for any recommendation that may be implied or stated herein.

The warranty contained in the contract of sale is the sole warranty. Any statements contained herein do not create new warranties or modify existing ones.

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## 4 Configuration requirements

The following requirements must be complied with when using the evaluation unit AC016S.

### 4.1 Hardware-dependent requirements

It must be ensured that the safety requirements of the respective application correspond to the requirements stated in these instructions. The specified technical data must be complied with.

By taking administrative measures in the application it must be ensured that a function check is carried out at least once a year. A function check is carried out by switching the AS-i supply voltage or the evaluation (data bit D0, 0 = evaluation ON) briefly off.

In case of faults within the evaluation unit which result in the defined safe state, the evaluation unit must be replaced.

### 4.2 Software-dependent requirements

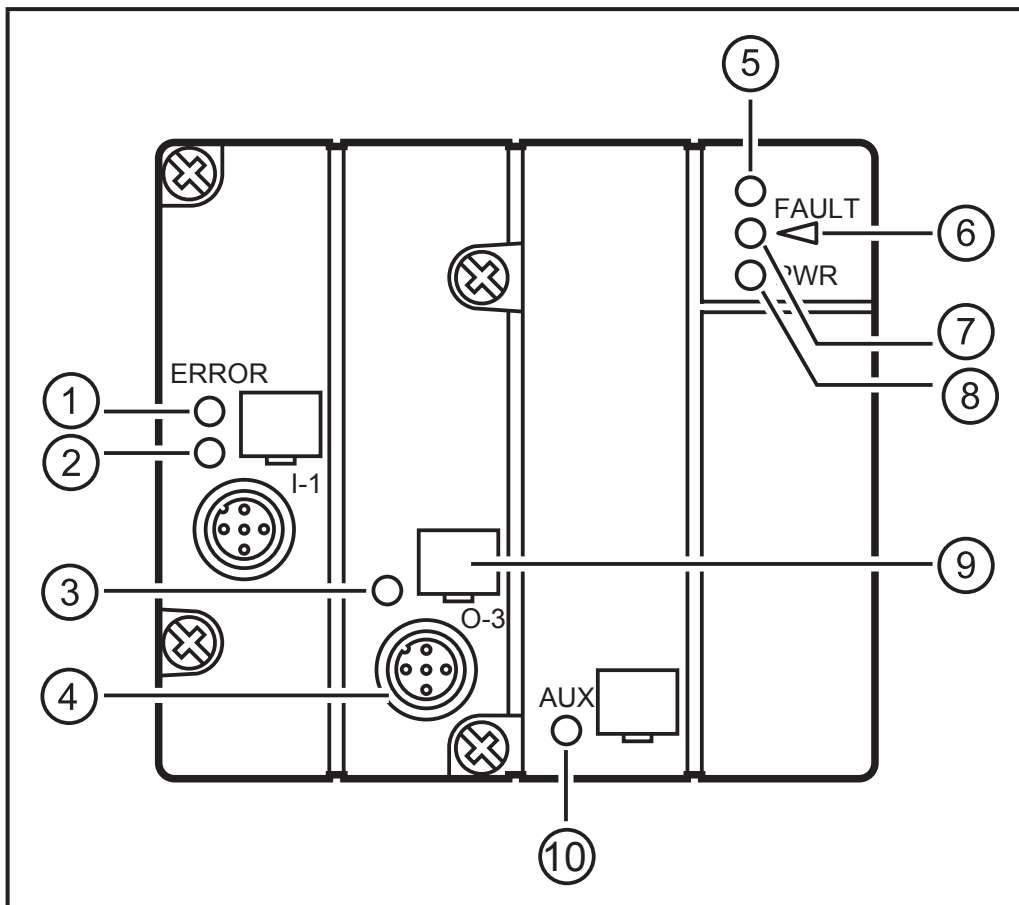
The complete description of the configuration of the AS-i safety monitor has to be taken into account!

## 5 Installation

- ▶ Mount the evaluation unit onto a wired FC or FC-E lower part (e.g. AC5000 or AC5003).
- ▶ Mount the evaluation unit and the lower part onto a 35 mm rail or fasten it onto a suitable mounting surface. Mounting position: vertical or horizontal.
- ▶ Carefully place the AS-i flat cable in the lower part using the supplied seals.
- ▶ To maintain the specified protection class: Tighten the 4 screws of the upper part evenly crosswise with 0.8 Nm.

When installing the module ensure that the seal is carefully inserted.

## 6 Operating and display elements



- 1: LED 4 red
- 2: LED 1 yellow
- 3: LED 5 yellow
- 4: M12 socket
- 5: LED 3  
infrared receiver
- 6: Fixture for  
IR adapter
- 7: LED 2 red
- 8: LED PWR green
- 9: Labels
- 10: LED AUX green

LED	Co- lour	State	Meaning
1	yellow	on	fail-safe sensor or safety chain enabled
2	red	on	FAULT AS-i communication error slave does not participate in the normal exchange of data, e.g. if slave address = 0
		flashing	periphery fault, e.g. sensor supply overloaded or shorted
3	---	---	infrared receiver
4	red	on	initialisation phase up to first enabling or error in the evaluation (ERROR)
5	yellow	on	unsafe switching output O-3 logically on
PWR	green	on	AS-i voltage supply ok
AUX	green	on	external voltage supply ok

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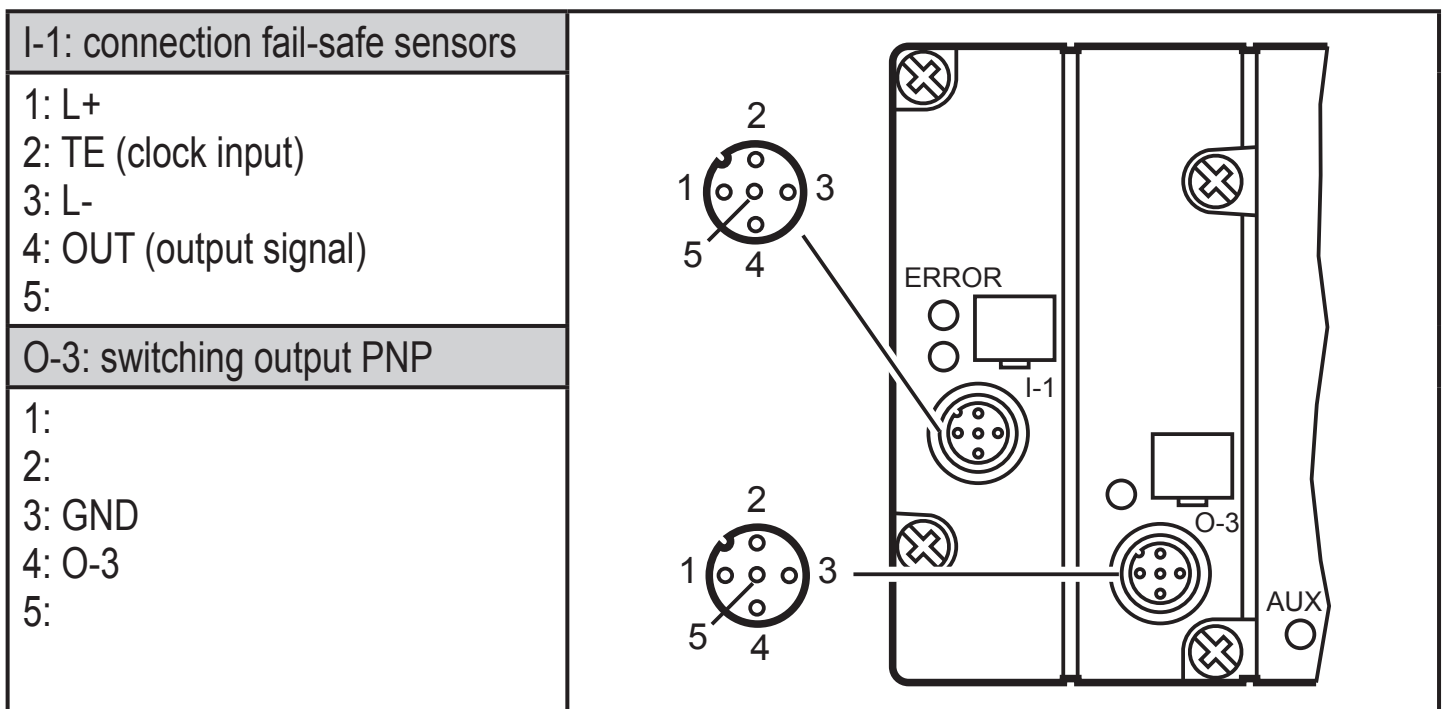
## 7 Set-up

### 7.1 Electrical connection



The supply of the fail-safe sensors comes from the AS-i system. Do not connect the inputs to an external potential.

Connect the M12 socket I-1 of the evaluation unit to the corresponding connections of the fail-safe sensor or the chain of fail-safe sensors (L+, TE, L- and OUT).



When the switching output O-3 is used, an FC-E lower part must be used!

If the socket O-3 is not used, it must be covered with the enclosed protective cap to maintain the specified protection rating.

The following fail-safe inductive sensors can be connected:

GM504S, GM505S, GI505S, GG505S, GG507S.

## 7.2 Data bits

Data bit	D3	D2	D1	D0
IN / OUT	SI-1	SI-1 / O-3	SI1-1	SI-1 / O-1

Activated input channel	Bit sequence D3-D0
SI1	0000
none	XXXX
Activated output	Bit sequence D3-D0
O-1	XXX1
O-3	X1XX

X = random

The code word 0000 causes the AS-i safety monitor to switch the installation into the safe state.

In the configuration software for the safety monitor the module must be used for the evaluation unit as double-channel forced module. For further details please see chapter "Monitoring devices" in the configuration software manual.

## 7.3 Addressing

The evaluation unit can be addressed via the AC1154 addressing unit.

- ▶ Assign a free address between 1 and 31.

The address is set to 0 at the factory.

If it is used with the FC lower part, e.g. AC5000 (without addressing socket):

- ▶ Address the module via the AC1154 addressing unit before mounting.

### 7.3.1 Infrared addressing

The evaluation unit also offers the option of infrared addressing with the AC1154 addressing unit.



The AS-i communication (yellow cable) must be switched off during the infrared addressing. To do so, disconnect the master.

- ▶ Supply the slaves with voltage via the AS-i power supply. Addressing is carried out via the IR addressing cable E70211.

When the ifm AS-i power supplies type SL are used, the communication can be deactivated via a jumper on the power supply.

## 8 Operation

### 8.1 Response times

The response time of the evaluation unit to a safety request is max. 220 ms. Within this period the safety code 0000b (=safe state) is statically transferred.

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### 8.2 Calculation of the total response time

For the calculation of the response time of the total system the response times of the other components also have to be added (fail-safe sensors, evaluation unit, safety monitor and possibly external relays).

Example:

For the GM504S fail-safe sensor the response time to a safety request is < 20 ms and for the AC001S safety monitor < 40 ms. The sum of the individual response times results in the total response time to a safety request of < 280 ms.

The switching times of external relays also have to be added.

### 8.3 Fault diagnosis

If after power on the evaluation unit is not enabled, a system fault is assumed. In the easiest case a connected fail-safe sensor is not in the operating range.

Location by means of the indicators:

#### 8.3.1 Wiring and sensor faults

- One way to locate wiring or sensor faults is the indication of the enable signal of the connected fail-safe inductive sensors (LED 1 yellow, → 6 Operating and display elements).
- The connected fail-safe sensors can be wired pseudo-serially, i.e. the clock or the enable signal is passed through from the first to the last connected fail-safe sensor.

If somewhere in this chain one or several faults occur, the enable signal is interrupted starting from the first detected fault source. The LED 1 yellow provides the information whether all connected fail-safe sensors have given the enable signal.

### 8.3.2 Internal faults

- If the evaluation unit detects a fault, the unit changes to the safe state (LED 4 red, → 6 Operating and display elements).
- A function test of the evaluation unit allows checking for the presence of a hardware error or whether the change to the safe state has been caused by external faults. To do so the evaluation has to be switched off briefly for min. 50 ms (data bit D0, 1= evaluation OFF).

### 8.3.3 Voltage supply

- If after power on the LED green PWR is not lit, the supply voltage must be checked.
- Overload and short circuit of the input supply are signalled to the AS-i master (version 2.1) via the "periphery fault" flag in the status register.

## 9 Safety characteristics

Characteristics	Value
Safety integrity level	SIL 3
Performance level	PL e
Category	Cat. 4
MTTF <sub>d</sub>	> 2500 years
Mission time T	10 years
PFH	1 x 10 <sup>-8</sup> / h
DC / CCF / Cat.	99 % / 70 % / 4

- These calculations were made on the basis of an ambient temperature of 40 °C. The evaluation unit is maintenance-free.
- The device meets the requirements of DIN EN ISO 13849-1:2008 category 4 PL e, SIL 3 (IEC 61508) and can be used in applications up to SIL 3 / PL e.
- The PFH values and MTTF values of the other components, especially of the AS-i safety monitor, can be found in the corresponding documentation.

Explanation of the abbreviations:

SIL	Safety Integrity Level	Safety Integrity Level SIL 1-4 to IEC 61508. The higher the SIL the lower the probability that a safety function will fail.
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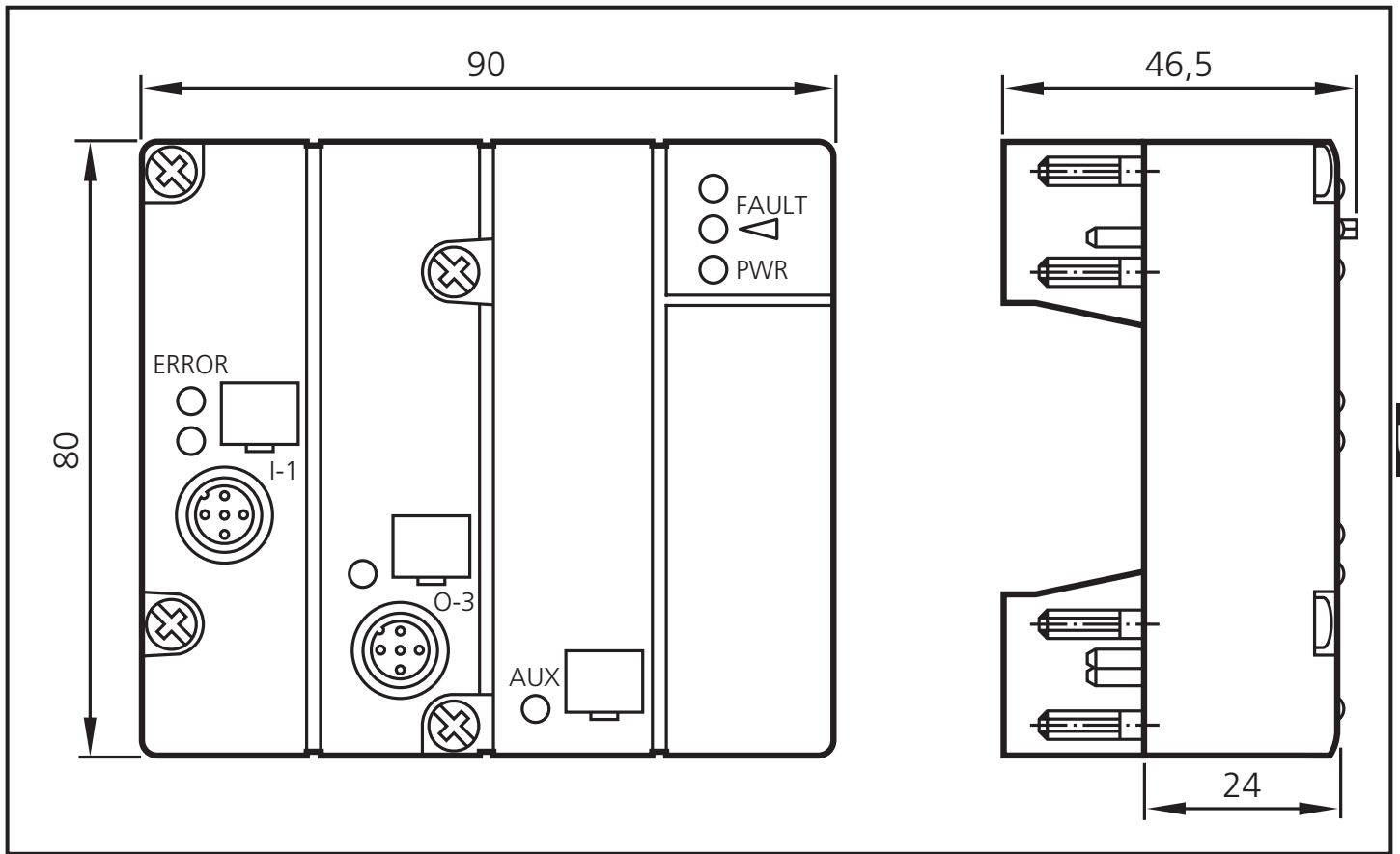
PL	Performance Level	Capability of safety-related parts to perform a safety function at predictable conditions to fulfil the expected risk reduction.
PFH	Probability of dangerous failure per hour	
Cat.	Category	Classification of the safety-related parts of a controller as regards their resistance to failures.
CCF	Common Cause Failure	
DC	Diagnostic Coverage	
T	Life time	Max. service life.
MTTF <sub>d</sub>	Mean Time To Dangerous Failure	

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## 10 Technical data

<b>Electrical design</b>	1 safe input 1 unsafe output
Operating voltage	26.5...31.6 V DC
Current consumption	≤ 250 mA
<b>Inputs</b>	
Wiring	DC PNP
Voltage supply	via AS-i
Input current	typ. 10 mA
Short circuit detection	yes
Overload protection	no
Cross fault monitoring	yes
<b>Switching output</b>	
Supply from an ext. 24 V DC	yes
Current rating per output	500 mA
Integrated watchdog	yes
<b>Function display</b>	
Operation LED	green
Fault LED	red
Function LED	yellow
Ambient temperature	-25...55 °C
Protection rating	IP 67
AS-interface / extended address mode possible	version 2.1 / no
AS-i profile	S-7.B.E
I/O configuration / ID code	7 [Hex] / B.E [Hex]
AS-i certificate	618011
Maximum number of safe modules per master	31
EMC	EN 50295
Housing materials	PBTP (Pocan)
Dimensions (HxWxD) [mm]	80 x 90 x 46.5 mm (HxWxD)
Cable length between module and mechanical contacts	≤ 5 m

# 11 Scale drawing



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## 12 Standards

The following standards and directives have been applied:

- MLR 2006/42/EC
- EMC Directive 2004/108/EC
- DIN EN ISO 13849-1: 2008
- IEC 61508 parts 1-7:2010
- EN50295:1999
- UL 508

The device shall be supplied from an isolating transformer having a secondary UL Listed fuse rated as noted in the following table.

Overcurrent protection		
Wire cross section control circuit		Maximum nominal current of the protective equipment ampere
AWG	(mm <sup>2</sup> )	
26	(0.13)	1
24	(0.20)	2
22	(0.32)	3
20	(0.52)	5
18	(0.82)	7
16	(1.3)	10

## 13 Approvals / Certificates

- EC declaration of conformity
- AS-Interface
- TÜV NORD
- UL (cULus) see [www.ifm.com](http://www.ifm.com)

