

ABB MEASUREMENT & ANALYTICS | DATA SHEET

ACF5000

Multi-component FTIR
emission monitoring system



Measurement made easy

From the pioneers in FTIR CEMS

- Continuous, quantitative and selective measurement of HCl, HF, H₂O, CO, CO₂, SO₂, NO, NO₂, CH₄, NH₃, N₂O, H₂CO, O₂ and VOC (other gases on request)
- Maximum 15 measuring components (standard), simple upgrade on request
- Proven hot wet extractive measurement technique
- High stability, accuracy and reliability through proven FTIR technology
- Fully integrated VOC and O₂ analyzers (optional)
- Unique air-driven injector pump, no moving parts, low condensate to handle
- QAL3 automatic span drift check without test gas
- Low ownership, maintenance and installation cost through multi-component measurement technology with only one sampling system
- Complete pre-engineered system, modest space requirement, compact and modular system design
- Clear-text status messages and user-friendly operator interface on a large back-lit display
- Measured value and status signal transmission to DCS and emission evaluators via Ethernet or Modbus TCP (analog and digital outputs, Modbus and PROFIBUS optional)
- Local control for service purposes via Ethernet and remote maintenance via UMTS
- Integration and display of signals from other detectors (e.g. dust, mercury, flow, pressure, temperature)

System description

Application and design

Because of the growing requirements in the field of environmental monitoring, increasing number of pollutants and with lower concentrations must be measured from combustion processes.

World leader in stack gas monitoring systems for decades and pioneer in FTIR technology, ABB Analytics is offering an inexpensive and forward-looking system with the ACF5000 multi-component FTIR emission monitoring system.

Recognized by the process industries for their ruggedness, the ABB FTIR spectrometers offer a measurement technology with the highest levels of accuracy, selectivity and reliability. Because of the FTIR measurement principle, the spectrometer is free from drift and does not require frequent adjustment, therefore there is no need to hold stocks of expensive, dangerous and toxic test gases.

Because it can easily be expanded through software to measure additional infrared-active components, the analysis system is also designed to expand with your future needs.

The sampling probe, sampling line and analyzer cell are heated allowing water vapor to be measured along with extremely low detection levels of pollutant such as HCl, NH₃ and HF.

The sample gas feeding is using an electronically controlled air injector, which creates a vacuum. This draws the sample gas into the analyzer cell without the use of a mechanical pump. As a beneficial side effect, the sample gas is diluted at the analyzer cell outlet, condensation is reduced, and disposal of the exhaust gas is safer. Since this sampling procedure uses no moving parts, maintenance costs are reduced, and system availability and safety are increased.

Applications

- Municipal waste incinerators
- Biomedical and sludge incinerators
- Hazardous waste incinerators at chemical plants
- Gasification and pyrolysis processes
- Cement kilns
- Solvent recovery and destruction
- DeNO_x and DeSO_x of power plants
- Crematoria
- Steel and aluminum smelters
- Brick, tiles and glass manufacturing
- Catalyst protection monitoring
- Combustion research

System devices and subassemblies

Sampling system

- Probe tube, optionally heated, lengths 500 to 2500 mm (20 to 100 in) for process temperature up to 500 °C (932 °F), optional up to 1350 °C (2462 °F)
- Filtering device, heated to 180 °C (356 °F)
- Sample gas line, heated to 180 °C (356 °F), length up to 60 m (200 ft). Length depending on installation location altitude, other lengths and temperature on request.
- Protective cover for probe
- Probe back purge module (optional)
- Automatic injection of test gases at probe for drift check (optional)

Sample gas conditioning

- Heated sample gas conditioning block with built-in stainless steel micro-porous filter
- Air driven aspirator pump module
- Connection and automatic switchover for zero and test gas supply
- Flow, pressure and temperature monitoring

Analyzers

- FTIR spectrometer with heated sample cell
- VOC analyzer (FID detector, optional)
- Oxygen analyzer (ZrO₂ detector, optional)

Control, display and operation

- Display and operator control unit built into cabinet door
- AO2000 system controller
- Control module for the injector pump
- Interfaces for measured values and status signals (standard: Ethernet with TCP/IP protocol and Modbus TCP/IP protocol, options: Modbus, PROFIBUS, analog and digital outputs, analog and digital inputs) as well as remote control and diagnosis (modem and/or Ethernet)
- Prepared for uninterrupted power supply of the most vital subassemblies (optional)

Air purification unit

A compressed-air purification unit (molecular sieve) is used to provide zero gas for the FTIR spectrometer and reference gas for the oxygen analyzer. Purge air is also used by the spectrometer and to purge the analysis system in the event of heating failure or loss of power.

... System description

Operation

The software installed in the system controller operates the analysis system completely automatically. It allows the following functions:

- Display of all measured results and clear status messages
- Manual operation of the system for commissioning and service
- Local operation for service purposes via Ethernet interface
- Remote diagnosis via UMTS
- Self-diagnosis of the FTIR spectrometer and archival of the status signal and measured data
- Optional automatic correction for dry/wet basis and reference measurement (to a fixed O₂ value)

The FTIR results are updated approx. every 30 seconds.

The system controller continuously monitors the temperature, pressure and gas flow to ensure automatic correction, reliability and precise measurement.

If the temperature of any heated module of the analysis system falls below the minimum allowed, a stream of clean air purge is triggered to protect all subassemblies that are in contact with the sample gas.

The Ethernet interface allows the analysis system to be coupled to the plant network for transfer of measured values and status signals. Data can be read using the AnalyzeIT Explorer or AO-OPC Server software tools.

The UMTS connections give access to the ABB Service Department (when enabled by the customer) for remote diagnosis and preventive maintenance scheduling which enables maximum system availability.

Adjustment

All FTIR device-dependent factors are taken into account through the daily automatic recording of the zero spectrum.

Since absorption spectra are absolute and do not drift, zero and span are effectively automatically corrected using zero gas only.

N₂ is used for zero adjustment of the VOC analyzer. 3 % of O₂ is used for zero adjustment of the O₂ sensor.

Manual adjustment check with gases and water vapor can easily be done at the analyzer cell or at the sampling probe according to internationally recognized requirements.

Validation unit for automatic span drift check without test gases

The ACF5000 can be optionally equipped with a validation unit as an alternative to flowing test gas for the FTIR spectrometer.

The validation unit is a disc with six holes of which five holes hold films or gas filled cells which can be swiveled into the optical path causing a spectral absorption for the corresponding components, e.g. HCl.

Hence the validation unit can be used to monitor precision and drift, e.g. as part of a QAL3 procedure or any other drift-monitoring procedure.

The benefit is that there is no need to introduce any test gases during normal operation. Only if a deviation between the expected value and the measuring value is detected, test gases are required to check the deviation.

Option 'Hydrogen monitoring'

Function

The 'Hydrogen monitoring' option is an additional safety measure when an FID is built-in in the analyzer system. If a leak occurs in the hydrogen path inside the analyzer cabinet and hydrogen accumulates inside the cabinet, both the hydrogen supply and the power supply are shut off before the explosion limit is reached – at 40% LEL. This prevents formation of an ignitable mixture.

Scope of supply and delivery

An ATEX-certified gas sensor with connection socket is installed in the analyzer cabinet. A solenoid valve that interrupts the hydrogen supply at 40% LEL and at power supply failure (H₂ safety valve) is installed outside on the right-side wall. A gas warning center for evaluating the gas sensor signal, a contactor for disconnecting the power supply to the analyzer cabinet, and a contactor for disconnecting the UPS if the system is prepared for a UPS are also supplied.

Certification

- CEM system certification according to EN 15267 parts 1 to 3 and EN 14181. Maintenance interval 12 months (MCERTS) and 6 months (TÜV). An internal validation unit can be used as an alternative to external test gas cylinders.
- Suitability for measurement tasks according to European Directives 2010/75/EC, 2000/76/EC, 2001/80/EC and quality assurance according to EN 14181
- The current product conformity certificates are available on <https://www.gal1.de/en/index.htm> and <https://www.csagroupuk.org/services/mcerts/mcerts-product-certification/mcerts-certified-products/>.
- Compliance to US EPA 40 CFR 60 and 40 CFR 75

Technical data

Measured components and measuring ranges

Measured components	Lowest ranges	
FTIR spectrometer ¹⁾		
H ₂ O	0 to 40 vol.%	
CO ₂	0 to 30 vol.%	
CO	0 to 75 mg/m ³	0 to 60 ppm
NO	0 to 150 mg/m ³	0 to 110 ppm
NO ₂	0 to 80 mg/m ³	0 to 40 ppm
N ₂ O	0 to 50 mg/m ³	0 to 25 ppm
SO ₂	0 to 75 mg/m ³	0 to 25 ppm
NH ₃	0 to 5 mg/m ³	0 to 7 ppm
HCl	0 to 15 mg/m ³	0 to 10 ppm
HF	0 to 3 mg/m ³	0 to 3 ppm
CH ₄	0 to 7.5 mg/m ³	0 to 10 ppm
CH ₂ O	0 to 20 mg/m ³	0 to 15 ppm
VOC ²⁾	0 to 30 mg/m ³	0 to 56 ppm
VOC analyzer (FID)		
VOC	0 to 15 mg/m ³	0 to 28 ppm
Oxygen analyzer		
O ₂	0 to 25 vol.%	

- 1) FTIR spectrometer performance is based on an optical path length of 3.2 m (10.5 ft)
- 2) VOC measured with FTIR (for process measurement only) is composed of the organic compounds methane (CH₄), ethane (C₂H₆), propane (C₃H₈), benzene (C₆H₆), toluene (C₇H₈) and dichloromethane (CH₂Cl₂).

Measuring ranges within ignition limits cannot be provided.

Other measured components and measuring ranges on request.

Performance for low measuring ranges in accordance with EN 15267

Cross-sensitivity

< ±4 % of measuring range

Linearity

< ±2 % of measuring range

Sensitivity drift

< ±3 % in maintenance interval

Zero drift

Corrected automatically

Response time (analysis system)

T₉₀ < 200 seconds, T₉₀ < 400 seconds for HCl, NH₃ and HF

Influence of ambient temperature changes

< ±5 % of measuring range per 10 K (18 °F) temperature change

Air pressure influence

None (automatically corrected through internal pressure compensation)

Limit of detection (2σ)

≤ 2 % of measuring range

System design

Design

Free standing cabinet in sheet metal, air conditioning unit optional

Protection class

IP54

Dimensions

See 'System design: Exterior view', page 7

Weight

Approx. 300 kg (660 lb)

Color

Light gray (RAL 7035)

Input, output and status signals

Measured signals

Output via Ethernet or Modbus TCP (analog and digital outputs, Modbus and PROFIBUS optional)

Status signals

Output and status signals from the measured concentrations, gas transport, sample conditioning system and operation are displayed on the built-in LCD display. Status signals: System failure, maintenance mode, maintenance request.

Additional status information for option with analog and digital outputs: Oxygen analyzer error, VOC analyzer / ASP failure and FTIR failure. Digital relay outputs: Floating contacts, open in unpowered state (fail safe).

Input signals

Analog and digital signals possible

Gas connections

Sample gas inlet

Special support for heated line in the right cabinet wall; screw fitting at ASP block for heated line TBL01-S (4/6 × 1 mm or ¼ in)

Sample gas outlet

Bulkhead union (stainless steel) for pipe 12 mm or ½ in

Test gases

Bulkhead unions for hose (PTFE) 4/6 × 1 mm or ¼ in

Instrument air

Connected to the aspirator pump module and compressed-air purification unit (hose 8/6 × 1 mm or ⅜ in).

Quality: Based on ISO 8573-1:2001 Class 2 (max. particle size 1 to 5 µm, max. 10 particles/m³, max. oil content 0.1 mg/m³, max. vapor pressure dew point -40 °C [-40 °F]). The requirement is for compressed air at 5.5 to 7 bar (80 to 100 psi), consumption 3000 to 4000 l/h (1.8 to 2.4 cfm).

Combustion gas for FID

Bulkhead union (stainless steel) with flow restrictor (max. 10 l/h H₂) for pipe 4/6 × 1 mm or ¼ in (option, when an FID is built-in in the analyzer system)

... Technical data

Power supply

Input voltage

230/400 V 3 Ph, N, PE or
 120/208 V 3 Ph, N, PE or
 100/200 V 3 Ph, N, PE (optional, with transformer),
 ± 10 %, 48 to 62 Hz.
 Non-floating PEN conductor not allowed.

Power consumption

System incl. probe filter	
at power-up	approx. 2200 VA
during operation	approx. 1500 VA
Heated probe tube type 42	approx. 800 VA
Heated sampling line TBL01	approx. 90 VA/m
Air conditioning unit (optional)	approx. 1000 VA
Prepared for UPS (optional)	approx. 500 VA

Overvoltage category/pollution degree

II/2

Service socket

230 VAC or 120 VAC, 48 to 62 Hz, max. 5 A
 (located in the cabinet light)

Sample gas inlet conditions

Temperature

Controlled at $180 \pm 2 \text{ °C}$ ($356 \pm 3.6 \text{ °F}$)

Pressure

Analysis cabinet inlet to sample gas conditioning block:
 900 to 1100 hPa (0.9 to 1.1 bar [13 to 16 psi]), lower pressure on request

Flow rate

Approx. 300 l/h (0.18 cfm)

Environmental conditions

Ambient temperature

In operation	
without air conditioning unit	5 to 30 °C (41 to 86 °F)
with air conditioning unit (option)	5 to 45 °C (41 to 113 °F)
During storage and transport	-25 to 65 °C (-13 to 149 °F)

Relative humidity

Max. 75 % as an annual average, max. 95 % for short periods, occasional and light condensation is permissible, supposed powered and purged system

Installation location

The analysis system is intended for indoor use only. The analysis system should be protected against radiated heat, heavy concentrations of dust, corrosive atmospheres and vibrations.

Installation location altitude max. 720 m (2360 ft) above sea level in accordance with EN 15267 (for length of sample gas line incl. probe = 60 m [200 ft]); greater altitudes on request.

Minimum distances for analyzer cabinet installation:

Right	0.5 m (20 in)	for the gas lines and the electrical lines as well as for air entry into the fan (option)
Left	0.5 m (20 in)	for air discharge from the fan (option)
	1.0 m (40 in)	for the air conditioning unit (option)
Front	1.0 m (40 in)	for opening the door (hinged on the left)
Top	0.5 m (20 in)	

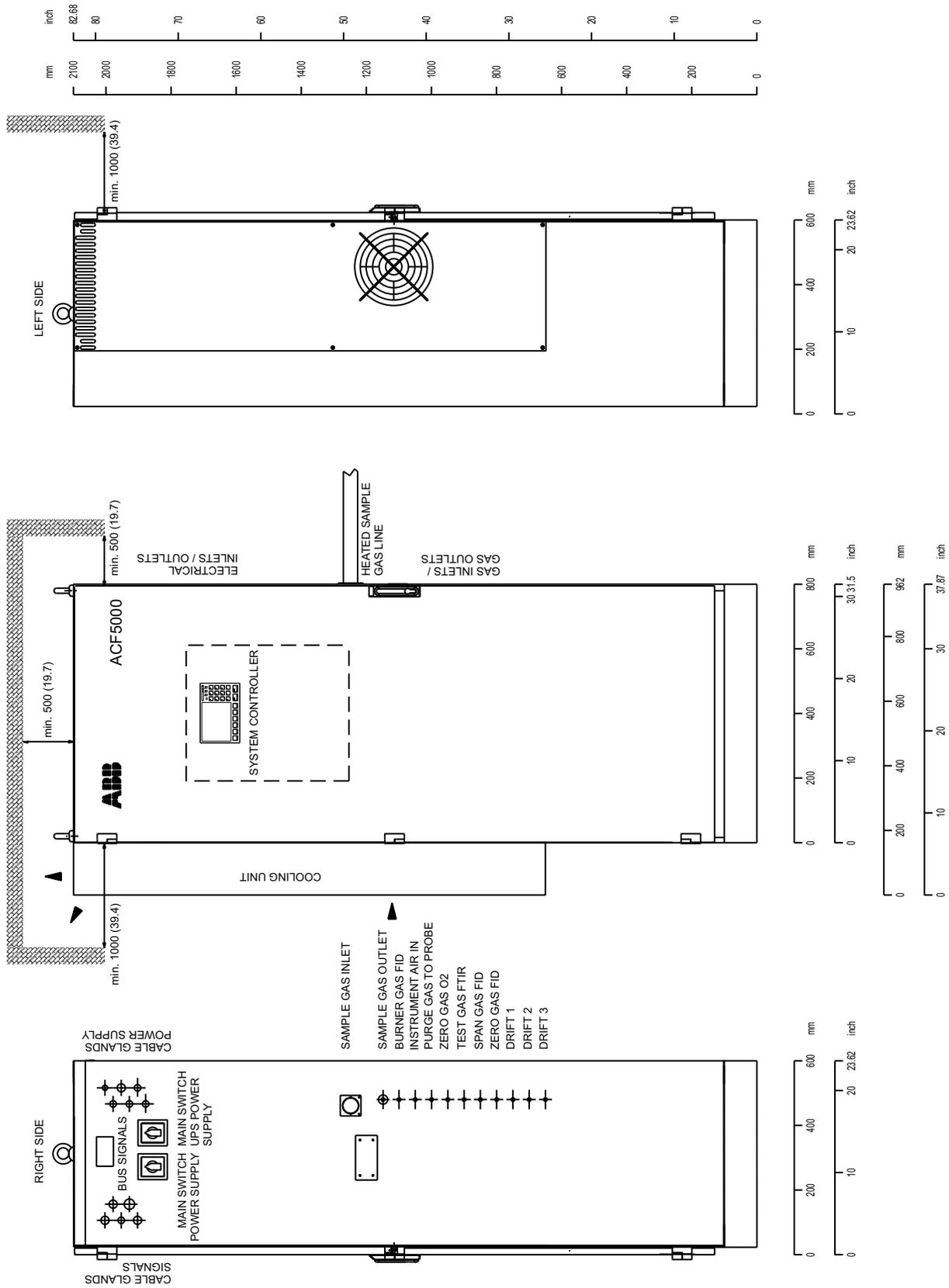
Storage and transport

It is mandatory that the cabinet or the FTIR spectrometer is hermetically sealed during storage and transport.

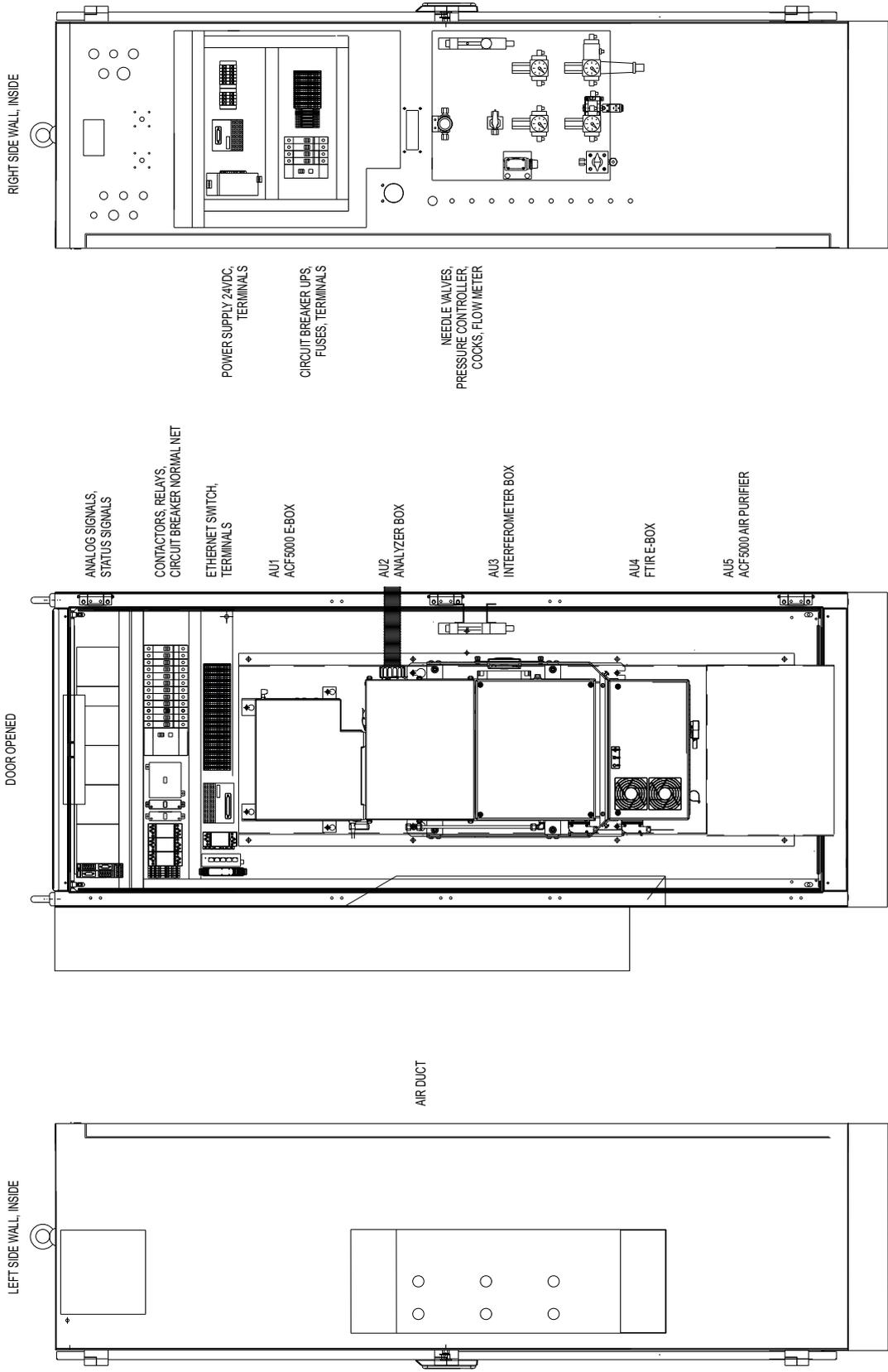
Note

The drawings on the following pages are for general information only. Each individual analysis system is delivered with a set of drawings specific to the order.

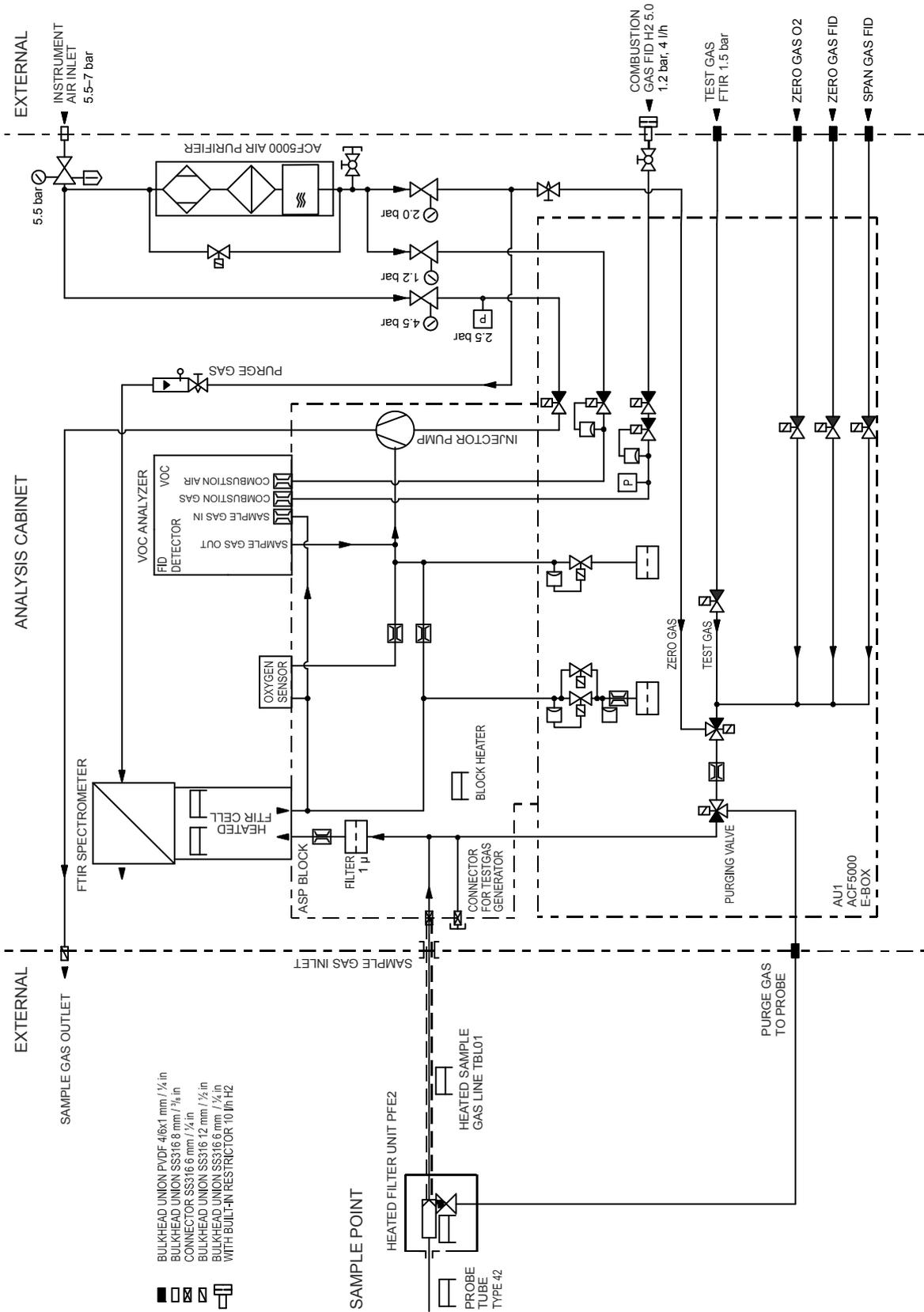
System design: Exterior view



System design: Interior view



Pneumatics diagram



Electrical connections: Power supply, CE version

POWER SUPPLY (BY CUSTOMER)
 FUSE-PROTECTION EXTERNAL 3x 20 A
 CABLE 5x 6 mm² (3x 25 A)
 CABLE GLAND M32
 (CABLE DIA. RANGE 7-15mm)

UPS POWER SUPPLY (BY CUSTOMER)
 FUSE-PROTECTION EXTERNAL 20A
 CABLE 3x 2.5 mm²
 CABLE GLAND M25
 (CABLE DIA. RANGE 6-13mm)

SAMPLE
 HEATER SAMPLE TUBE TYPE 42(-E84/-E85)
 CABLE 3x 1,5 mm²
 CABLE GLAND M25
 (CABLE DIA. RANGE 6-13mm)

CABLE 3x 0,75 mm²
 CABLE GLAND M20
 (CABLE DIA. RANGE 5-10mm)

CONNECTION VIA TERMINAL BOX ON-SITE

SAMPLE
 HEATER FILTER UNIT PFE2 (-E86)
 CABLE 3x 1,5 mm²
 CABLE GLAND M20
 (CABLE DIA. RANGE 5-10mm)

CABLE 3x 0,75 mm²
 CABLE GLAND M20
 (CABLE DIA. RANGE 5-10mm)

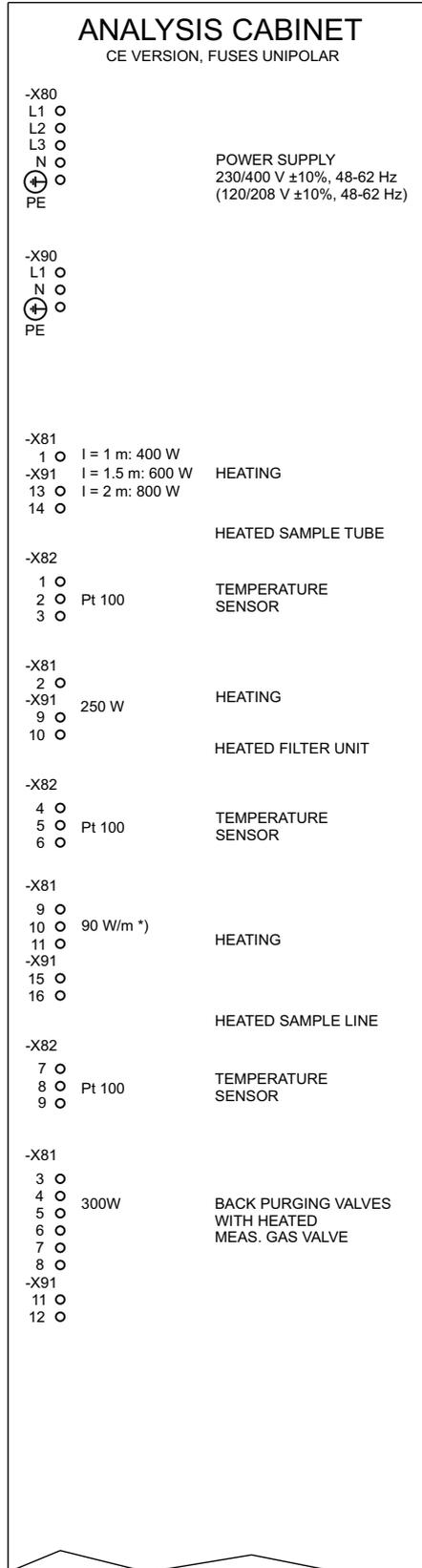
CONNECTION VIA TERMINAL BOX ON-SITE

HEATED SAMPLE LINE TBL01 (-E83)
 CABLE 5x2,5 mm² OR 3x2,5mm²
 CABLE GLAND M25
 (CABLE DIA. RANGE 6-13mm)

CABLE 3x 0,75 mm²
 CABLE GLAND M20
 (CABLE DIA. RANGE 5-10mm)

SAMPLE
 SOLENOID VALVES BACK PURGING
 (-Y3.1/-Y1.1/-Y2.1/-Y4/-Y5) AND
 HEATER MEAS. GAS VALVE (-E87/-E88)
 CABLE 10x 1,5 mm²
 CABLE GLAND M25
 (CABLE DIA. RANGE 6-13mm)

*) max. LENGTH
 @ 230/400V
 l ≤ 35 m [114.8 ft] (1~)
 l > 35...60 m [114.8...196.9 ft] (3~)
 @ 120/208V
 l ≤ 15 m [49.2 ft] (1~)
 l > 15...40 m [49.2...131.2 ft] (3~)



Electrical connections: Power supply, CSA version

POWER SUPPLY (BY CUSTOMER)
 FUSE-PROTECTION EXTERNAL 3x25A
 CABLE 5xAWG8
 CABLE GLAND M32
 (CABLE DIA. RANGE 0.28-0.59")

UPS POWER SUPPLY (BY CUSTOMER)
 FUSE-PROTECTION EXTERNAL 20A
 CABLE 3xAWG14
 CABLE GLAND M25
 (CABLE DIA. RANGE 0.24-0.51")

SAMPLE
 HEATER SAMPLE TUBE TYPE 42(-E84/-E85)
 CABLE 3xAWG16
 CABLE GLAND M25
 (CABLE DIA. RANGE 0.24-0.51")

CABLE 3xAWG20
 CABLE GLAND M20
 (CABLE DIA. RANGE 0.2-0.39")

SAMPLE
 HEATER FILTER UNIT PFE2 (-E86)
 CABLE 3xAWG16
 CABLE GLAND M20
 (CABLE DIA. RANGE 0.2-0.39")

CABLE 3xAWG20
 CABLE GLAND M20
 (CABLE DIA. RANGE 0.2-0.39")

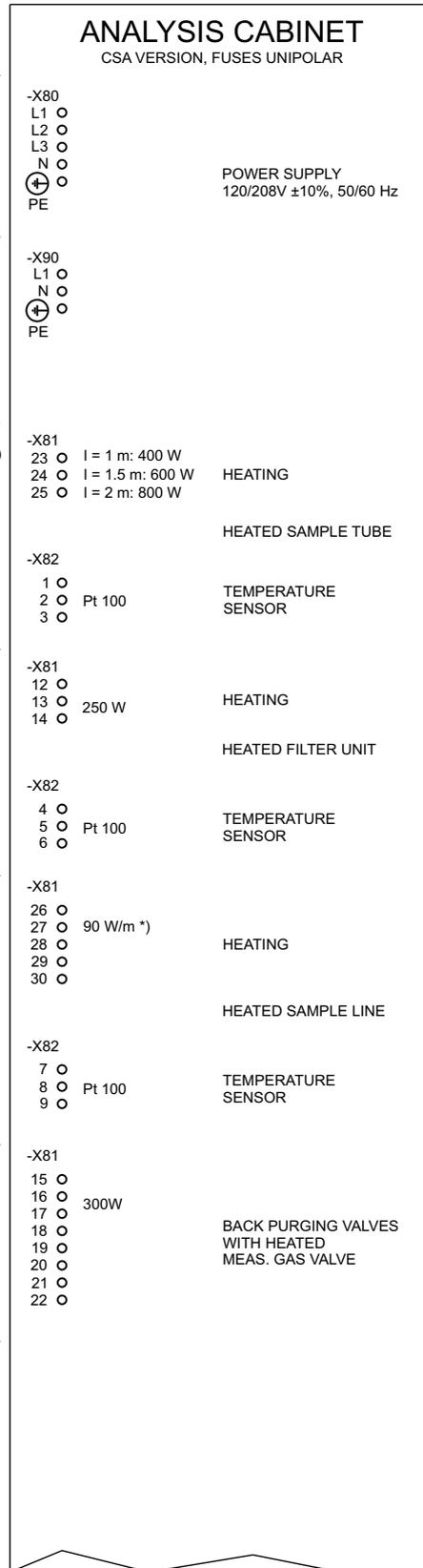
HEATED SAMPLE LINE TBL01 (-E83)
 CABLE 5xAWG14 OR 3xAWG14
 CABLE GLAND M25
 (CABLE DIA. RANGE 0.24-0.51")

CABLE 3xAWG20
 CABLE GLAND M20
 (CABLE DIA. RANGE 0.2-0.39")

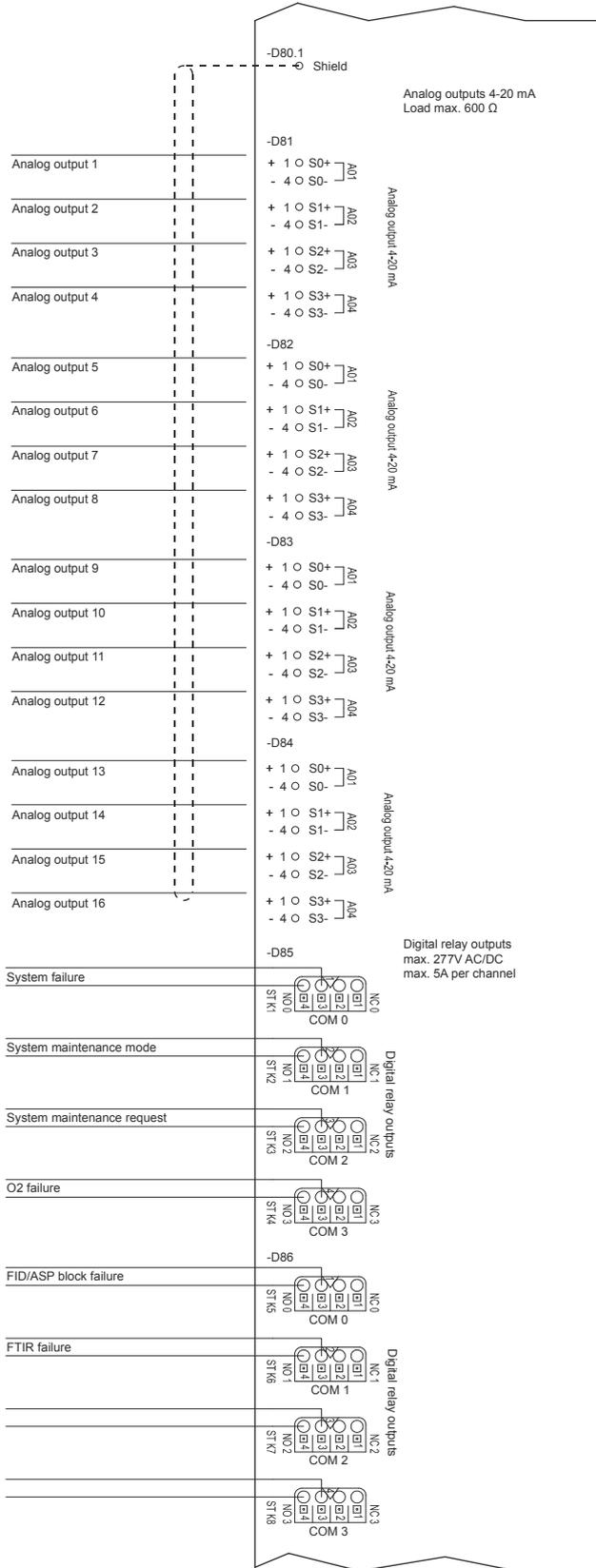
SAMPLE
 SOLENOID VALVES BACK PURGING
 (-Y3.1/-Y1.1/-Y2.1/-Y4/-Y5) AND
 HEATER MEAS. GAS VALVE (-E87/-E88)
 CABLE 10xAWG16
 CABLE GLAND M25
 (CABLE DIA. RANGE 0.24-0.51")

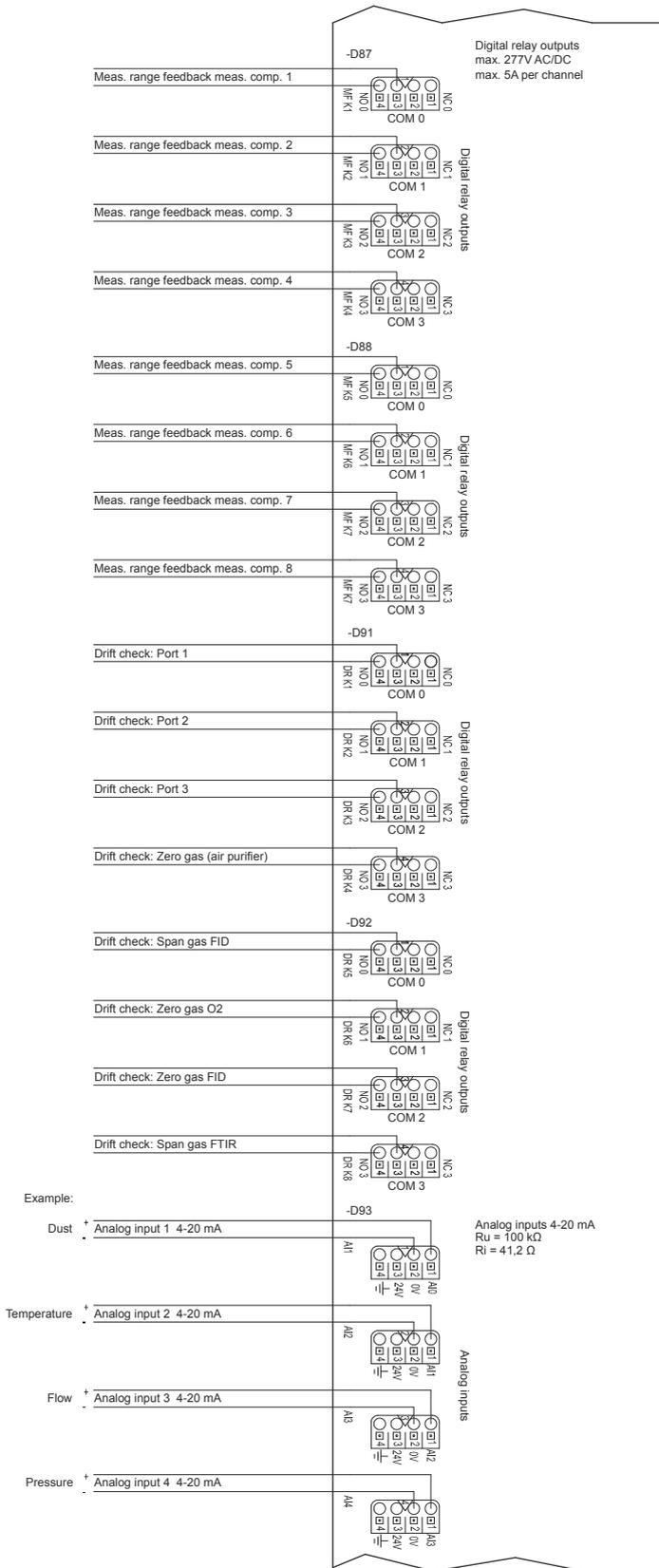
*) max. LENGTH
 @ 120/208V

l ≤ 15 m [49.2 ft] (1~)
 l > 15...40 m [49.2...131.2 ft] (3~)



Electrical connections: Input, output and status signals





... Electrical connections: Input, output and status signals

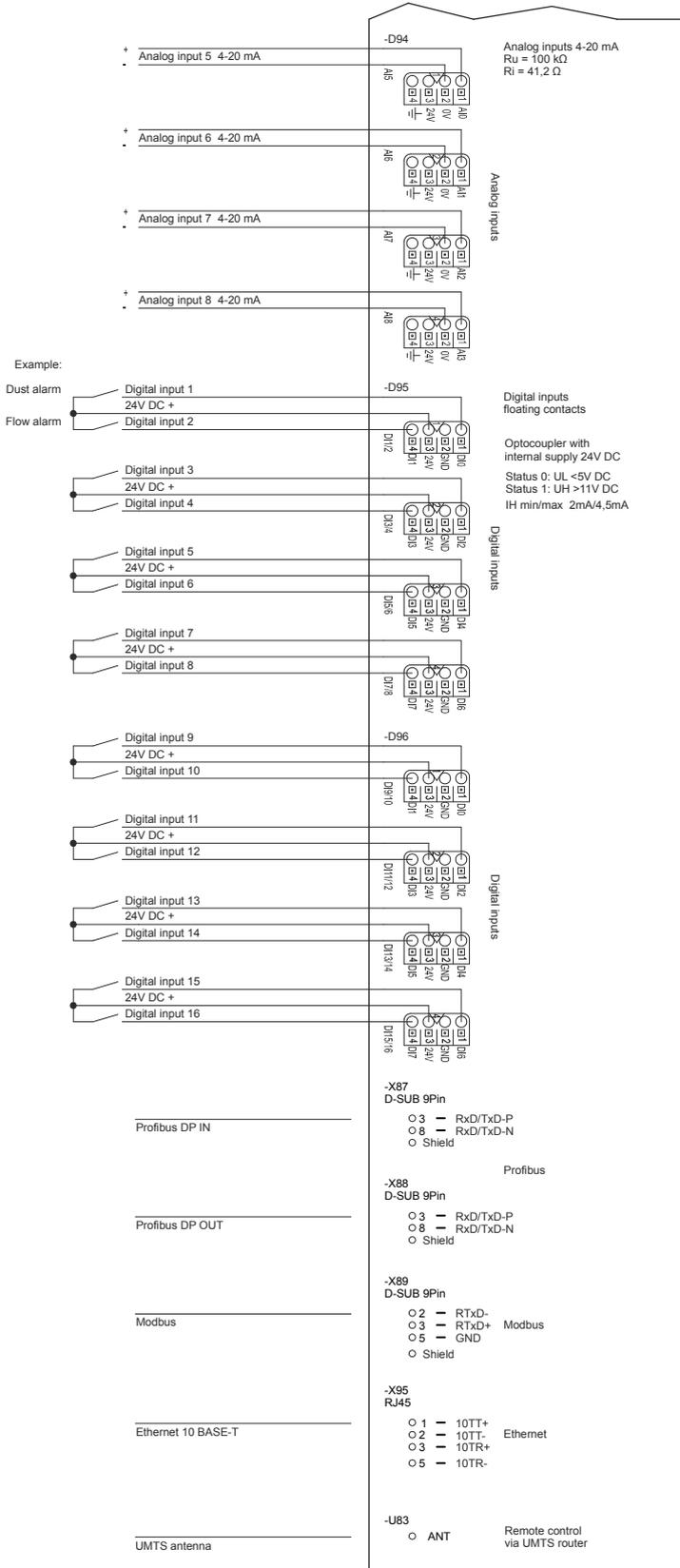




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