Data sheet DS/ACF5000-EN Rev. I

ACF5000
Multi-component FTIR emission monitoring system

Measurement made easy

From the pioneers in FTIR CEMS

Continuous, quantitative and selective measurement of HCl, HF, H_2O, CO, CO_2, SO_2, NO, NO_2, CH_4, NH_3, N_2O, H_2CO, O_2 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 O_2 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)

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Introduction

Application and design

As a result of the growing requirements in the field of environmental monitoring, increasing number of pollutants and with lower concentrations has to be measured from combustion processes.
World leader in stack gas monitoring systems for decades and pioneer in FTIR technology, ABB Analytical 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. As a result 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, NH_3 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. Thus, no moving part is used resulting in less maintenance. 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.

Applications

- Municipal waste incinerators
- Biomedical and sludge incinerators
- Hazardous waste incinerators at chemical plants
- Gasification and pyrolysis processes
- Cement kilns
- Solvent recovery and destruction
- DeNOx and DeSOx 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
- Oxygen analyzer (ZrO_2 detector, optional)
- VOC analyzer (FID 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 via Ethernet (OPC) and Modbus TCP (analog and digital outputs, Modbus and PROFIBUS optional)
  - Remote diagnostics via Ethernet and UMTS (optional)
- 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 also to purge the analysis system in the event of heating failure or loss of power.

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 O_2 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.

N_2 is used for zero adjustment of the VOC analyzer. 3 % of O_2 is used for zero adjustment of the O_2 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.

Certification

- CEM system certification according to EN 15267 parts 1–3. 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
- MCERTS certificate available
- Compliance to US EPA 40 CFR 60 and 40 CFR 75

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Technical data

Measured components and measuring ranges

FTIR spectrometer [1]	Lowest ranges	
H_2O	0–40 vol.%	
CO_2	0–30 vol.%	
CO	0–75 mg/m³	0–60 ppm
NO	0–150 mg/m³	0–110 ppm
NO_2	0–80 mg/m³	0–40 ppm
N_2O	0–50 mg/m³	0–25 ppm
SO_2	0–75 mg/m³	0–25 ppm
NH_3	0–5 mg/m³	0–7 ppm
HCl	0–15 mg/m³	0–10 ppm
HF	0–3 mg/m³	0–3 ppm
CH_4	0–7.5 mg/m³	0–10 ppm
CH_2O	0–20 mg/m³	0–15 ppm
VOC [2]	0–30 mg/m³	0–56 ppm
VOC analyzer (FID)		
VOC	0–15 mg/m³	0–28 ppm
Oxygen analyzer		
O_2	0–25 vol.%	

1) FTIR spectrometer performance is based on an optical path length of 3.2 m / 126 in.

2) VOC measured with FTIR (for process measurement only) is composed of the organic compounds methane (CH_4), ethane (C_2H_6), propane (C_3H_8), benzene (C_6H_6), toluene (C_7H_8) and dichloromethane (CH_2Cl_2).

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)
T_{90} < 200 seconds, T_{90} < 400 seconds for HCl, NH_3 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 Section “System design (exterior view)”, page 6

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 (4/6 x 1 mm)

Sample gas outlet

Screw fitting (steel) for pipe 12 mm or ½ in.

Test gases

Screw fittings for hose (PTFE) 4/6 x 1 mm or ¼ in.

Instrument air

Connected to the aspirator pump module and compressed-air purification unit (hose 4/6 x 1 mm or ¼ in.).
Quality: Based on ISO 8573-1:2001 Class 2 (max. particle size 1–5 µm, max. 10 particles/m^3, max. oil content 0.1 mg/m^3, max. vapor pressure dew point –40 °C / –40 °F). The requirement is for compressed air at 5.5–7 bar / 80–100 psi, consumption 3000–4000 l/h / 1.8–2.4 cfm.

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 W
during operation	approx. 1500 W
Heated probe tube type 42	approx. 800 W
Heated sampling line TBL01	approx. 90 W/m
Air conditioning unit (optional)	approx. 1000 W
Prepared for UPS (optional)	approx. 500 W

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 ± 2 °C / 356 ± 3.6 °F

Pressure

Analysis cabinet inlet to sample gas conditioning block: 900–1100 hPa (0.9–1.1 bar / 13–16 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 (optional)	+5 to +45 °C / +41 to +113 °F
During storage and transport	–25 to +65 °C / –13 to +149 °F

Relative humidity

≤ 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.
Minimum distances for analyzer cabinet installation:

Right	min. 500 mm / 20 in. for the connected cables and pipes
Left	min. 1000 mm / 40 in. for the air conditioning unit (optional)
Front	min. 1000 mm / 40 in. to open the door (hinged at left)
Top	min. 500 mm / 20 in. with air conditioning unit (optional)

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.

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.

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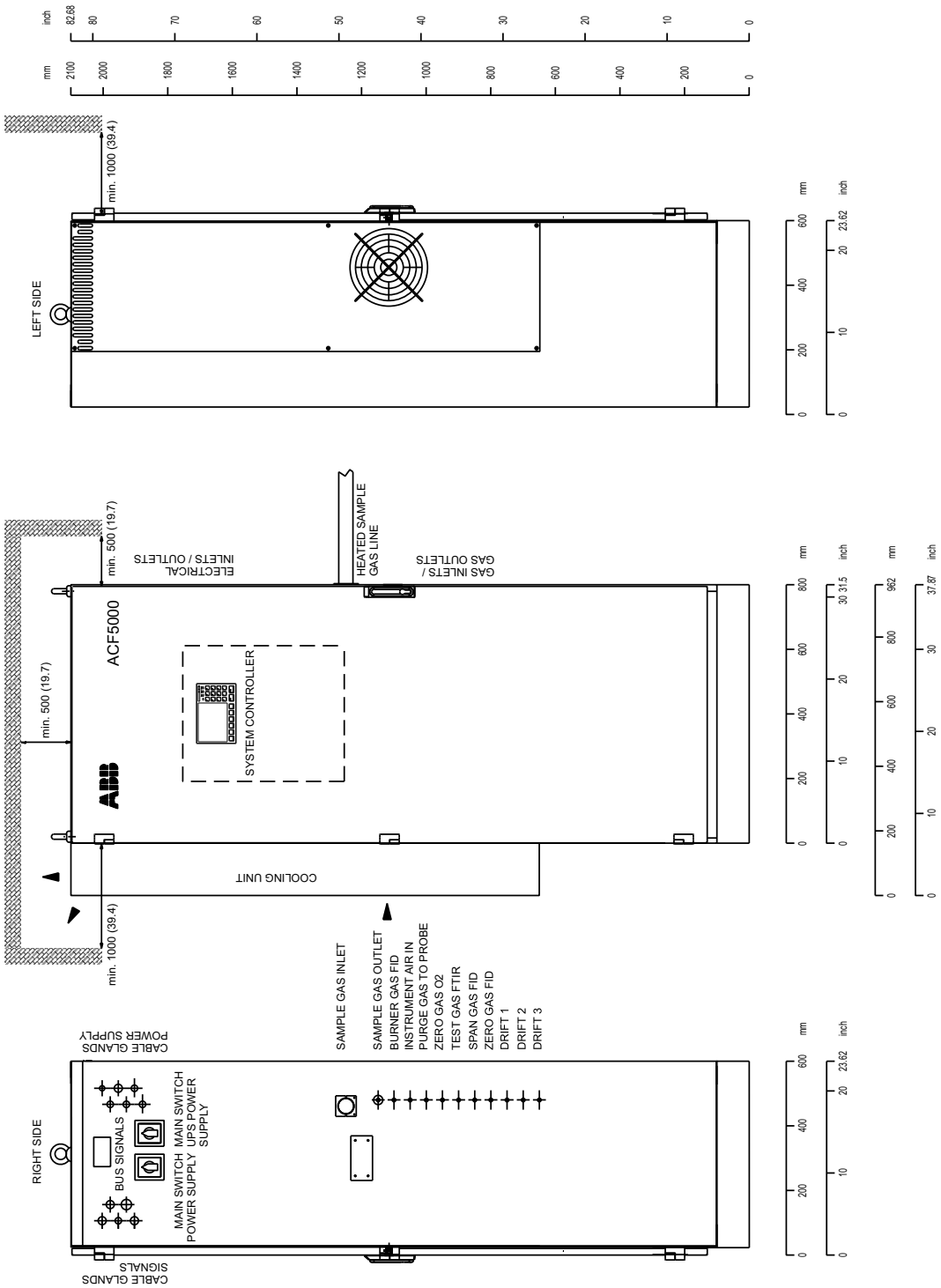
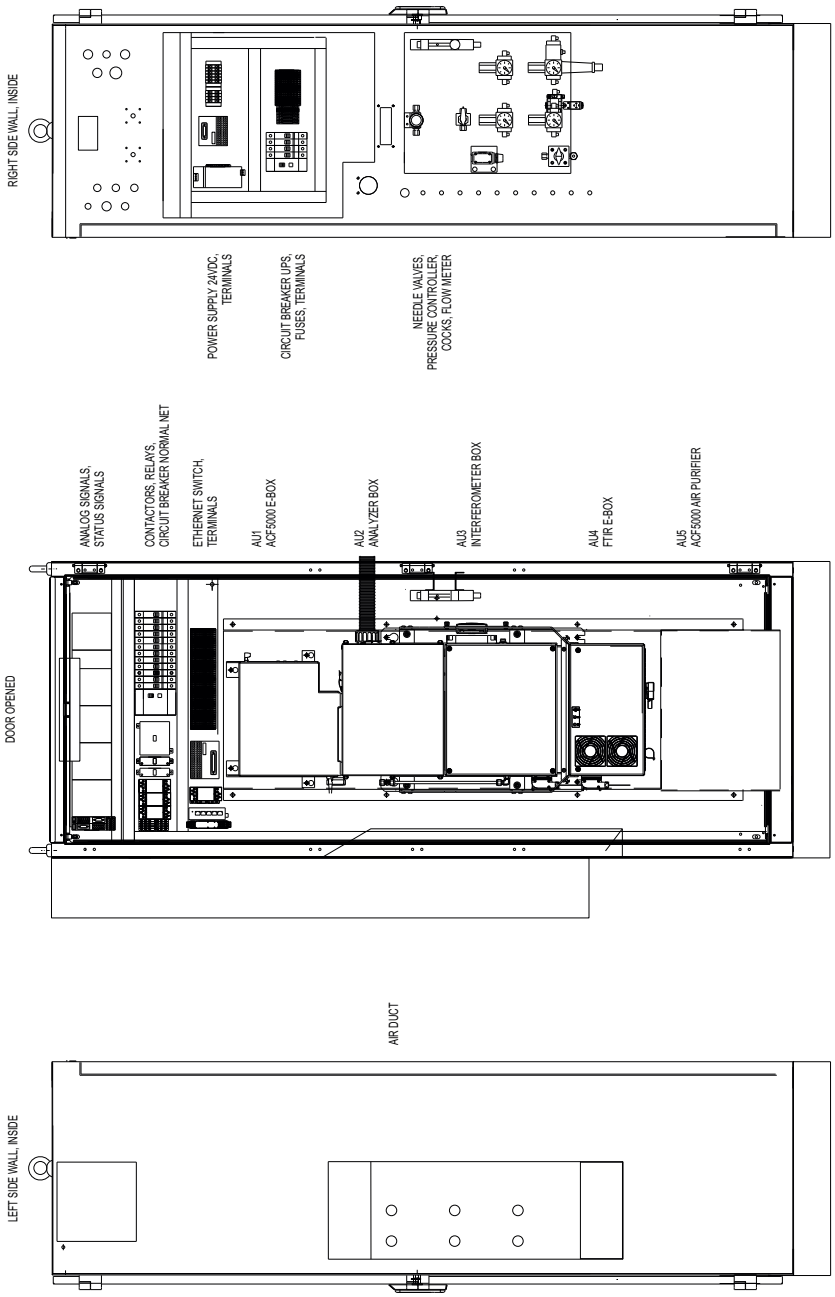
System design (exterior view)

Dimensions in mm (inch)



System design (interior view)



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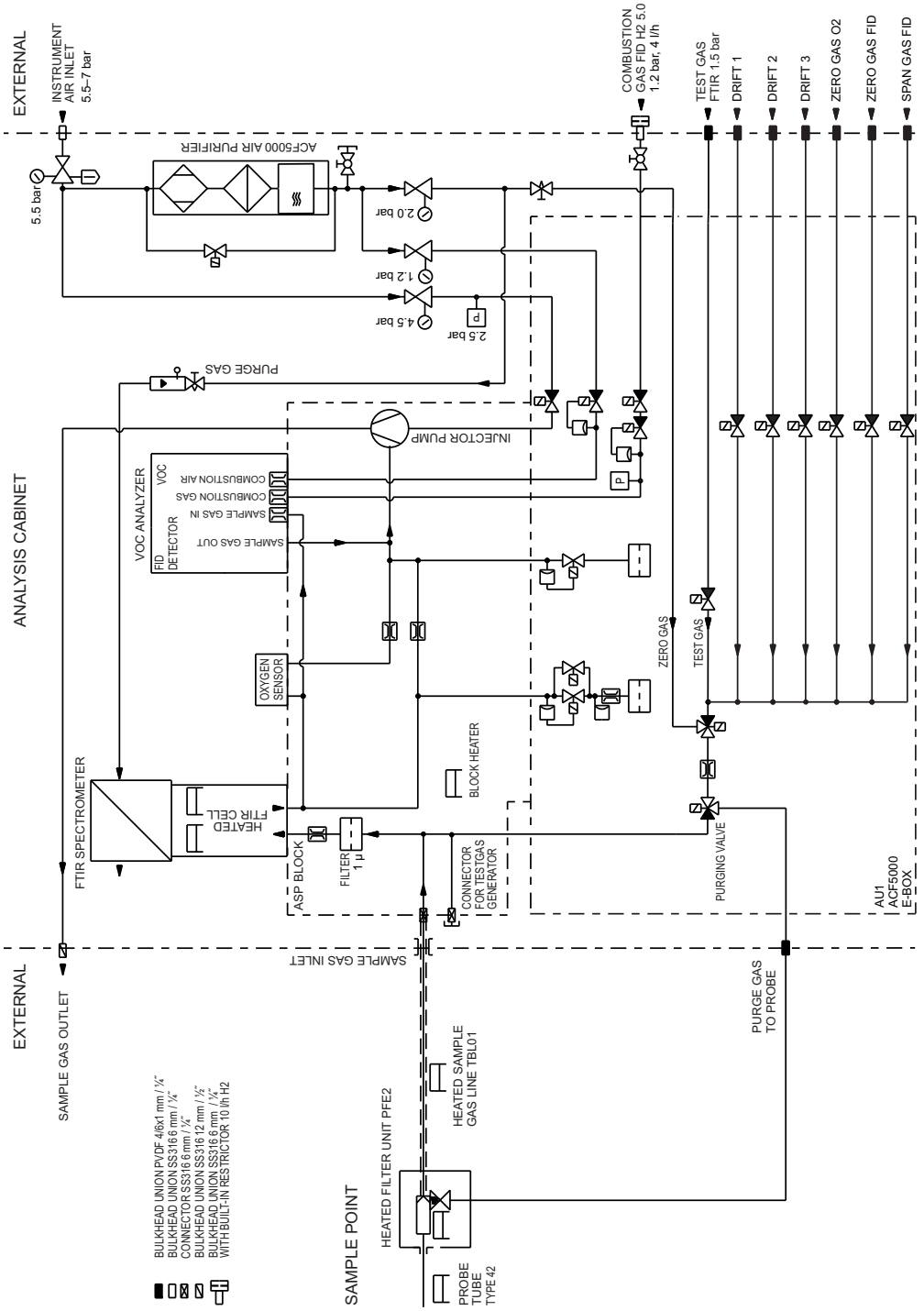
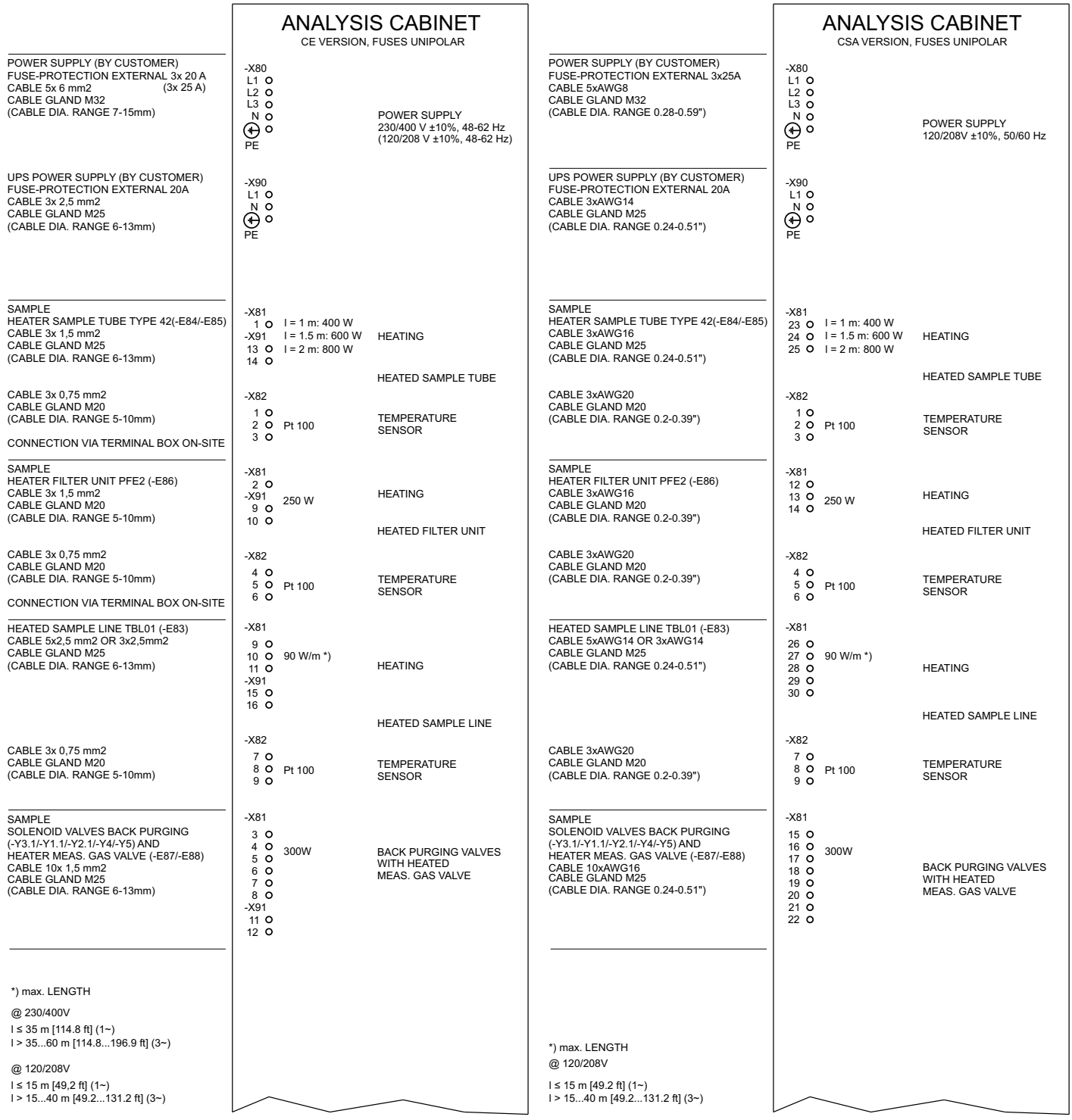
Pneumatics diagram



Connection diagram (power supply, CE version and CSA version)



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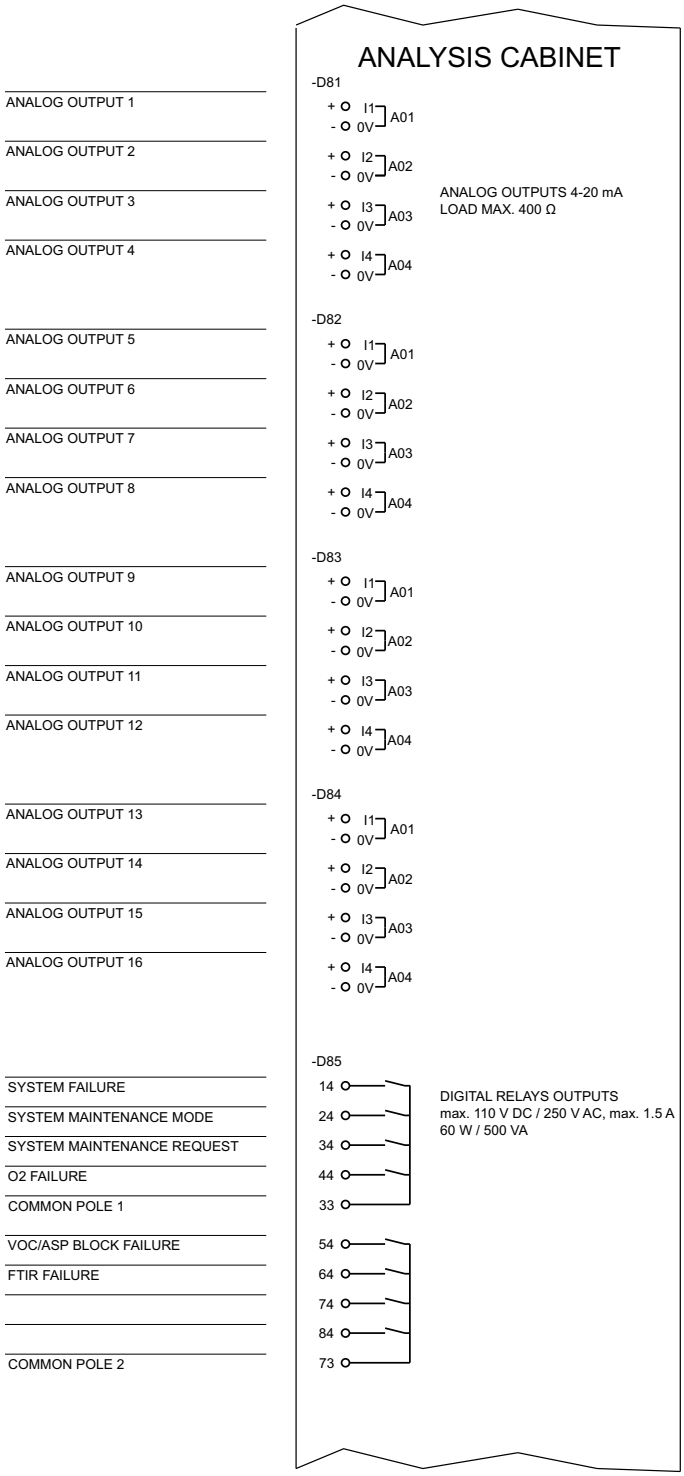
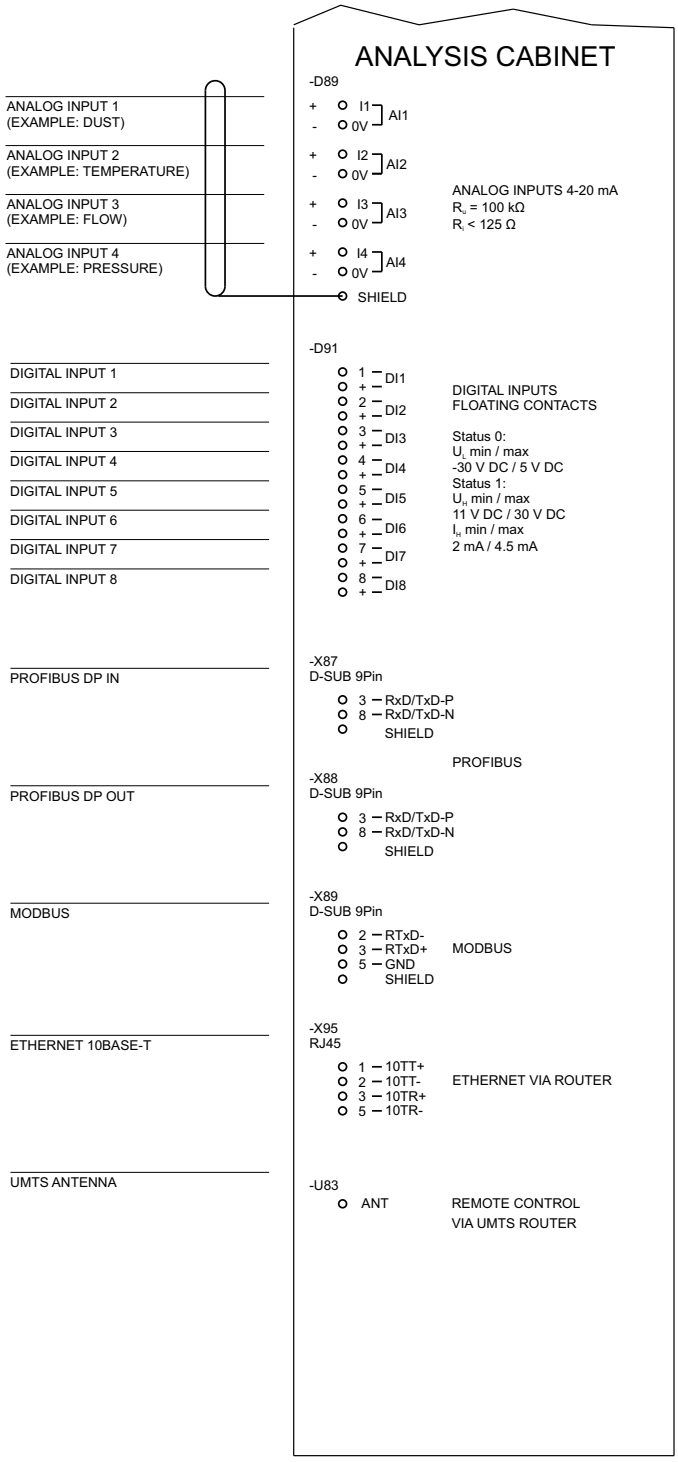
Connection diagram (analog and digital outputs)



Connection diagram (analog and digital inputs, digital interfaces)



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