

ABB MEASUREMENT & ANALYTICS | DATA SHEET | DS/AFM631-EN REV. C

AFM631

Aztec 600 ISE fluoride analyzer



Measurement made easy

Reliable on-line monitoring of fluoride in drinking water

Reliable fluoride measurement

- continuous measurement using ISE technology
- automatic 2-point calibration
- temperature-controlled flow cell
- buffered measurement for improved accuracy

Easy to operate

- familiar Windows™ menu system
- built-in context-sensitive help
- data trending and analysis

Easy to maintain

- simple-to-perform annual service
- helpful maintenance diagnostics screens

Improved reporting

- audit and alarm logs
- onboard data logging
- in-built SD card reader for secure archiving

Full communications

- web- and ftp-enabled for easy data file access, remote viewing and configuration
- email capability
- optional PROFIBUS® DP V1.0

The Aztec 600 colorimetric range

The Aztec 600 analyzers from ABB are a range of compact, yet reliable, on-line ion-selective (ISE) and colorimetric analyzers designed for monitoring the key parameters in water treatment.

They combine Aztec's unique fluid handling system with the latest electronics platform (featuring Windows menu system), to create a range of analyzers that provide accurate, reliable measurement, that are simple-to-operate and maintain.

The following parameters are available in the Aztec 600 range:

Colorimetric:

- aluminium
- ammonia
- color
- iron
- manganese
- phosphate

ISE:

- ammonia
- fluoride



Figure 1 Aztec 600 Colorimetric analyzer (left) and Aztec 600 ISE analyzer (right)

Aztec 600 ISE fluoride analyzer

The Aztec 600 fluoride analyzer has been designed specifically for the measurement of fluoride in drinking water for fluoridation schemes.

It offers continuous, reliable and accurate on-line analysis of fluoride levels in surface waters, boreholes and treated waters up to 100 mg/l F⁻.

Users of this system also benefit from the AFM631's low maintenance requirements, ease of use, auto-calibration and proven chemistry methodology.

Process data, as well as the content of alarm and audit logs, can be saved to a removable SD card for record keeping and analysis using ABB's DataManager Pro data analysis software.

Applications

Typical applications for the AFM631 include:

- monitoring of fluoride levels in source water
- monitoring of drinking water fluoridation
- monitoring of defluoridation processes

Drinking water fluoridation

In many parts of the world, fluoride is added to public water supplies to help improve dental health. This process is called water fluoridation.

Fluoride is found in all natural waters at some concentration. Surface waters generally have low concentrations of fluoride of less than 0.5 mg/l, although groundwater may contain much higher levels of fluoride if it has been exposed to many inorganic fluoride-containing minerals.

Studies have shown that the addition of low concentrations of fluoride of 1 mg/l can assist in reducing the incidence of tooth decay. However, excessive exposure to fluoride in drinking water can induce dental fluorosis (the brown staining and / or pitting of teeth). Long-term exposure to high levels of fluoride can also lead to skeletal fluorosis.

It is therefore essential that water companies are able to accurately monitor and regulate fluoride doses within the prescribed limits.

User benefits of on-line fluoride monitoring using the AFM631

The need for accurate dosing

Given the potentially hazardous nature of the chemicals used in fluoridation, and the potential consequences of over-fluoridation, the addition of fluoride to drinking water must be accurately controlled and carefully monitored to ensure that locally-set prescribed operational criteria is adhered to.

Accurate dosing of the chemicals used to fluoridate the water can be further complicated by underlying levels of natural fluoride in certain areas. In these areas, the dosing of chemicals to the water supply must be adjusted to take account of the existing background natural levels.

The Aztec 600 solution

The Aztec 600 fluoride analyzer provides a continuous measurement of the fluoride residual so that the chemical dose can be controlled automatically or trimmed by adjusting the pump stroke to maintain the target fluoride dose concentration.

Controlling the fluoride dose based on the continuous fluoride residual, as opposed to just flow proportional dosing, not only accounts for any variation in the natural fluoride concentration, but also any failures or calibration errors in the dosing equipment.

The high and low alarms from the AFM631 can be linked to an appropriate alarm monitoring system enabling immediate process decisions to be made to ensure that the fluoride residual stays within the plant's target operating band. If the upper limit is exceeded, the analyzer automatically signals for the fluoridation process to be shut down.

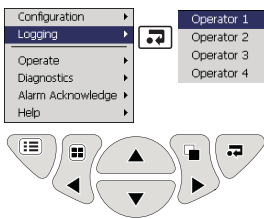
To help operators to verify analyzer performance, the Aztec 600 fluoride analyzer features automatic 2-point calibration with separate high and low standard solutions; providing users with a powerful, accurate and reliable tool for efficient monitoring and control of fluoride dosing.

Overview of Aztec 600 ISE fluoride analyzer

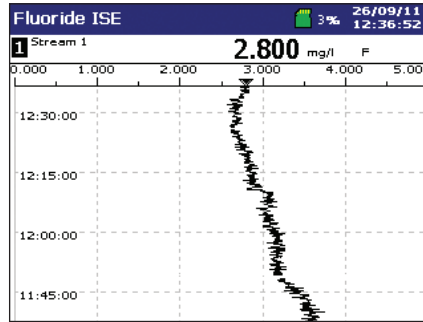
Easy-to-use Windows menu system



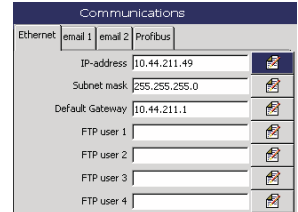
Simple navigation



Graphical results trending



Flexible communications



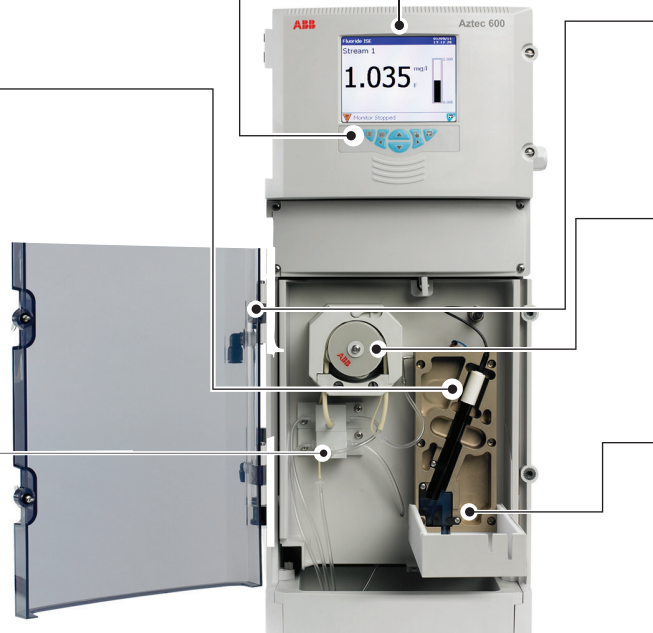
- Ethernet connectivity
- 6 current outputs
- 10 alarm relays (configurable)
- PROFIBUS DP v1.0
- SD memory card
- Process data trends

Temperature-controlled flow cell for accurate measurement

- Adjusts and stabilizes sample temperature
- Maintains electrodes at constant temperature
- Removes measurement errors caused by temperature fluctuation

Automatic 2-point calibration

- Verifies analyzer's performance
- Fully user-programmable
- Compensates for any electrode drift



Integrated side-sample pot for simple installation

- Magnetic sample flowswitch alarms when sample is not present

Buffered measurement for greater accuracy

- Up to 3 months continuous measurement between routine buffer replacements with EcoMode (refer to "Solution usage" on page 8)

Continuous measurement using ISE technology

- Updated measurement result every 2 seconds
- Maintenance-free combination fluoride electrode

Reliable measurement

The AFM631 has been designed for ease-of-use and maintenance simplicity, while offering the benefits of flexible communication and advanced data acquisition.

Measuring principle

The Aztec 600 ISE fluoride analyzer measures total solubilized fluoride potentiometrically using a combination fluoride ion-selective electrode.

With this type of electrode the fluoride sensing electrode and the reference electrode are combined in one body.

The fluoride sensing tip contains a single crystal of Lanthanum Fluoride, an ionic conductor in which fluoride ions are mobile. When the electrode is immersed in a solution containing fluoride ions, the difference in fluoride ion activity across the membrane generates an electrical potential. Like most ion-selective electrodes, the fluoride probe produces a logarithmic output in respect to the measured concentration.

One of the key benefits of this electrode design is that the reference gel electrolyte is fully enclosed and does not need regular replenishment, making it easier for non-skilled operators to use.

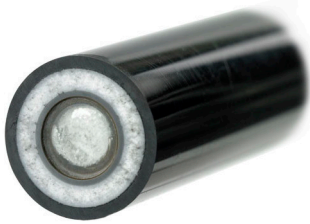


Figure 2 Fluoride electrode tip

Buffered measurement for greater accuracy

In some drinking waters there is a residual of iron or aluminium from the chemical coagulants that have been added during the water treatment process. These metal ions can form a complex with the fluoride that complicates the analysis.

To ensure the most accurate measurement, the sample is pre-treated with a chemical buffer reagent prior to analysis. This avoids errors caused by variation in sample pH and eliminates the effects of polyvalent cations (for example, Fe^{3+} and Al^{3+}) that form complexes with fluoride.

The chemical buffer adjusts the ionic strength, buffers pH and contains a chelating agent to break up metal-fluoride complexes.

One of the key benefits of this particular electrode design is that the outer body is translucent so that the internal filling solution can be viewed easily whilst in operation. If the gas-permeable membrane is damaged, allowing alkaline solution to leak, the filling solution changes color from yellow to blue so that it can be seen and replaced easily.

Temperature-controlled flow cell

It is important to control both sample and electrode temperature as any variation affects the electrode potential, resulting in significant measurement errors.

The Aztec 600 ISE fluoride electrode is housed in a fully enclosed temperature-controlled cell that adjusts and stabilizes the temperature of the sample before it is introduced to the electrode. This ensures that a constant temperature is maintained during both calibration and measurement.



Figure 3 Electrode in temperature-controlled flow cell

Automatic calibration

The Aztec 600 ISE range features automatic 2-point calibration that verifies the analyzer's performance against standards of a known concentration. Calibration frequency can be programmed by the user to occur either weekly or up to 4 times per day.

Measurement technique

A single peristaltic pump caters for all fluid and chemical handling. This draws sample from the process in through the analyzer side sample pot. The sample is then combined with the buffer reagent.

The reagent is used to adjust the sample pH, break up any fluoride complexes and provide a nearly uniform ionic strength background.

The conditioned sample is passed through a temperature-controlled block that stabilizes the temperature of the sample and ensures it is mixed thoroughly before it is presented to the fluoride electrode.

The output of the electrode is converted, by the analyzer, to indicate the fluoride concentration in ppm, mg/l, ppb or $\mu\text{g/l}$.

Finally, the sample flows to waste.

During automatic calibration, the sample supply is isolated and the calibration standards are presented to the electrode by sequencing of the high and low standard solenoid valves.

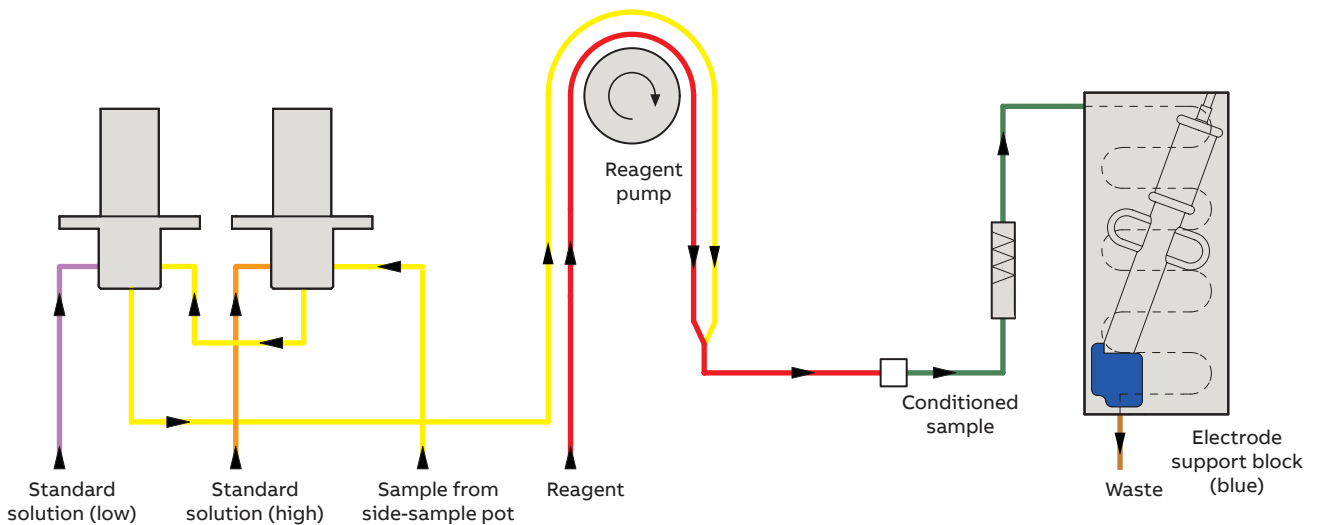


Figure 4 Schematic flow diagram

...Reliable measurement

Simple to operate

The powerful and user-friendly, Windows menu-driven software enables users to operate the analyzer with the minimum amount of training.

The comprehensive range of menu screens is simple-to-access using the 6 membrane keys.



Figure 5 Windows-based interface

These menus include data logging and graphical trending screens, operation command screens, full setup configuration screens and a range of self-diagnostics (including full calibration and operating status screens).

Historical logs provide operators with access to alarm data and audit trail data. Process data and historical logs are archived securely to a removable SD card.

All information is displayed clearly on the easy-to-read 145 mm (5.7 in.) color LCD display and is available in a range of languages.

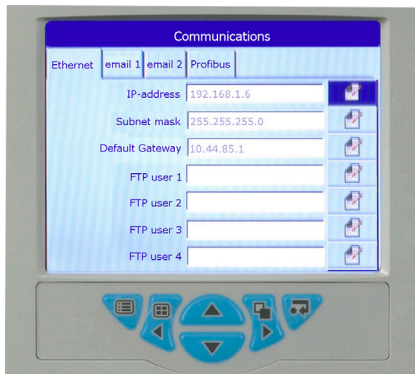


Figure 6 Communications window

Simple to maintain

The Aztec 600 ISE range is designed to be as maintenance-free as possible. The inherent product design and auto-calibrating features reduce the amount of maintenance required for external cleaning of sample lines, changing of reagents and probe membrane and annual servicing.

Service schedule

Period	Schedule*
12 monthly	Replace fluoride electrode, pump capstans and sample tubing.
24 monthly	Replace fluoride electrode, pump capstans and analyzer tubing.

All parts are provided in convenient maintenance kits.

Solution usage

The analyzer features an EcoMode function that reduces the amount of buffer and sample drawn into the analyzer during measurement by approximately one third when compared to the standard operating speed. EcoMode enables 3 months continuous measurement between routine buffer replacements in addition to a reduction in the analyzer waste generated. EcoMode can be activated or deactivated by the user.

Solution	Average consumption
Calibration standards	2.5 liters (0.66 US gallons) every 60 days*.
Buffer	10 liters (2.64 US gallons) every 2 to 3 months.

*Based on a daily calibration

Flexible communications

Ethernet-ready

The AFM631 provides 10BaseT Ethernet communications via a standard RJ45 connector and uses industry-standard protocols TCP/IP, FTP and HTTP. The use of standard protocols enables easy connection into existing PC networks.

Data file access via FTP (file transfer protocol)

The AFM631 features FTP server functionality. The FTP server in the analyzer is used to access its file system from a remote station on a network. This requires an FTP client on the host PC. Both MS-DOS® and Microsoft® Internet Explorer version 5.5 or later can be used as an FTP client.

- Using a standard web-browser or other FTP client, data files contained within the analyzer's memory or memory card can be accessed remotely and transferred to a PC or network drive.
- Four individual FTP users' names and passwords can be programmed into the AFM631. An access level can be configured for each user.
- All FTP log-on activity is recorded in the audit log of the analyzer.
- Using ABB's data file transfer scheduler program, data files from multiple analyzers can be backed-up automatically to a PC or network drive for long-term storage, ensuring the security of valuable process data and minimizing operator intervention.

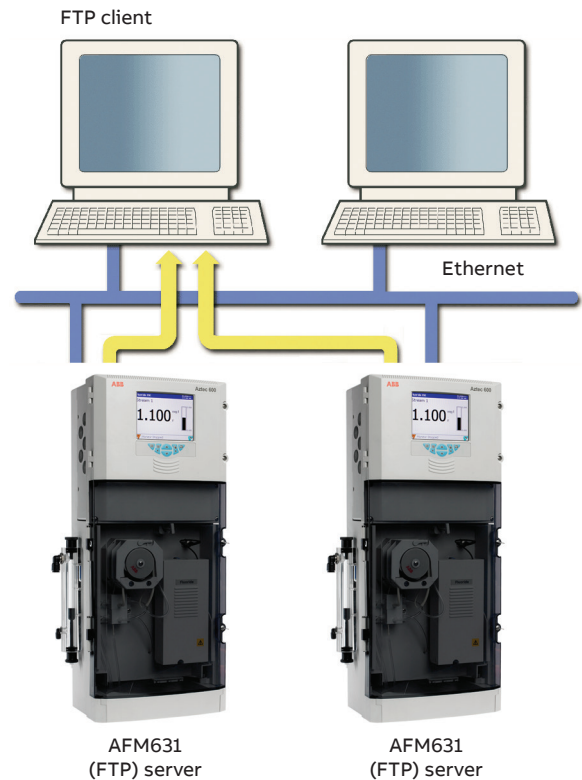
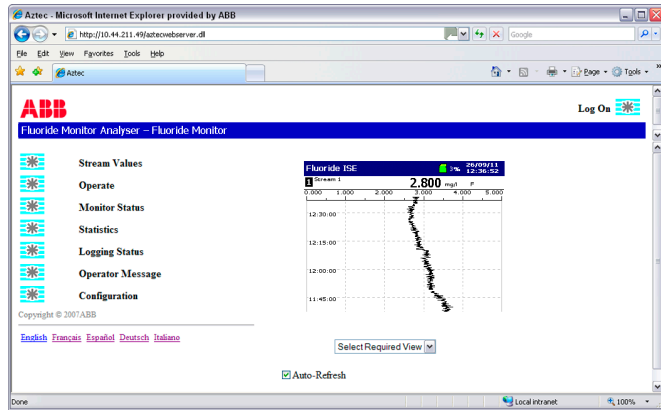


Figure 7 Aztec 600 FTP server

...Flexible communications

Embedded web server

The AAM 631 has an embedded web-server that provides access to web pages created within the analyzer. The use of HTTP (Hypertext Transfer Protocol) enables standard web browsers to view these pages.



- Accessible through the web pages are the current display of the analyzer, detailed information on stream values, reagent and solution levels, measurement status and other key information.
- The audit and alarm logs stored in the analyzer's internal buffer memory can be viewed on the web pages.
- Operator messages can be entered via the web server, enabling comments to be logged to the analyzer.
- The web pages and the information they contain are refreshed regularly, enabling them to be used as a supervision tool.
- The analyzer's configuration can be selected from an existing configuration in the internal memory or a new configuration file transferred to the instrument via FTP.
- The analyzer's real-time clock can be set via the web server. Alternatively, the clocks of multiple analyzers can be synchronized using ABB's File Transfer Scheduler software.

Email notification

Via the AFM631's built-in SMTP client, the analyzer is able to email notification of important events. Emails triggered from alarms or other critical events can be sent to multiple recipients. The analyzer can also be programmed to email reports of the current measurement status or other parameters at specific times during the day.

PROFIBUS

The AFM631 can be equipped with PROFIBUS DP V1.0 to enable full communications and control integration with distributed control systems.

Specification

Measurement

Range

0.100 to 100 ppm F

Measurement principle

Combination fluoride ion-selective electrode

Measurement mode

Continuous

Measurement performance

Accuracy¹

- $<\pm 2\%$ of reading² or ± 0.02 ppm for 0.1 to 10 ppm F (whichever is the greater)
- $<\pm 3\%$ of reading²

Repeatability

$<\pm 2\%$ of reading³ or ± 0.02 ppm (whichever is the greater)

Response time

- Normal operating mode: T90 typically 5 minutes
- EcoMode: T90 typically <7.5 minutes

Resolution

0 to 10 ppm: 0.001 ppm
10 to 100 ppm: 0.01 ppm

Calibration

2-point, automatic calibration, with the option of manual initiation. The interval between automatic calibrations is selectable manually from four times a day to once per week.

Environmental data

Ambient operating temperature:

5 to 40 °C (41 to 104 °F)

Ambient operating humidity:

Up to 95 % RH non-condensing

Sample temperature:

1 to 40 °C (33.8 to 104 °F)

Sample flow:

Continuous, 200 to 500 ml/min

Sample pressure:

5 psi maximum

Sample limitations:

Samples containing particles 100 microns (0.004 in.) in diameter or larger may require pre-filtration.

Maintenance

Routine service interval:

12 months

Display

Color, TFT, liquid crystal display (LCD) with built-in backlight and brightness adjustment

Diagonal display area:

- 145 mm (5.7 in.)
- 76800 pixel display*

* A small percentage of the display pixels may be either constantly active or inactive.

Max. percentage of inoperative pixels <0.01 %.

Dedicated operator keys

- Group select / left cursor
- View select / right cursor
- Menu key
- Up / increment key
- Down / decrement key
- Enter key

Mechanical data

Ingress protection

IP31**

Sample connections

Inlet:

- 6 mm OD x ¼ in. BSP push-fit elbow

Outlet:

- 10 mm OD x ⅜ in. BSP push-fit elbow

Dimensions

Height:

653 mm (25.7 in.)

Width:

366 mm (14.4 in.) max.

Depth:

- 183 mm (7.2 in.) door closed
- 430 mm (16.9 in.) door open

Weight:

15 kg (33 lb)

Materials of construction

Electronics enclosure:

- 10 % glass-loaded polycarbonate

Main enclosure:

- Noryl

Lower tray:

- 20 % glass-loaded polypropylene

Door:

- Acrylic

Electrical

Power supply ranges

- 100 to 240 V max. AC 50 / 60 Hz $\pm 10\%$ (90 to 264 V AC, 45/65 Hz)
- 18 to 36 V DC (optional)

Power consumption

- 75 W max. – AC
- 100 W max. – DC

¹ Maximum measured error across full measurement range.

² Testing based on IEC 61298 Parts 1-4 : Edition 2.0 2008-10.

³ Testing based on BS ISO 15839 : 2003.

** Not evaluated for UL or CB

...Specification

Analog outputs

6 isolated current outputs, fully assignable and programmable over a 0 to 20 mA range (up to 22 mA if required)

Alarms / relay outputs

One per unit:

- Stop relay
- Attention relay
- Failure relay
- Calibrate relay

Six per unit:

- Fully user-assignable alarm relays

Rating

Voltage:

- 250 V AC
- 30 V DC

Current:

- 5 A AC
- 5 A DC

Loading (non-inductive):

- 1250 VA
- 150 W

Connectivity / communications

Ethernet connection

Web server with ftp for real-time monitoring, configuration, data file access and email capability

Communications

PROFIBUS DP V1.0 (optional)

Data handling, storage and display

Security

Multi level security:

- Operator and configuration password or security switch

Storage

Removable Secure Digital (SD) card

Trend analysis

Local and remote

Data transfer

SD card or FTP

Approvals, certification and safety

Safety approval

cULus

CE mark

Covers EMC & LV directives (including latest version EN 61010)

General safety

- EN61010-1
- Overvoltage Class II on inputs and outputs
- Pollution category 2

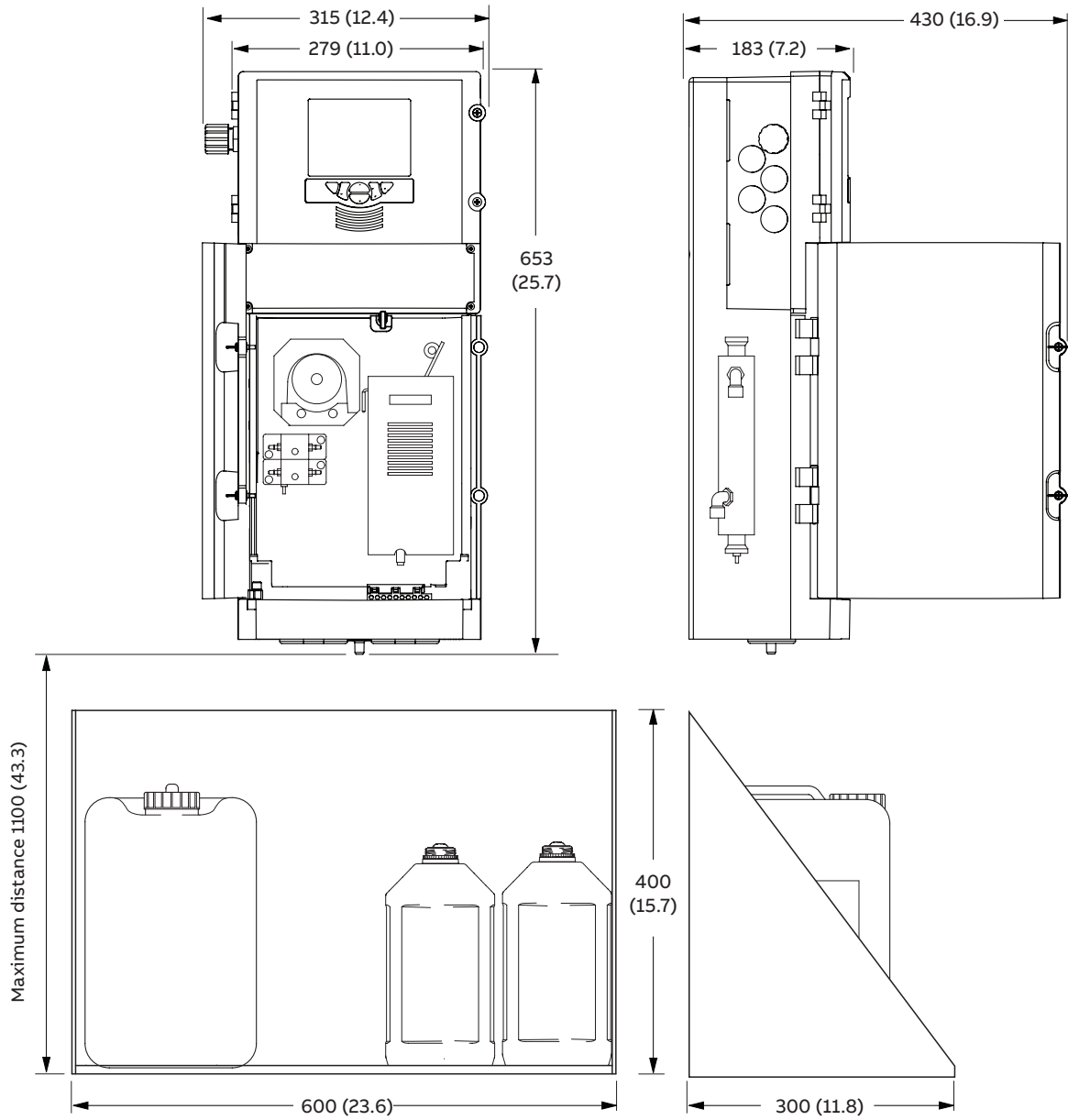
EMC

Emissions & immunity

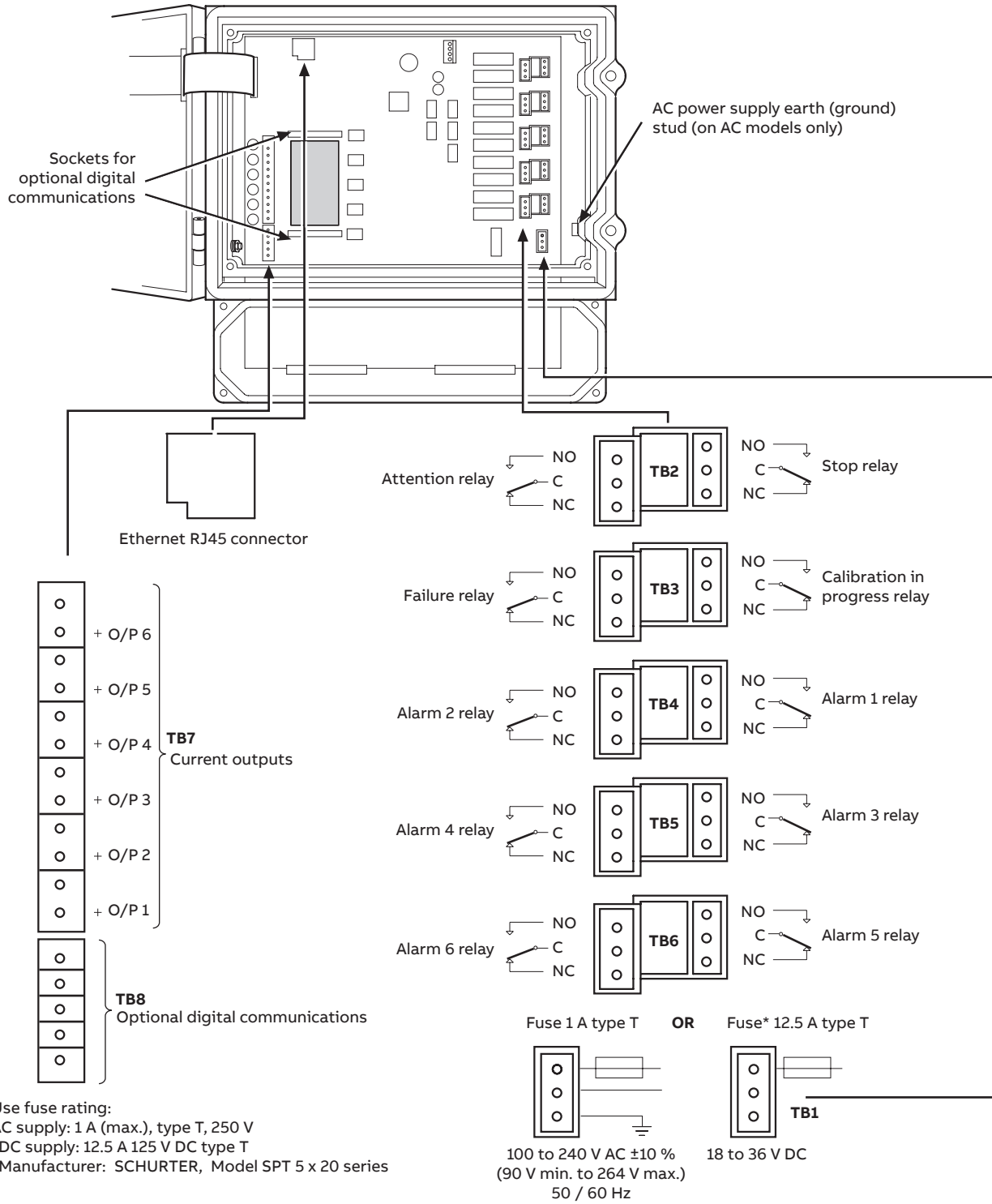
Meets requirements of IEC61326 for an industrial environment

Overall dimensions (shown with optional reagent tray)

All dimensions in mm (in.)



Electrical connections



Ordering information

	Standard ordering code					Optional ordering code						
	AFM631/	A1	A1	XX	XX	XX	XX	XX	XX	XX	XX	
Aztec 600 ISE fluoride analyzer												
Measuring range 0.100 to 100 ppm F		A1										
Number of streams Single stream			A1									
Power supply 90 to 264 V AC / 50 to 60 Hz 18 to 36 V DC					A1 A2							
Output signal 4 to 20 mA + Ethernet 4 to 20 mA + Ethernet + PROFIBUS DPV1										A1 D2		
Display language German Italian Spanish French English											A1 A2 A3 A4 A5	
Add 1 or more 2-digit codes after the standard ordering information to select any additional options if required.												
Reagent level sensors Calibration standard level sensors												S1
Data storage SD Card												D1
Certificates Calibration certificate												CD
Reagent storage Reagent tray Reagent tray + reagent containers												R1 R2
Maintenance kits Annual maintenance kit												V1
Documentation language German Italian Spanish French English												M1 M2 M3 M4 M5

Sales



Service



Software



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