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PRODUCT DATASHEET

HMI – Automação e Instrumentação, Lda.

Travessa da Indústria, nº 111
4780-573 Santo Tirso
PORTUGAL

Tel. +351 252 850 501
Fax. +351 300 013 487

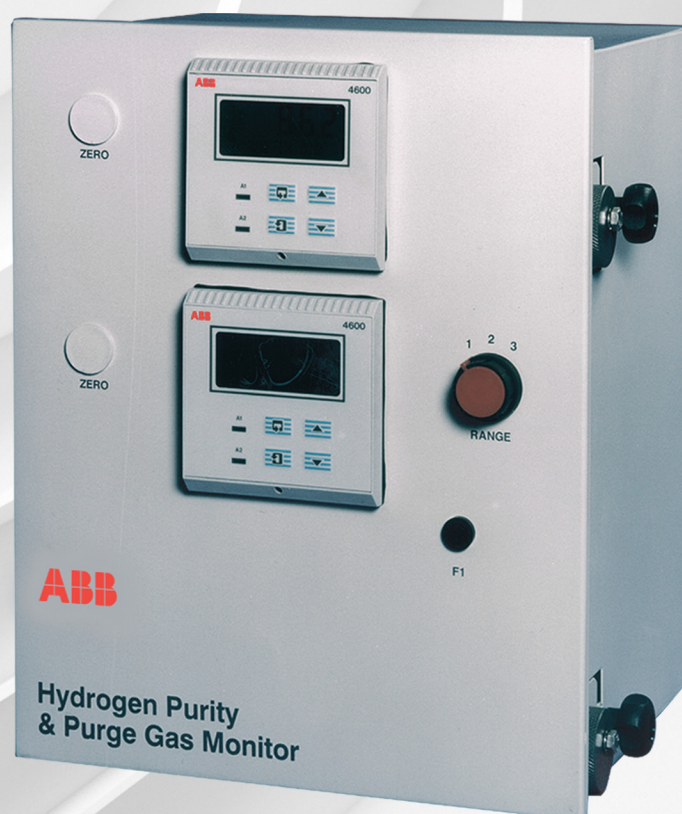
Web: www.hmi.pt

Email: hmi@hmi.pt

ABB MEASUREMENT & ANALYTICS | DATA SHEET

AK100 Series

ATEX compliant gas analyzer system
for hydrogen-cooled alternators



Measurement made easy

Superior technology and quality from the world leader in hydrogen measurement

ATEX compliant

- Intrinsically safe to  II (1)G EN60079-0 & 11 compliant

Safety

- Early warning of hazardous hydrogen / air mixtures

Cost savings

- Maintenance of hydrogen purity ensures efficient cooling of the alternator to optimize plant performance

Choice

- Separate display units for hydrogen purity and purge gas for ease of use and duplicate systems for enhanced security

Low cost of ownership

- No moving parts and just one consumable item ensure minimal maintenance and running costs

Confidence

- ABB has over 80 years experience of katharometer design and operation

General

The AK10x range of instruments is designed to provide reliable and accurate hydrogen purity and purge gas measurement to ensure the safe and efficient operation of hydrogen cooled turbo-generators.

Hydrogen purity

Modern high capacity turbo-generators need to be cooled efficiently. Hydrogen, with a thermal conductivity of about seven times that of air, is in general use as the coolant.

Any drop in hydrogen purity during operation of the machine has two adverse effects:

- The first, and most important, is to compromise the safe operation of the generator. Accurate measurement of hydrogen purity is essential to provide an early warning of a potentially explosive mixture of hydrogen and air.
- The second is the economic impact of reduced efficiency. To increase plant performance and control generating cost per megawatt, turbine generators must perform with optimum efficiency. A drop in hydrogen purity causes additional windage losses and consequently reduces generator efficiency.

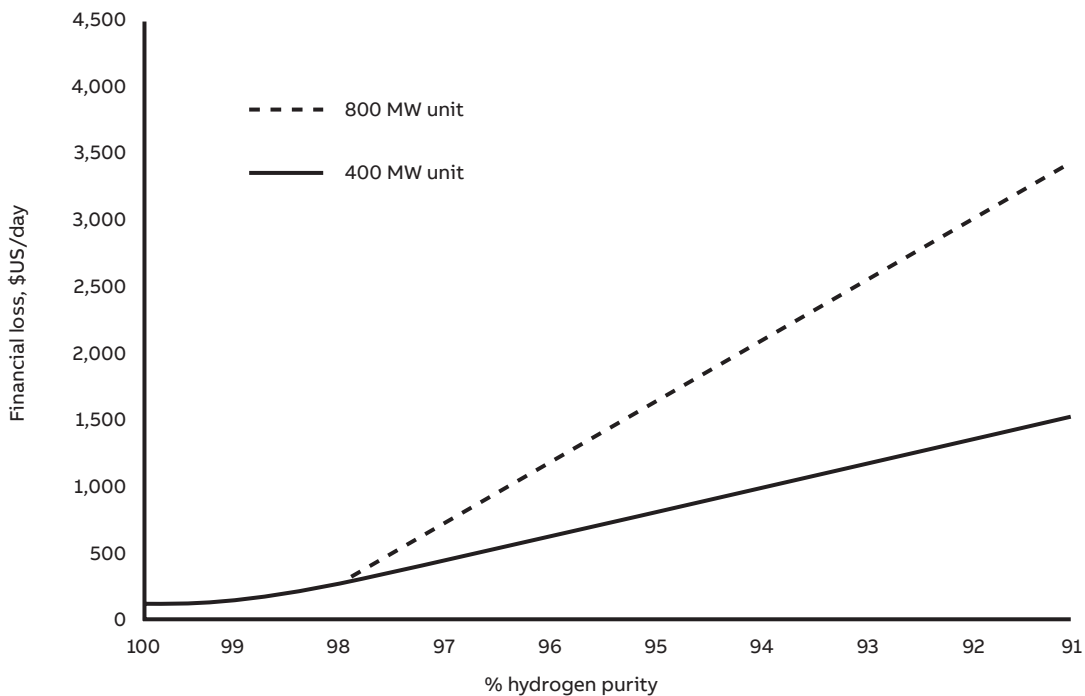
Purge gas

To complete the system the AK10x series also incorporates a purge gas analyzer.

During commissioning and de-commissioning of a system it is essential that the hydrogen is safely introduced and removed from the turbo-generator.

To avoid an explosive mixture of air and hydrogen during commissioning, air must first be purged from the system by an inert gas; carbon dioxide is in common use for this purpose although argon or nitrogen are gaining popularity. The hydrogen coolant is then introduced and replaces the purge gas.

To de-commission the turbo-generator the purge sequence is reversed.



Typical cost of decreased hydrogen purity

Katharometer

Principle of operation

The AK10x range of gas analyzers utilize thermal conductivity as its principle for measurement. When a constant current is passed through an electrical conductor surrounded by gas in a chamber, the temperature rises to a point of thermal equilibrium. Provided radiation, convection and end-conduction losses are minimized, the temperature of the conductor depends upon the heat loss by conduction through the gas. The temperature attained is therefore related to the thermal conductivity of the surrounding gas and hence the resistance of the wire is a function of the thermal conductivity.

The katharometer comprises a wheatstone bridge, each arm of which contains a fine, glass-coated, platinum wire. One pair of parallel arms is sealed in a reference gas of known thermal conductivity and the other pair is exposed to the sample gas. A constant current is passed through the bridge network. Any difference between the thermal conductivities of the reference and sample gases causes an imbalance of the bridge. This imbalance is a function of the difference in thermal conductivities of the two gases so the analyzer can be calibrated directly in terms of the percentage of one gas to another.

Product description

A complete system comprises:

- Display monitor
- One (or two) gas analysis panels
- One (or two) power supply units

Display monitor

The 6553 display monitor includes one or two 4689 digital transmitters, the range selector switch (excluding AK104), katharometer remote zero adjustment control and zener diode safety barriers.

Digital transmitters

The 4600 series universal transmitter provides the operator interface and communication to other devices. The signal from the sensing system is converted by the transmitter and the measurement is presented on a large, easy-to read, backlit liquid crystal display. This display is used in conjunction with the four tactile membrane keypads to prompt the user through the programming procedures. The transmitter is fitted with two-step alarms for falling hydrogen purity.

Zener barrier devices

Zener barrier devices are included in the display monitor enclosure to prevent any dangerous electrical feedback from the transmitters to the hazardous area.

Power supply

The 4234 power supply units provide the analyzer assemblies with an intrinsically safe, stable constant current. These power units must be installed in a 'safe' area but the current output from them may be transmitted to the katharometers in the hazardous area.

Gas analysis panel

Gas analysis assemblies, 6540 (low pressure variant) and 6548 (high pressure variant) are fitted with a thermally lagged katharometer, a needle flow-control valve, a flow gauge and a drying chamber.

AK101 hydrogen purity and purge gas analyzer

Industry standard version comprising:

- Two gas analysis panels, the first measuring hydrogen purity and the second measuring the two purge gas ranges.
- Two power supply units.
- One display monitor containing two digital transmitters. The upper transmitter displays hydrogen purity and the lower transmitter displays the two purge gas ranges. The range selector switch controls the range to be displayed and deactivates the unused transmitter display as appropriate.

AK102 dual 3-range analyzer

100 % redundancy and validation version comprising:

- Two gas analysis panels each measuring hydrogen purity plus the purge gas ranges.
- Two power supply units.
- One display monitor containing two digital transmitters. Both the upper and the lower digital transmitters display the hydrogen purity range and the two purge gas ranges. Each digital transmitter has its own range selector switch to control the range to be displayed.

AK103 single 3-range analyzer

Simple solution for purity and purge measurement comprising:

- One gas analysis panel measuring hydrogen purity plus the purge gas ranges.
- One power supply.
- One display monitor containing one digital transmitter that displays the hydrogen purity range and the purge gas ranges. The range selector switch controls the range to be displayed.

AK104 hydrogen purity analyzer

Single range version comprising:

- One gas analysis panel measuring hydrogen purity.
- One power supply unit.
- One display monitor containing a single digital transmitter that displays hydrogen purity. Designed for applications where the purge gas cycle is controlled by other means and measurement of purge gas is not required.

Operating range

Range for hydrogen purity:

- 85 to 100 % H₂
- 80 to 100 % H₂ user selectable

Range for purge gas:

- 0 to 100 % hydrogen in purge gas *
- 0 to 100 % air in purge gas *

Alternative range for hydrogen purity:

- 100 % to 85 % H₂
- 100 % to 80 % H₂ user selectable
(does not conform to ATEX directive)

* Carbon dioxide standard; argon or nitrogen also available.

Analyzer panels

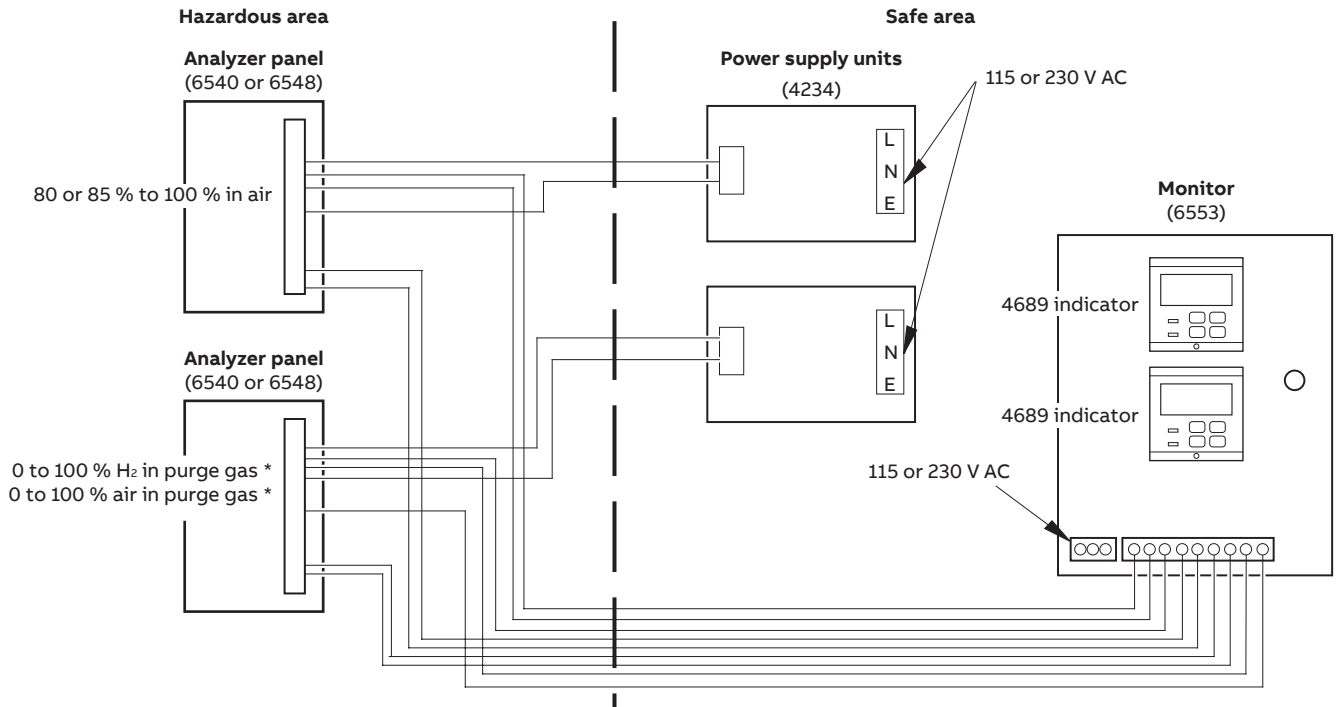
The analyzer panels are available with options for use on low pressure or high pressure, gas sample systems (see system diagrams following).

The 6540–203 panels are suitable only for use on systems where the gas sample is vented to atmosphere and the pressure in the analyzer panel is therefore only marginally above atmospheric pressure (1 bar absolute).

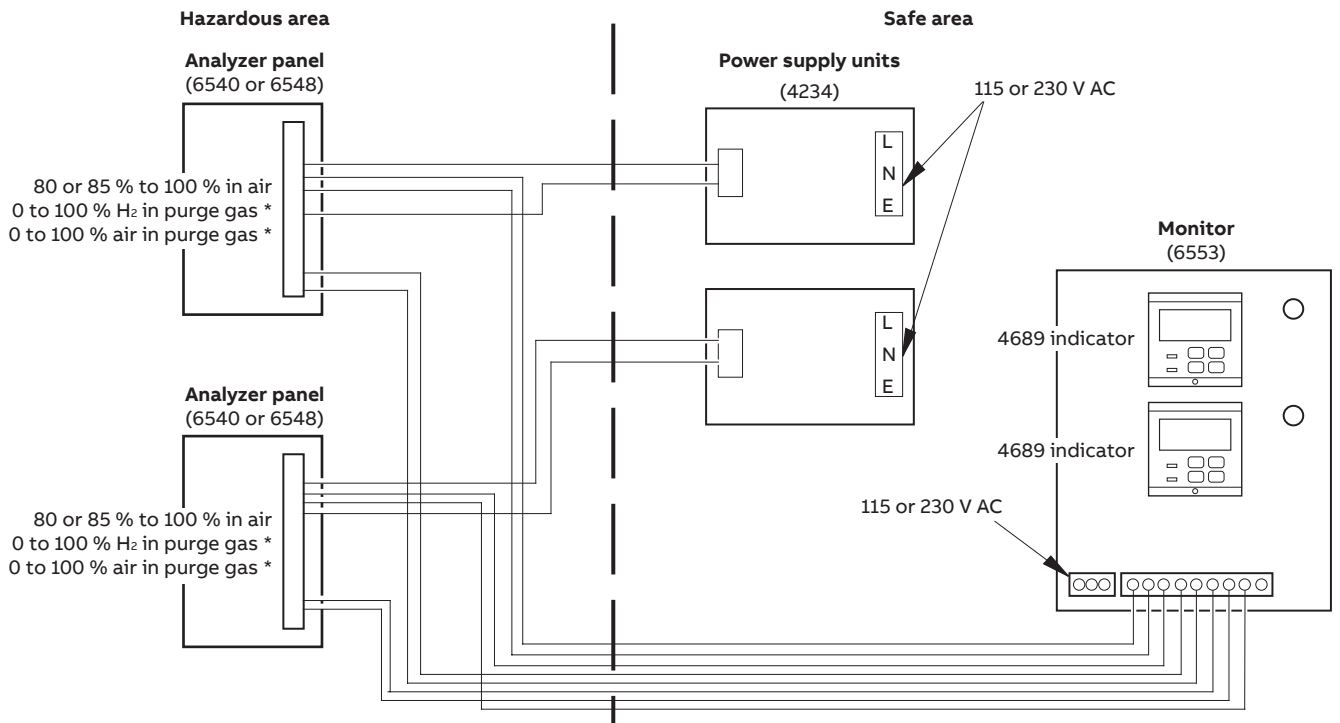
For applications where the gas sample may be returned to the generator cooling system at an elevated pressure, the 6548-000 analyzer panel must be used. This panel is equipped with fittings suitable for such duties and is pressure tested to 10 bar (gauge).

Note. As no certification exists for measurements at pressures above 1bar absolute (nominal), it must be understood that the stated I.S. certification does not cover use at higher pressures.

...Analyzer panels

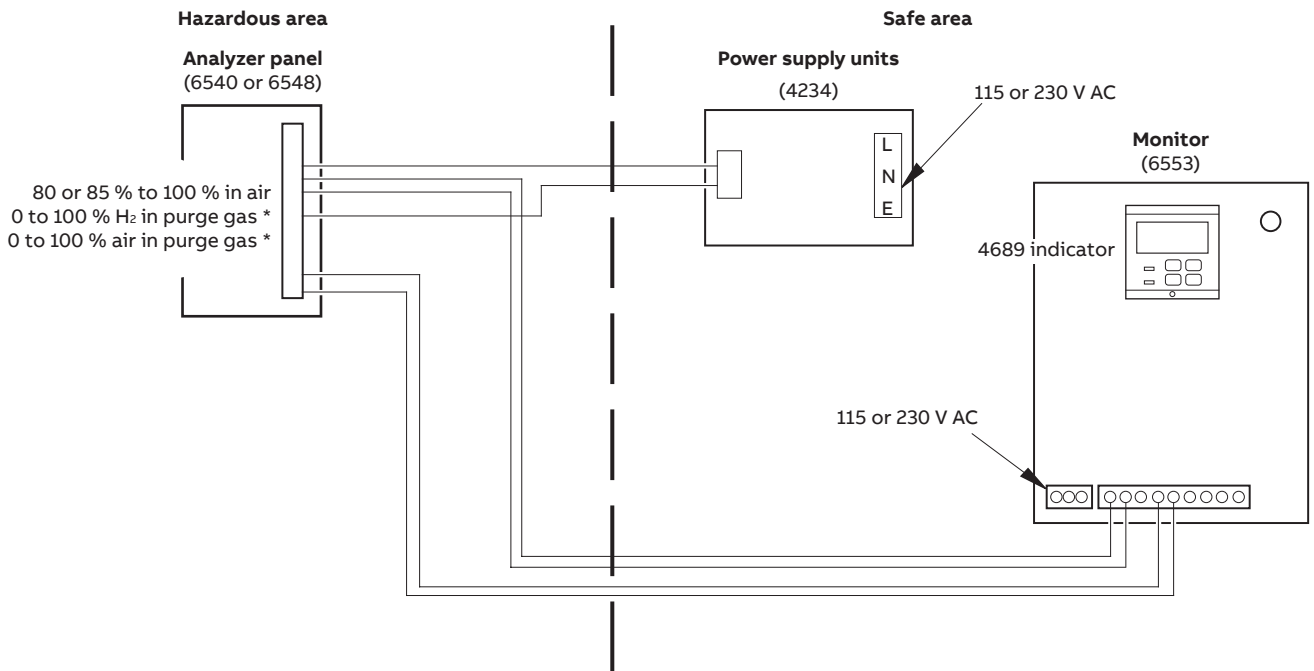


AK101 purity and purge gas analyzer system

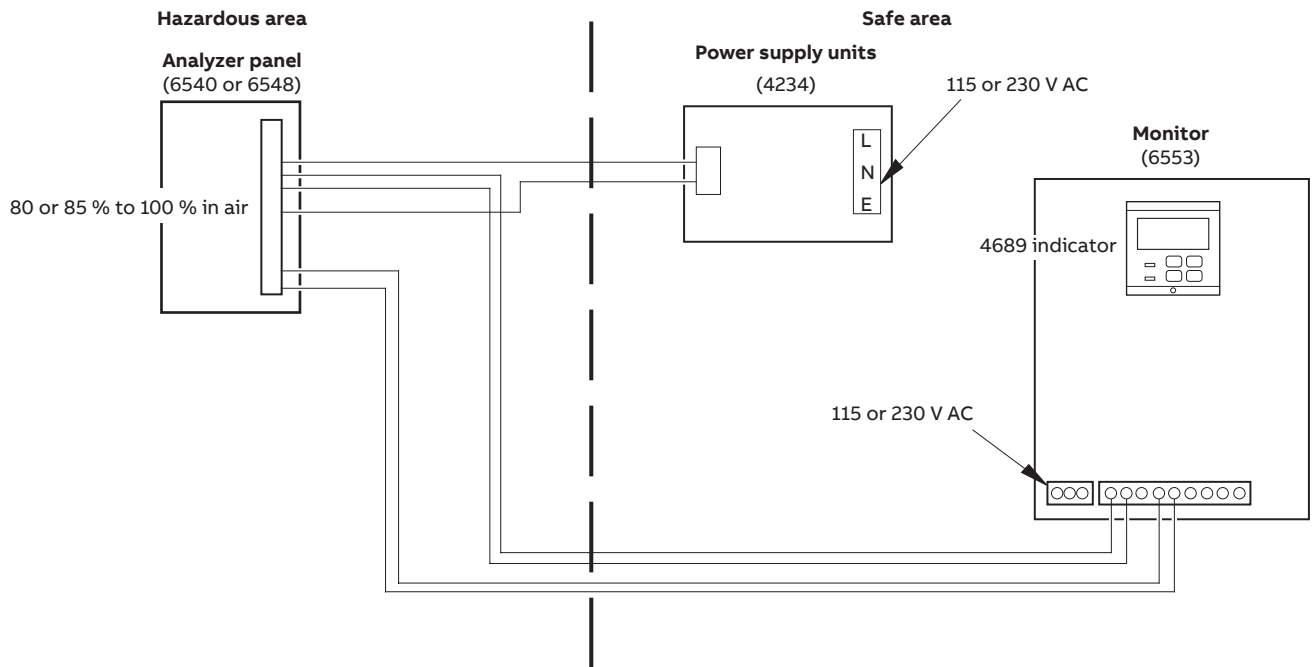


AK102 dual 3-range analyzer system

* Carbon dioxide standard; argon or nitrogen also available



AK103 single 3-range analyzer system

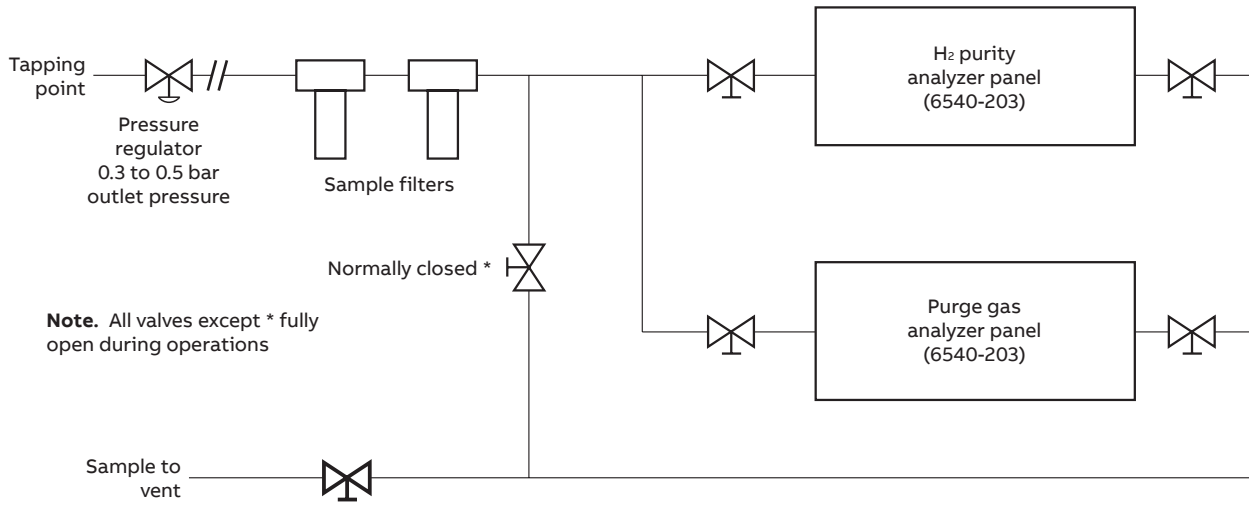


AK104 hydrogen purity analyzer

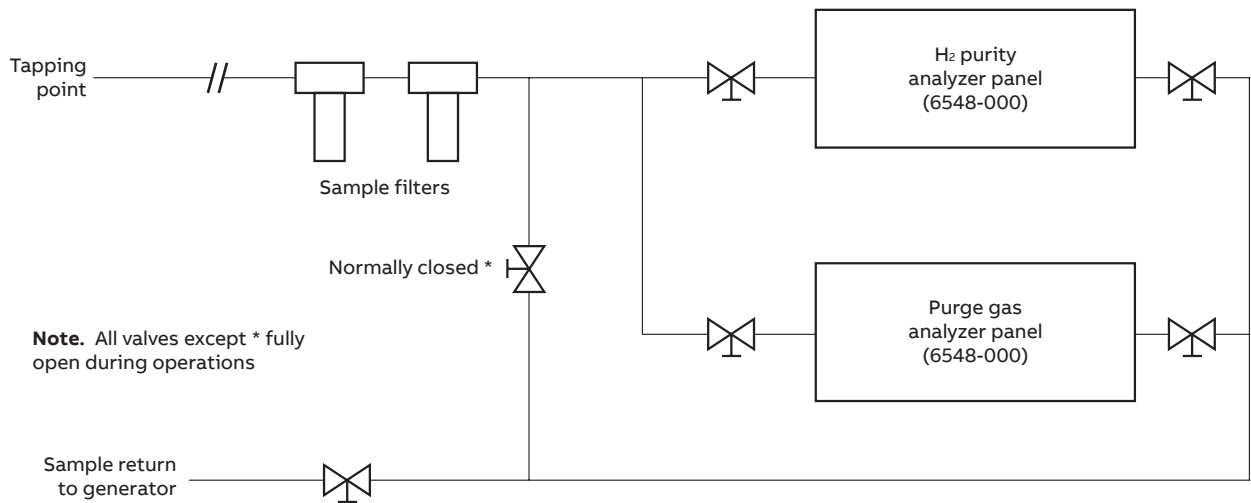
* Carbon dioxide standard; argon or nitrogen also available

Low and high pressure systems

The schematic diagrams below show typical arrangements, identifying the types of low or high pressure gas analyzer panels.



Low pressure system – sample vented




High pressure system – sample non-vented

Specification

6553 gas monitor

Approvals

- CENELEC approved
- [Ex ia Ga] IIC ($-20^{\circ}\text{C} \leq T_a \leq +40^{\circ}\text{C}$)
- BASEEFA Certificate No. BAS 01 ATEX 7043
-  II (1)G
- EN61010-1:2010 compliant

Ranges

- 80 % or 85 % to 100 % H₂ in air
- 0 to 100 % H₂ in purge gas *
- 0 to 100 % air in purge gas *

Range selector switch positions (when fitted)

- 1 – percentage by volume, hydrogen in air
- 2 – percentage by volume, hydrogen in purge gas *
- 3 – percentage by volume, air in purge gas *

Accuracy (display units)

± 0.25 % of scale span

Ambient temperature range

0 to 40 °C (32 to 104 °F)

Power supply

110/120V AC or 200/220/240V AC, 50/60Hz
(two separate versions)

Fuse rating

F1 / F2 500 mA, 250 V AC rated 1500 A @ 250 V AC,
HRC, ceramic, fast blow

Power consumption

30 VA approximately

Outline dimensions

290 x 362 x 272 mm (11.4 x 14.25 x 10.9 in.)

Weight

12 kg (26.4 lb)

Environment

Sheltered interior, 0 to 90 % RH

Outputs and set points

No. of relays

- AK101 – 3 (2 for H₂ purity, 1 for purge gas)
- AK102 – 4 (H₂ purity)
- AK103 – 2 (H₂ purity)
- AK104 – 2 (H₂ purity)

Relay contacts

Single pole changeover

Rating	250 V AC	250 V DC max.
	3 A AC	3 A DC max.
Loading (non-inductive)	750 VA	30 W max.
(inductive)	75 VA	3 W max.

Insulation

2kV RMS contacts to earth (ground)

Remote range indication

Rating	250 V AC	300 V AC max.
	150 mA AC	150 mA AC max.

No. of set points

- AK101 – 3 (2 for H₂ purity, 1 for purge gas)
- AK102 – 4 (H₂ purity)
- AK103 – 2 (H₂ purity)
- AK104 – 2 (H₂ purity)

Set point adjustment

Programmable

Set point hysteresis

±1 % fixed

Local set point annunciation

Red LED

Retransmission

No. of retransmission signals

- AK101 – 2 fully isolated (1 for H₂ purity, 1 for purge gas)
- AK102 – 2 fully isolated
- AK103 – 1 fully isolated
- AK104 – 1 fully isolated (H₂ purity)

Output current

0 to 10 mA, 0 to 20 mA or 4 to 20 mA programmable

Accuracy

±0.25 % FSD ±0.5 % reading

Resolution

0.1 % at 10 mA, 0.05 % at 20 mA

Max. load resistance

750 Ω (20 mA max.)


* **Note.** Purge gas options include:

- CO₂ (carbon dioxide)
- N₂ (Nitrogen)
- Ar (Argon)

...Specification

4234 power supply unit

Approvals

- CENELEC approved
- [Ex ia Ga] IIC ($-20^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$)
- BASEEFA Certificate No. BAS 01 ATEX 7041
-  II (1)G
- EN61010-1:2010 compliant

Power supply

115 V AC 50/60 Hz (4234501) or
230 V AC 50/60 Hz (4234500)

Power consumption

30 W max.

Fuse rating

- T250 mA 250 V AC rated 1500 A HRC ceramic,
250 V AC rated
- 20 x 5 mm

DC output

350 mA stabilized $\pm 0.14\%$

Load conditions

1 Katharometer 13 Ω max.
Interconnecting cable 2 Ω max.

Ambient temperature range

-20 to 55°C (-4 to 131°F)

Supply variations

± 15 V (115 V supply) or ± 30 V (230 V supply) 46 to 64 Hz

Regulation

Within $\pm 0.5\%$ for:

- Load variation of $\pm 15\%$
- Supply variation of $\pm 15\%$
- Ambient temperature variation of $\pm 20^{\circ}\text{C}$ (36°F)
- ± 4 Hz frequency variation

Ripple

Less than 0.5 % of set output peak / peak
across a 10 Ω load

Stability

Within $\pm 0.7\%$ of initial setting, over period of 1 month
with load resistance, supply voltage and ambient
temperature at nominal stated values

Overall dimensions

160 x 170 x 110 mm (6.3 x 6.7 x 4.3 in.)

Weight


2.12 kg (4.8 lb) approx.

Environment

Sheltered interior

6540-203 and 6548-000 katharometer analyzer panel

Approvals

- CENELEC approved
- Ex ia Ga IIC ($-20^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$)
- BASEEFA Certificate No. BAS 01 ATEX 1042
-  II 1G
- Model 6540-203 incorporating Model 6539-960 (H₂) or
Model 6539-960 (purge gas) katharometer unit
- Model 6548-000 incorporating Model 6548-001
(H₂ and purge gas) katharometer unit

Power supply

350 mA DC, from 4234500 or 4234501 power supply unit

Signal output

0 to 10 mV for each range (air in N₂ 1.0 mV)

Accuracy

$\pm 2\%$ of scale span, each range
 $\pm 5\%$ of scale span, air in N₂

Dead time

Typically 5 s

Response time

Typically 40 s for 90 % step change at katharometer
(tubing and drying chamber introduce extra delays)

Ambient temperature

55°C (131°F) max.
 0°C (32°F) min.

Sample connections

Compression couplings:

- 6 mm OD tube (Model 6548-000)
- 8 mm OD tube (Model 6540-203)

Sample pressure

Minimum 125 mm H₂O
Maximum 0.35 bar (gauge) Model 6540-203
Maximum 10 bar (gauge) Model 6548-000

Sample temperature

0 to 55°C (32 to 131°F)

Normal sample flowrate

100 to 150 ml/min.

Maximum gas flowrate

250 ml/min

Minimum gas flowrate

50 ml/min

Outline dimensions

610 x 305 x 152 mm (24 x 12 x 6 in.)

Weight

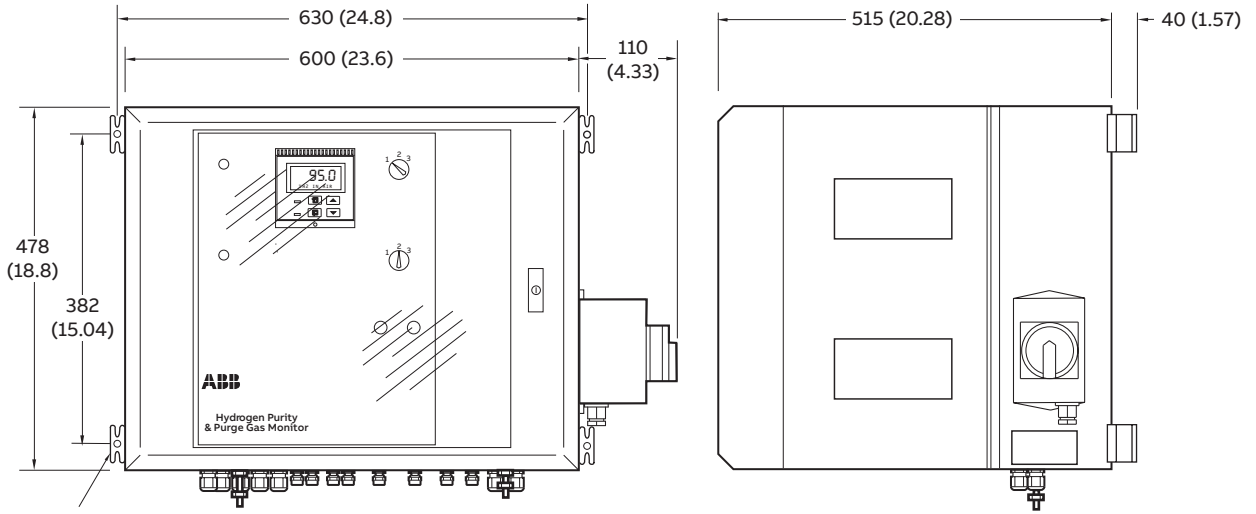
8.6 kg (18.9 lb)

Environment

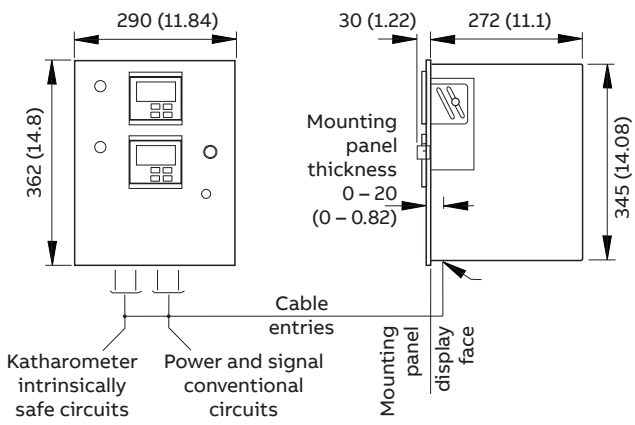
Sheltered interior

...Overall dimensions

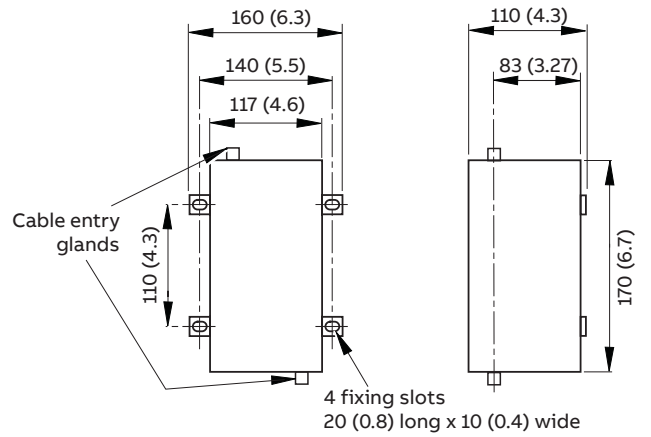
Dimensions in mm (in.)



4 mounting brackets Ø 10 (0.39) holes



Model 6553 monitor



Intrinsically safe power supply unit (Model 4234500 or 4234501)

Ordering information

ATEX compliant gas analyzer for hydrogen-cooled alternators

	AK10	X/	X	X	X	X	X	X	X
Display monitor unit									
Separate H ₂ purity and purge gas displays		1							
Dual 3-range displays (H ₂ purity and 2 x purge gas)		2							
Single 3-range (H ₂ purity and 2 x purge gas)		3							
Single hydrogen purity display		4							
Hydrogen purity range									
80/85 % to 100 %			1						
100 % to 85 % (does not conform to ATEX directive)			2						
100 % to 80 % (does not conform to ATEX directive)			3						
Purge gas									
None (AK104 only)				0					
CO ₂				1					
Argon				2					
Nitrogen (AK101 only)				3					
Gas analysis panel *									
None					0				
Low pressure and flame traps for vent to atmosphere 0.35 barg (5 psi) max.					2				
High pressure for closed loop 10 barg (145 psi) max.					3				
Cubicle									
Without cubicle						0			
Gas sample flow alarm (available only with cubicle option)									
Not fitted							0		
Katharometer power supply ***									
None								0	
115 V 50 / 60 Hz								1	
230 V 50 / 60 Hz								2	
Special feature									
None									0
Special									9
System labels and instruction manuals**									
English									1
French									2
German									3
Polish									7

* 2 gas analysis panels are required for AK101 and AK102

** Check with factory for availability

*** 2 katharometer power supplies are required for AK101 and AK102

Notes



ABB Limited**Measurement & Analytics**

Oldends Lane

Stonehouse

Gloucestershire GL10 3TA

UK

Tel: +44 (0)1453 826 661

Fax: +44 (0)1453 829 671

Mail: instrumentation@gb.abb.com**ABB Limited****Measurement & Analytics**

125 E. County Line Road

Warminster PA 18974

USA

Tel: +1 215 674 6000

Fax: +1 215 674 7183











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Tel. +351 252 850 501
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