Data Sheet
SS/6553_3

ATEX Compliant Gas Analyzer for Hydrogen-cooled Alternators

Type 6553

- **CENELEC (ATEX) Certification**
  – intrinsically safe to EExia IIC for hydrogen
- **Continuous monitoring**
  – fail-safe alarms indicate immediate danger conditions
- **Direct-reading Katharometer in single, dual and triple range panels**
  – low installation and maintenance costs
- **Option of independent redundant systems**
  – enhanced security of measurement
- **Customized LCD indication**
  – full flexibility of membrane touch-pad switches

Superior technology and quality from the world leader in hydrogen measurement

Application

Modern high capacity turbogenerators need to be efficiently cooled. Hydrogen, with a thermal conductivity of about seven times that of air, is in general use as the coolant. Great care and accurate measurement is necessary to ensure that the hydrogen remains pure during operation of the machine: air entering the system could produce a potentially explosive mixture.

The highest level of hydrogen purity is required in order to reduce the 'windage' losses.

Similarly, when it is necessary to remove the hydrogen for maintenance, it is not desirable to purge directly with air, due to the risk of explosion. The purging sequence therefore comprises two distinct operations: hydrogen is purged from the system using carbon dioxide, nitrogen or argon; followed by the removal of the purge gas with air. This sequence is reversed for refilling.

The Katharometer provides a reliable means of measuring any two component (binary) gas mixtures and is the ideal monitoring system for turbogenerator applications.

Katharometer

Principle of Operation

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. Where sensitivity allows, two filaments can be replaced by fixed resistors.

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. Providing 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.

Any difference between the thermal conductivities of the reference and sample gases causes an imbalance of the bridge. The out-of-balance current is therefore a function of the difference in thermal conductivities of the two gases and a display unit can be calibrated directly in terms of the percentage of one gas with another.

Description

A complete system for the turbogenerator application comprises:

- Display and control monitor
- Two gas analysis assemblies
- Two power supply units

The power supply units Model 4234500 or 4234501 provide the analyzer assemblies with a stable 350mA d.c. supply. These power units must be installed in a 'safe' area but the current output from them may be transmitted to the Katharometers in the danger area.

Two gas analysis assemblies (Models 6540–203 or 6548–000) are necessary to provide the three required ranges. Each assembly is fitted with a thermally lagged Katharometer, a needle flow-control valve, a flow gauge and a drying chamber.

The Katharometer system is available in three formats all of which are CENELEC certified EExia IIC T4. T_{amb} –20°C/+55°C (Zone 0):

1) One Katharometer system indicates only Hydrogen purity by measuring 100 to 85%, or 85 to 100%, H_2 in air.

   An optional range of 80 to 100% H_2 in air is user selectable.

   This is accompanied by a dual range Katharometer measuring the purge sequence 0 to 100% H_2 in purge gas and 0 to 100 % air in purge gas.

2) For applications where duplication of reading is important, two Katharometer systems can be used, each incorporating three-range Katharometers and measuring 85% to 100% H_2 in air; 0 to 100% H_2 in purge gas; and 0 to 100% air in purge gas.

3) Where only the Hydrogen purity measurement is required a single instrument is used measuring 85 to 100% H_2 in air or 100 to 85% H_2 in air.

The Display and Control Monitor Model 6553 is CENELEC Certified EExia IIC T_{amb} –20°C/+40°C and designed to be incorporated into the turbogenerator purge control cubicle. Two ABB 4689 Indicators are provided. The upper indicator is calibrated to the required hydrogen-in-air range and is fitted with two-step alarms for falling hydrogen purity and the means to drive the instrument downscale (the low purity end) when the input is open circuited. The lower indicator is dual ranged for the purge sequence and also has a device to drive downscale (to zero) when the input is open circuited. This indicator can also display the hydrogen purity shown in the upper display in addition to the purge ranges

Where duplication of all three ranges is required they are displayed on both indicators.

Two potentiometers enable the Katharometer zeros to be adjusted from the control cubicle. The overall system is certified intrinsically safe to BAS System No. Ex 01E2044 when wired in accordance with the certified system drawing.

H_2 purity alarms are only active on the hydrogen purity range switch position 1.

Digital Indicators

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 information is presented on a large, custom designed, easy-to-read, backlit liquid crystal display. This display is used, in conjunction with the four tactile membrane key pads, to prompt the user through the programming procedures.

Zener Diode Safety Barriers

Zener barrier devices, certified to CENELEC standard (Certificate No. BAS 99 ATEX 7285), are included in the Model 6553 cabinet to prevent any dangerous electrical feedback from the indicators to the danger area. The action of the barriers is to pass the signal, with negligible distortion, up to the avalanche voltage of the zener diodes. Above this voltage the zener diodes become conducting and hold the voltage between the terminals to a safe level. The devices are fully encapsulated.

Analyzer Panels

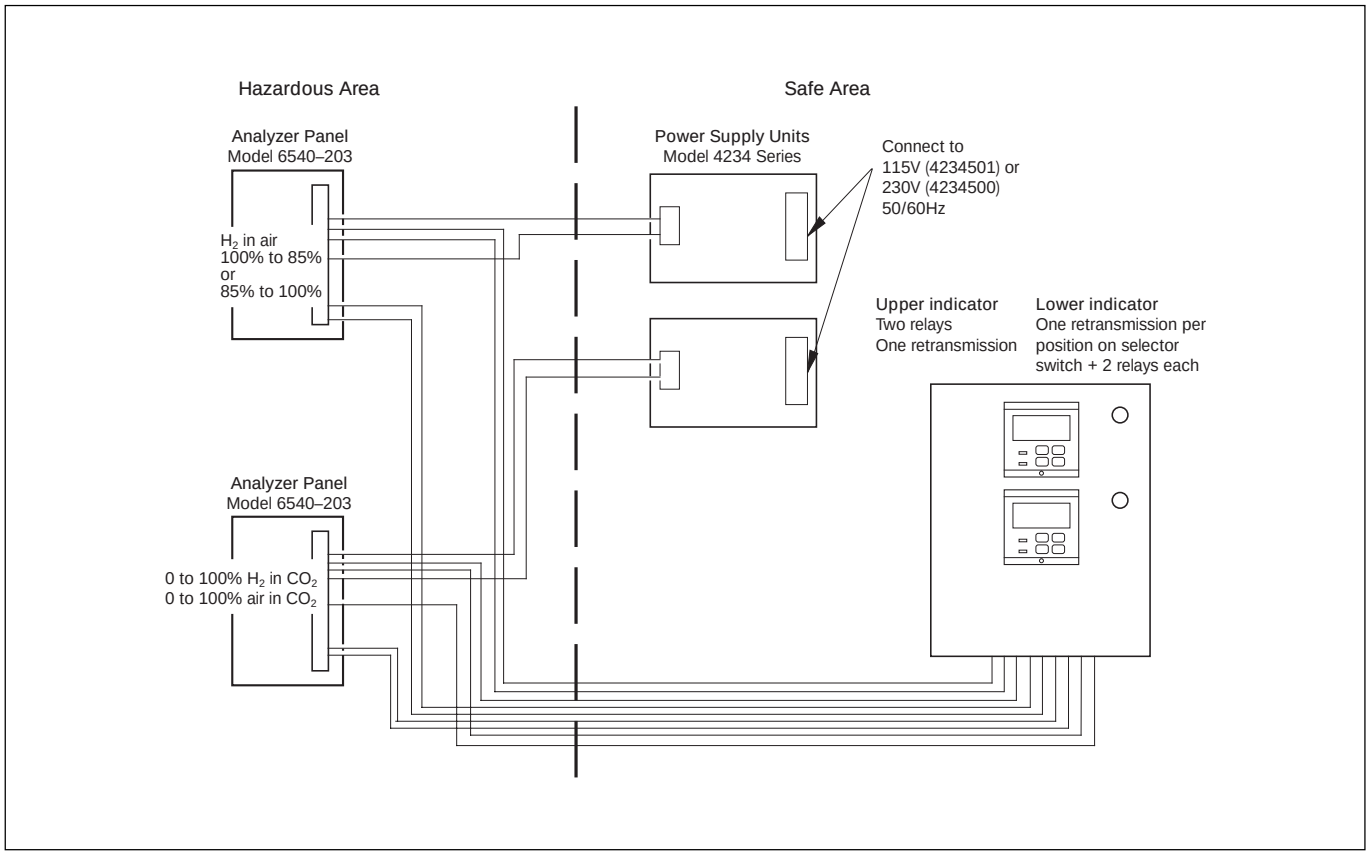
In addition to the Katharometer range options, the Analyzer Panels are also available with options for use on low pressure or high pressure gas sample systems (see system diagrams below and overleaf).

The Model 6540–203 Panels are only suitable 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).

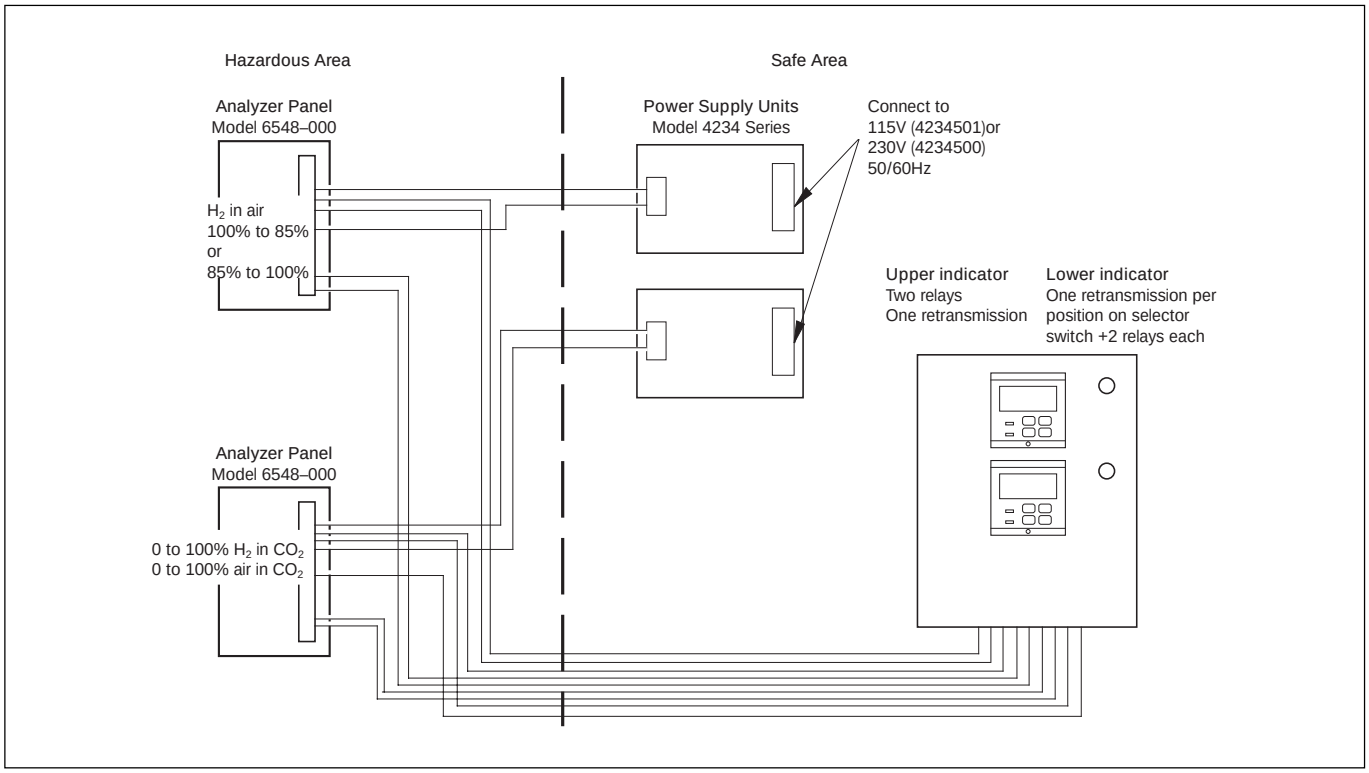
For applications where the gas sample may be returned to the generator cooling system at an elevated pressure, the Model 6548–000 Analyzer Panel must be used. This analyzer panel is equipped with items and fittings suitable for such duties and is pressure tested to 10 bar (gauge). As no certification 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.

The system diagrams illustrating these options show the purge gas as being CO_2, with ranges of 0 to 100% H_2 in CO_2 and 0 to 100% air in CO_2. These Katharometers are calibrated specifically for these ranges and cannot be used or modified for use with alternative purge gases, such as Nitrogen or Argon. Similarly the 4689 Digital Display Unit software is dedicated to the specified purge gas to be used.

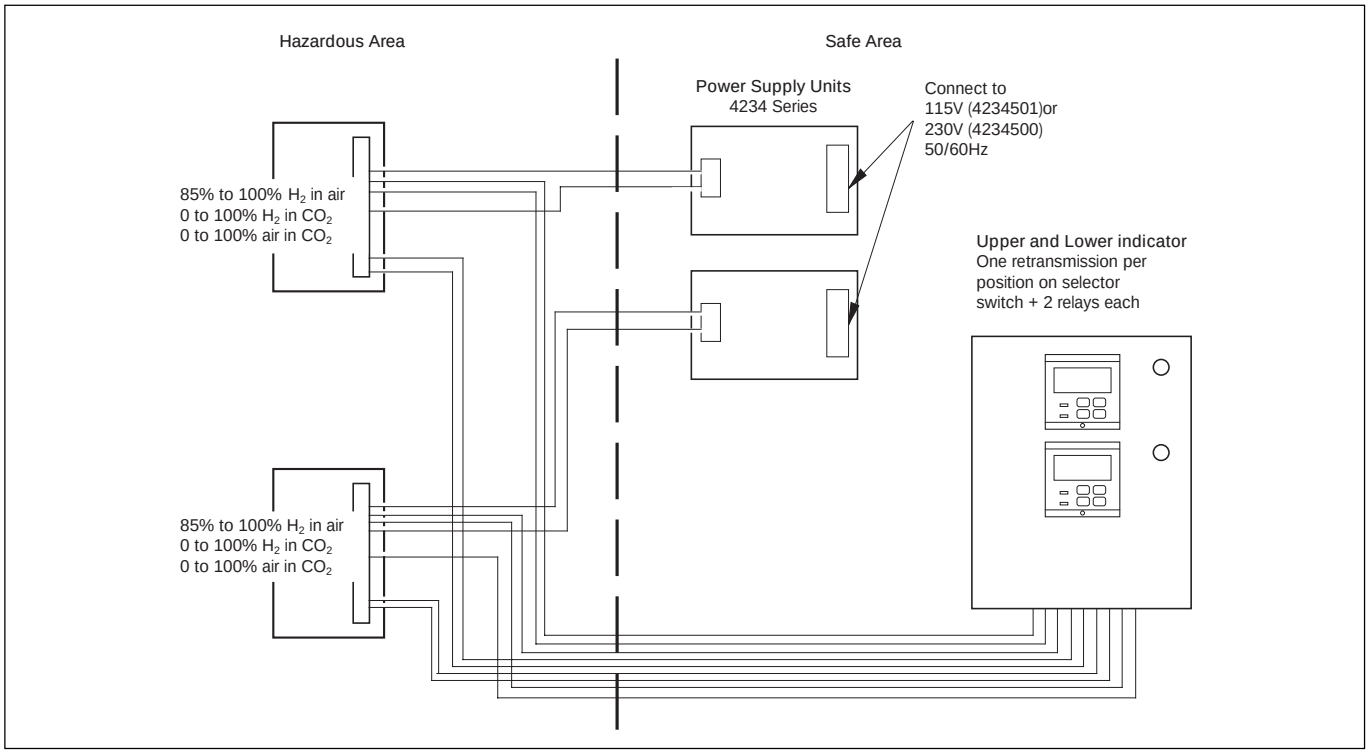
Where an alternative purge gas is to be used this must be identified at the time of ordering with the appropriate order codes.



Low Sample Pressure System – Standard System Interconnection Diagram
(Model 6553, Analyzer Panels Model 6540–203 and 4234 Series Power Supply Units)

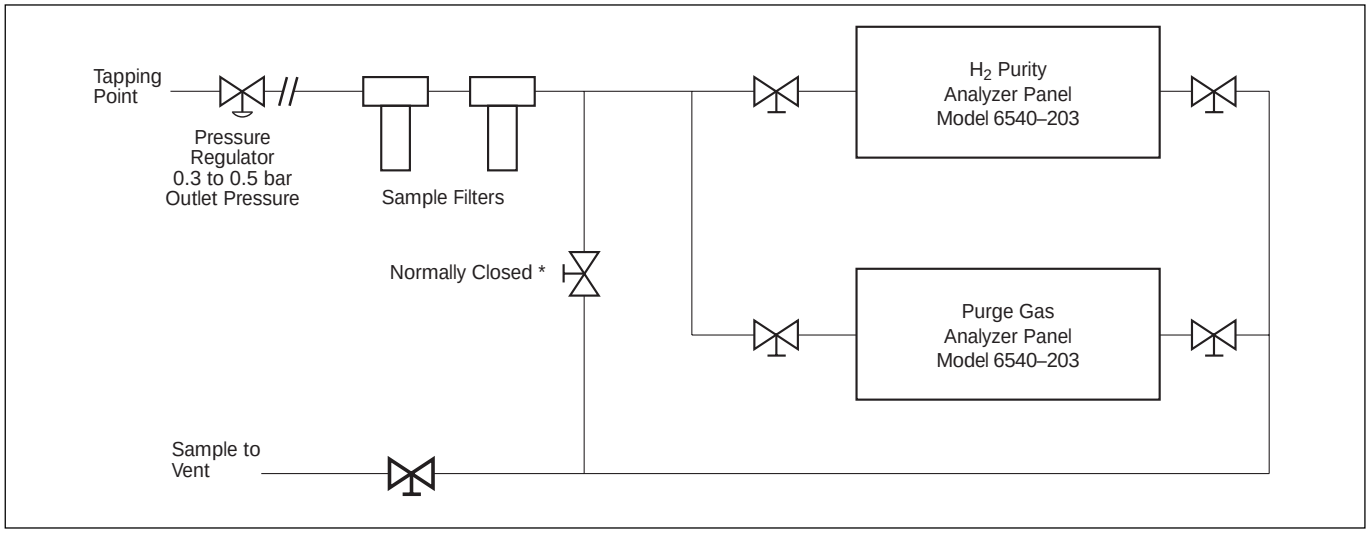


High Sample Pressure System – Standard System Interconnection Diagram
(Model 6553, Analyzer Panels Model 6548–000 and 4234 Series Power Supply Units)

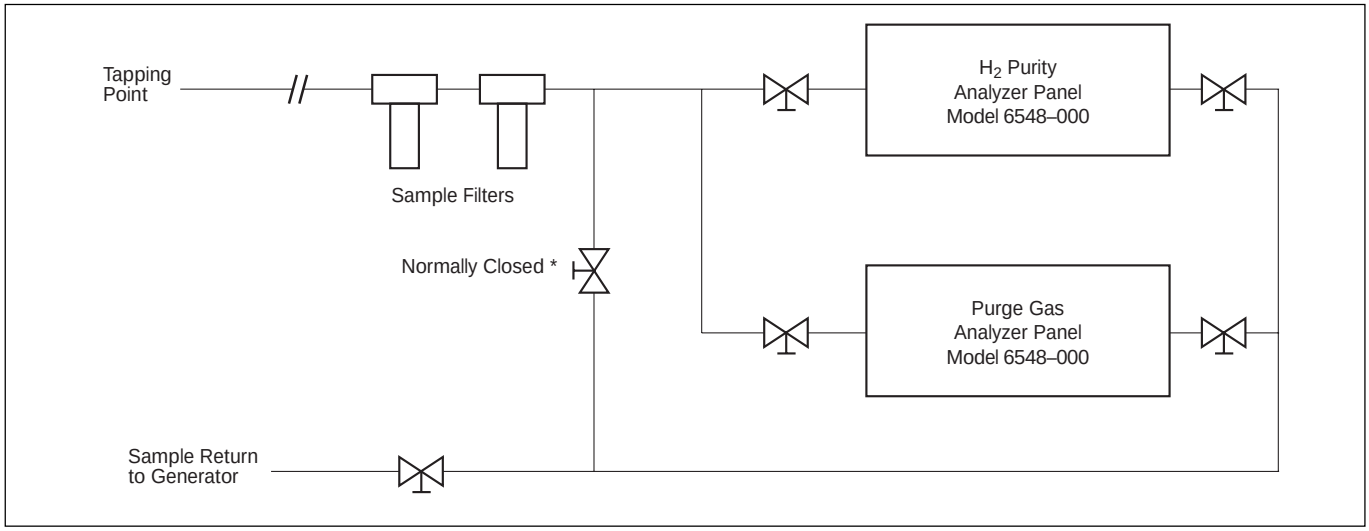


2 x 3-Range Interconnection Diagram
(Model 6553, Analyzer Panels 6540–203 or 6548–000 and 4234 Series Power Supply Units)

Purge Gas Systems



*Low Pressure System – Sample Vented (all valves except * fully open during operations)*



*High Pressure System – Sample Non-vented (all valves except * fully open during operations)*

Low and High Sample Pressure Systems

The above illustrations show typical sample system arrangements, identifying the choice of gas analyzer panel required to suit either low or high pressure sample conditions.

Cubicles

When simplified installation is required the Model 6553 Display Unit and 4234 Power Supply Units can be supplied ready-mounted in a wall-mounting enclosure.

Access to the display unit is via the front door which is fitted with a window for visibility of the selected range. The two power supplies and the rear of the 6553 unit are accessed by a hinged rear compartment.

The cubicle is pre-wired so that the only electrical connections required are between the customer terminals (in the cubicle and on the analyzer panels) and the electrical supply.

Specification

Model 6553 Gas Monitor

Approvals

CENELEC approved
[EExia] IIC T_{amb} –20°C to +40°C

BASEEFA Certificate No. BAS 01 ATEX 7043

Available ranges

(a) 100 to 85% H_2 in air + others (80% or 85% to 100%)

(b) 0 to 100% H_2 in CO_2

(c) 0 to 100% air in CO_2

Digital Display Units

Air in CO_2/H_2 in CO_2	Model 4689-500
100 to 85% H_2 in air	Model 4689-501
All three ranges	Model 4689-502
85 to 100% H_2 in Air	Model 4689-503
Air in N_2/H_2 in N_2	Model 4689-504
H_2 in Air/Air in A/H_2 in A	Model 4689-505

Range Selector Switch Positions (when fitted)

(1) Percentage by volume, hydrogen in air

(2) Percentage by volume, hydrogen in carbon dioxide

(3) Percentage by volume, air in carbon dioxide

Accuracy (display units)

± 0.25% of scale span

Ambient Temperature Range

0 to 45°C (32 to 113°F)

Power Supply

110/120V ac or 200/220/240V a.c., 50/60Hz
(two separate versions)

Power Consumption

30VA approximately

Outline Dimensions

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

Weight

12kg (26.4lb)

Environment

Sheltered interior, 0 to 90% RH

Outputs and Set Points

No. of relays

Two

No. of set points

Two

Set point adjustment

Programmable

Set point hysteresis

±1% fixed

Local set point annunciation

Red l.e.d.

Relay contacts

Single pole changeover

Rating	250V a.c.	250V d.c. max.
	3A a.c.	3A d.c. max.
Loading (non-inductive)	750VA	30W max.
(inductive)	75VA	3W max.

Insulation

2kV r.m.s. contacts to earth (ground)

Retransmission

No. of retransmission signals

One fully isolated – standard

Output current

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

Accuracy

±0.25% f.s.d. ±0.5% reading

Resolution

0.1% at 10mA, 0.05% at 20mA

Max. load resistance

750 ohm (20mA max.)

…Specification

Series 4234 Power Supply Unit

Approvals

CENELEC approved
[EExia] IIC Tamb –20°C to 55°C

BASEEFA Certificate No. BAS 01 ATEX 7041

Input Voltage

115V a.c. 50/60Hz or (Model 4234501)

230V a.c. 50/60Hz (Model 4234500)

Fuse Rating

250mA HRC ceramic

DC Output

350mA stabilized ±0.14%

Load Conditions

1 Katharometer 13Ω max.

Interconnecting cable 2Ω max.

Ambient Temperature Range

–20 to 55°C (–4 to 131°F)

Supply Variations

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

Regulation

Within ± 0.5% for:

(i) Load variation of ± 15%

(ii) Supply variation of ± 15%

(iii) Ambient temperature variation of ± 20°C (36°F)

(iv) ±4Hz frequency variation

Ripple

Less than 0.5% of set output peak/peak across

a 10Ω load

Stability

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

Outline Dimensions

117 x 170 x 110mm (4.6 x 6.7 x 4.3 in.)

Weight

2.12kg (4.8 lb) approx.

Environment

Sheltered interior

Models 6540–203 and 6548–000 Katharometer Analyzer Panel

Approvals

CENELEC approved EExia IIC T4. T_{amb} –20°C to +55°C

BASEEFA Certificate No. BAS 01 ATEX 1042

Model 6540–203 incorporating Model 6539–960 (H_2) or Model 6539–960 (CO_2) Katharometer Unit

Model 6548–000 incorporating Model 6548–001 (H_2 and CO_2) Katharometer Unit

Power Supply

350mA d.c., from Model 4234500 or 4234501 Power Supply Unit

Signal Output

0 to 10mV for each range

Accuracy

± 2% of scale span, each range

Dead Time

Typically 5s

Response Time

Typically 40s for 90% step change at Katharometer
Tubing and drying chamber introduce extra delays

Ambient Temperature

55°C (131°F) max.

Sample Connections

Compression couplings:
6mm o.d. tube (Model 6548-000)
8mm o.d. tube (Model 6540-203)

Sample Pressure

Minimum 125mm H_2O

Maximum 0.35 bar (Gauge) Model 6540–203

Maximum 10 bar (Gauge) Model 6548–000

Normal Sample Flowrate

100 to 150ml/min.

Maximum Gas Flowrate

250ml/min

Minimum Gas Flowrate

50ml/min

Outline Dimensions

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

Weight

8.6kg (18.9lb)

Environment

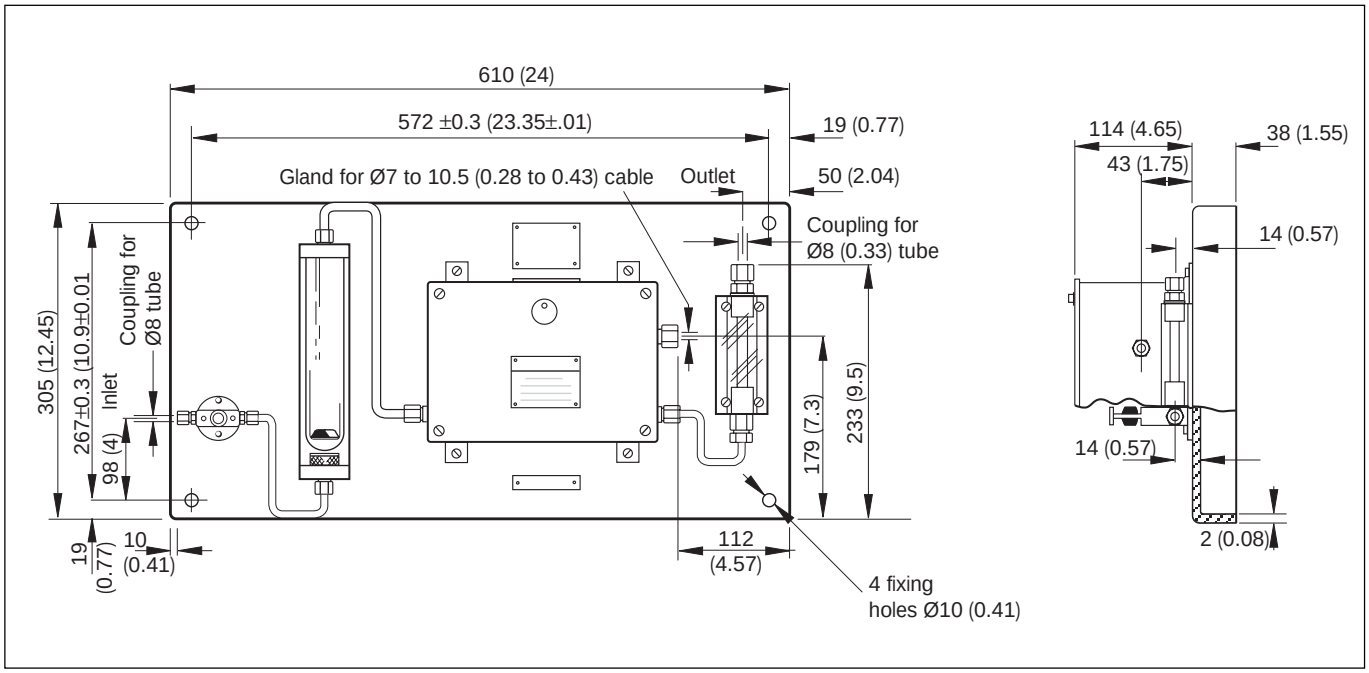
Sheltered interior

Notes.

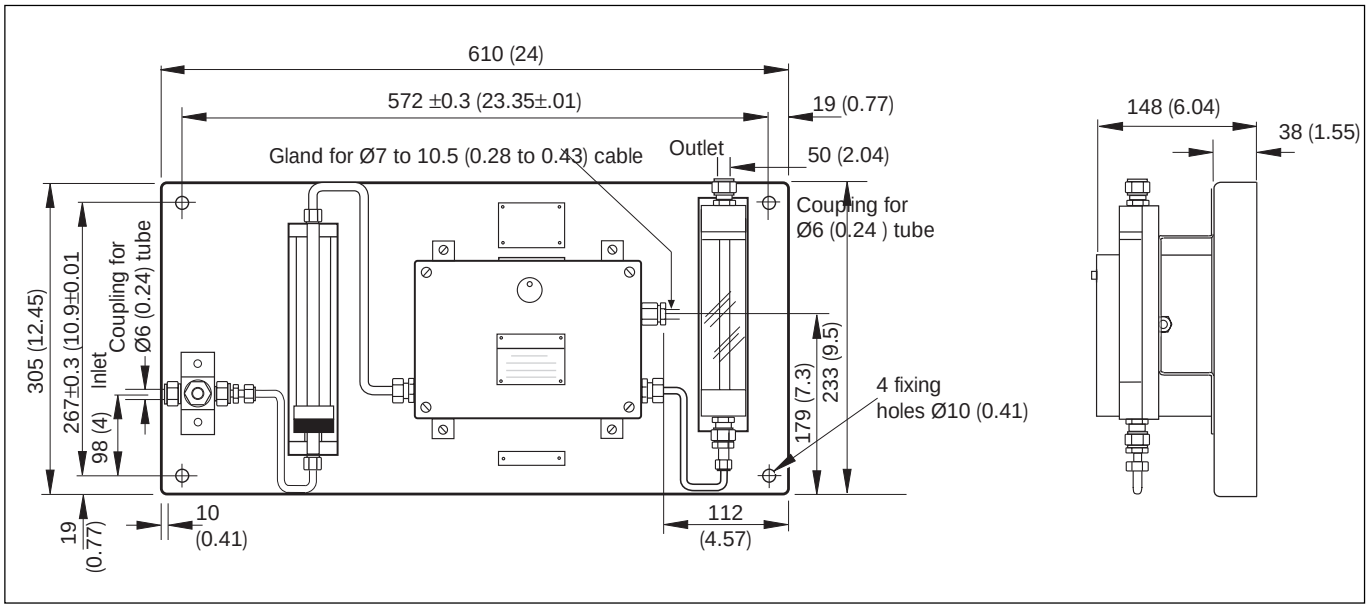
1. Systems can be supplied for use with Nitrogen or Argon purge gases as an alternative to the CO_2 ranges. Details on application to the Company.
2. Variations to the earlier certificate (SFA 3012:1972) allow the use of these items in systems supplied previously to that standard.

Overall Dimensions

Dimensions in mm (in.)

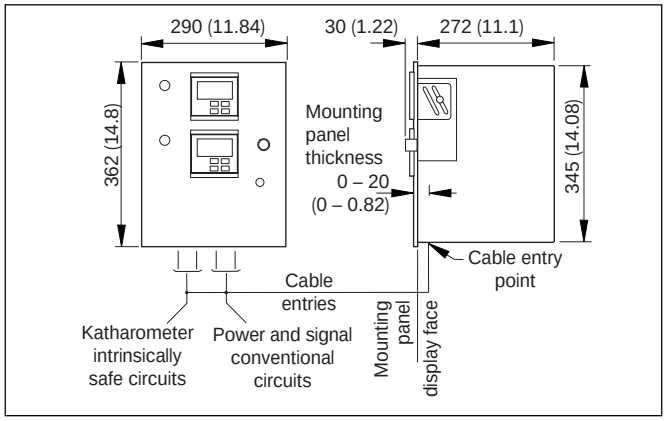


Katharometer Analyzer Panel Assembly (Model 6540–203)

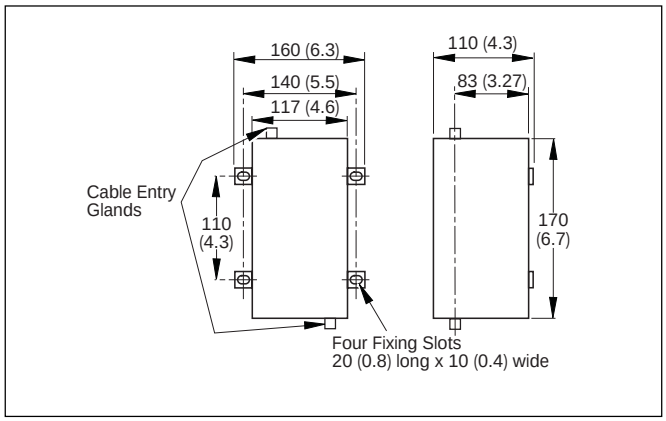


Katharometer Analyzer Panel Assembly (Model 6548–000)

...Overall Dimensions



Model 6553 Monitor



Intrinsically Safe Power Supply Unit (Model 4234500 or 4234501)

Ordering Information

Valid Option Combinations

(Refer to Ordering Information table opposite)

	Purity Only Single display (Upper)	3-Range Single display (Upper)	Standard Purge System	2 x 3 Ranges
A	6	6	6	6
B	1, 2, 5, 6	3, 4	1, 2, 5, 6	3, 4, 7, 8
C	0	0	3	3
D	0	0	1	4, 5, A, B
E	0	2	2	3
F	0	0	0	0
G	1 to 3	1 to 3	1 to 3	1 to 3
H	1, 5	1, 5	1, 4	1, 2, 4
J	0, 9	0, 9	0, 9	0, 9
K	1, 3	1, 3	1, 3	1, 3

...Ordering Information

Atex Compliant Gas Analyzer for Hydrogen-cooled Alternators	6553/	X	X	X	X	X	X	X	X	X	X
A Features of Upper Indicator											
Two alarms + retransmission 4 to 20mA		6									
B Scale of Upper Indicator											
100 to 85% H_2 in Air – Not Failsafe			1								
100 to 80% H_2 in Air – Not Failsafe			2								
0 to 100% Air in CO_2, 0 to100% H_2 in CO2, 85 to 100% H_2 in Air			3								
0 to 100% Air in CO_2, 0 to100% H_2 in CO2, 80 to 100% H_2 in Air			4								
85 to 100% H_2 in Air – Failsafe			5								
80 to 100% H_2 in Air – Failsafe			6								
0 to 100% Air in Ar, 0 to 100% H_2 in Ar, 85 to 100% H_2 in Air			7								
0 to 100% Air in Ar, 0 to 100% H_2 in Ar, 80 to 100% H_2 in Air			8								
C Features of Lower Indicator											
Indicator not fitted				0							
Two alarms + retransmission 4 to 20mA				3							
D Scale of Lower Indicator											
Indicator not fitted					0						
0 to 100% Air in CO_2, 0 to100% H_2 in CO_2					1						
100 to 85% H_2 in Air – Not Failsafe					2						
100 to 80% H_2 in Air – Not Failsafe					3						
0 to 100% Air in CO_2, 0 to 100% in CO_2, 85 to 100% H_2 in Air					4						
0 to 100% Air in CO_2, 0 to 100% in CO_2, 80 to 100% H_2 in Air					5						
85 to 100% H_2 in Air – Failsafe					6						
80 to 100% H_2 in Air – Failsafe					7						
0 to 100% Air in Ar, 0 to 100% H_2 in Ar, 85 to 100% H_2 in Air					A						
0 to 100% Air in Ar, 0 to 100% H_2 in Ar, 80 to 100% H_2 in Air					B						
E Range Selector Switch											
Not fitted						0					
Fitted, with facilities for Remote Indication of switch position (upper indicator)						2					
Fitted with two range switches, upper and lower indicator + remote indication						3					
F Not Used											
G Language for Labels											
English							1				
French							2				
German							3				
Polish							4				
H Cubicle Type											
Without cubicle								1			
Cubicle 2 x 3 range + flow alarms (Ar/CO_2)								2			
Cubicle dual display								4			
Cubicle single display								5			
J Special Features											
None									0		
Fitted									9		
K Mains Supply											
115V 50/60Hz											1
230V 50/60Hz											2

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