

Gas Analyzer Systems for Hydrogen-cooled Alternators

AK101 and AK104



ABB

The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company and is indicative of our dedication to quality and accuracy.

EN ISO 9001:2000



Cert. No. Q 05907

EN 29001 (ISO 9001)



Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.



Electrical Safety

This instrument complies with the requirements of CEI/IEC 61010-1:2001-2 "Safety requirements for electrical equipment for measurement, control, and laboratory use". If the instrument is used in a manner NOT specified by the Company, the protection provided by the instrument may be impaired.

Symbols

One or more of the following symbols may appear on the instrument labelling:

	Warning – Refer to the manual for instructions		Direct current supply only
	Caution – Risk of electric shock		Alternating current supply only
	Protective earth (ground) terminal		Both direct and alternating current supply
	Earth (ground) terminal		The equipment is protected through double insulation

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

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1 INTRODUCTION

Caution. This operating manual applies only to those systems that have been designed and constructed to the standards specified in the schedules of the ATEX certificates listed. The separate units to which these certificates apply are clearly identifiable by model numbers and the data on the identification and ATEX certification labels fixed to them. Other combinations of similar equipment built to any earlier specifications are not covered by BASEEFA certificate number BAS Ex 01E2044. This is particularly important where new replacement units are to be incorporated into existing installations covered by any earlier certification standards. If in any doubt about the installation of particular combinations of certified equipment, contact the Company for advice before proceeding.

It is essential that units are installed strictly in accordance with the appropriate standards for electrical equipment for use in flammable atmospheres. Any deviation from the specified installation conditions, or any unauthorized repairs or adjustments can invalidate the safety assurances given by the certification of the unit.

The ultimate responsibility for any particular installation lies with the installing user/contractor.

This manual gives the installation, operating and maintenance information for the Company's Models AK101 & AK104 Intrinsically Safe Gas Analyzer Systems, normally used with hydrogen-cooled electrical power generators.

The complete AK100 Analyzer system uses a combination of three different units. Each unit is certified independently for use as part of an intrinsically safe system to meet the standards of the ATEX directive 9/94/EC for use in association with Group IIC (hydrogen) hazardous atmospheres in accordance with the following standards:

EN 50014 : 1997 + Amendments 1 & 2 EN 50020 : 1994	006539 & 006548 Katharometer Units 4234 500/501 Power Supply Unit 6553 Display/Control Unit
EN 50284 : 1999	006539 & 006548 Katharometer Units
EN 50039 : 1980	System

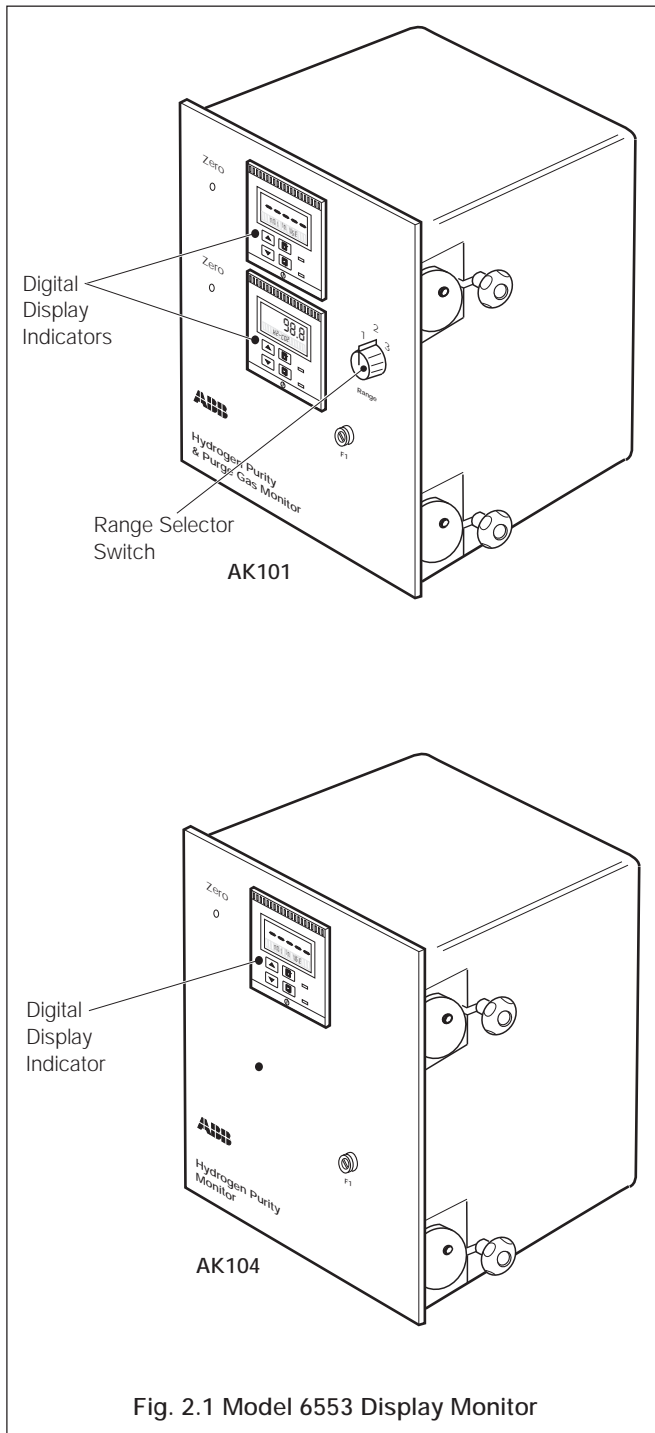
The different units of the system are:

- 1) Model 6553 Display Unit, available in several options. The inputs to the unit are certified to code [EEx ia] IIC T_{amb}= -20 to 40°C under BAS 01 ATEX 7043 certificate with the unit installed in the **safe** area only.
- 2) Model 006539-960K (or J) and 006548-001 Katharometer Units that form part of an intrinsically safe Model 006540-203 and 006548-000 Katharometer Analyzer Panel. These units are certified to code EEx ia IIC T_{amb}= -20 to 55°C under BAS 01 ATEX 1042 certificate for installation in the **hazardous** area (ZONE 0).
- 3) Model 4234 500 and Model 4234 501 constant current Power Supply Unit, that provide the supply for one Katharometer Unit. These power supply units have their output certified to code [EEx ia] IIC T_{amb}= -20 to 55°C under BAS 01 ATEX 7041 certificate for installation in the **safe** area only.

If further information or assistance is required, contact our specialist staff at one of the addresses on the back cover of this manual. Specialist training courses can also be arranged at our Training Centre.

2 DESCRIPTION

All the various system options comprise one or more of the following units with the further option of fitting the display units and power supply units in a cubicle.



2.1 Model 6553 Display Unit

The display unit must be mounted in a **safe** area and is suitable for panel mounting or installation into a control cubicle. The unit houses one or two Model 4689 digital display, each equipped with protected access for zero adjustment, Model AK101 is equipped with a range selector switch – see Fig. 2.1. Model AK104 is a single display for Hydrogen purity and as such requires no range change selector switch.

2.1.1 Range Display

A selector switch for each display provides independent parameter selection as follows:

- Position (1) **Percentage of Hydrogen in Air by volume.**
Displayed on the upper display.
This is the hydrogen purity measurement of the coolant gas during normal operation of the system. The display covers a range of 85 to 100% or 80 to 100% hydrogen in air depending on the range selected. An alarm output and a retransmission signal (4 to 20mA) are provided.
- Position (2) **Percentage of Hydrogen in Purge gas* by volume.**
Displayed on the upper display.
This range is for use in hydrogen filling or purging operation. Alarm output and a value retransmission signal (4 to 20mA) are provided.
- Position (3) **Percentage of Air in Purge gas* by volume.**
This range is for use in purge gas filling or purging operations. Alarm output and a value retransmission signal (4 to 20mA) are provided.

Each display defaults to NOT IN USE when not selected.

A further option of providing remote indication of range selector switch may be available, depending on the number of alarms specified.

The 4689 Display Units provide software specific to the katharometer systems with relay action of the alarms fixed as 'fail safe'. All user-programmable data can be protected from unauthorized alteration by a programmable 5-digit security number.

The zero adjustments on the front panel of the 4689 enable remote zeroing of the katharometers mounted in the **hazardous** area. The adjustment access for a particular display is adjacent to the display and at the same level.

The 4689 has a protective case that can be removed for access to the interior without removing the whole unit from the control panel.

The 4689 also contains encapsulated zener diode safety barrier devices to limit the electrical energy that can be supplied from the instrument circuits into the **hazardous** area. These devices are located below the display units, on a rail that **MUST** be earthed (grounded). A metal screening arrangement segregates the connections made to equipment in the **hazardous** area. The unit is protected on the mains input side by two fuses, one for each circuit, accessible from the front of the panel.

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

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

...2 DESCRIPTION

2.2 Model 006540203 or 006548000 Katharometer Analyzer Panel – Fig. 2.2

Each panel comprises a metering valve, a drying chamber, a thermally lagged katharometer (Model 006539 or 006548) and a flowmeter. These items are mounted on a flat panel suitable for fixing to a vertical surface close to the sample point. The katharometers are calibrated for the hydrogen purity measurement as well as hydrogen in purge gas* and air in purge gas*.

Each katharometer assembly incorporates a Wheatstone Bridge comprising fine, glass-coated platinum filaments. One pair of parallel arms is sealed in the reference gas and the other pair exposed to the sample gas.

When the intrinsically safe stabilized current from the 4234 power supply unit (Model 4234 500 or 4234 501) is passed through this bridge, the temperature of the platinum filaments rises to a point of thermal equilibrium. Under conditions that are arranged to give minimum radiation and convection heat transfer, the equilibrium temperature depends on the thermal conductivity of the gas surrounding the filament. Thus any difference between the thermal conductivity of reference and sample gases causes an imbalance in the bridge; this imbalance (as a millivolt signal) is indicated by the display.

Zener diodes are connected across the input connections from the power supply unit to the katharometer in order to limit the maximum voltage that could be developed across the filament bridge under external fault conditions. Under fault conditions the current is limited to a safe value by the power supply unit.

*Note. Purge gas options include:

CO₂ (Carbon dioxide)
N₂ (Nitrogen)
Ar (Argon)

2.3 Model 4234 500/4234 501 Power Supply Units (PSU) – Fig. 3.3

Caution. Do not connect the mains supply to the PSU with the output terminals open circuit.

Caution. Ensure that the PSU is correct for the mains supply voltage available. A nominal 115V unit cannot be adapted for use with a nominal 230V supply, or vice versa.

To operate a katharometer unit in the hazardous area, one Model 4234 PSU is required for each katharometer. The PSU supplies a stabilized DC current output and **must** be mounted in the **safe** area. There are two versions available:

Model 4234 500 for a nominal 230V AC supply voltage
Model 4234 501 for a nominal 115V AC supply voltage

The stabilized current output is current and voltage limited to restrict the energy supply into the hazardous area.

The PSU is housed in a metal case fitted with lugs for wall/panel mounting. Cable gland entries are provided at opposite ends of the case for supply voltage input and stabilized current output cables to the hazardous area.

The circuit is protected by cartridge fuses. These fuses **must** have a high breaking capacity (HBC) rating of 1500A to comply with the terms of the certification.

2.4 Remote Indicator/Controllers

The 6553 Display Unit has retransmission outputs for connection to indicator/controllers, providing that they are installed in the **safe** area and the installation conforms to the requirements given in Section 5.1.

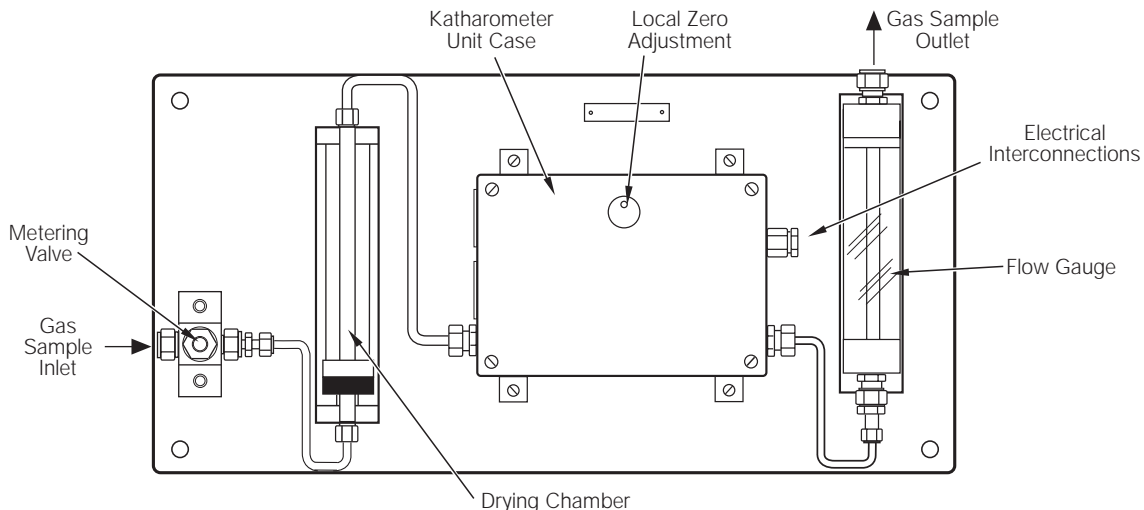


Fig. 2.2 Location of Items – Model 6540 203 and 6548 000 Katharometer Analyzer Panels

3 PREPARATION

3.1 Identification

It is essential that installers and users clearly identify the various units of the monitoring system as follows:

3.1.1 Model 6553 Display Unit – Fig. 3.1

Several versions of the 6553 Display Unit are available and are defined by the code number explained in Section 3.1.4.

Identification and certification labels are fixed to the outside of the unit case as shown in Fig. 3.1. Use the ordering code table in Section 3.1.4 to interpret the identification label code and obtain a precise description of the 6553 Display Unit.

Note. Location of the identification label on the 4689 display unit is also shown in Fig. 3.1.

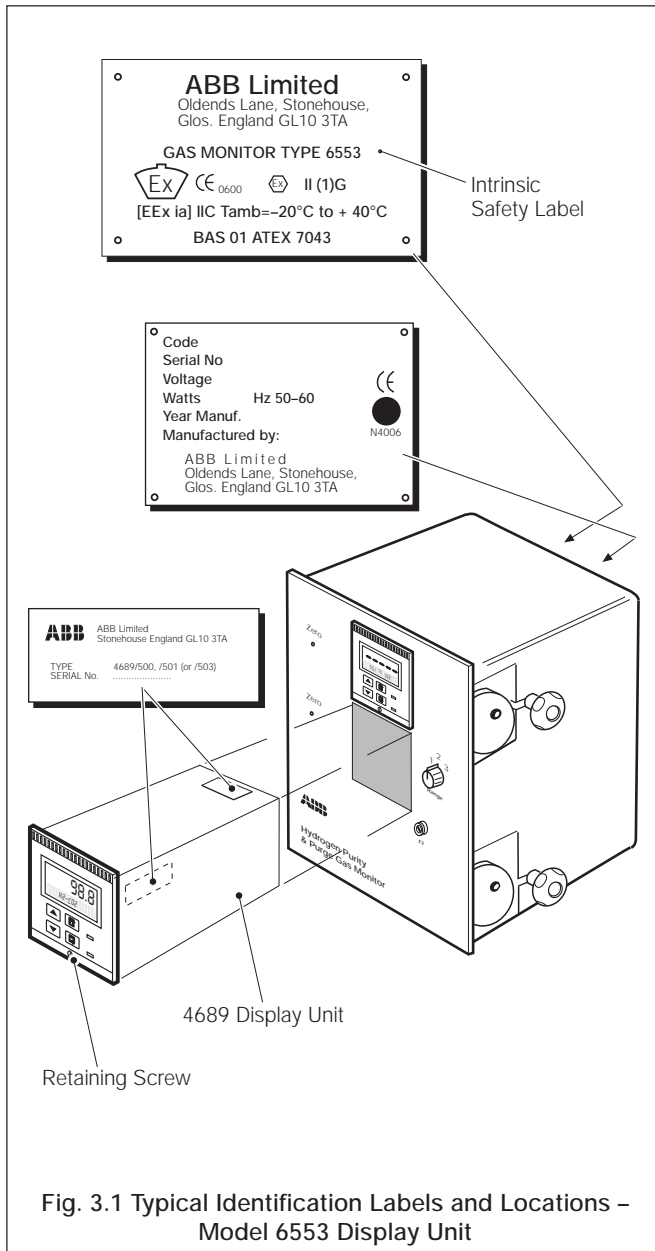


Fig. 3.1 Typical Identification Labels and Locations – Model 6553 Display Unit

3.1.2 Model 006540 203 or 006548 000 Katharometer Analyzer Panels – Fig. 3.2

The panel is identified by the reference number label as shown in Fig. 3.2. The identification and certification labels of the individual katharometer units (fixed to the katharometer case) are also shown in Fig. 3.2.

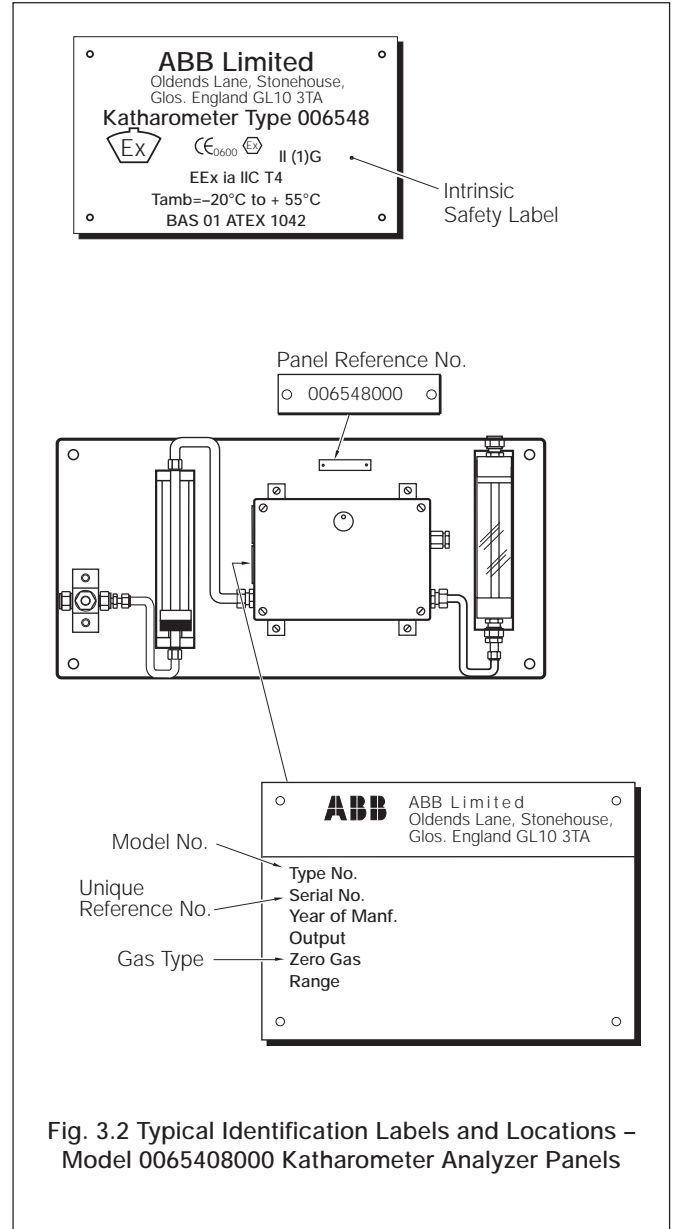


Fig. 3.2 Typical Identification Labels and Locations – Model 0065408000 Katharometer Analyzer Panels

...3 PREPARATION

3.1.3 Model 4234 Power Supply Unit – Fig. 3.3

The identification and certification labels are fixed to the outside of the unit case, as shown.

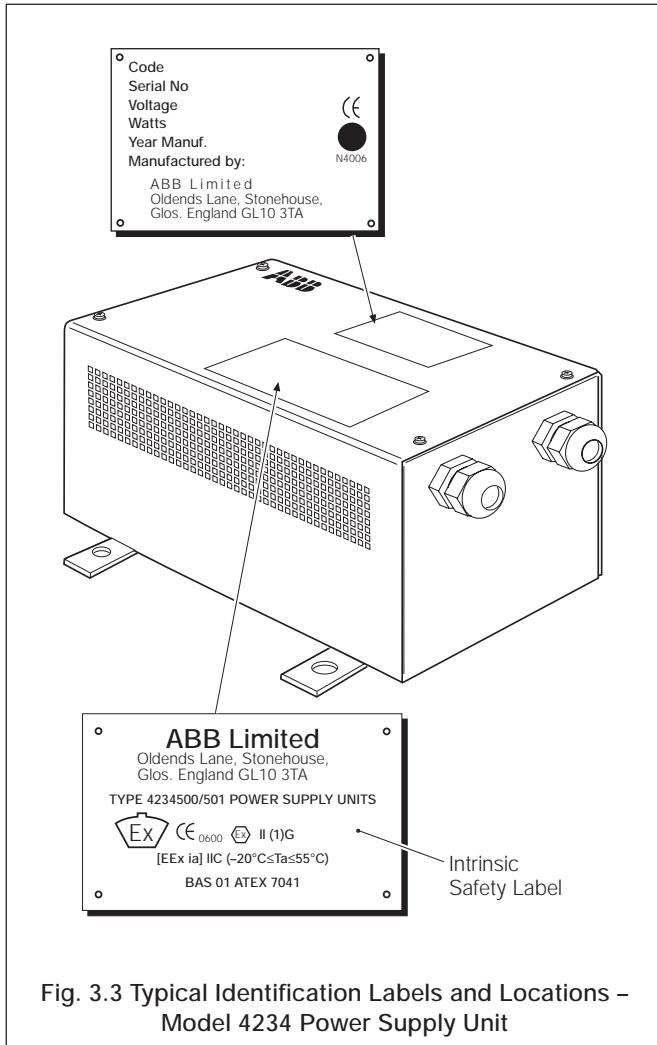


Fig. 3.3 Typical Identification Labels and Locations – Model 4234 Power Supply Unit

3.1.4 AK100 Ordering Information

ATEX Compliant Gas Analyzer for Hydrogen-cooled Alternators	AK10	X /	X	X	X	X	X	X	X	X
Display Monitor										
Separate H ₂ Purity & 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				3						
Gas Analysis Panel*										
None					0					
Low pressure (for vent to atmosphere 0.35barg (5 psi) max.					1					
Low pressure & flame traps (for vent to atmosphere 0.35barg (5 psi) max.					2					
High pressure for closed loop 10barg (145 psi) max.					3					
Cubicle										
Without cubicle						0				
With cubicle						1				
With cubicle plus isolator †						2				
With cubicle plus isolator plus MCBs and power supply indicators †						3				
Gas Sample Flow Alarm (only available with Cubicle option)										
Not fitted							0			
One flow alarm fitted AK103 and AK104 (single gas analysis panel versions)							1			
Two flow alarm fitted AK101 and AK102 (dual gas analysis panel versions)							2			
Katharometer Power Supply										
None								0		
115V 50/60Hz								1		
230V 50/60Hz								2		
Special Feature										
None									0	
Special									9	
System Labels and Instruction Manuals**										
English										1
French										2
German										3
Polish										7

* Two Gas Analysis panels are required for AK101 and AK102.

** Check with Factory for availability.

† Not normally fitted to AK102 systems that require 100% redundancy.

The equipment conforms with the requirements of ATEX directive for Class IIC gases to Code EEx ia IIC provided that the equipment is installed in accordance with instructions provided.4.1 Locating and Mounting System Items

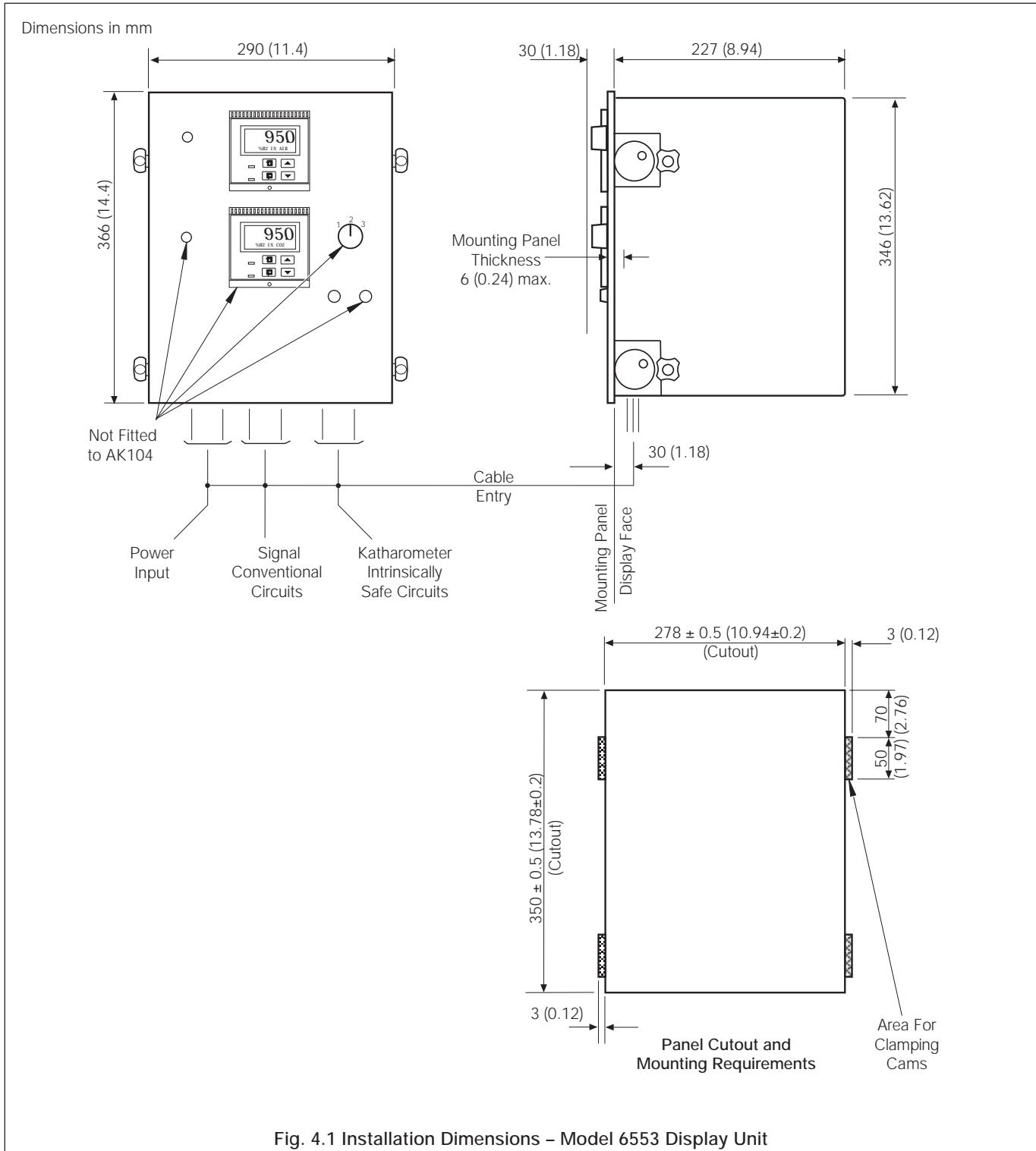
4 MECHANICAL INSTALLATION

4.1 Locating and Mounting System Items

4.1.1 Model 6553 Display Unit – Fig. 4.1

Note. The display unit **must** be located in the **safe** area of the application plant in a sheltered interior environment.

The display unit is designed for panel-mounting in a position to suit reading of the displays and with access to the rear for electrical interconnections. The panel preparation requirements and installation dimensions are shown in Fig. 4.1. The display unit is secured to the panel by four adjustable cam brackets – two each side of the unit chassis.

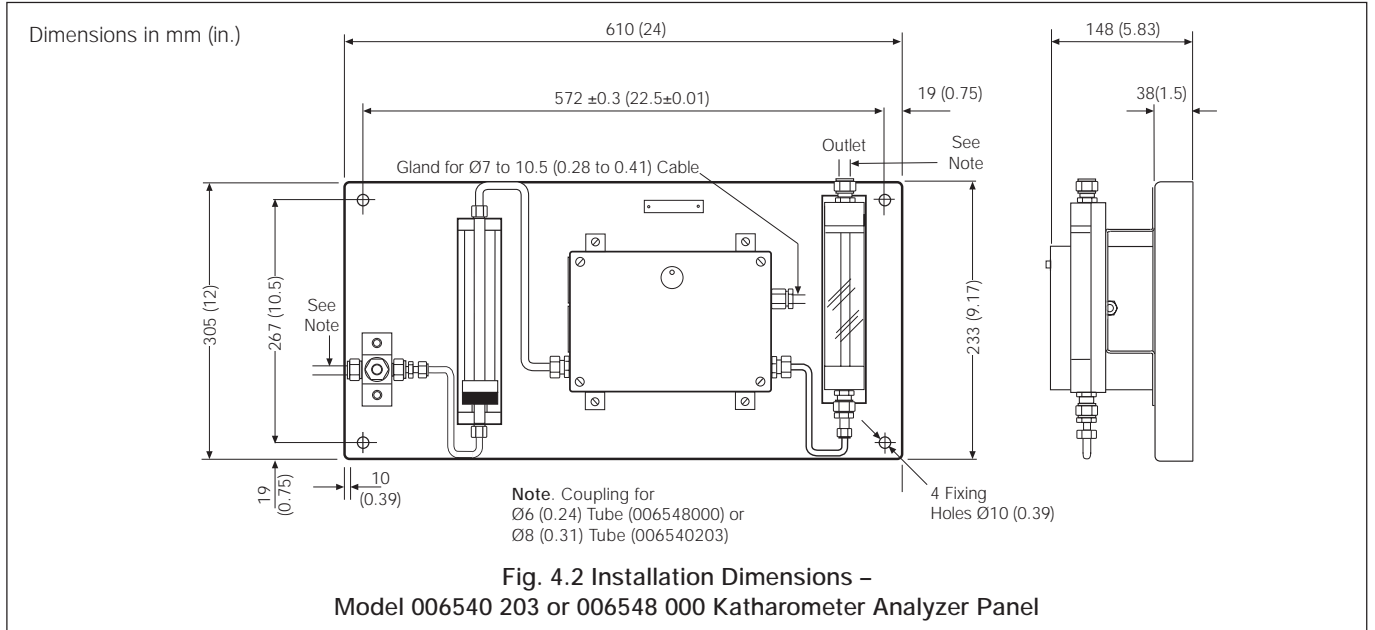


4.1.2 Katharometer Analyzer Panel – Fig. 4.2

Note. The panel may be located in the hazardous area (Zone 0, 1 or 2) of the application plant in a sheltered interior environment.

Avoid a location that subjects the katharometer unit to direct sunlight. When two katharometer panels are used locate them in positions that have the same ambient temperature.

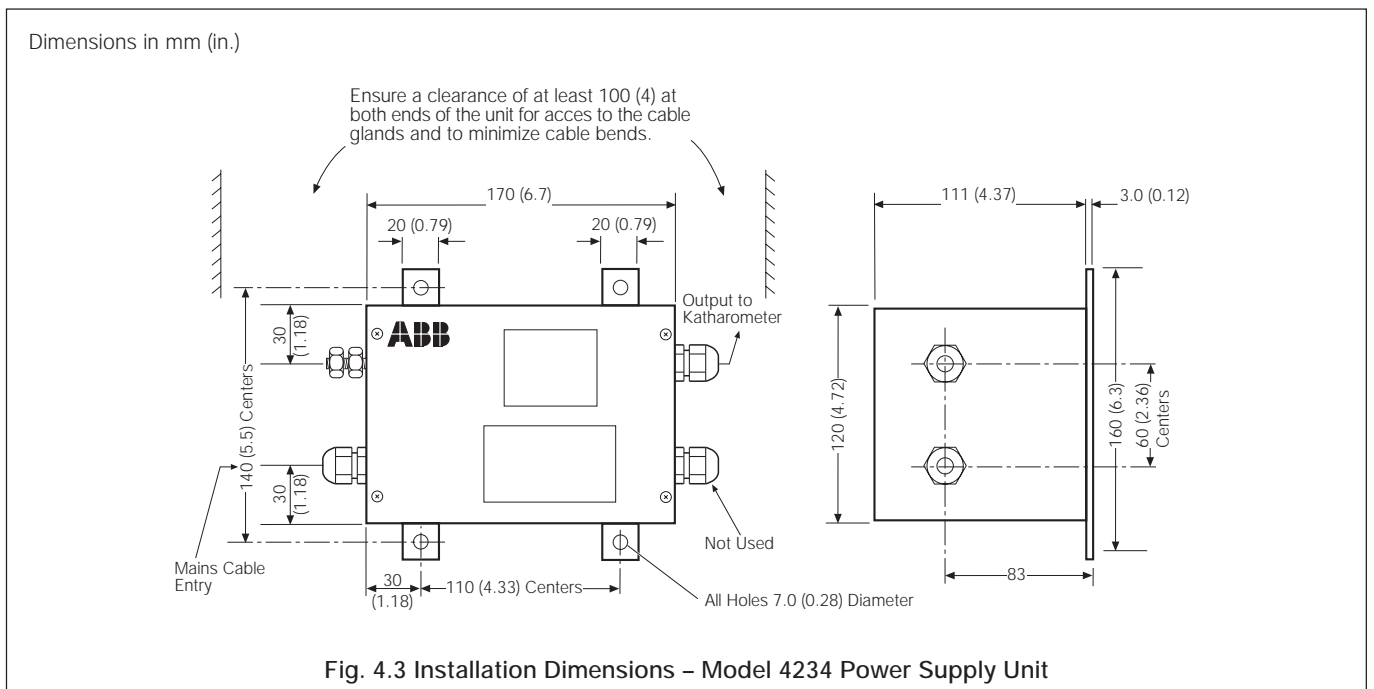
The katharometer unit is fixed to the panel that has fixing holes at each corner for mounting on a suitable vertical surface close to the sample tapping point. The installation dimensions for the panel are shown in Fig. 4.2.



4.1.3 Model 4234 Power Supply Unit – Fig. 4.3

Note. The unit **must** be located in the **safe** area of the application plant in a sheltered interior environment.

The power supply unit has four fixing lugs for mounting on a suitable vertical surface. The installation dimensions are shown in Fig. 4.3.

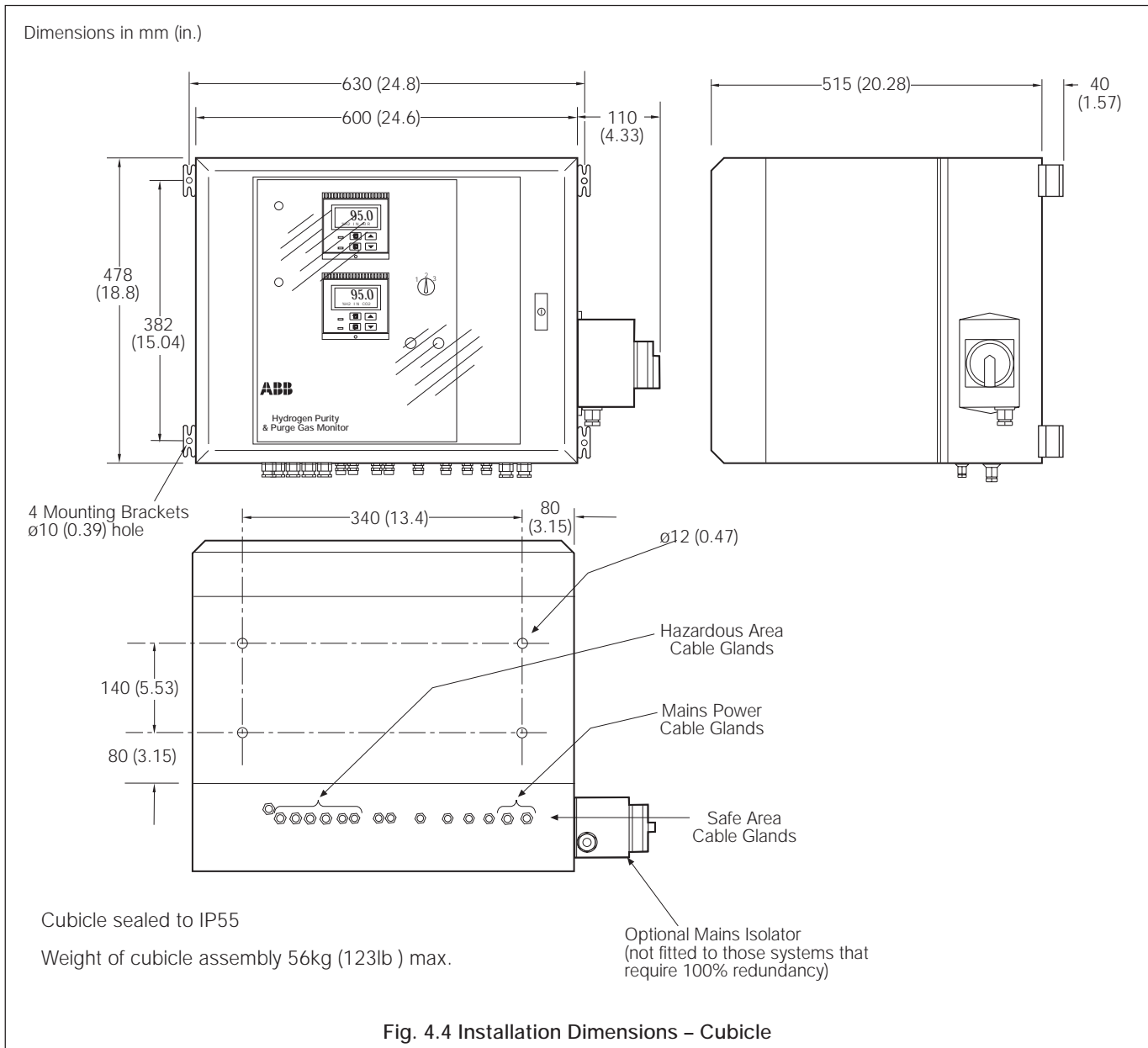


...4 MECHANICAL INSTALLATION

4.1.4 Cubicle Mounted System – Figs 4.4 and 4.5

The cubicle **must** be located in a **safe** area of the application plant and mounted either on the base using four M10 fixings or to a vertical surface using the four fixing brackets on the back-plate.

Overall dimensions of the cubicle are given in Fig. 4.4 and the principal base case components are shown in Fig. 4.5.



4.2 Sample Gas Interconnections

Note. A hazardous mixture of hydrogen-in-air could develop in the event of leakage from the sample gas system. Katharometer Analyzer panels must be located in a ventilated area.

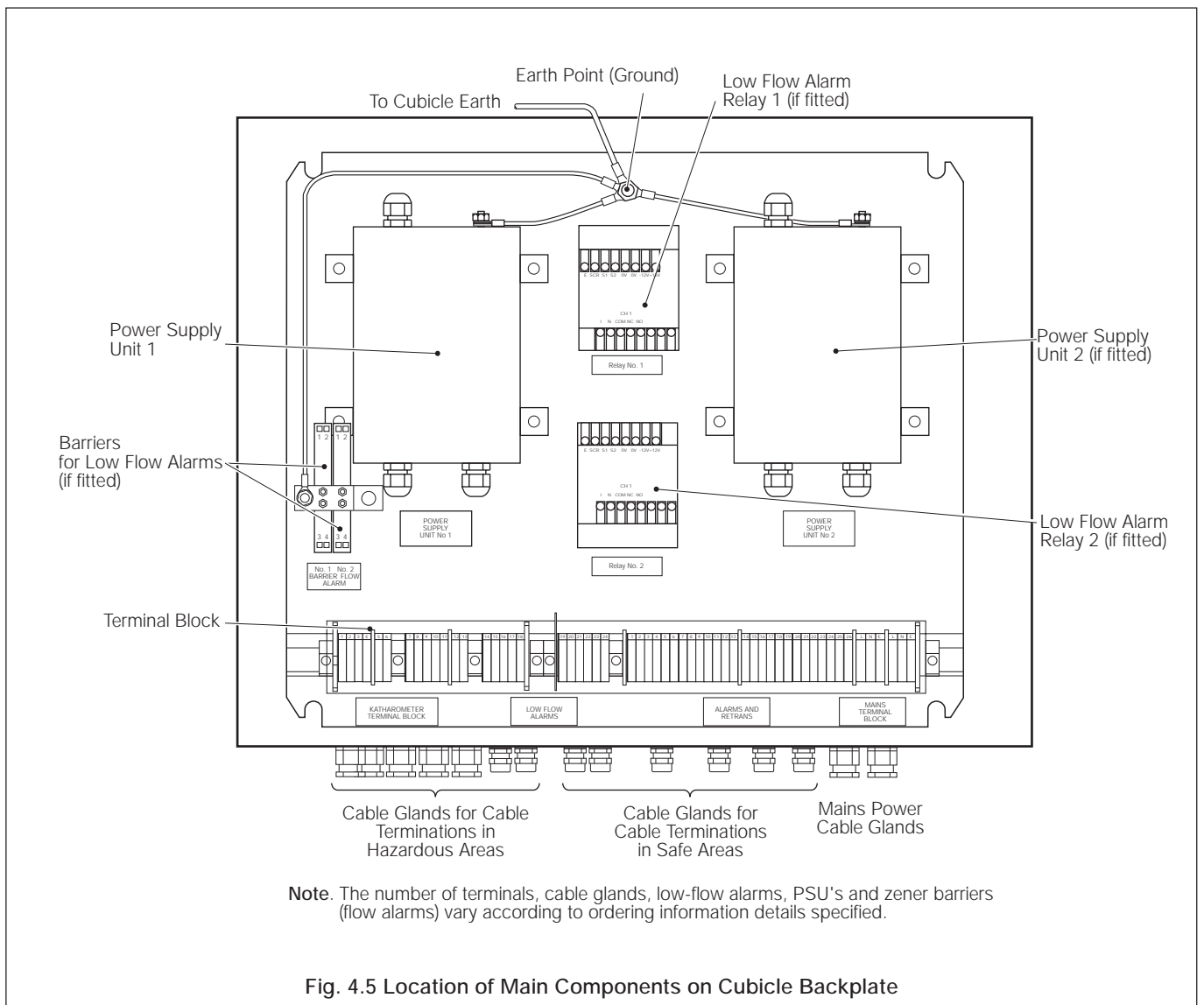
The sample pressure must not exceed 0.35bar (Gauge) for Model 6540–203 and 10bar (Gauge) for Model 6548–000.

The incoming sample gas temperature must not exceed 55°C (131°F). Ideally the sample gas temperature should be allowed to reach ambient temperature before entry to the katharometer unit.

If there is a risk of significant particle contamination incorporate a suitable 1µm filter unit in the system before the sample gas enters the Analyzer system.

Compression couplings are supplied at the sample inlet and outlet to the katharometer panel. These couplings are suitable for connecting 8mm (0.31 in.) (Model 006540 203) or 6mm (0.24 in.) (Model 006548 000) outside diameter metal tube. It is recommended that stainless steel tube is used.

The complete tubing system should be tested for leaks in accordance with the requirements of the responsible authority.



Warning.

- Equipment in this system operates on AC mains supply voltage electricity. Suitable safety precautions must be taken to avoid the possibility of electric shock.

Caution.

- Although certain instruments are fitted with internal fuse protection, a suitably rated external protection device, either a 3A fuse or miniature circuit breaker (MCB) must also be fitted by the installer.
- The proper electrical connections and wiring standards must be achieved to establish the intrinsic safety of the system, as certified.
- AC input, intrinsically safe DC output and non-intrinsically safe wiring must all be routed separately.

Fig. 5.1 shows the interconnecting wiring requirements for the AK100 Gas Analyzer system, that must be strictly observed. Details of cable requirements, that must be strictly adhered to, are also given – see Section 5.2.1.

After completing the wiring, check that the continuity earthing (grounding) and isolation of all circuits is to the required local electrical standards for intrinsically safe circuits.

The separate units of the Analyzer system must be interconnected as shown in Sections 5.1.1, 5.1.2 and 5.1.3.

5.1.1 Model 6553 Display Unit – Fig. 5.2

Caution. No connections must be made to the hazardous area terminals (Terminal Blocks TB5 & TB6) other than as specified in wiring diagram Fig. 5.3. The appropriate cable requirements must be strictly adhered to.

Remove the outer case from the back of the unit to gain access to the terminal blocks.

Make electrical connections through the bottom of the unit into the terminal blocks immediately above them – see Fig. 5.2.

The alarm and signal outputs on terminal blocks TB3 & TB4 may be connected as required. The availability of signal outputs vary with the particular 6553 system – refer to Fig. 5.3 for details.

Make the wiring connections in accordance with the information given in the wiring diagram Fig. 5.3 and Section 5.1.

Refer Fig. 5.4 for connections to cubicle-mounted display unit.

Continued on page 17.

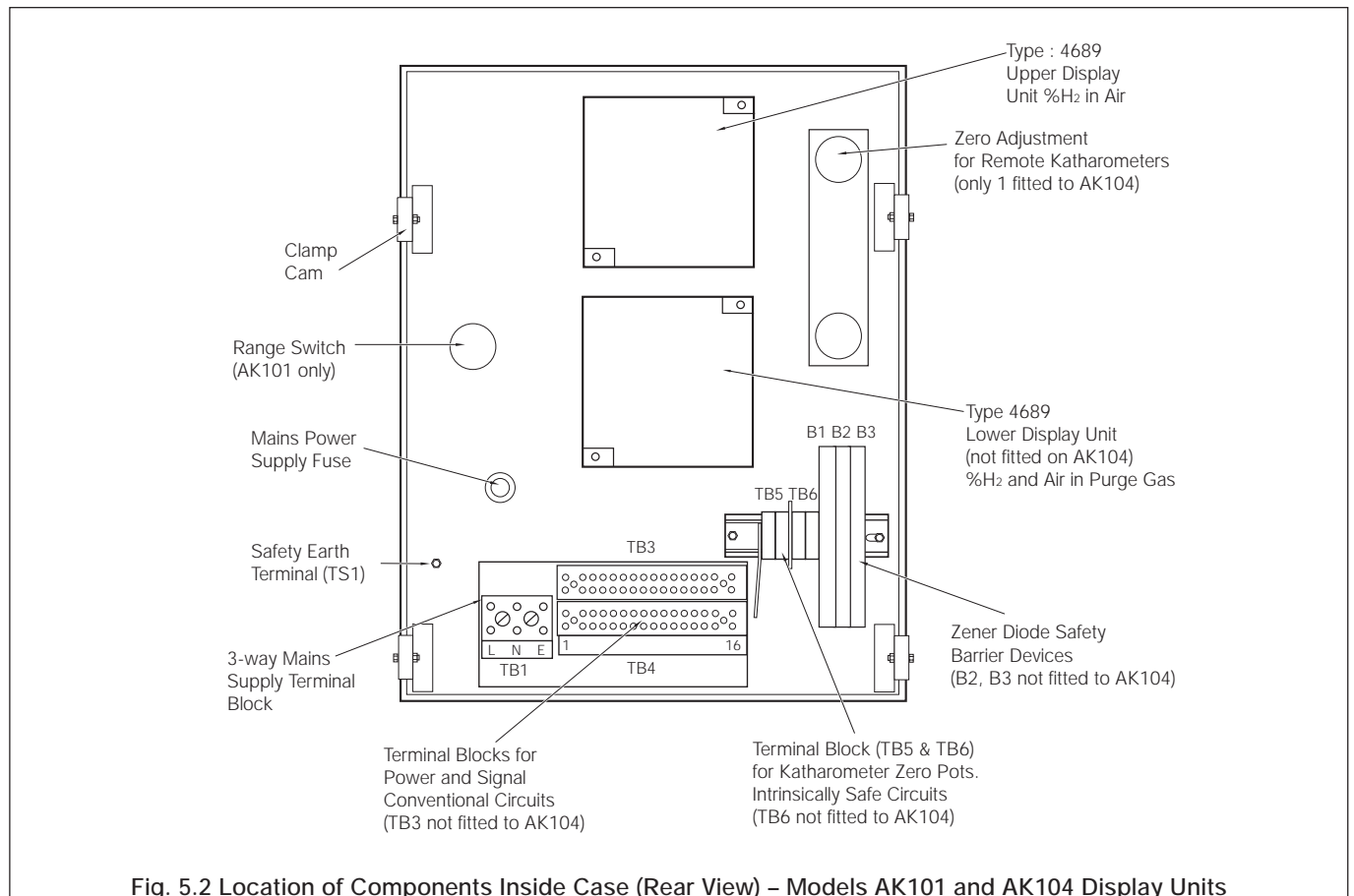


Fig. 5.2 Location of Components Inside Case (Rear View) – Models AK101 and AK104 Display Units

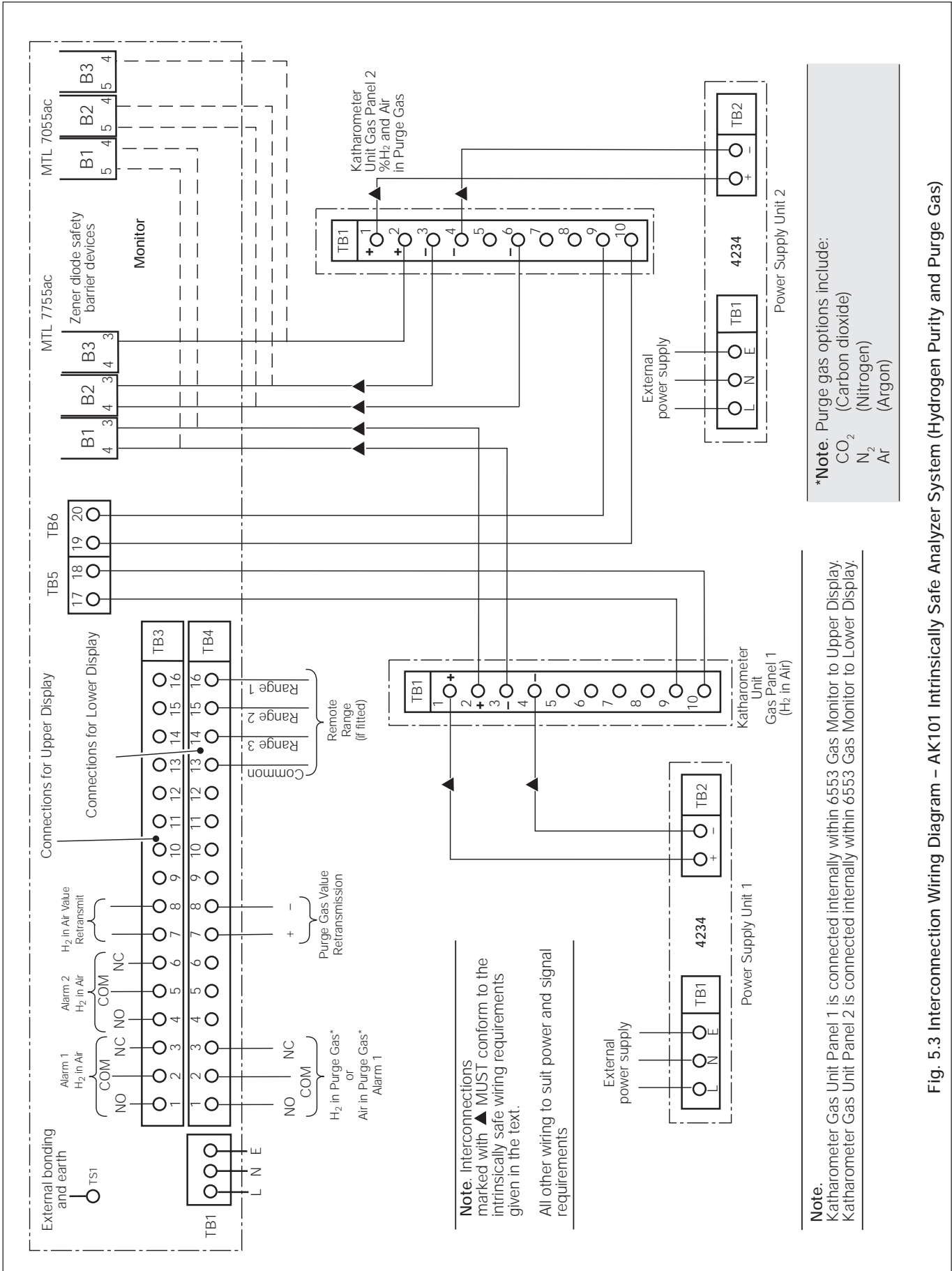


Fig. 5.3 Interconnection Wiring Diagram – AK101 Intrinsically Safe Analyzer System (Hydrogen Purity and Purge Gas)

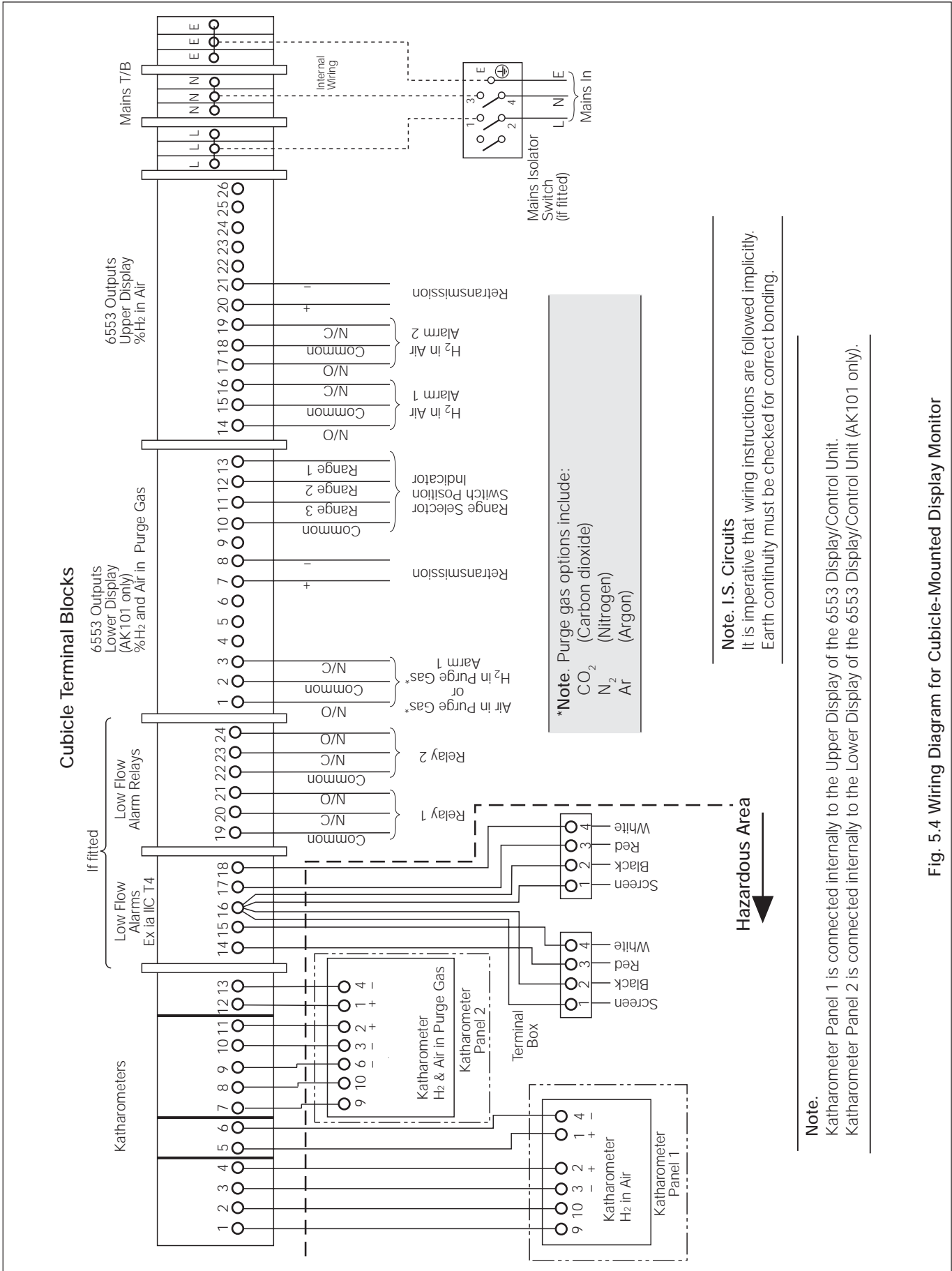


Fig. 5.4 Wiring Diagram for Cubicle-Mounted Display Monitor

Caution. The integrity of the fail-safe operation of the zener diode safety barrier devices depends on a Safety Earth connection which must not have a resistance greater than 1Ω to the application plant earth (ground).

Make the Earth (Ground) and **Safety Earth** connection at the stud (TS1) – see Fig. 5.2.

On completion of wiring and checks, replace the outer case and secure the clamping brackets to the mounting panel.

5.1.2 Model 006540 203 and 006548 000 Katharometer Analyzer Panel

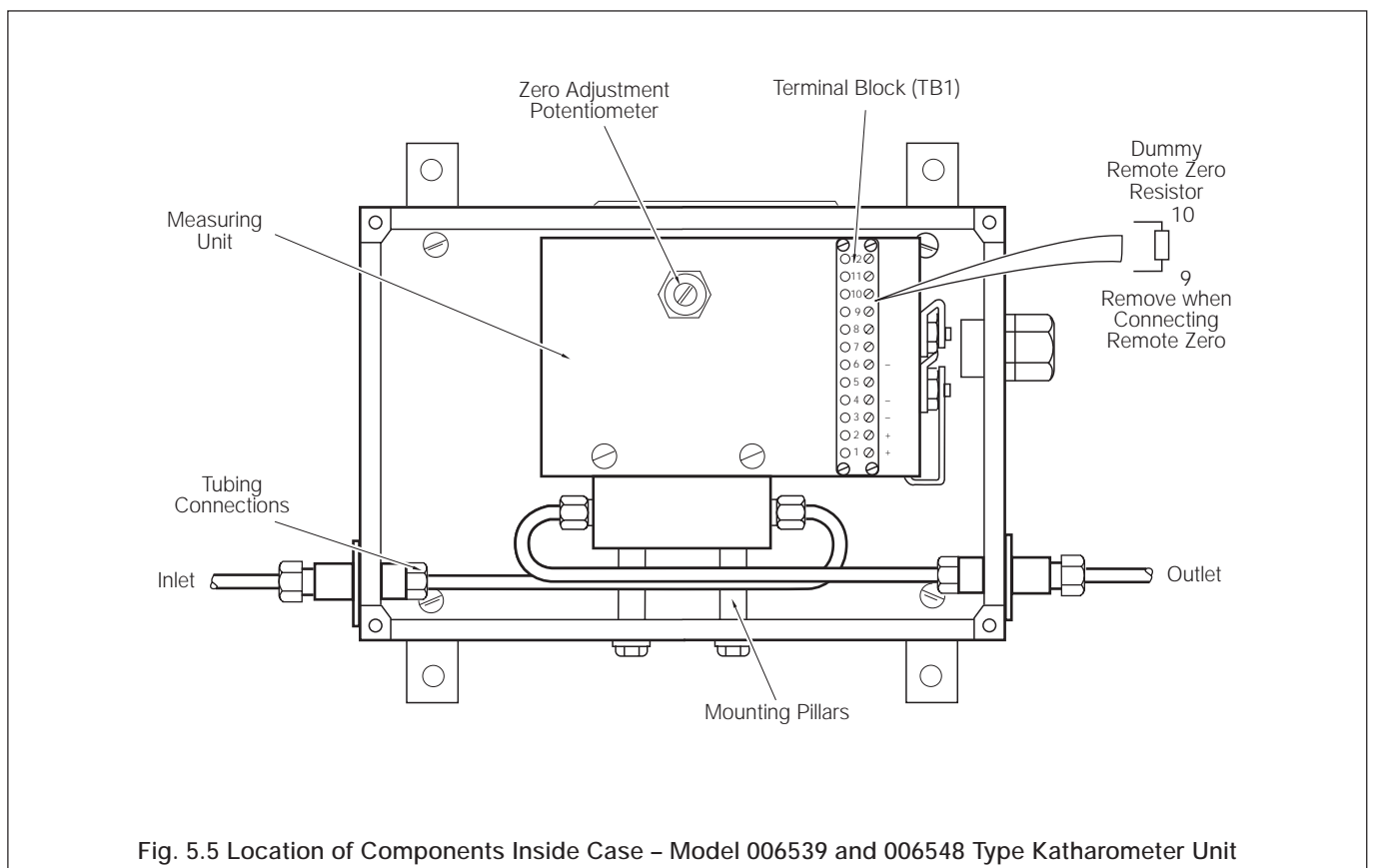
To gain access to the connection terminal block TB1:

- 1) Remove four screws in the cover of the katharometer unit.
- 2) Remove cover

Make the electrical connections to the Display Unit in accordance with the information given in wiring diagrams in Figs 5.3, 5.4 and 5.5 and Section 5.2.

The electrical connections are made at the terminal block (TB1) via the cable gland or any replacement gland to suit the intrinsically safe wiring requirements. When the appropriate interconnections have been made, if remote zero is to be used, remove the 510Ω dummy remote zero resistor from across terminals 9 and 10 and set the zero adjustment potentiometer on the katharometer to the approximate mid-point.

Replace the cover when wiring is complete.



...5 ELECTRICAL INSTALLATION

5.1.3 Model 4234 Power Supply Unit – Fig. 5.6

Caution. Do NOT connect mains supply to the power supply unit with the output terminals on open circuit.

Note. Ensure that the power supply unit is correct for the mains supply voltage available. A nominal 115V unit cannot be adapted for use with a nominal 230V supply or vice versa.

Remove the cover of the unit to gain access to the terminal blocks inside.

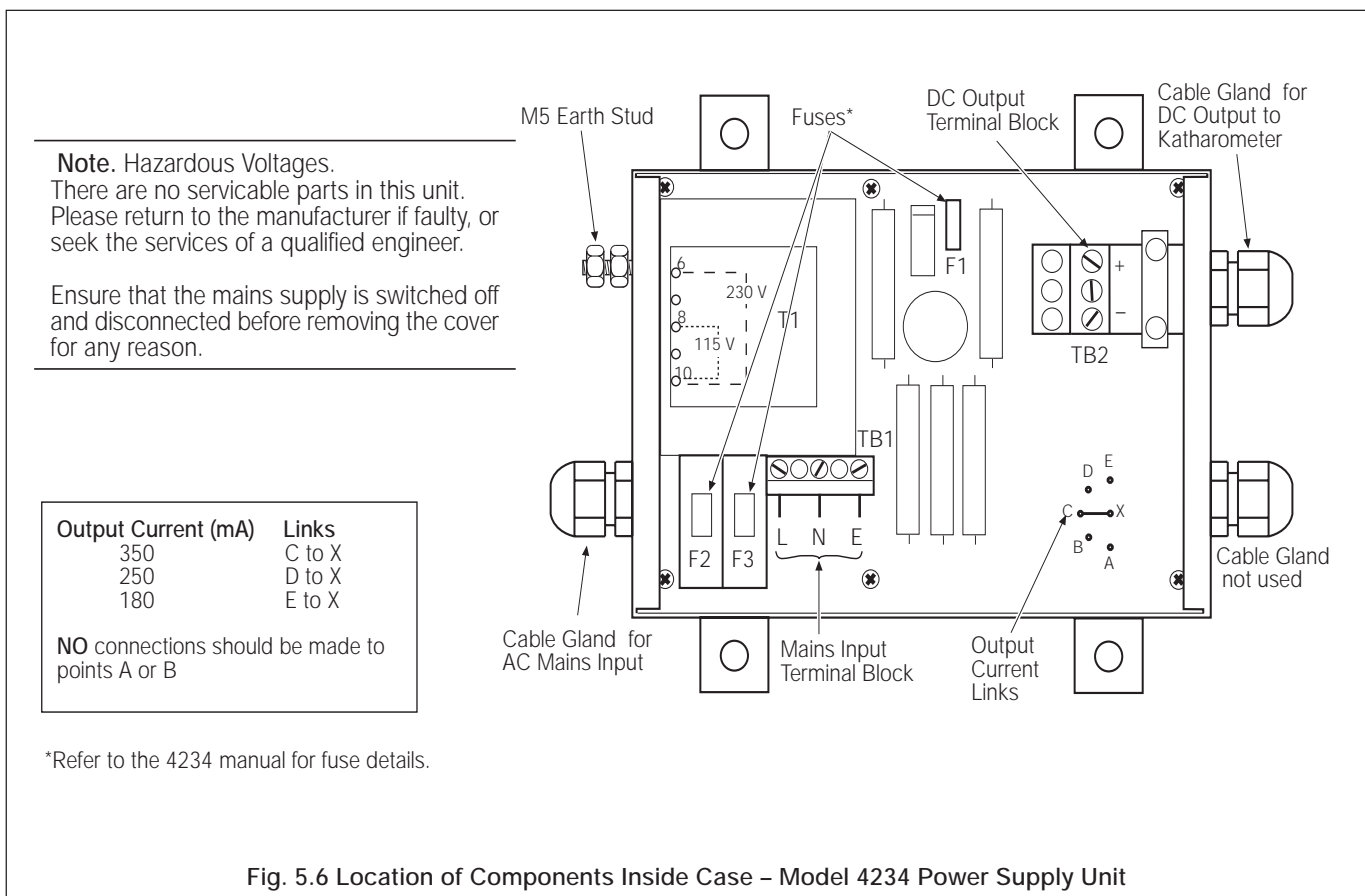
Identify the terminal block (TB1) adjacent to the transformer T1 and ensure the correct transformer tapping is used for the incoming mains supply, i.e.

- link from tapping 6 to 10 for 230V, or
- link from tapping 8 to 10 for 115V.

Make electrical connections in accordance with the information given in the wiring diagrams Figs 5.1 and 5.3 and the cable details in Section 5.2.1.

The electrical connections are made at terminal blocks TB1 and TB2 through the appropriate cable gland or any replacement gland to suit intrinsically safe wiring requirements. Secure the incoming cable by the cable clips adjacent to the terminal blocks.

Replace the cover when wiring is complete.



5.2 Intrinsically Safe Requirements

These requirements relate to the interconnecting wiring made to and from Model 6540 203 and 6548 000 Katharometer Analyzer Panels in the hazardous area and those for remote ancillary items connected to the system.

5.2.1 Cable Requirements

The interconnecting cables between the various units of the gas analysis system are subject to stringent limitations because of the requirements of the intrinsic safety certification. These are listed below and detailed in Fig. 5.1.

All cables entering the **hazardous** area must be kept separate from cables in the **safe** area. Cables entering the **hazardous** area must not be run with other cables and terminations must have an earthed screen to separate them from connections for other circuits. The detailed requirements are as follows:

1) Connections between Model 006540 203 or 006548 000 Katharometer Analyzer Panels and the 4234 PSU

All cables from the katharometer in the hazardous area must have an inductance/resistance ratio not exceeding $20\mu\text{H}/\Omega$ (for Group IIC gases). Also the maximum loop resistance of this interconnecting cable is limited to 1.5Ω ; This may place a limitation on the length of the total cable run.

Twist single-sheathed conducting cables together to reduce their mutual inductance, route them separately from cabling for non-intrinsically safe circuits in the safe area.

2) Connections between Model 006540 203 or 006548 000 Katharometer Analyzer Panels and Model 6553 Display Unit

Katharometer to display unit cables carrying the output signals through zener barrier units inside the display unit are subject to a maximum inductance/resistance ratio of $20\mu\text{H}/\Omega$ (for group IIC gases). These wires are indicated by a ▲ in Figs. 5.3 and 5.3a.

5.2.2 Recommended Cables

The choice of wiring cable is restricted by the limitations imposed by the certification parameters. Care must be taken to ensure that the specification of the cable required for interconnection lengths is such that the certification parameter limits are not exceeded – see Notes 2a, b and c in Fig. 5.1.

Cables manufactured to DEF STAN 61-12 Part 5 should comply, but care must be taken over the number or cores included in the cable; there is a significant difference between the 2-core and 6-core cables. The diameter over the screen in the 6-core cable is greater than that of the 2-core and this diameter affects both the inductance and capacitance values.

The values of a typical DEF STAN 61-12 Part 5 cable are:

	2-core	6-core
Inductance ($\mu\text{H}/\text{metre}$)	0.325	0.467
Capacitance (pF/metre)	190	143
L/R ($\mu\text{H}/\Omega$)	8.6	11.4
Test voltage	2kV AC for one minute	
Rated voltage	440V RMS	

Typical cables may be obtained at the following addresses:

www.permanoid.co.uk
www.Belden.com

Note. Interconnection lengths and number of cores will dictate which cable is required e.g. Belden 9512 cable.

5.2.3 Installing Remote Ancillary Items

Any indicator/controllers, or other electrical equipment, connected to TB1 of the Model 6553 Display Unit must not be supplied from, nor contain, a voltage source greater than 250V DC or 250V RMS with respect to earth.

5.2.4 Full Intrinsically Safe Requirements

For systems to be modified or used with other gases the full ATEX requirements must be complied with as follows:

- 1) The total Capacitance and Inductance or Inductance to Resistance ratio (L/R) of the cables connecting the katharometer unit to the hazardous area terminals of the display unit (TB2) and power supply unit terminals (TB1) must not exceed the values given in Fig. 5.1.
- 2) Any junction boxes used in the hazardous or safe areas must conform to ATEX Directive 9/94/EC, specifically clauses 6.1 and 6.3.1 of EN50020:1994.

When the AK100 gas analyzer system has been correctly installed in accordance with the requirements for intrinsic safety in Section 5.2, refer to Section 6 for system set up.

6 SETTING UP

6.1 Katharometer Analyzer Panel – Filling the Drying Chamber – Fig. 6.1

- 1) Remove the drying chamber on the katharometer analyzer panel by unscrewing the large knurled nut at the base of the chamber. Pull the chamber down and out of the sealing groove to remove it from the panel.

Note. The desiccant used in the drying chamber is either granular anhydrous calcium sulphate or calcium chloride and absorbs moisture from the atmosphere. The drying chamber has a capacity of 140ml approx. and requires approx. 100g of desiccant to fill it. Filling and resealing must be carried as quickly as possible.

- 2) Open a container of fresh desiccant and fill the drying chamber.
- 3) Replace the drying chamber in its sealing groove and reposition the chamber to enable it to be secured and sealed by hand tightening the knurled nut.
- 4) Carry out an approved leak testing procedure before passing sample gas through the system.

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

CO ₂	(Carbon dioxide)
N ₂	(Nitrogen)
Ar	(Argon)

6.2 Setting Sample Flow

When all tubing interconnections have been made and external parts of the sample system checked for leaks, carry out the following procedure:

- 1) Supply calibration quality purge gas* through the gas analyzer system at the normal working pressure of the application plant and within the following limits:

Model 6540-203

125mm H₂O min. to 0.35bar (gauge) max.

Model 6548-000

125mm H₂O min. to 10bar (gauge) max.

Note. In some instances testing for leaks with purge gas* may not be considered an adequate check of gas tight integrity in respect of the more penetrating hydrogen gas. Consideration should be given to the use of a gas, such as helium, which has penetrating properties nearer to that of hydrogen.

- 2) Slowly open the metering valve to give a nominal flowrate of gas of 100 to 150ml min⁻¹. Do not exceed the maximum flowrate 250ml/min.
- 3) Set the flowrate and shut off the calibration gas external to the analyzer system.
- 4) Repeat this procedure for each katharometer analyzer panel, as required.

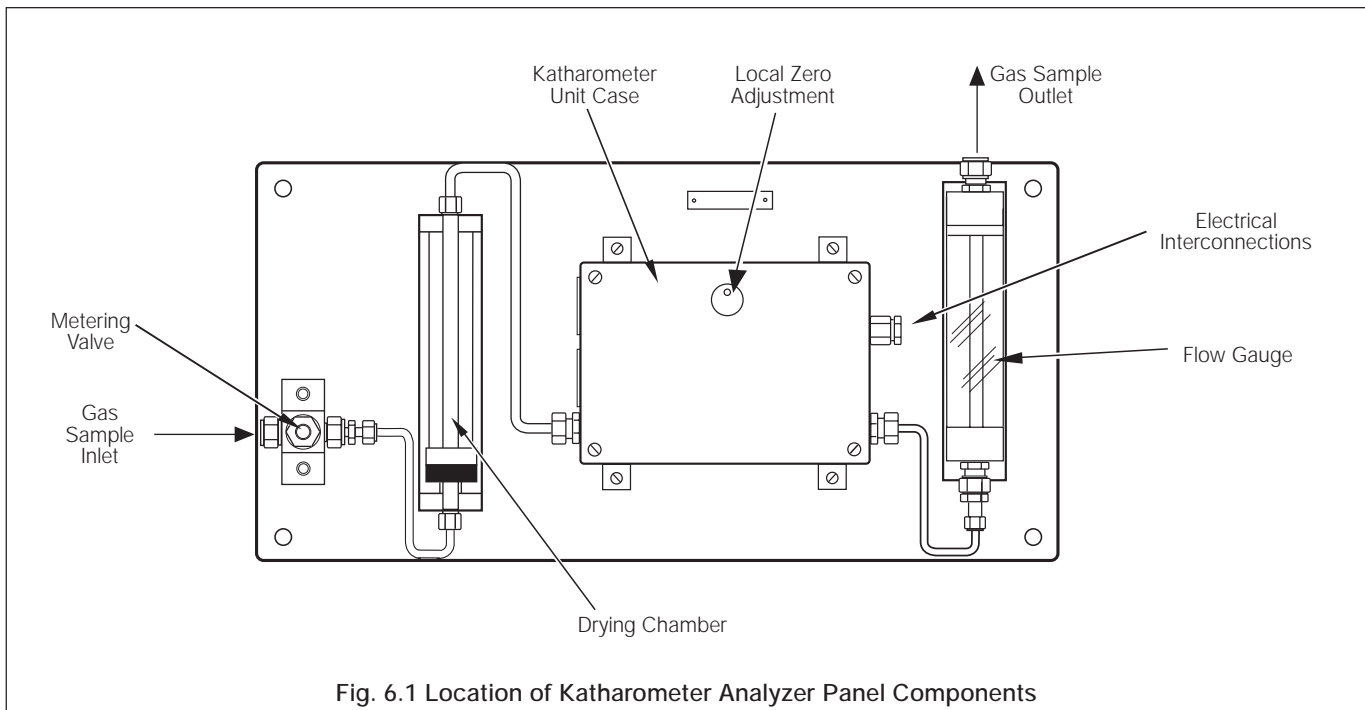


Fig. 6.1 Location of Katharometer Analyzer Panel Components

6.3 Electrical Checks

Carry out the electrical checks detailed in Sections 6.3.1 and 6.3.2.

6.3.1 Power Supply Unit Output

Warning. This unit is part of the certified intrinsically safe system. Appropriate safety precautions must be taken to prevent any incendive electrical discharges in the hazardous area when carrying out this task.

Testing the output may only be carried out with the hazardous area cable disconnected.

- 1) Electrically isolate the PSU.
- 2) Remove the cover from the PSU.
- 3) Disconnect the output wires to the hazardous area at terminals TB2+ and TB2-.

Warning. Ensure that proper electrical safety precautions are taken at all times when undertaking this procedure.

- 4) Switch on the PSU and check that the output measures 350mA into a 14 Ω load.
- 5) On completion of tests isolate the unit and reconnect the output wires to the hazardous area.
- 6) Replace the cover on the unit.

6.3.2 Zener Diode Safety Barrier Devices

The zener diode safety barrier devices (MTL7755ac or MTL7055ac) in the 6553 Display Unit are checked at the time of manufacture. To ensure absolute safety when fitting a new instrument, check that the barriers in the display unit are properly earthed by carrying out a routine test before using the analyzer system.

Warning .

- This unit is part of the certified intrinsically safe system. Appropriate safety precautions must be taken to prevent any incendive electrical discharges in the hazardous area when carrying out this task.
 - If these tests reveal a faulty zener barrier, the barrier **MUST** be replaced by a new unit. The barrier is a sealed unit and no repair is permitted. The correct zener barriers are certified intrinsically safe and conform to the ATEX Directive 9/94/EC, certificate number BAS 01 ATEX 7217 (MTL 7755ac) or BAS 99 ATEX 7285 (MTL 7055ac).
 - Replacement Zenner barriers **MUST** be of the same type.
-

6.3.3 Checking System Earth

Check that the resistance between earth terminals on the analyzer system and the application plant system safety earth does not exceed 1 Ω .

7 CONTROLS & DISPLAYS

7.1 Displays – Fig. 7.1

The displays mounted in the 6553 panel comprises a 5-digit, 7-segment digital upper display line and a 16-character dot-matrix lower display line. The upper display line shows actual values of hydrogen purity, hydrogen in purge gas*, air in purge gas*, alarm set points or programmable parameters. The lower display line shows the associated units or programming information.

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

CO₂ (Carbon dioxide)
 N₂ (Nitrogen)
 Ar (Argon)

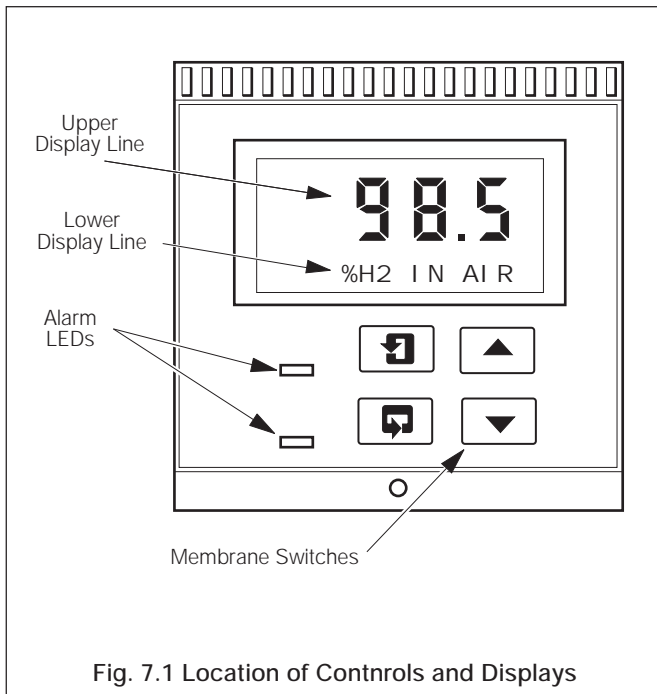
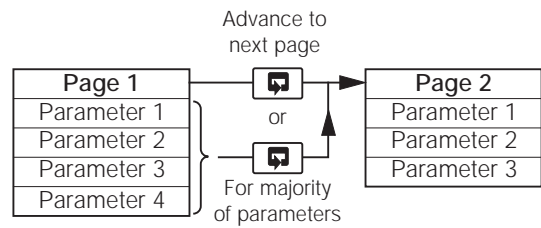
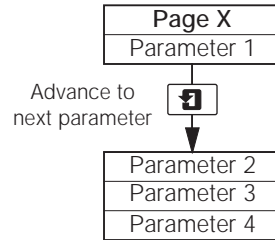


Fig. 7.1 Location of Controls and Displays

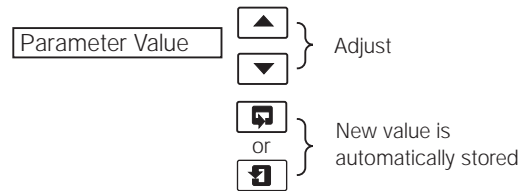
7.2 Switch Familiarization – Figs. 7.1 and 7.2



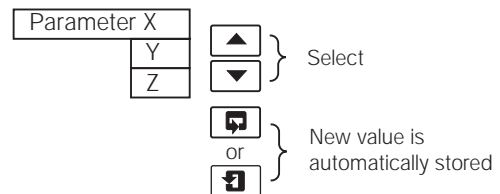
A – Advancing to Next Page



B – Moving Between Parameters



C – Adjusting and Storing a Parameter Value



D – Selecting and Storing a Parameter Choice

Fig. 7.2 Function of the Membrane Switches

8 START-UP

Warning. When the apparatus is connected to its supply, terminals may be live and the opening of covers or removal of parts (except those to which access may be gained by hand) is likely to expose live parts.

8.1 Instrument Start-Up

In normal operation, the range selector switch is set to position 1 and the instrument displays the **Range 1 Operating Page** – see Section 9.2. This is a general use page in which the alarm set points may viewed but not altered. To change an alarm set point or program a parameter refer to Section 10. A 5-digit Security Code is used to prevent unauthorized access to programmable parameters. The value is preset at 00000 to allow access during commissioning but should be altered to a unique value, known only to authorized operators, as described in the **Setup Outputs Page** – see Section 10.3.3.

When all the required wiring connections and electrical checks have been made correctly, switch on the power supplies to the various units as follows:

- 1) Switch on the supply to the PSU.
- 2) Switch on the supply to the 6553 Display Unit.
- 3) If cubicle-mounted, switch on supply via the isolator switch, if fitted.

8.2 Alarm Set Point

8.2.1 Type of Alarm Action

The alarm relay coil is energized during normal non-alarm relay states and is de-energized upon recognition of an alarm condition, thereby providing 'fail-safe' alarms. For example, with Alarm 1 set point = 95.0%, when the display is indicating greater than 95.0% (plus hysteresis), Alarm Relay 1 is energized and Alarm 1 LED is OFF. When the display indicates less than 95.0% (minus hysteresis), Alarm Relay 1 is de-energized and Alarm 1 LED is ON. This operating mode ensures that an alarm condition is signalled in the event of a mains power failure. Repeat the procedure for Alarm Relay 2 set point = 90.0%.

8.2.2 Hydrogen Alarm Set Point

It is recommended that the hydrogen alarm set-points are based on a reducing percentage of hydrogen as it is displaced by air entering the application plant. This can be achieved by setting Alarm 1 and Alarm 2 to give ample warning of the development of a potentially explosive mixture. Factory settings are Alarm 1 = 95.0% and Alarm 2 = 90.0%.

The procedure is as follows:

Access the programming pages (Section 10) and set the alarm set-points in accordance with the information in the **Set Up Outputs Page**. The hydrogen alarm set point can only be set with the selector switch in position 1.

8.3 Electrical Calibration

The instrument is factory calibrated for electrical voltage signal input. No adjustment is normally necessary for correct functioning of the display unit. If electrical calibration is required, a voltage source capable of supplying 0.00 mV and 10.00 mV is needed. Disconnect the katharometer input from the display unit and the voltage source signal applied according to the instructions in the **Electrical Calibration Page** – see Section 10.

Note. The 4689 instruments incorporate a two-point calibration sequence requiring both zero and span inputs for a calibration. It is not possible to adjust either the range zero or the range span scale points independently.

8.4 Gas Calibration

8.4.1 Introduction

Before putting the system on-line, it is recommended that a calibration check for the 'zero' reading is made using calibration standard sample gas.

The 'zero gas' is marked permanently on the data plate of the katharometer unit. This gas, when passed through the katharometer, gives a zero millivolt output. To provide a fail-safe condition for hydrogen purity, the zero gas is 85% hydrogen-in-nitrogen mixture. If power is lost to the katharometer, a hydrogen purity alarm condition occurs on the display unit.

Full scale output from the katharometer is obtained by a 100% hydrogen gas sample and no adjustment of the katharometer output is normally required. The maximum signal for the full scale reading is sealed during manufacture and must not be altered by users.

8.4.2 Purge Gas

When a purge gas katharometer forms part of the 6553 System, the startup procedure is as follows:

Notes.

1. The procedure outlined here is not normally necessary as the ranges have been set at the factory.
2. Test for leaks in accordance with the requirements of the responsible authority after making any gas connections.

-
- 1) Pass suitable calibration quality gas through the purge gas* katharometer, on the appropriate katharometer analyzer panel. The gas should be at the normal working pressure of the sample gas. This provides the correct flowrate of purge/sample gas as set previously.

*Note. Purge gas options include:

CO₂ (Carbon dioxide)
N₂ (Nitrogen)
Ar (Argon)

- 2) Power up the monitor unit, and the purge gas katharometer unit by switching on the appropriate power supply unit.
- 3) Set the range selector switch on the gas monitor unit to position (3).
- 4) The upper display unit indicates NOT IN USE.
- 5) The lower display unit indicates the selected measurement parameter – percentage by volume of air in purge gas* (%AIR IN *) – on its lower display line. The upper display line indicates a value for the parameter.
- 6) With suitable calibration gas passing through the sample system at the normal flowrate, the upper line of the lower display unit should stabilize within 2 hours to read 0.0.
- 7) If necessary, refer to Section 10.3.3 for a full calibration sequence.

Note. A remote zero adjustment facility is available at the lower 'zero' potentiometer adjacent to the display unit. Adjustment is made by inserting a screwdriver through the hole behind the small escutcheon plate.

- 8) Reset the range selector switch on the gas monitor to position 2. The upper display continues to indicate NOT IN USE.
- 9) The lower display unit indicates the selected measurement parameter – percentage by volume of hydrogen in purge gas* (%H2 IN *) – on the lower line. The upper line indicates a value for the parameter.
- 10) With purge gas* continuing to pass through the sample system, the upper line of the lower display unit should stabilize within a few minutes to read 0.0.
- 11) If necessary, refer to Section 10.2.3 for a full calibration sequence.

Note. No adjustment of the lower zero potentiometer is necessary as any adjustment required will already have been made while calibrating the 'Air in purge gas*' range.

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

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

8.4.3 Hydrogen

Note. Test for leaks in accordance with the requirements of the responsible authority after making any hydrogen connections.

- 1) Pass calibration quality hydrogen gas through the (H2) Katharometer Unit on the appropriate katharometer analyzer panel, at the normal working pressure of the sample gas system. This provides the correct flowrate of gas, as set previously.
- 2) Power up the monitor unit and the hydrogen katharometer unit by switching on the appropriate power supply unit.
- 3) If fitted, set the range selector switch on the monitor unit to position (1).
- 4) The upper (hydrogen) display indicates the measurement parameter – percentage by volume of hydrogen in air (%H2 IN AIR) – on the lower line. The upper display line indicates a value for the parameter.
- 5) If fitted, the lower (purge gas) display unit indicates NOT IN USE.
- 6) With hydrogen calibration gas passing through the sample system at the normal flowrate, the upper display line of the top display unit should stabilize within 2 hours to read 100.0.
- 7) If necessary, refer to Section 10.1.3 for a full calibration sequence.

Note. Remote zero adjustment is available – see Fig. 2.1. Adjustment is made by inserting a screwdriver through the hole behind the small cover plate.

9 OPERATION

9.1 Normal

During normal operation the AK100 Gas Analyzer System is used to indicate the purity of hydrogen used as a coolant. The displays show the percentage of hydrogen in air, which should be safely in excess of the explosive limit at the hydrogen rich end.

There are no routine adjustments required to the gas analyzer system after completion of start-up procedures and putting on-line in monitoring mode. The system requires only the carrying out of safety routines and minor adjustments to the metering valve to maintain the required flowrate.

A summary of the functions and status of the system for the different range selector switch positions is shown in Table 9.1.

Note. Sections 9.1.1 and 9.1.2 only apply to the AK101.

9.1.1 Purging of Hydrogen Coolant Gas

Initially, inert purge gas* is introduced into the system. When the hydrogen concentration is safely below the explosive limit, air is introduced into the system to completely displace the other two gases.

The AK100 Gas Analyzer System provides all the necessary indications and output signals to enable this operation to be carried out safely.

In respect of the operation of the gas analyzer system(s), the procedures are as follows:

Note. Suitable safety procedures apply to the operation of gas cooling and sample systems.

- 1) Select position (2) of the range selector switch on the display unit. The displays and functions are shown in Table 9.1.
- 2) Commence the purging operation.
- 3) When the changeover to introduce air into the application plant is made, select position (3) of the range selector switch on the display unit. The displays and functions are shown in Table 9.1.

*Note. Purge gas options include:

CO₂ (Carbon dioxide)
N₂ (Nitrogen)
Ar (Argon)

9.1.2 Filling with Hydrogen Coolant Gas

This procedure is a reversal of the purging procedure.

Initially, inert purge gas* is introduced into the application plant until the air content is safely below the explosive limit for air in hydrogen. When this limit is reached, hydrogen is gradually introduced into the system to displace the other two gases.

With respect to the operation of the gas analyzer system, the procedure is as follows:

Warning. Suitable safety precautions apply to the operation of the gas cooling and sample systems.

Note. For optimum accuracy it is recommended that the filling operation commences within 24 hours of carrying out the calibration procedure.

- 1) Select position (3) of the range selector switch on the display unit. The displays and functions are shown in Table 9.1.
- 2) When the changeover to introduce hydrogen into the application plant is made, select position (2) of the range selector switch on the display unit. The displays and functions are shown in Table 9.1.
- 3) When the display indicates that hydrogen filling is complete, position the range selector switch at (1). The hydrogen measurement analyzer system is now on-line in monitoring mode – see Section 9.2.

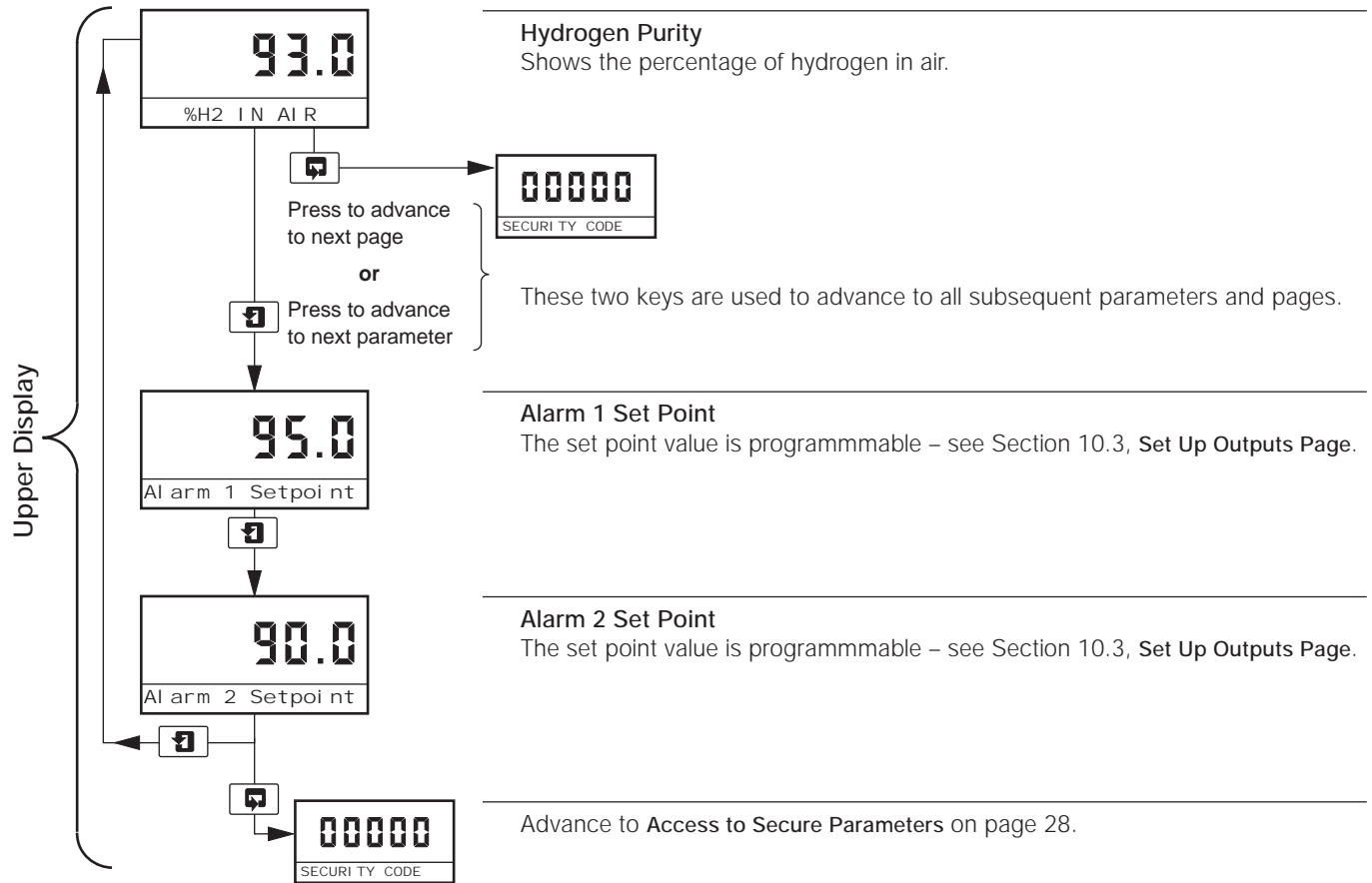
	Range Selector Switch Position (AK101 only)	Upper Display Line		Lower Display Line		Alarm 1 Set Point	Alarm 2 Set Point
		Actual Display	Function	Actual Display	Function		
Upper Display	(1)	xxx.x	Variable Value	%H ₂ in Air	Hydrogen Purity	As required	As required
	(2)	----	Inhibit	NOT IN USE	Inhibit	Inhibit	Inhibit
	(3)	----	Inhibit	NOT IN USE	Inhibit	Inhibit	Inhibit
Lower Display (AK101 only)	(1)	----	Inhibit	NOT IN USE	Inhibit	Inhibit	Inhibit
	(2)	xxx.x	Variable value	%H ₂ in *	Purge Gas Purity	As required	Not available
	(3)	xxx.x	Variable value	%Air in *	Purge Gas Purity	As required	Not available

Not applicable to the AK104

Table 9.1 Functions and Status of Display Units for Different Range Selector Switch Positions

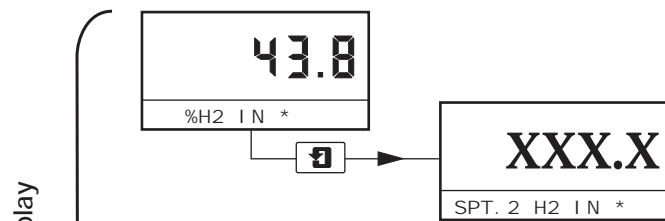
9.2 Range 1 Operating Page

Range 1 is selected for normal operations and the **Operating Page** indicates the purity of the hydrogen used as a coolant. The alarm set points can be viewed but not altered. To change the alarm set points or program other parameters refer to Section 10.



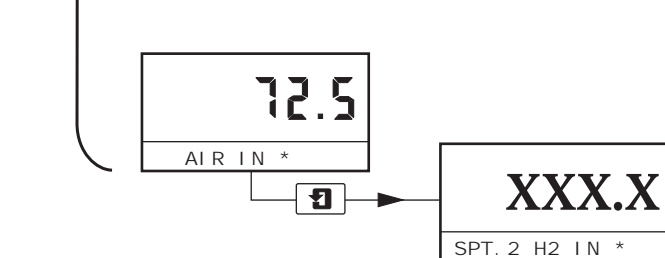
9.3 Range 2 Operating Page – AK101 only

Set to Range 2 the single Alarm Set Point value may be changed, this is displayed in the **Operating Page**.



9.4 Range 3 Operating Page – AK101 only

Set to Range 3 the single Alarm Set Point value may be changed, this is displayed in the **Operating Page**.



***Note.** Purge gas options include:
 CO₂ (Carbon dioxide)
 N₂ (Nitrogen)
 Ar (Argon)

10 PROGRAMMING

Note:
The following programming pages apply to both display units.

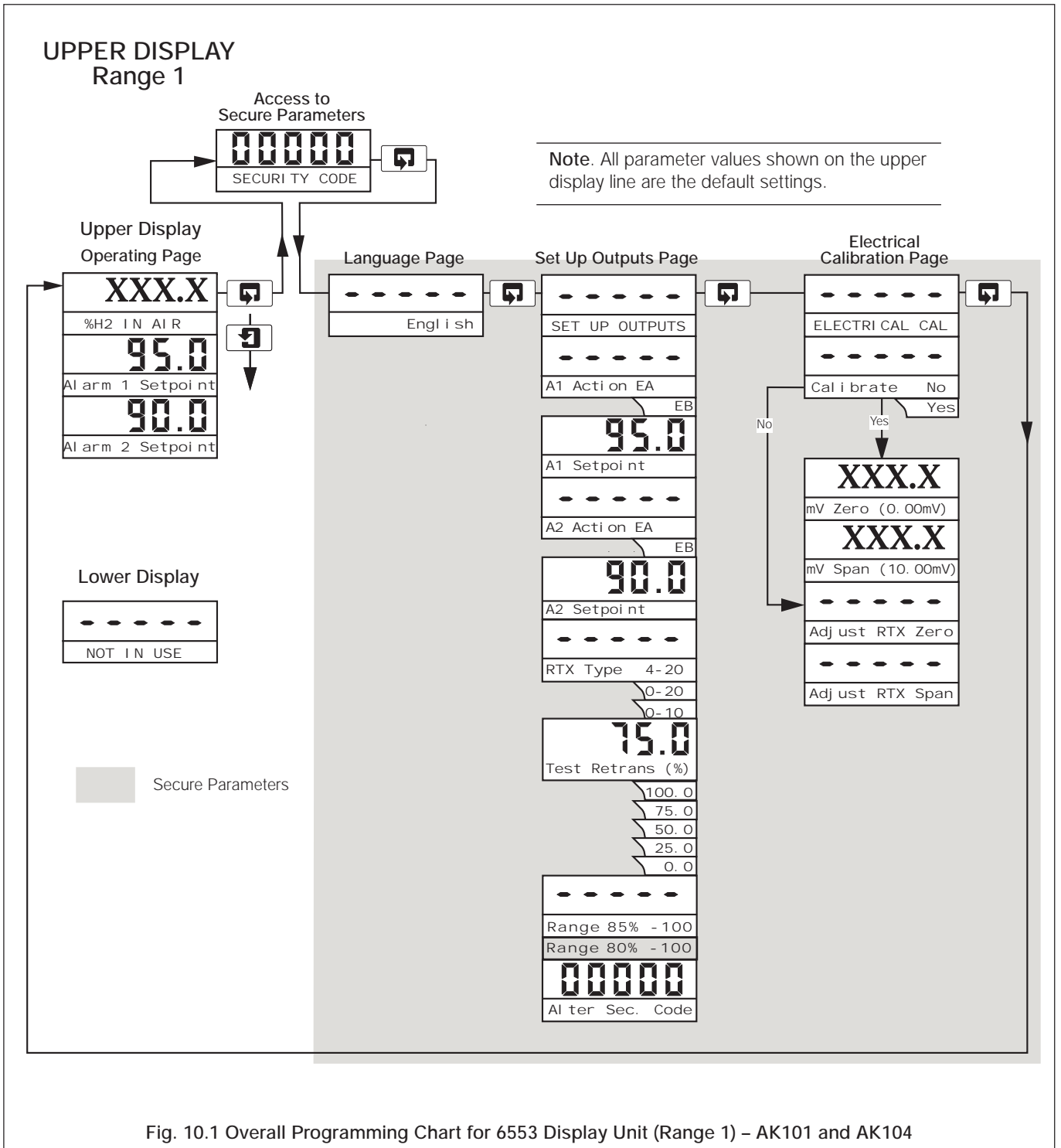
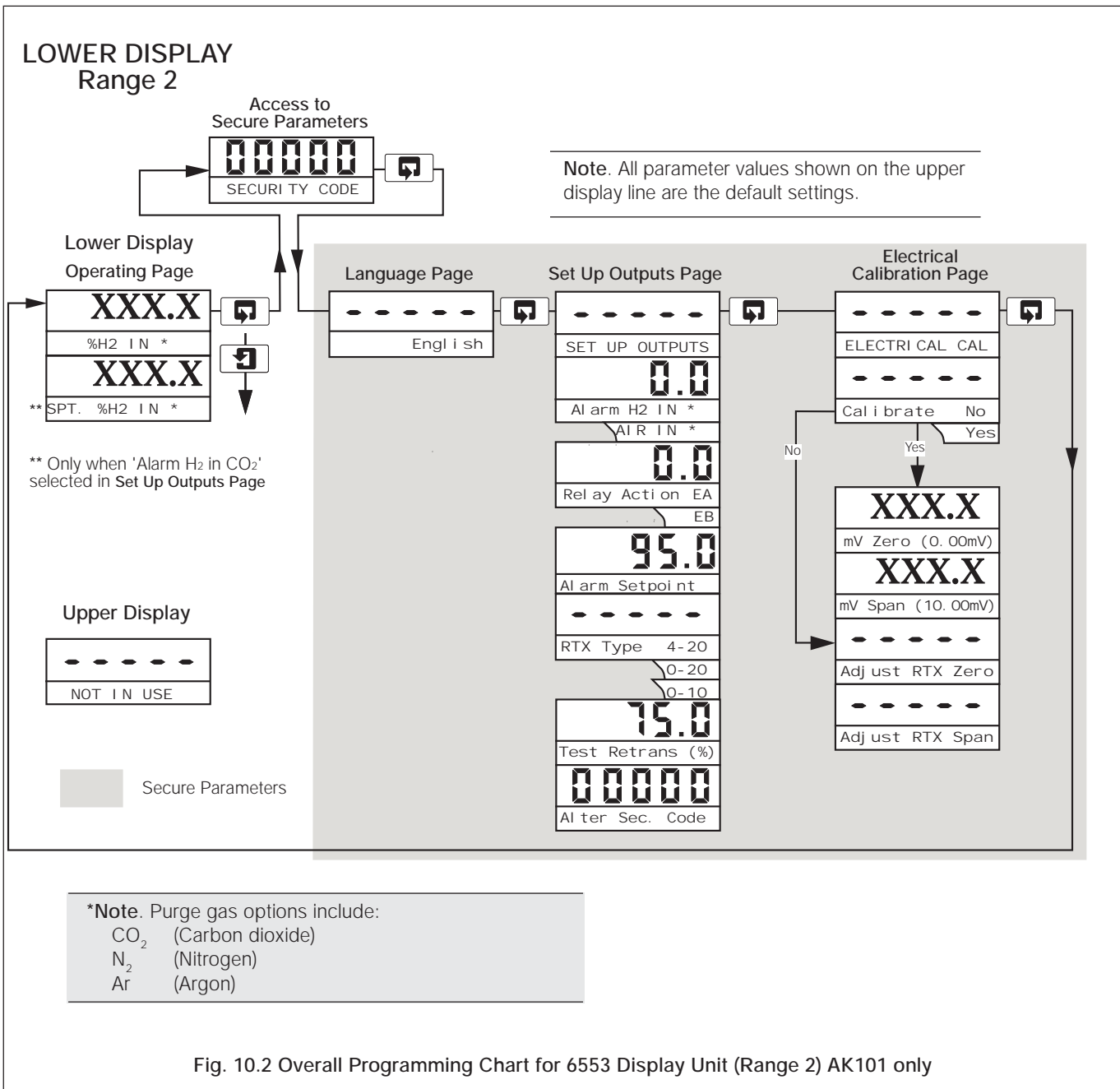


Fig. 10.1 Overall Programming Chart for 6553 Display Unit (Range 1) – AK101 and AK104

Note. Programming of the Language page, Set Up Outputs page and the Electrical Calibration page should be carried out within Range 2. If circumstances require, they can also be accessed from Range 3. It is not necessary to work through the Set Up Outputs page and the Electrical Calibration page in Range 3 once they have been set up in Range 2.



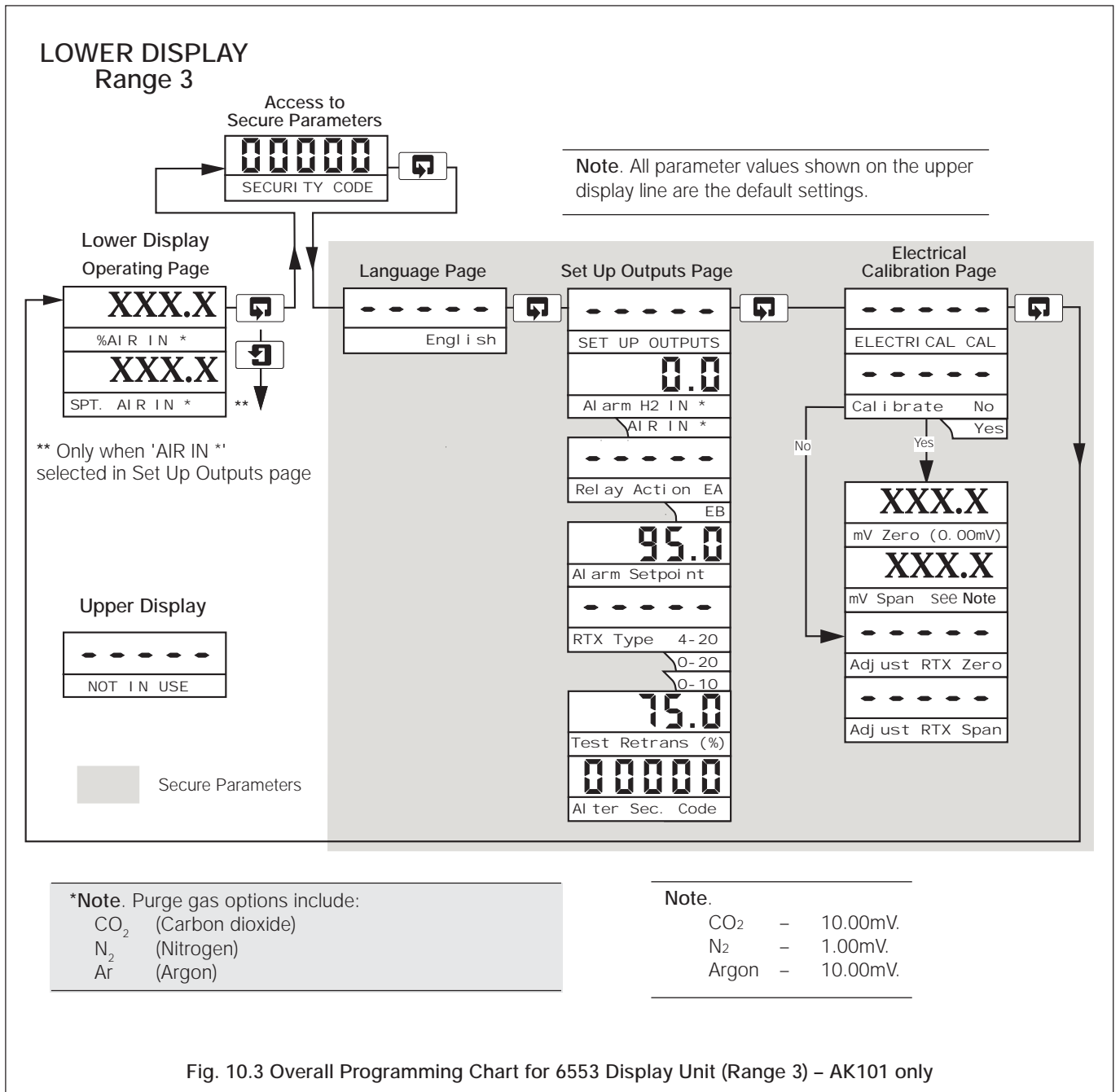


Fig. 10.3 Overall Programming Chart for 6553 Display Unit (Range 3) - AK101 only

10.1 Range 1 (UPPER DISPLAY)

10.1.1 Access to Secure Parameters

A 5-digit code is used to prevent unauthorized access to the secure parameters.



Security Code

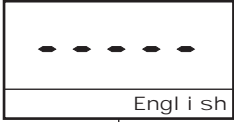
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the **Operating Page**.

Note. The security code is preset at '00000' to allow access during commissioning but should be altered to a unique value, known only to authorized operators – see **Alter Security Code** parameter in **Set Up Outputs Page**.



Advance to Language Page.

10.1.2 Language Page



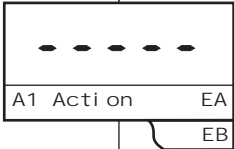
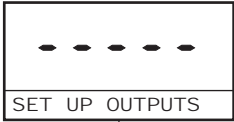
Language Page

Select the required language for the display.



Advance to Set Up Outputs Page.

10.1.3 Set Up Outputs Page



Alarm 1 Action

For 'Fail-Safe' alarm operation the relay's alarm state must be the same as the power-down state, i.e. the relay is de-energized.

For high alarm operation the relay must be **Energized Below** the alarm set point (**EB**).

For low alarm operation the relay must be **Energized Above** the alarm set point (**EA**).

The alarm LEDs are illuminated in the alarm condition.

Select the required alarm action from the following table:

Alarm Action	LED Action for Input Above Set Point	LED Action for Input Below Set Point	Relay Action for Input Above Set Point	Relay Action for Input Below Set Point
EB	ON	OFF	De-energized	Energized
EA	OFF	ON	Energized	De-energized

The set point band is defined as the actual value of the set point \pm 1% of the set point value. Alarm action occurs if the input value is above or below the set point band. If the input moves within the set point band the last alarm action is maintained.



Continued on next page...

...10.1.3 Set Up Outputs Page (UPPER DISPLAY)

Continued from previous page

95.0
A1 Set Point



Alarm 1 Set Point

The Alarm 1 Set Point can be set to any value within the input range being displayed. The set point value is subject to hysteresis within the set point band as detailed above. Set the alarm set point to the required value.

Advance to next parameter

A2 Action EA
EB



Alarm 2 Action

See Alarm 1 Action.

Advance to next parameter

90.0
A2 Set Point



Alarm 2 Set Point

See Alarm 1 Set Point.

The decimal point position is set automatically. The alarm LEDs are illuminated in the alarm condition.

Advance to next parameter

RTX Type 4-20
0-20
0-10



Retransmission Output Type

The retransmission output is assigned to the hydrogen purity range. Select the retransmission output range required (4 to 20mA, 0 to 20mA or 0 to 10mA).

Advance to next parameter

100.0
Test Retrans (%)
100.0
75.0
50.0
25.0
0.0



Test Retransmission Output

The instrument transmits a test signal of 0, 25, 50, 75 or 100% of the retransmission range. The % test signal selected is shown on the upper line of the display.

Example – for the range 0 to 20mA and 50% retransmission test signal, 10mA is transmitted.

Advance to next parameter

RTX Range 85%



Select the retransmission test signal required:

Ranges	4689 500/501	100 to 85% and 100 to 80%
	4689 500/503	85 to 100% and 80 to 100%

Advance to next parameter

Return to top of page

00000
Alter Sec. Code



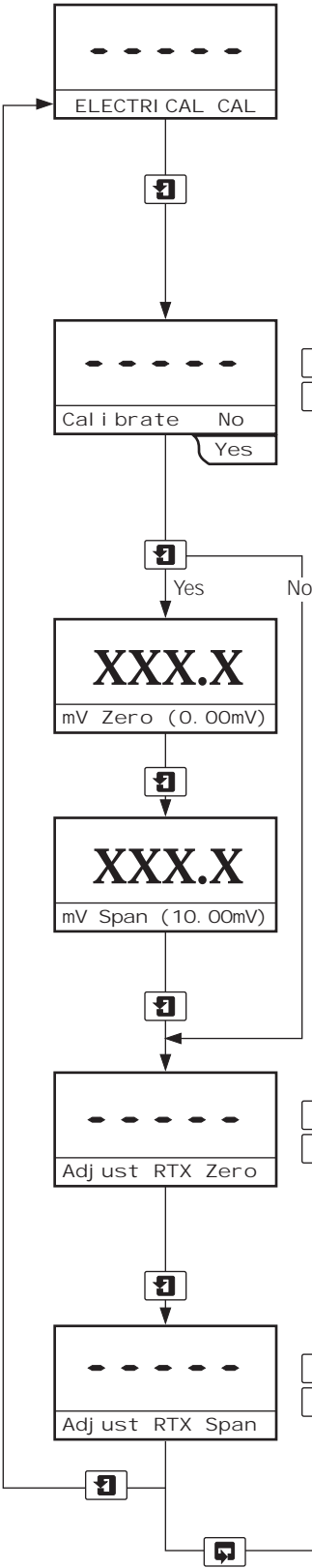
Alter Security Code

Set the security code to a value between 00000 and 19999. This value will then have to be entered to regain access to the secure parameters.



Advance to Electrical Calibration Page.

10.1.4 Electrical Calibration Page (UPPER DISPLAY)



Notes.

- 1) The 4689 instruments incorporate a two-point calibration sequence requiring both zero and span inputs for a calibration. It is not possible to adjust the range zero or the range span scale points independently.
- 2) The instruments are fully calibrated before despatch and should not normally require further calibration.

Select Calibration

Select the calibration requirement using the ▲ or ▼ keys.

Calibrate No (default) skips to Adjust RTX Zero frame.
Calibrate Yes enables zero and span electrical calibrations to be carried out.

Advance to next parameter

Calibration Range Zero (80 or 85% H₂ in Air)

Apply a signal input equivalent to %H₂ IN AIR range zero (0.00mV).
Allow the instrument to stabilize.

Advance to next parameter

Calibration Range Span (100% H₂ in Air)

Apply a signal input equivalent to %H₂ IN AIR range span (+10.00mV).
Allow the instrument display to stabilize.

Advance to next parameter

Adjust Retransmission Zero

Adjust the retransmission zero (e.g. 4.00mA) to the appropriate zero value.
The retransmission zero signal is either 85% or 80% H₂ in Air as selected in Set Up Outputs Page.
Allow the output signal to stabilize.

Advance to next parameter

Adjust Retransmission Span

Adjust the retransmission span (e.g. 20.00mA) to the appropriate maximum value.
The retransmission span signal corresponds to 100% H₂ in Air.
Allow the output signal to stabilize.

Return to Operating Page.

10.2 Range 2 (LOWER DISPLAY) – AK101 only

10.2.1 Access to Secure Parameters

A 5-digit code is used to prevent unauthorized access to the secure parameters.



Security Code

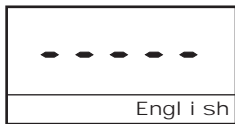
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the **Operating Page**.

Note. The security code is preset at '00000' to allow access during commissioning but should be altered to a unique value, known only to authorized operators – see Alter Security Code parameter in Set Up Outputs Page.



Advance to **Language Page**.

10.2.2 Language Page



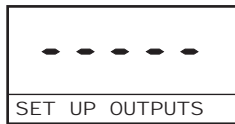
Language Page

Select the required language for the display.

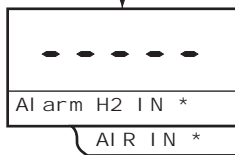


Advance to **Set Up Outputs Page**.

10.2.3 Set Up Outputs Page



Advance to next parameter.



Purge Gas Alarm Select

Select the parameter on which the purge gas alarm is to operate.

Reprogram as required to agree with selected range:
for Range 2 select %H2 IN PURGE GAS*,
for Range 3 select %AIR IN PURGE GAS*.



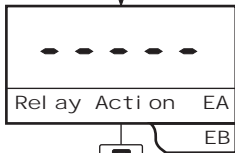
Continued on next page...

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

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

...10.2.3 Set Up Outputs Page (LOWER DISPLAY) – AK101 only

Continued from previous page



Purge Gas Relay Action

For 'Fail-Safe' alarm operation the relay's alarm state must be the same as the power-down state, i.e. the relay is de-energized.

For high alarm operation the relay must be Energized Below the alarm set point (EB).

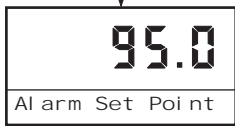
For low alarm operation the relay must be Energized Above the alarm set point (EA).

The alarm LEDs are illuminated in the alarm condition.

Select the required alarm action from the following table:

Alarm Action	LED Action for Input Above Set Point	LED Action for Input Below Set Point	Relay Action for Input Above Set Point	Relay Action for Input Below Set Point
EB	ON	OFF	De-energized	Energized
EA	OFF	ON	Energized	De-energized

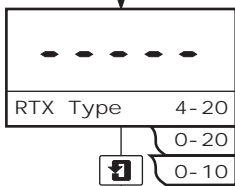
The set point band is defined as the actual value of the set point \pm 1% of the set point value. Alarm action occurs if the input value is above or below the set point band. If the input moves within the set point band the last alarm action is maintained.



Purge Gas Alarm Set Point

The alarm set point can be set to any value within the input range being displayed. The set point value is subject to hysteresis within the set point band as detailed above. Set the alarm set point to the required value.

Advance to next parameter

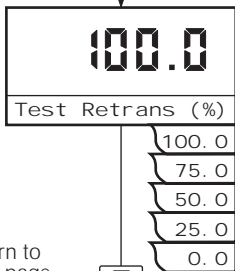


Retransmission Output Type

The retransmission output is assigned to the purge gas concentration.

Select the retransmission output current range required (4 to 20mA, 0 to 20mA or 0 to 10mA).

Advance to next parameter



Test Retransmission Output

The instrument transmits a test signal of 0, 25, 50, 75 or 100% of the retransmission range. The % test signal selected is shown on the upper line of the display.

Example – for the range 0 to 20mA and 50% retransmission test signal, 10mA is transmitted.

Select the required retransmission test signal.

Advance to next parameter



Alter Security Code

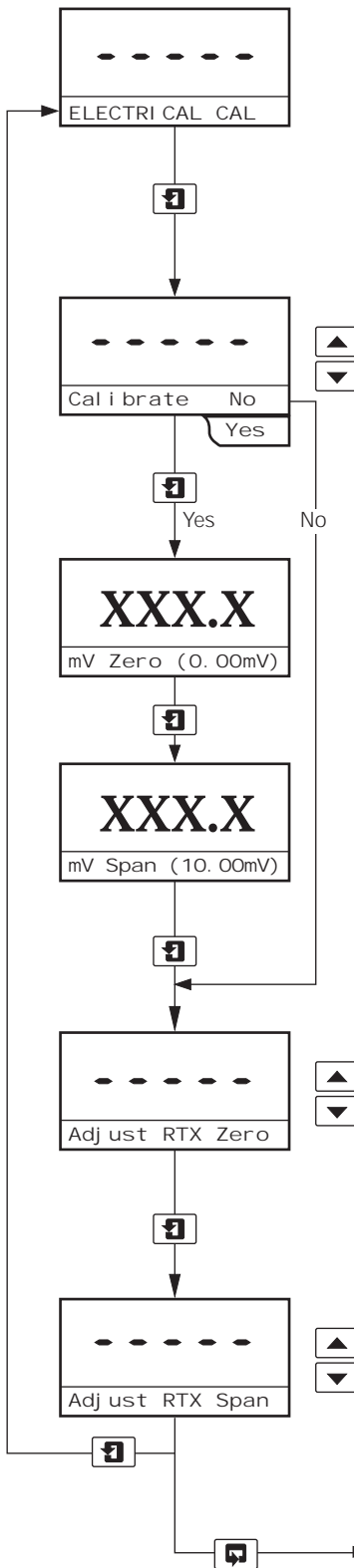
Set the security code to a value between 00000 and 19999.

This value will then have to be entered to regain access to the secure parameters.

Advance to Electrical Calibration Page.

Return to top of page

10.2.4 Electrical Calibration Page (LOWER DISPLAY) – AK101 only



Notes.

- 1) The 4689 instruments incorporate a two-point calibration sequence requiring both zero and span inputs for a calibration. It is not possible to adjust the range zero or the range span scale points independently.
- 2) The instrument is fully calibrated before despatch and should not normally require further calibration.

Calibration

Proceed as described in Section 8.3 Calibration, but apply a signal input equivalent to range zero (0.0mV). Allow the instrument display to stabilize.

Advance to next parameter

Calibration Range Zero (0% H₂ in CO₂)

Proceed as described in Section 8.3 Calibration, but apply a signal input equivalent to %H₂ IN PURGE GAS* range zero (0.00mV). Allow the instrument to stabilize.

Advance to next parameter

Calibration Range Span (100% H₂ in CO₂)

Apply a signal input equivalent to %H₂ IN PURGE GAS* range span (10.00mV). Allow the instrument display to stabilize.

Advance to next parameter

Adjust Retransmission Zero

Adjust the retransmission zero (e.g. 4.00mA) to the appropriate zero value. The retransmission zero signal is either 85% or 80% H₂ in Air as selected in **Set Up Outputs Page**. Allow the output signal to stabilize.

Advance to next parameter

Adjust Retransmission Span

Adjust the retransmission span (e.g. 20.00mA) to the appropriate maximum value. The retransmission span signal corresponds to 100% H₂ in Air.

Allow the output signal to stabilize.

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

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

10.3 Range 3

10.3.1 Access to Secure Parameters (LOWER DISPLAY) – AK101 only

A 5-digit code is used to prevent unauthorized access to the secure parameters.



Security Code

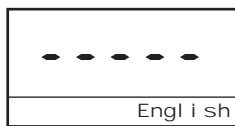
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the **Operating Page**.

Note. The security code is preset at '00000' to allow access during commissioning but should be altered to a unique value, known only to authorized operators – see **Alter Security Code** parameter in **Set Up Outputs Page**.



Advance to **Language Page**.

10.3.2 Language Page



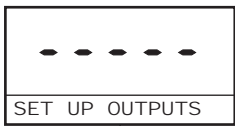
Language Page

Select the required language for the display.

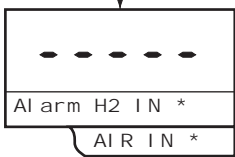


Advance to **Set Up Outputs Page**.

10.3.3 Set Up Outputs



Advance to next parameter.



Purge Gas Alarm Select

Select the parameter on which the purge gas alarm is to operate.

Reprogram as required to agree with selected range:
 for Range 2 select H2 IN PURGE GAS*,
 for Range 3 select AIR IN PURGE GAS*.



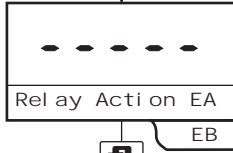
Continued on next page.

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

CO₂ (Carbon dioxide)
 N₂ (Nitrogen)
 Ar (Argon)

...10.3.3 Set Up Outputs Page (LOWER DISPLAY) – AK101 only

Continued from previous page



Purge Gas Relay Action

For 'Fail-Safe' alarm operation the relay's alarm state must be the same as the power-down state, i.e. the relay is de-energized.

For high alarm operation the relay must be Energized Below the alarm set point (EB).

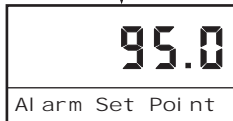
For low alarm operation the relay must be Energized Above the alarm set point (EA).

The alarm LEDs are illuminated in the alarm condition.

Select the required alarm action from the following table:

Alarm Action	LED Action for Input Above Set Point	LED Action for Input Below Set Point	Relay Action for Input Above Set Point	Relay Action for Input Below Set Point
EB	ON	OFF	De-energized	Energized
EA	OFF	ON	Energized	De-energized

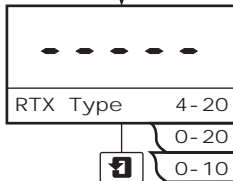
The set point band is defined as the actual value of the set point \pm 1% of the set point value. Alarm action occurs if the input value is above or below the set point band. If the input moves within the set point band the last alarm action is maintained.



Purge Gas Alarm Set Point

The alarm set point can be set to any value within the input range being displayed. The set point value is subject to hysteresis within the set point band as detailed above. Set the alarm set point to the required value.

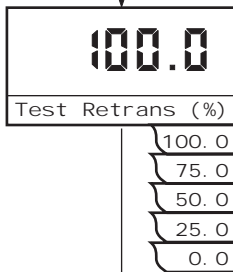
Advance to next parameter



Retransmission Output Type

The retransmission output is assigned to the purge gas concentration. Select the retransmission output current range required (4 to 20mA, 0 to 20mA or 0 to 10mA).

Advance to next parameter



Test Retransmission Output

The instrument transmits a test signal of 0, 25, 50, 75 or 100% of the retransmission range. The % test signal selected is shown on the upper line of the display.

Example – for the range 0 to 20mA and 50% retransmission test signal, 10mA is transmitted.

Select the required retransmission test signal.

Advance to next parameter

Return to top of page

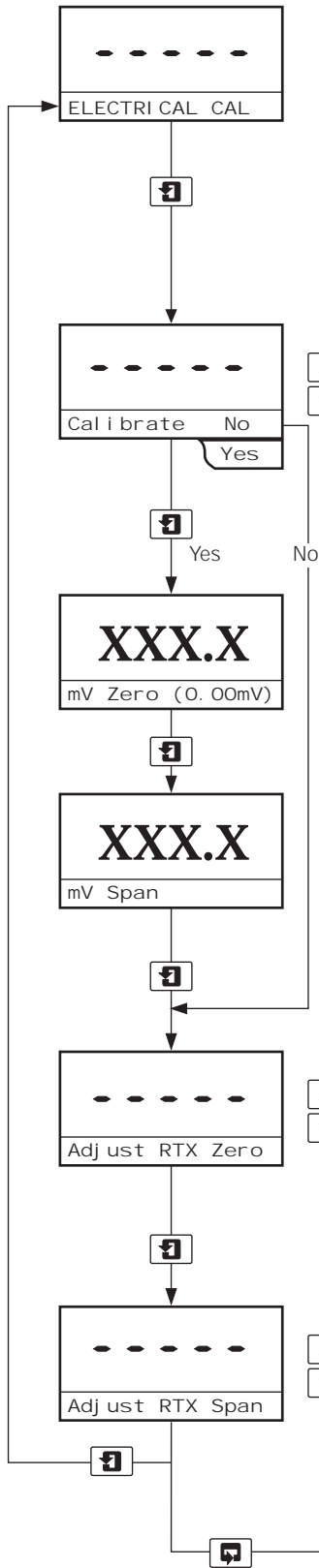


Alter Security Code

Set the security code to a value between 00000 and 19999. This value will then have to be entered to regain access to the secure parameters.

Advance to Electrical Calibration Page.

10.3.4 Electrical Calibration Page (LOWER DISPLAY) – AK101 only



Notes.

- 1) The 4689 instruments incorporate a two-point calibration sequence requiring both zero and span inputs for a calibration. It is not possible to adjust the range zero or the range span scale points independently.
- 2) The instrument is fully calibrated before despatch and should not normally require further calibration.

Select Calibration

Select the calibration requirement using the or keys.

Calibrate No (default) skips to Adjust RTX Zero frame.

Calibrate Yes enables zero and span electrical calibrations to be carried out.

Advance to next parameter

Calibration Range Zero (0% Air in CO₂)

Proceed as described in Section 8.3 Calibration, but apply a signal input equivalent to %AIR IN CO₂ range zero (0.00mV). Allow the instrument to stabilize.

Advance to next parameter

Calibration Range Span (100% Air in CO₂)

Apply a signal input equivalent to:

- %AIR IN CO₂ range span (10.00mV)
- N₂ range span (1.00mV)
- Argon range span (10.00mV)

Allow the instrument display to stabilize.

Advance to next parameter

Adjust Retransmission Zero

Adjust the retransmission zero (e.g. 4.00mA) to the appropriate zero value. The retransmission zero signal is either 85% or 80% H₂ in Air as selected in **Set Up Outputs Page**. Allow the output signal to stabilize.

Advance to next parameter

Adjust Retransmission Span

Adjust the retransmission span (e.g. 20.00mA) to the appropriate maximum value. The retransmission span signal corresponds to 100% H₂ in Air.

Allow the output signal to stabilize.

11 MAINTENANCE

This section covers the requirements for fault finding, diagnostic tests and maintenance tasks.

Warning.

- Each unit of this system forms an integral part of a certified intrinsically safe system. Appropriate safety precautions must be taken to prevent any incendive electrical discharges in the hazardous area when carrying out any of the following tasks.
 - Equipment in this system operates at AC mains supply voltage. Suitable precautions must be taken to avoid the possibility of electric shock.
 - The maximum pressure and temperature limits specified for particular parts of the system must not be exceeded.
-

11.1 General Maintenance

11.1.1 Pressure

The operation of the katharometer units is not affected significantly by changes in pressure providing that they are within the pressure limits – see Section 13.

11.1.2 Flow

The katharometer zero balance and sensitivity are independent of the sample flowrate, as the sample gas sensing system depends on molecular diffusion. However, the speed of response is affected by the flowrate. This means that the flow resistance of the drying chamber is a compromise between obtaining speed of response, and avoiding a rapid degradation of the desiccant.

11.1.3 Leaks

There is an inherent safety requirement that there are no leaks into or out of the sample system. Any leaks could also affect the correct operation of the katharometer unit.

11.1.4 Vibration

The katharometer unit tolerates reasonable levels of mechanically induced vibration. Pulsations due to unsteady sample flow can affect the katharometer filaments and cause errors due to excessive cooling.

11.1.5 Contamination

Contamination in the sample system can arise from oil or suspended particles, or from erosion of material from the sample system upstream of the katharometer unit.

11.1.6 Ambient Temperature

The calibration of the katharometer is not affected significantly by variations of the ambient temperature. Temperature changes can affect the sensitivity and reduce accuracy on sensitive ranges.

11.1.7 Bridge Current

The working current of the katharometer bridge is 350mA supplied from the PSU. This value must remain stable during normal operation as the katharometer output signal is proportional to the cube of the bridge current.

11.2 Diagnostic Tests

Warning.

- These units are part of the certified intrinsically safe system. Appropriate safety precautions must be taken to prevent any incendive electrical discharges in the hazardous area when carrying out this task.
 - Ensure that the proper electrical safety precautions are taken at all times when undertaking this procedure.
-

11.2.1 Checking Output of the PSU

Carry out the test procedure in Section 6.3.1.

11.2.2 Checking Integrity of Zener Diode Safety Barrier Devices

Carry out the test procedure in Section 6.3.2.

11.2.3 Checking the Katharometer Output

- a) Electrically isolate the display unit.
- b) Remove the outer cover from the katharometer unit.
- c) With the katharometer operating, check if the voltage across terminals TB1 – 1 and TB1 – 4 is not above 4V with 350mA passing. If the voltage is above this value it is likely that one or more filaments of the bridge is broken.
- d) With the katharometer operating, check that the voltage across terminals TB1 – 1 and TB1 – 4 is below 2.8V with 350mA passing. If the voltage is below this value and there is no zero adjustment available, it is likely that there is an accumulation of liquid within the katharometer block – see Section 11.4.1.
- e) If the reading from the test made at step c) is unstable when the katharometer block is tapped gently, this could indicate that a filament is damaged but not open circuit.

If any of these tests indicate that the katharometer is faulty the complete katharometer unit must be returned for repair or replacement.

The span adjustment of katharometer units are sealed and must not be adjusted unless necessary – see Section 8.4.2.

11.3 Routine Maintenance

11.3.1 Hydrogen Katharometer Calibration

Carry out a calibration check in accordance with Section 8.

Calibration should be carried out at intervals of 3 months of on-line use.

11.3.2 Purge Gas Katharometer Calibration

Carry out a calibration check in accordance with Section 8.3.

Calibration should be carried out before using the katharometer for monitoring a purging procedure.

11.3.3 Changing Desiccant in Drying Chamber

The need to change the desiccant in the drying chamber on the Katharometer Analyzer panel depends on the condition of the sample gas.

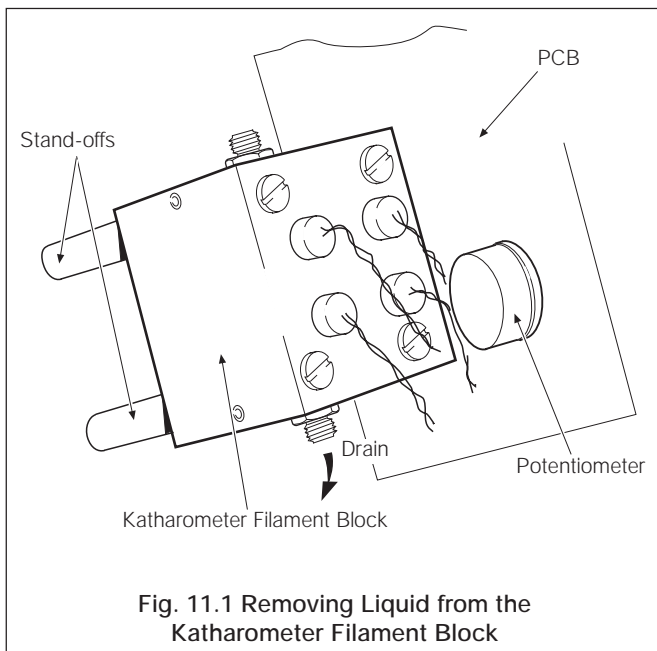
It is recommended that the Analyzer system is monitored regularly during the initial phase of operation for indications that the desiccant is exhausted. A suitable maintenance interval for this task can then be established.

As the desiccant degrades, the white grains have a yellowish tinge and the granular form becomes more consolidated. If liquid contamination occurs, the desiccant becomes brown and consolidated.

Warning. Suitable safety precautions apply to the operation of the gas cooling and sample systems.

- Isolate the sample gas system from the main system. Carry out a limited hydrogen purging operation on the sample system in accordance with the instructions of the responsible authority.
- Fill the drying chamber – see Section 6.1.
- After purging any residual air from the sample system in accordance with the requirements of the responsible authority, allow hydrogen to pass through the katharometer again.

This procedure should be undertaken on the basis of instrument response or at intervals of 1 year.



11.4 Repair Maintenance

11.4.1 Removing Liquid from Katharometer Measurement Block – Fig. 11.1

If tests indicate that there is likely to be an accumulation of liquid in the katharometer filament block, remove the liquid using the following procedure. This procedure should be undertaken as required:

- Electrically isolate the defective katharometer at its PSU.
- Isolate the gas sample system to the particular katharometer from the main gas cooling system. Purge the sample system of hydrogen in accordance with the requirements of the responsible authority.

Caution. The thermal insulation inside the case must not be damaged or removed.

- Remove the cover of the katharometer unit and dismantle the internal sample system pipework.
- Remove the fixing screws securing the mounting pillars to the case – see Fig. 5.5.
- Disconnect the interconnecting wiring at terminal block TB1.

Note. Do not insert any type of probe into the gas system of the katharometer filament block assembly or use compressed air to blow through the system.

- Remove the katharometer filament block assembly from the case and tilt at 45° to the horizontal. This allows any liquid to drain from the measurement block – see Fig. 11.1.
- Pour a small quantity of rectified spirit (ethanol) through the katharometer filament block. Allow as much liquid as possible to drain out. Assist this by gentle shaking. Repeat this procedure several times until all evidence of contamination is removed.
- Fit the katharometer filament block assembly into its case. Replace the fixing screws and make the electrical interconnections at terminals TB1 – 1 and TB1 – 4.
- Fit the internal sample gas tubing.
- Remake the sample gas tube interconnection couplings.
- Replace the desiccant in the drying chamber in accordance with the procedure in Section 11.3.3.
- Carry out a leak test in accordance with the requirements of the responsible authority.
- Power up the katharometer unit by switching on the appropriate PSU.
- Pass dry air or another suitable dry gas through the katharometer at the normal sample flowrate for 24 hours.

Continued...

- o) Isolate the katharometer unit at its PSU.
- p) Make the remaining electrical connections at TB1 of the katharometer unit – see Fig. 5.5 on page 17.
- q) Replace the cover of the katharometer unit.
- r) Power up the katharometer unit from its PSU.
- s) Carry out calibration procedure – see Section 8.3.

Note. It is possible that the zero reading may drift for several days after the removal of liquid.

11.4.2 Removal/Replacement of an Indicator Unit

- a) Electrically isolate the 6553 Display Unit.
- b) Release the retaining screw through the display facia and carefully withdraw the chassis from its edge connectors and out through the front panel – see Fig. 3.1 on page 5.
- c) To replace the unit, carefully insert it into the display facia and press firmly into position before tightening the retaining screw.
- d) Power up the display unit and carry out a calibration – see Section 8.3.

11.4.3 Error Messages

If the error message 'NV Memory Error' is displayed the contents of the non-volatile memory has not been read correctly during power up.

To rectify the fault, switch off, wait 10 seconds and switch on again. If the fault persists, contact the Company.

Warning. Interference with any unit or its components implies acceptance of responsibility by that person for ensuring the continuing maintenance of intrinsic safety requirements. Unauthorized repair or spare parts or incorrect assembly may render any unit unfit for use in an intrinsically safe application.

Note. Although the digital display units may be marked 4600 on their display facia, they are dedicated variants which are not interchangeable with the Company's standard 4600 Controller/Display. These dedicated display units are identified (4689 500 & 501 or 503) as shown in Fig. 3.1 on page 5.

When ordering a katharometer unit, it is necessary to specify the zero gas and range in association with the Company part number. See the typical identification label shown in Fig. 3.2 on page 5.

12.1 Consumables

Description	Part No.
Model 006548 000 & 006540 203	
Katharometer Analyzer Panels	
Granular anhydrous CaCl ₂	Sourced locally

12.2 Routine Maintenance Parts

Description	Part No.
Model 6553 Display unit	
Fuse, 500mA a/s 20 x 5 mm glass cartridge	0231 538
Function selector switch, 3 position, 2 wafer	006553 510
Potentiometer (1kΩ), zero adjustment	002569 036
Katharometer Analyzer Panel	006540 203 006548 000
Seal, top of drying chamber	002310 012 002310 012
Seal, bottom of drying chamber	006519 160 0211 035
Gauze, drying chamber	006525 700 006548 018

12.3 Repair Maintenance Parts

Description	Part No.
Model 4234 Power Supply Unit	
Nominal 230V unit	4234 500
Nominal 115V unit	4234 501
Fuses	
F2/F3 – 250mA/≥1500A HBC cartridge	0231577
F1 – 400mA cartridge	0231555
Katharometer Analyzer Panel	006540 203 006548 000
Flowmeter	006525 460 0216 485
Valve, metering	006540 361 0216 484
Coupling seal ring	006525 130
Katharometer unit	006539 960K (or J) 006548 001
Model 6553 Display unit	
Display units H ₂ in Air (100% to 80/85%)	4689 501
Display units H ₂ in Air (80/85% to 100%)	4689 503
Display units H ₂ /Air in CO ₂ (0 to 100%)	4689 500
Display units H ₂ /Air in N ₂ (0 to 100%)	4689 504
Zener diode safety barrier devices MTL 7055ac	0248 297
Zener diode safety barrier devices MTL 7755ac	0248 296

13 SPECIFICATION

6553 Gas Monitor

Approvals

CENELEC approved
EEx ia IIC T_{amb} -20 C to +40 C
BASEEFA Certificate No. BAS 01 ATEX 7043
II (1)G

Ranges

- (a) 80% or 85% to 100% H₂ in air
- (b) 0 to 100% H₂ in Purge Gas *
- (c) 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 45 C (32 to 113 F)

Power Supply

110/120V AC or 200/220/240V AC, 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

- AK101 – Three (Two for H₂ Purity, One for Purge Gas)
- AK102 – Four (H₂ Purity)
- AK103 – Two (H₂ Purity)
- AK104 – Two (H₂ Purity)

Relay contacts

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

Insulation

2kV RMS contacts to earth (ground)

Remote range indication

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

No. of set points

- AK101 – Three (Two for H₂ Purity, One for Purge Gas)
- AK102 – Four (H₂ Purity)
- AK103 – Two (H₂ Purity)
- AK104 – Two (H₂ Purity)

Set point adjustment

Programmable

Set point hysteresis

1% fixed

Local set point annunciation

Red LED

Retransmission

No. of retransmission signals

- AK101 – Two fully isolated (One for H₂ Purity, One for Purge Gas)
- AK102 – Two fully isolated
- AK103 – One fully isolated
- AK104 – One fully isolated (H₂ Purity)

Output current

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

Accuracy

0.25% FSD 0.5% reading

Resolution

0.1% at 10mA, 0.05% at 20mA

Max. load resistance

750 (20mA max.)

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

CO₂ (Carbon dioxide)
N₂ (Nitrogen)
Ar (Argon)

4234 Power Supply Unit

Approvals

CENELEC approved
[EEx ia] IIC T_{amb} -20 C to +55 C

BASEEFA Certificate No. BAS 01 ATEX 7041
II (1)G

Input Voltage

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

Fuse Rating

250mA HRC ceramic

DC Output

350mA stabilized 0.14%

Load Conditions

1 Katharometer 13 max.
Interconnecting cable 2 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:

Load variation of 15%

Supply variation of 15%

Ambient temperature variation of 20 C (36 F)

4Hz frequency variation

Ripple

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

Overall Dimensions

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

Weight

2.12kg (4.8 lb) approx.

Environment

Sheltered interior

Note.

Variations to the earlier certificate (SFA 3012:1972) allow the use of
these items in systems supplied to that standard.

6540-203 and 6548-000 Katharometer Analyzer Panel

Approvals

CENELEC approved
EEx ia IIC T_{amb} -20 C to +55 C

BASEEFA Certificate No. BAS 01 ATEX 1042
II (1)G

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

350mA DC, from 4234500 or 4234501 power supply unit

Signal Output

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

Accuracy

2% of scale span, each range
5% of scale span, Air in N₂

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

Sample Pressure

Minimum 125mm H₂O

Maximum 0.35bar (Gauge) Model 6540-203

Maximum 10bar (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.

PRODUCTS & CUSTOMER SUPPORT

Products

Automation Systems

- *for the following industries:*
 - Chemical & Pharmaceutical
 - Food & Beverage
 - Manufacturing
 - Metals and Minerals
 - Oil, Gas & Petrochemical
 - Pulp and Paper

Drives and Motors

- *AC and DC Drives, AC and DC Machines, AC motors to 1kV*
- *Drive systems*
- *Force Measurement*
- *Servo Drives*

Controllers & Recorders

- *Single and Multi-loop Controllers*
- *Circular Chart, Strip Chart and Paperless Recorders*
- *Paperless Recorders*
- *Process Indicators*

Flexible Automation

- *Industrial Robots and Robot Systems*

Flow Measurement

- *Electromagnetic Flowmeters*
- *Mass Flow Meters*
- *Turbine Flowmeters*
- *Flow Elements*

Marine Systems & Turbochargers

- *Electrical Systems*
- *Marine Equipment*
- *Offshore Retrofit and Refurbishment*

Process Analytics

- *Process Gas Analysis*
- *Systems Integration*

Transmitters

- *Pressure*
- *Temperature*
- *Level*
- *Interface Modules*

Valves, Actuators and Positioners

- *Control Valves*
- *Actuators*
- *Positioners*

Water, Gas & Industrial Analytics Instrumentation

- *pH, conductivity, and dissolved oxygen transmitters and sensors*
- *ammonia, nitrate, phosphate, silica, sodium, chloride, fluoride, dissolved oxygen and hydrazine analyzers.*
- *Zirconia oxygen analyzers, katharometers, hydrogen purity and purge-gas monitors, thermal conductivity.*

Customer Support

We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

United Kingdom

ABB Limited
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

United States of America

ABB Inc.
Tel: +1 775 850 4800
Fax: +1 775 850 4808

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.

Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

ABB has Sales & Customer Support
expertise in over 100 countries worldwide

www.abb.com

The Company's policy is one of continuous product
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