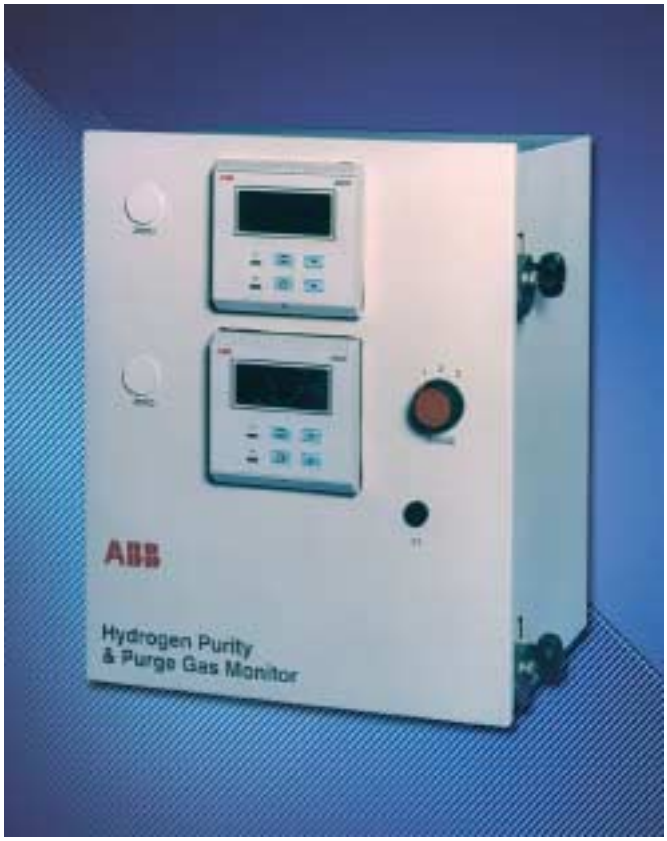
Operating Instructions
IM/6553013_4

ATEX Compliant Gas Analyzer for Intrinsically Safe Hydrogen & Purge Gas Purity Measurement

Type 6553



ABB

The Company

EN ISO 9001:2000

Cert. No. Q 05907

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.

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

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.

Stonehouse, U.K.

0255

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.

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
	**Caution** – Risk of electric shock
	Protective earth (ground) terminal
	Earth (ground) terminal

	Direct current supply only
	Alternating current supply only
	Both direct and alternating current supply
	The equipment is protected through double insulation

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.

CONTENTS

1 INTRODUCTION

Warning. This operating manual applies only to those systems which 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 BASEFA 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, please 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 range of Model 6553 Intrinsically Safe Gas Analyser Systems, normally used with hydrogen cooled electrical power generators.

The complete 6553 analyser system uses a combination of three different units. Each unit is independently certified 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 Gas Monitor Unit
EN 50284 : 1999	006539 & 006548 Katharometer Units
EN 50039 : 1980	System

The different units of the system are:

1) The Model 6553 Gas Monitor Unit which is available in several options. The inputs to these units are certified to code [EEx ia] IIC Tamb=–20°C to +40°C under BAS 01 ATEX 7043 certificate with the unit installed in the **safe** area only.

2) The Model 006539-960K (or J) and 006548-001 Katharometer Units which forms part of an intrinsically safe Model 006540-203 and 006548-000 Katharometer Analyser Panel. The 006539-960 and 006548-001 units are certified to code EEx ia IIC T4 Tamb=–20°C to +55°C under BAS 01 ATEX 1042 certificate for installation in the **hazardous** area (ZONE 0).

3) The Model 4234 500/501 constant current Power Supply Unit, which provides a suitable supply for one katharometer unit. These units have their output certified to code [EEx ia] IIC Tamb=–20°C to +55°C under BAS 01 ATEX 7041 certificate for installation in the **safe** area only.

If further information or assistance is required, Company specialist staff, service centres or worldwide organization may be contacted through the most convenient address given on the back cover of this manual. Specialist training courses can also be arranged by our Training Centre.

2 DESCRIPTION

All the various system options consist of one or more of the following units with the further option of fitting the monitor and power supply units in a cubicle. Specific information relating to a cubicle option will be supplied separately.

2.1 Model 6553 Gas Monitor

The Gas Monitor is a unit suitable for panel mounting or in a control cubicle in the safe area. The various monitor options use one or two digital displays with protected access for zero adjustments and may also have a range selector switch – see Fig. 2.1.

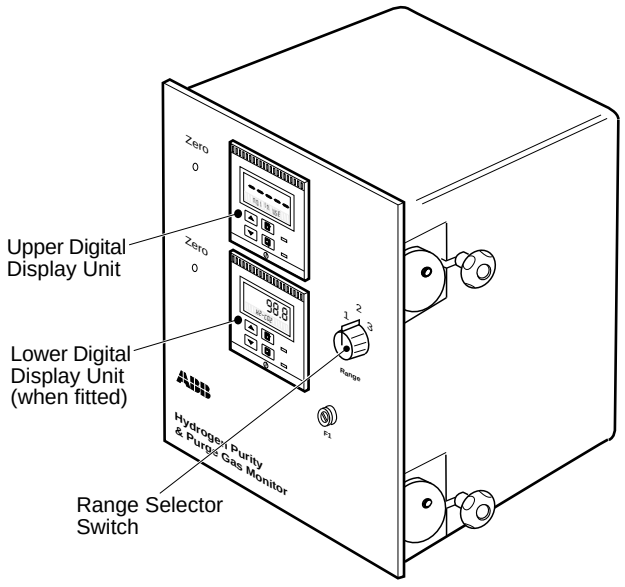


Fig. 2.1 Model 6553 Gas Monitor

2.1.1 Dual Range Display

When a dual range display is fitted, the range selector switch may be used to select parameters as follows:

Position (1) Percentage of hydrogen in air, by volume, shown on the **upper display**.

Position (2) Percentage of hydrogen in carbon dioxide, by volume, shown on the **lower display**.

Position (3) Percentage of air in carbon dioxide, by volume, shown on the **lower display**.

The upper display is single range, and is preprogrammed to indicate the hydrogen purity measurement of the coolant gas under normal operation of the system.

Ranges (hydrogen purity in air):

100 to 85% or 100 to 80% (4689501 display)
85 to 100 % or 80 to 100% (4689503 display)

with two alarm set points. Two alarm outputs and a value retransmission signal are also available.

With a second (lower) display fitted (4689500), this may be dual range marked 0 to 100% hydrogen in carbon dioxide and 0 to 100% air in carbon dioxide for use in the hydrogen purging operation. A range selector switch is fitted with the dual range display, and a value retransmission signal and two alarms are available. With the dual range display there is a further option of providing remote indication of the range selector switch position. There is a further option of fitting a second single range bottom display similar to the top display. An alarm output and a value retransmission signal are available from this display option.

Each display defaults to indicate NOT IN USE when not selected.

The Model 4689 displays are dedicated variants of the Company's Model 4600 Series Indicator/Controllers. With this special variant (4689), the displays and alarm indicators on the front panel remain the same but software control is specific to the Katharometer systems. 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 monitor allow remote zeroing of the katharometers in the **hazardous** area. The adjustment access for a particular display is adjacent to the display and at the same level.

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

The monitor also contains encapsulated zener barrier units to limit the electrical energy level that can be applied from the instrument circuits into the **hazardous** area. These zener barrier units are located below the display units, on a bus-bar which **MUST** be earthed (grounded). A metal screening arrangement segregates the connections made to equipment in the **hazardous** area. A main fuse is fitted inside the monitor case for the electricity supply line.

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

Each panel comprises a metering valve, a drying chamber, a thermally lagged katharometer 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 carbon dioxide and air in carbon dioxide.

Each sealed katharometer assembly incorporates a Wheatstone Bridge made up of 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.

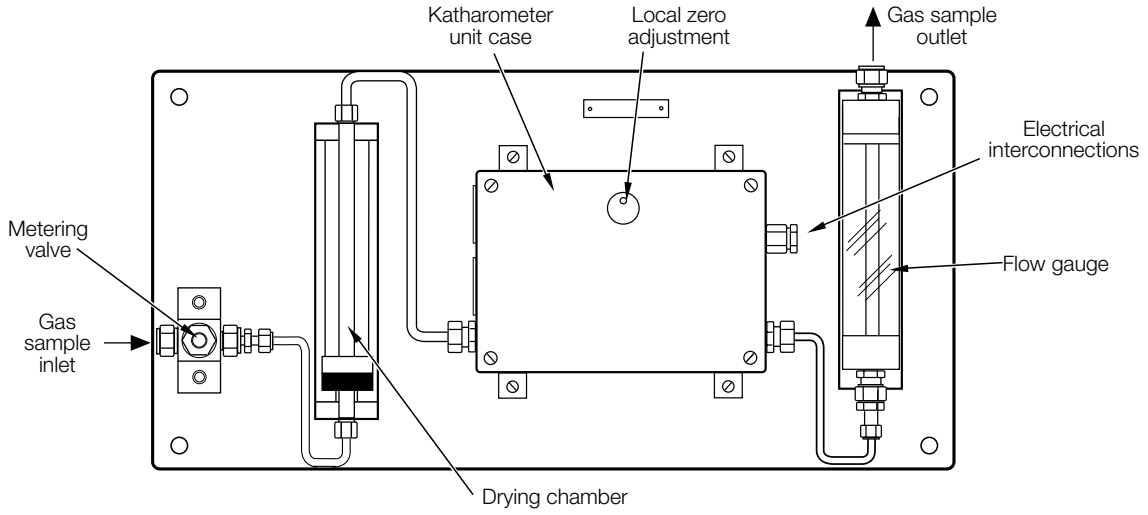


Fig. 2.2 Location of Items – A Katharometer Analyser Panel

When the intrinsically safe stabilized current from the 4234 power supply unit (model 4234500 or 4234501) is passed through this bridge, the temperature of the platinum filaments rises to a point of thermal equilibrium. Under conditions which 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 monitor unit.

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

2.3 Model 4234500/4234501 Power Supply Units (PSU) – Fig. 3.3

Warning. Do NOT connect mains supply to the PSU with the output terminals on open circuit. This causes premature component failure.

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

To operate a katharometer unit in the hazardous area, one Model 4234 PSU is required for each katharometer. The PSU supplies a stabilized mA d.c. signal, and must be mounted in the safe area. There are two separate versions available:

Model 4234500 for a nominal 230 V a.c. supply voltage
Model 4234501 for a nominal 115 V a.c. 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 output cables to the hazardous area.

The circuit is protected by a cartridge fuse. This fuse must have a high breaking capacity (h.b.c.) rating of 1500 A to comply with the terms of the certification.

2.4 Remote Indicator/Controllers

The 6553 monitor unit has provision for retransmission values and ancillary indicator/controllers may be connected to these outputs, providing that they are installed in the safe area and the installation conforms to the requirements given in Section 5.1.

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 Monitor Unit – Fig. 3.1

The 6553 monitor is available in several options, these being defined by the code number as given in Section 3.1.4.

The identification and certification labels are fixed to the outside of the monitor case as shown in Fig. 3.1. The precise interpretation of the identification code gives information on the 6553 system as a whole, as shown in Section 3.1.5.

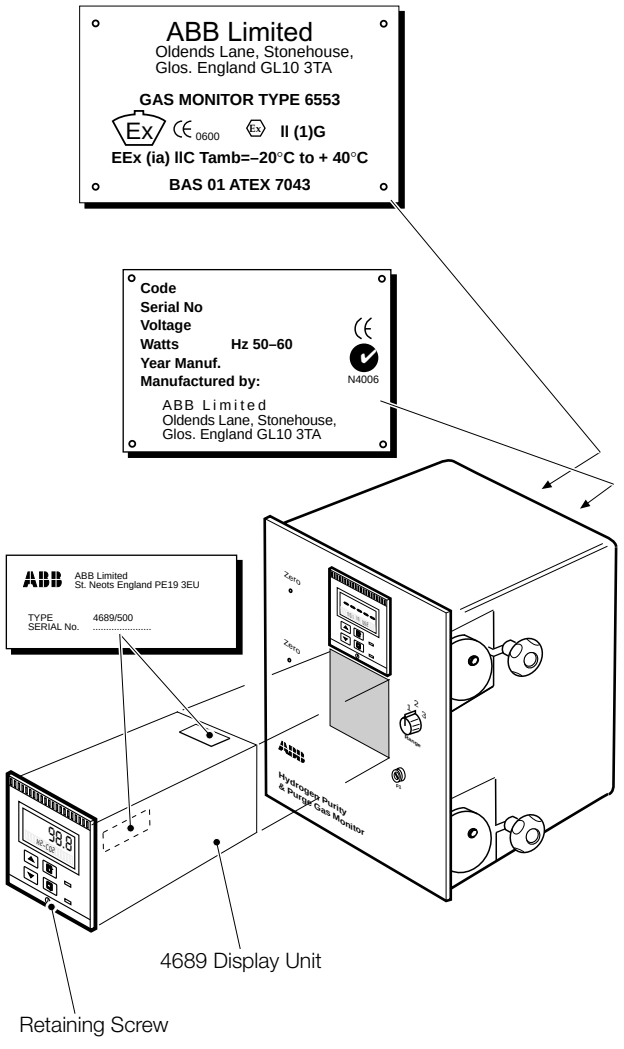


Fig. 3.1 Typical Identification Labels and Locations – Model 6553 Gas Monitor Unit with Digital Displays

Note. Although the display units may be marked as '4600' on their front panels, they are special units for this monitor and a standard Model 4600 cannot be used. The precise identity of the display unit is given on the identification label shown in Fig. 3.1.

3.1.2 Models 006540203 and 006548000 Katharometer Analyser Panels – Fig. 3.2

The identification of a panel is given by the panel 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.

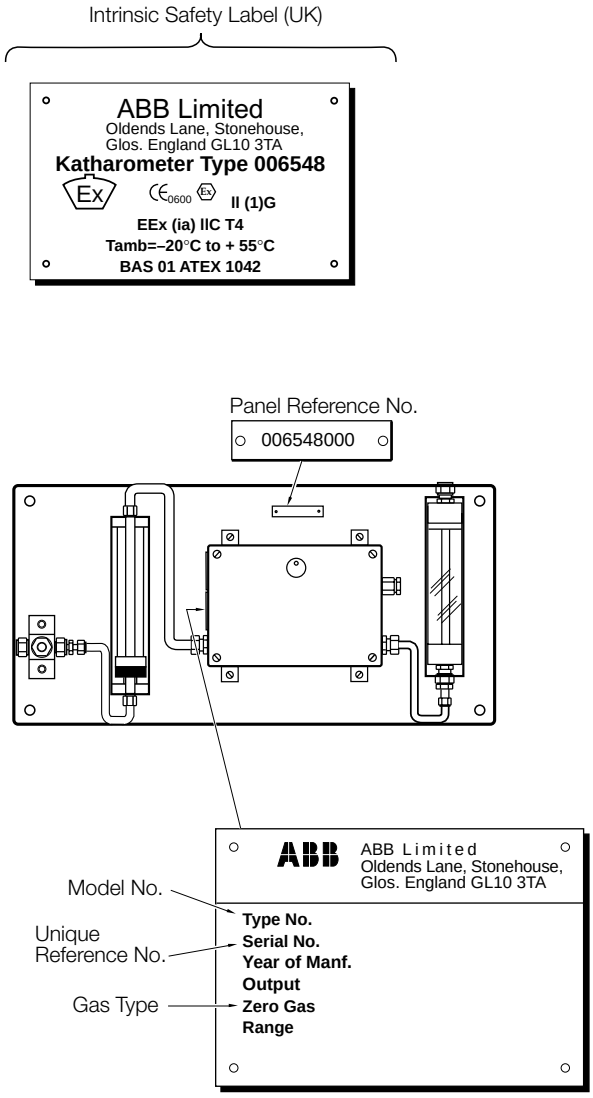


Fig. 3.2 Typical Identification Labels and Locations – Model 006548000 Katharometer Analyser Panel

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.

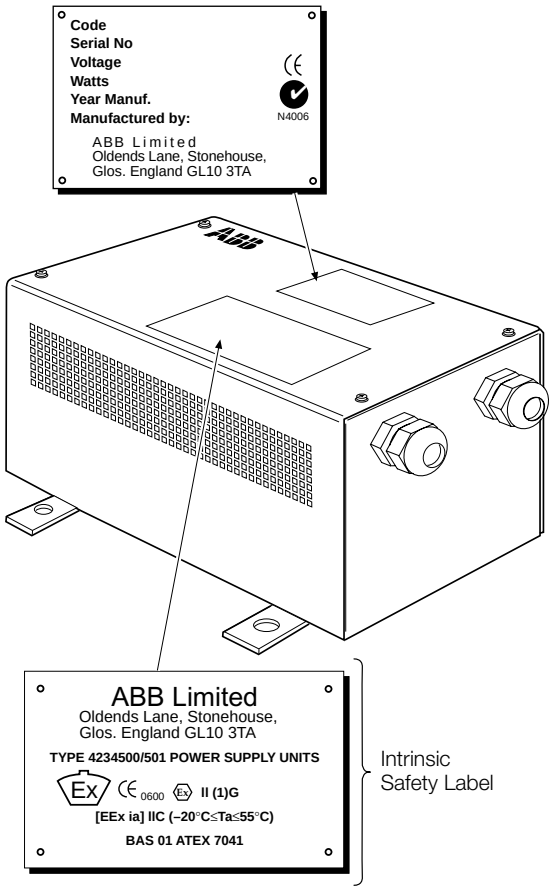


Fig. 3.3 Typical Identification Labels and Locations – Model 4234 Power Supply Unit

3.1.4 Coding System

6553/	X	X	X	X	X	X	X	X	X	X
	A	B	C	D	E	F	G	H	J	K

- Features of Upper Indicator
- Scale of Upper Indicator
- Features of Lower Indicator
- Scale of Lower Indicator
- Range Selector Switch
- Not Used
- Fitted with Labels
- Cubicle Type
- Special Features
- Mains Supply

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. The display unit and power supply units **must be** installed in a **safe** (non-hazardous) area, and katharometer panel may be mounted close to the sample point in the **hazardous** area.

Ordering Code – 6553 Hydrogen Purity and Purge Gas

A Features of Upper Display
6 Two alarms + retrans. 4–20 mA

B Scale of Upper Display
1 100–85% H_2 in Air
2 100–80% H_2 in Air
3 0–100% Air in CO_2, 0–100% H_2 in CO_2, 85–100% H_2 in Air
4 0–100% Air in CO_2, 0–100% H_2 in CO_2, 80–100% H_2 in Air
5 85–100% H_2 in Air
6 80–100% H_2 in Air
7 0–100% Air in Ar, 0–100% H_2 in Ar, 85–100% H_2 in Air
8 0–100% Air in Ar, 0–100% H_2 in Ar, 80–100% H_2 in Air

C Features of Lower Display
0 Indicator Not Fitted
3 Two alarms + retrans. 4–20 mA

D Scale of Lower Display
0 Indicator Not Fitted
1 0–100% Air in CO_2, 0–100% H_2 in CO_2
2 100–85% H_2 in Air
3 100–80% H_2 in Air
4 0–100% Air in CO_2, 0–100% H_2 in CO_2, 85–100% H_2 in Air
5 0–100% Air in CO_2, 0–100% H_2 in CO_2, 80–100% H_2 in Air
6 85–100% H_2 in Air
7 80–100% H_2 in Air
A 0–100% Air in Ar, 0–100% H_2 in Ar, 85–100% H_2 in Air
B 0–100% Air in Ar, 0–100% H_2 in Ar, 80–100% H_2 in Air

E Range Selector Switch
0 Not fitted
2 Fitted, with facilities for Remote Indication of Switch Position – only upper display fitted
3 Fitted with two range switches, upper and lower display + remote indication of selected ranges

F Additional Output Signal – Not Used

G Language
1 English
2 French
3 German
4 Polish

H Type of Cubicle
1 Without Cubicle.
2 Cubicle – 2 x 3-range only (Ar or CO_2)
4 Cubicle – dual display
5 Cubicle – single display

J Special Features
0 None
9 Fitted

K Mains Supply
1 115 V, 50/60 Hz
2 230 V, 50/60 Hz

Valid Option Combinations (6553/[X])

[X]	2 x 3 ranges	Purity only: Single Display (upper)	3-Range: Single Display (upper)	Std. purge system
A	6	6	6	6
B	3,4,7,8	1,2,5,6	3,4	1,2,5,6
C	3	0	0	3
D	4,5,A,B	0	0	1
E	3	0	2	2
F	0	0	0	0
G	1 to 3	1 to 3	1 to 3	1 to 3
H	1,2	1,5	1,5	1,4
J	0,9	0,9	0,9	0,9
K	1,2	1,2	1,2	1,2

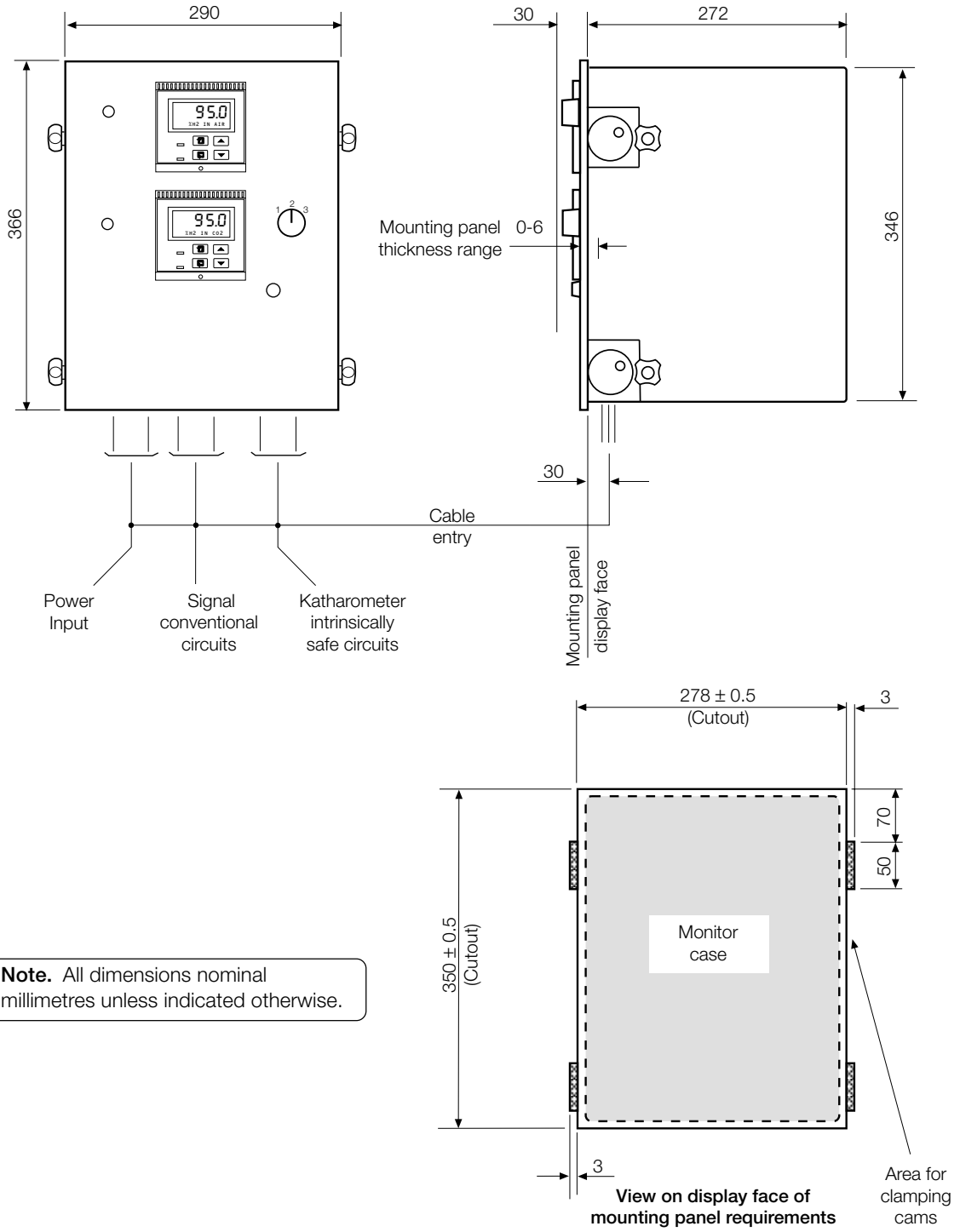
4 MECHANICAL INSTALLATION

4.1 Locating and Mounting System Items

4.1.1 Model 6553 Gas Monitor – Fig. 4.1

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

The monitor is intended to be panel mounted in a position to suit reading of the displays and with access to the rear to enable wiring interconnections to be made. The panel preparation requirements and installation dimensions are shown in Fig. 4.1. The monitor is secured to the panel by four cam fixings.



Note. All dimensions nominal millimetres unless indicated otherwise.

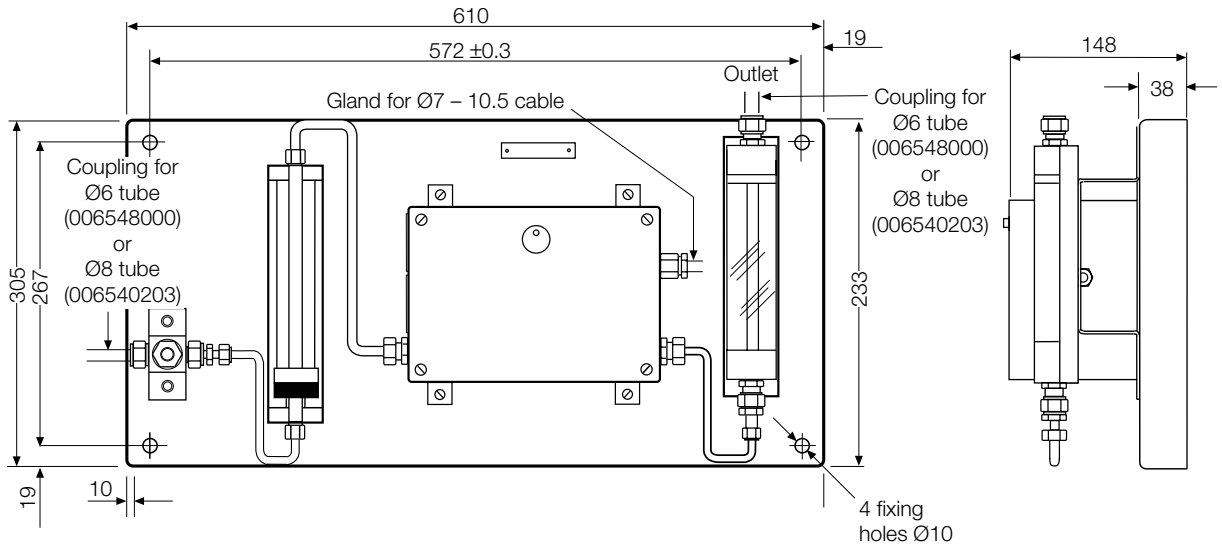
Fig. 4.1 Installation Dimensions and Interconnection Positions – Model 6553 Gas Monitor Unit with Digital Displays

4.1.2 Katharometer Analyser Panels – Fig. 4.2

Caution. Ensure that the correct panel, specifying zero gas 'Hydrogen' or 'CO2', is located at the required position and ensure that the panel is of the correct pressure rating.

The panel is located in the hazardous area (zone 0,1 or 2) of the application plant in a sheltered interior environment. Avoid a location which subjects the katharometer unit to direct sunlight. When two katharometer panels are used they should be positioned so as to be at the same ambient temperature.

The katharometer unit is fixed to the panel, which has fixing holes at each corner, and should be mounted on a suitable vertical surface close to the sample tapping point. The installation dimensions for the panel is shown in Fig. 4.2.



Note. All dimensions nominal millimetres unless indicated otherwise.

Fig. 4.2 Installation Dimension and Interconnection Positions – Model 006540203 or 006548000 Katharometer Analyser Panel

4.1.3 Model 4234 Power Supply Unit – Fig. 4.3

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

The power supply unit has 4 fixing lugs and should be mounted on a suitable vertical surface. The installation dimensions are shown in Fig. 4.3.

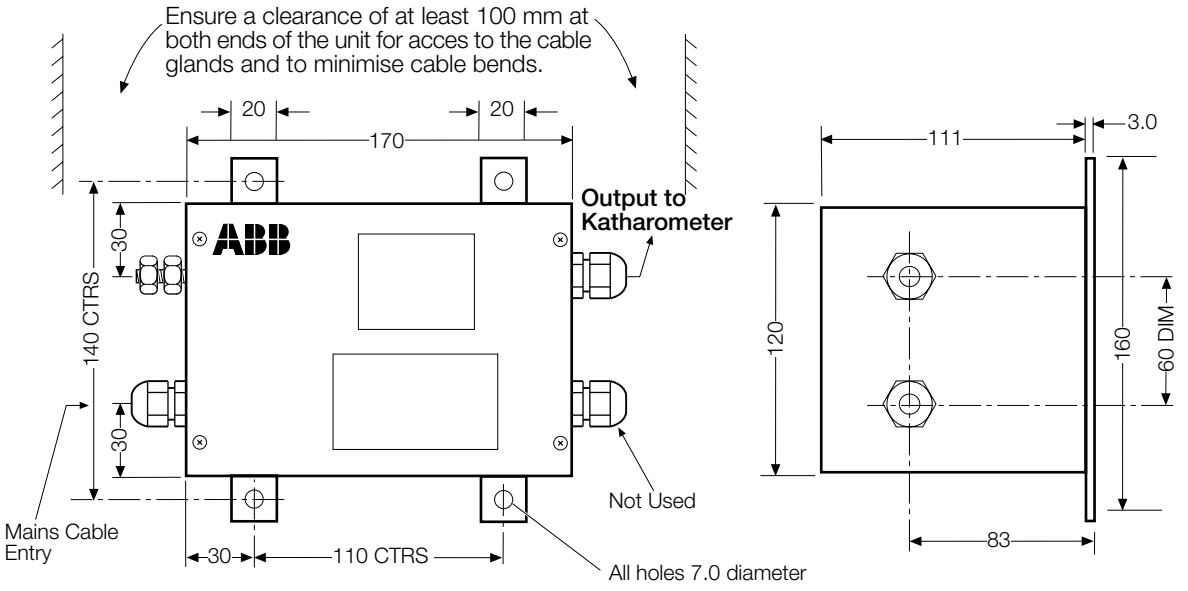


Fig. 4.3 Installation Dimension and Interconnection Positions – Model 4234 Power Supply Unit

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 either mounted 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.

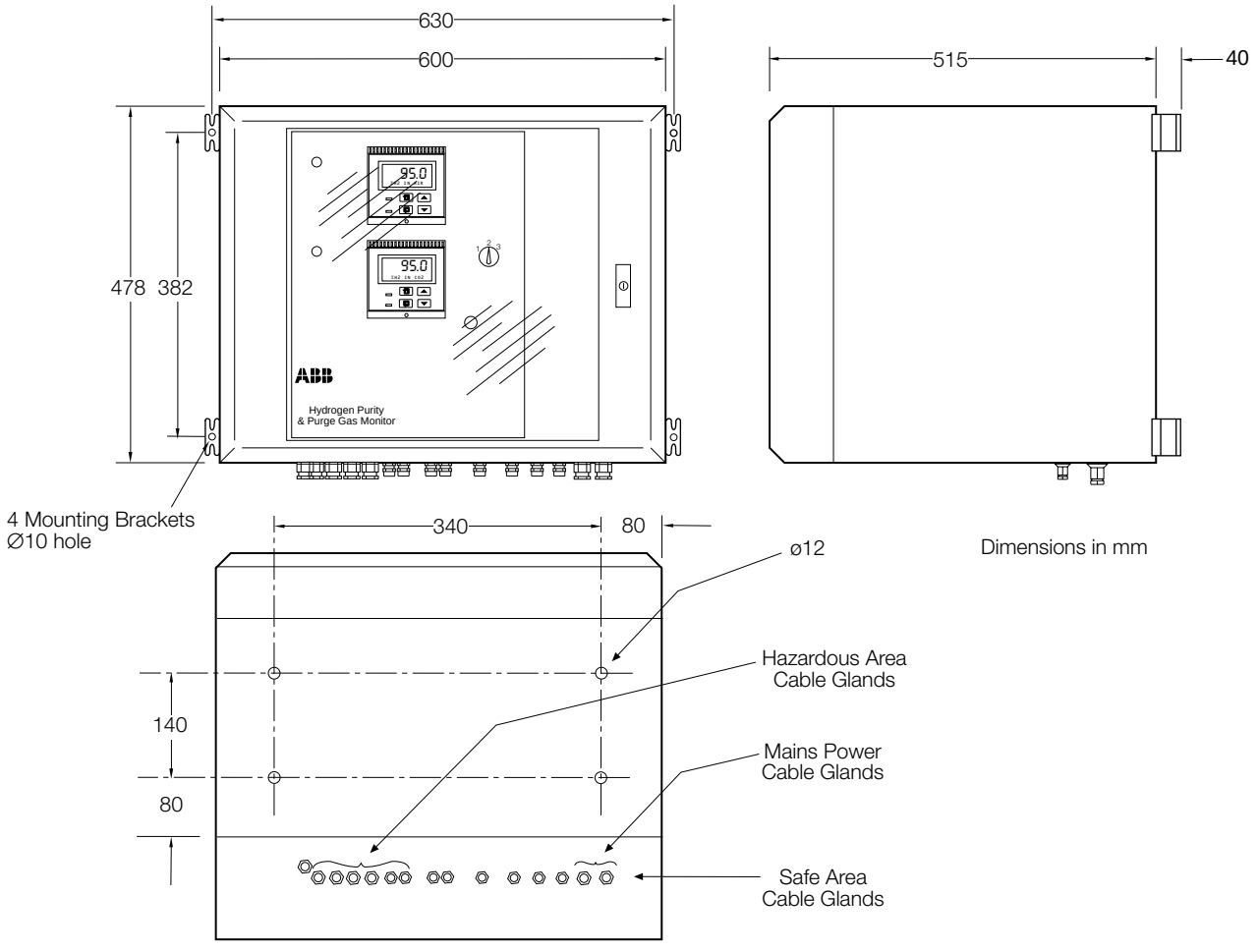


Fig. 4.4 Installation Dimensions – Cubicle

4.2 Sample Gas Interconnections

Warning. A hazardous mixture of hydrogen in air could develop in the event of leakage from the sample gas system. Katharometer analyser panels should be located in a ventilated area.

The sample pressure must not exceed the value given in Section 13.

The incoming sample gas temperature must not exceed the temperature given in Section 13. 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, a suitable 1μm filter unit should be incorporated in the system before the sample gas enters the analyser system.

Compression couplings are supplied at the sample inlet and outlet to the katharometer panel. These couplings are suitable for connecting 8 mm (Model 006540 203) or 6 mm (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.

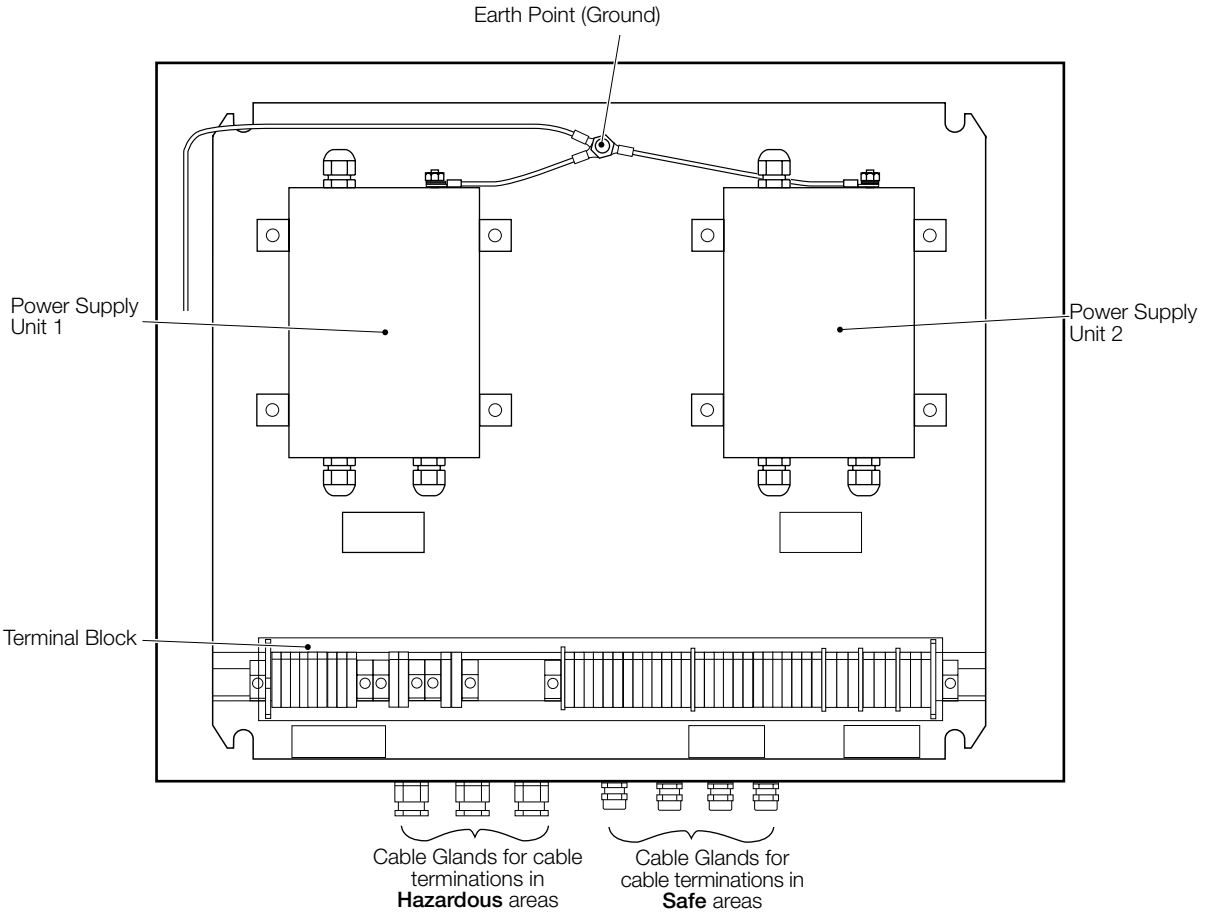


Fig. 4.5 Location of Main Components on Cubicle Backplate

5 ELECTRICAL INSTALLATION

5.1 Electrical Interconnections – Fig. 5.1

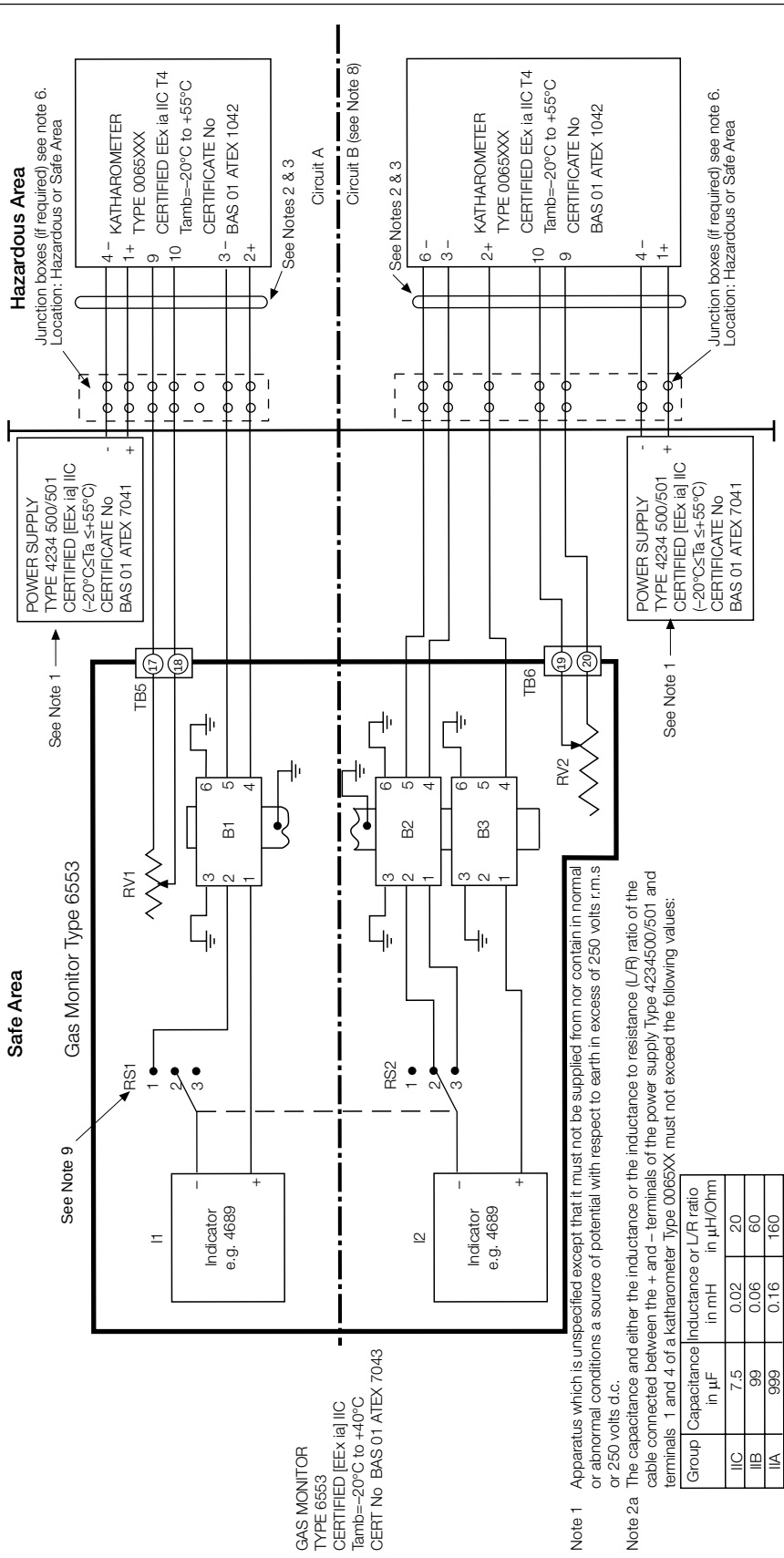


Fig. 5.1 System Diagram

Note 1 Apparatus which is unspecified except that it must not be supplied from nor contain in normal or abnormal conditions a source of potential with respect to earth in excess of 250 volts r.m.s or 250 volts d.c.

Note 2a The capacitance and either the inductance or the inductance to resistance (L/R) ratio of the cable connected between the + and – terminals of the power supply Type 4234500/501 and terminals 1 and 4 of a katharometer Type 0065XX must not exceed the following values:

Group	Capacitance in µF	Inductance or L/R ratio in mH	in µH/Ohm
IIC	7.5	0.02	20
IIB	99	0.06	60
IIA	999	0.16	160

Note 2b The capacitance and either the inductance or the inductance to resistance (L/R) ratio of the cables connected between (a) terminals 17 & 18 of the gas monitor Type 6653 and terminals 9 & 10 of a katharometer Type 0065XX, (b) terminals 19 & 20 of the gas monitor and terminals 9 & 10 of a katharometer Type 0065XX, (c) terminal 4 & 5 of barrier B1 of gas monitor Type 6653 and terminals 2 & 3 of a katharometer Type 0065XX, must not exceed the following values:

Group	Capacitance in µF	Inductance or L/R ratio in mH	in µH/Ohm
IIC	38	0.40	75
IIB	999	1.20	225
IIA	999	3.20	600

Note 2c The capacitance and either the inductance or the inductance to resistance (L/R) ratio of the cables connected between 4 & 5 of barrier B2 plus terminal 4 of barrier B3 of gas monitor Type 6653 and terminals 2, 3 & 6 of a katharometer Type 0065XX, must not exceed the following values:

Group	Capacitance in µF	Inductance or L/R ratio in mH	in µH/Ohm
IIC	38	0.20	40
IIB	999	0.60	120
IIA	999	1.60	320

Note 3 The cable may be separate cables or may be installed as separate circuits within a type 'A' or a type 'B' multicore cable as defined in EN50039(1980) subject to the following:
a. Each circuit shall be individually screened within a type 'A' multicore cable.
b. The peak voltage of any other circuit within a type 'B' multicore cable must not exceed 60 volts.

Note 4 The installation must comply with national requirements (e.g. in the UK EN60079-14:1997).

Note 5 The system must be marked with a durable label. The label should appear on or adjacent to the principal item of electrical apparatus in the system or at the interface between the intrinsically safe and non-intrinsically safe circuits.
This marking shall include the word SYST or SYSTEM. e.g.
'BAS SYSTEM No Ex 01E2044' or 'BAS No Ex 01E2044 SYST'

Note 6 A junction box, if used, must satisfy the requirements of Clauses 6.1 and 6.3.1 of EN50020:1994.

Note 7 Circuit A or Circuit B may be omitted.

Note 8 Circuit B may be identical to Circuit A.

Note 9 This item may or may not be fitted.

Warning.

- Equipment in this system operates on a.c. mains supply voltage electricity. Suitable safety precautions must be taken to avoid the possibility of electric shock.
- Although certain instruments are fitted with internal fuse protection, a suitably rated external protection device, either a 3 A fuse or miniature circuit breaker (m.c.b.), 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.
- A.C input, intrinsically safe d.c. output and non-intrinsically safe wiring must all be routed separately.

Fig. 5.1 shows the interconnecting wiring requirements for the gas analyser system, which must be strictly observed. Details of cable requirements, which 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 analyser system must be interconnected as shown in Sections 5.1.1, 5.1.2 and 5.1.3.

5.1.1 Model 6553 Gas Monitor – Fig. 5.2

Warning. 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 also satisfied.

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

The electrical connections are made 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.

See Fig. 5.4 for connections to cubicle-mounted monitor.

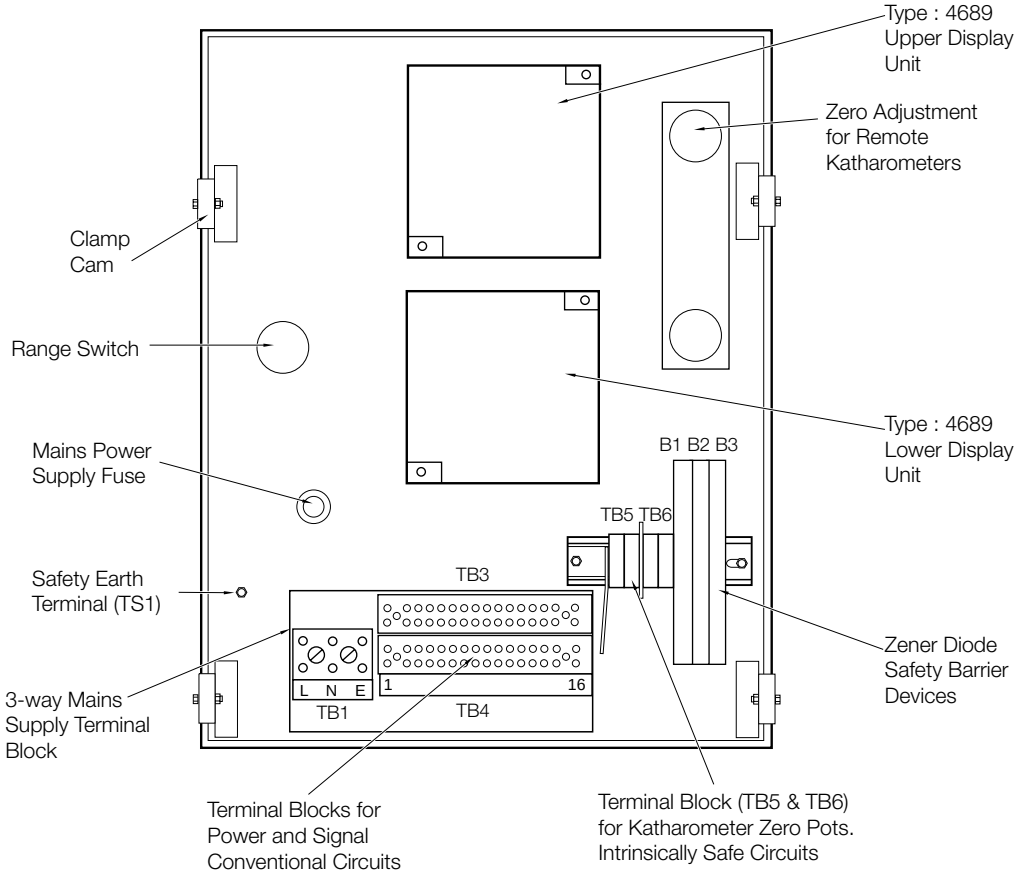


Fig. 5.2 Location of Components Inside Case – Model 6553 Gas Monitor

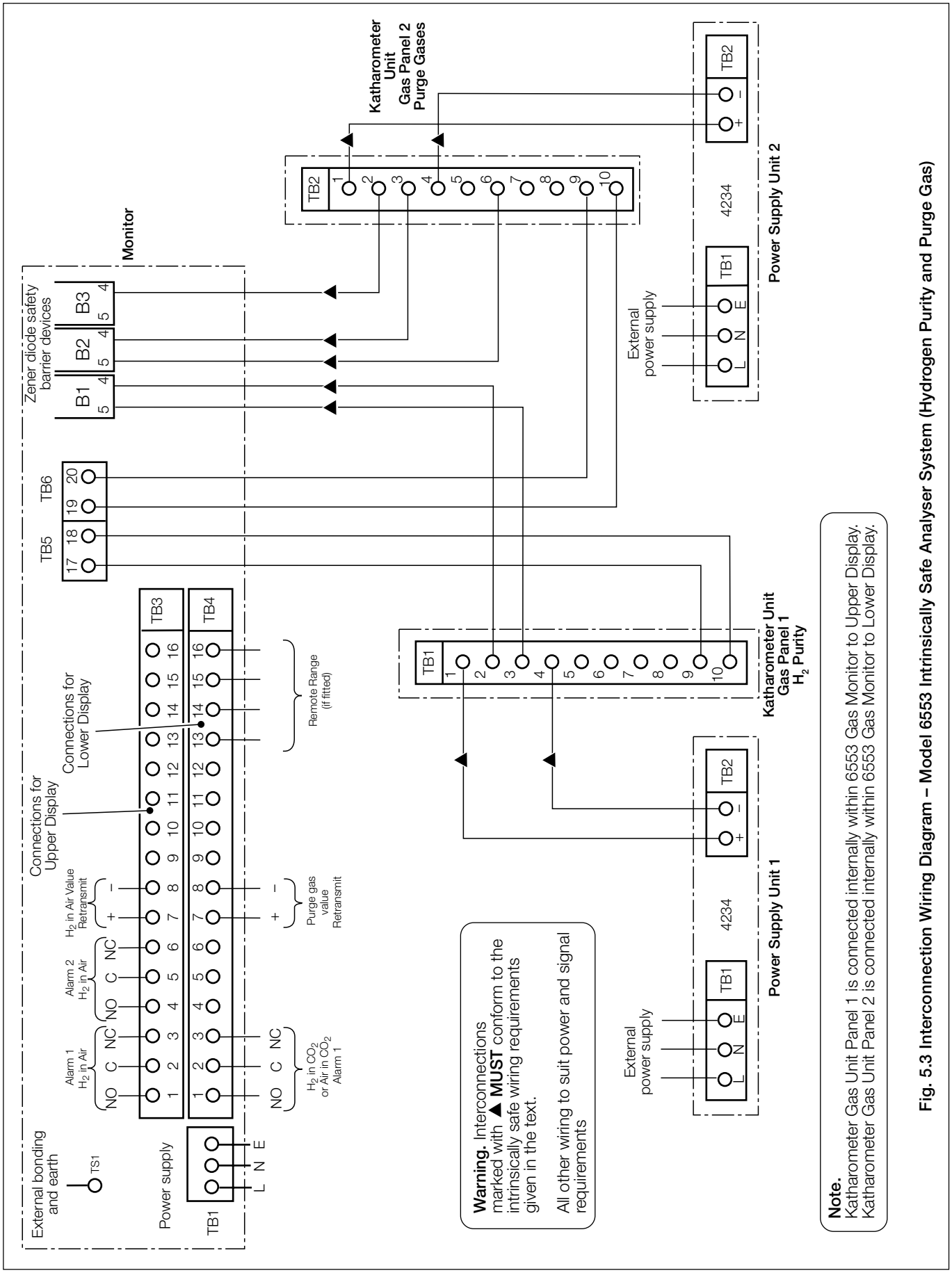


Fig. 5.3 Interconnection Wiring Diagram – Model 6553 Intrinsically Safe Analyser System (Hydrogen Purity and Purge Gas)

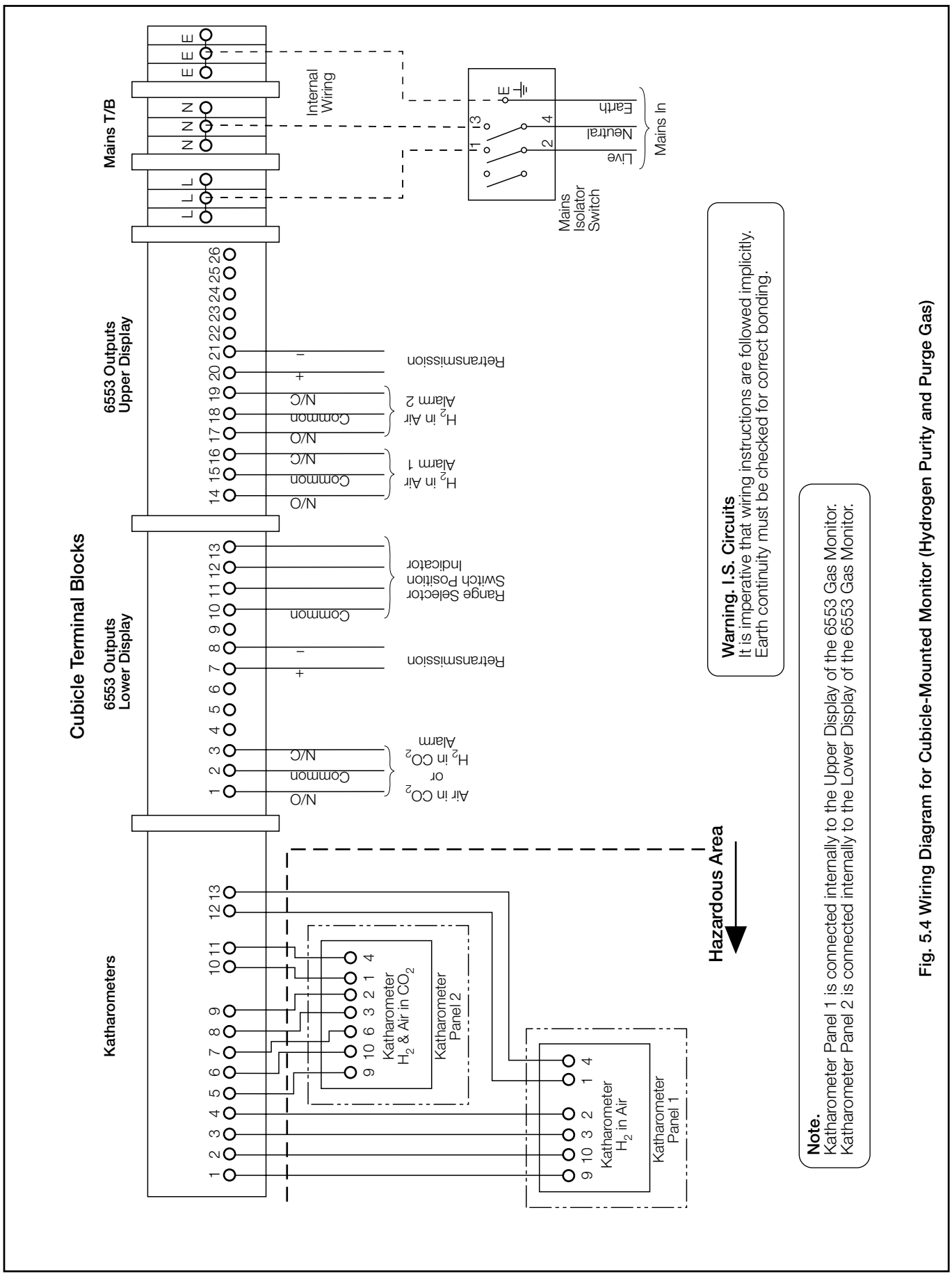


Fig. 5.4 Wiring Diagram for Cubicle-Mounted Monitor (Hydrogen Purity and Purge Gas)

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 1R0 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 006540203 and 006548000 Katharometer Analyser Panel

Access to terminals

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

1) Remove four screws in the cover of the katharometer unit.
2) Remove cover to access the terminal block (TB1) inside.

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 510R 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.

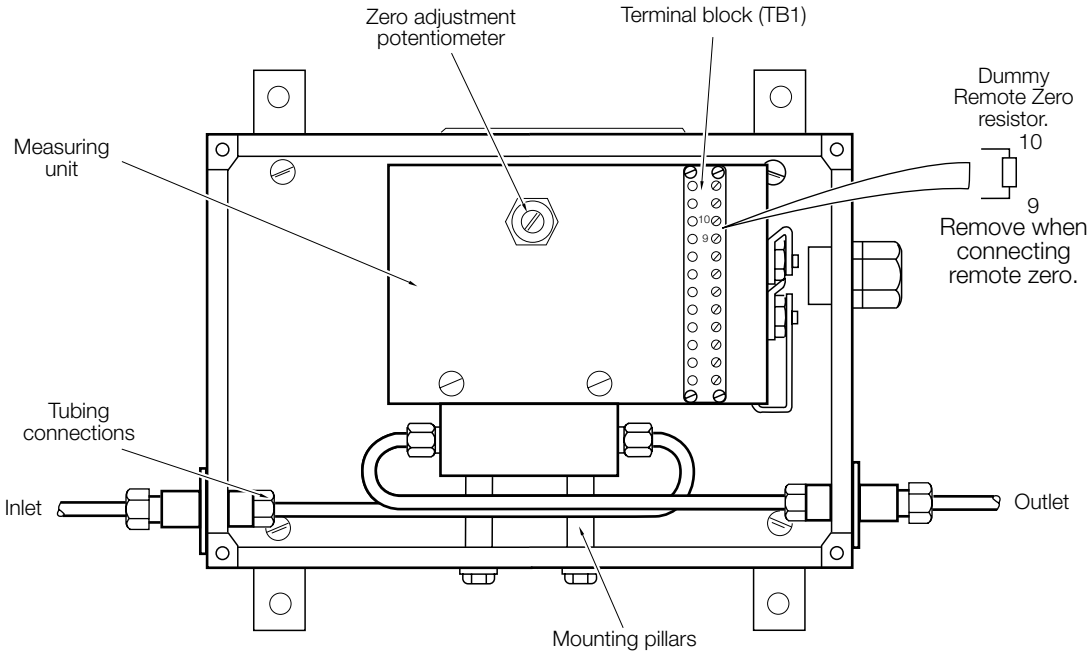


Fig. 5.5 Location of Components Inside Case – Model 006539 and 006548 Type Katharometer Units on 006540203 & 006548000 Panels respectively

5.1.3 Model 4234 Power Supply Unit – Fig. 5.6

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

Caution. Ensure that the power supply unit is correct for the mains supply voltage available. A nominal 115 V unit cannot be adapted for use with a nominal 230 V supply, or the other way around.

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

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

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

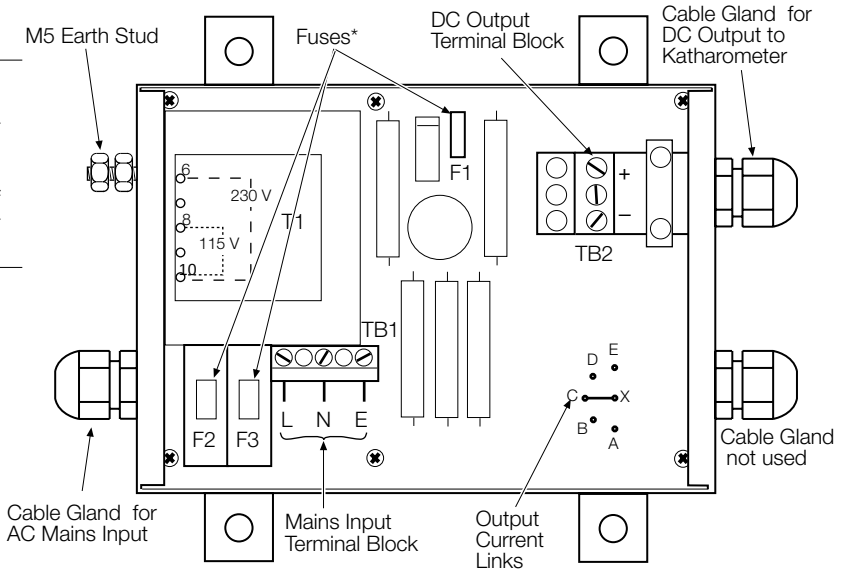
Replace the cover when wiring is complete.

Note. Hazardous Voltages
There are no servicable parts in this unit. Please return to the manufacturer if faulty, or seek the services of a qualified engineer.

Ensure that the mains supply is switched off and disconnected before removing the cover for any reason.

Output Current (mA)	Links
350	C to X
250	D to X
180	E to X

NO connections should be made to points A, B D or E



*Refer to the 4234 manual for fuse details.

Fig. 5.6 Location of Components Inside Case – Model 4234 Power Supply Unit

5.2 Intrinsically Safe Requirements

These requirements relate to the interconnecting wiring made to and from Model 6540 203 and 6548 000 Katharometer Analyser 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 Analyser Panels and the 4234 PSU.**

   All cables from the Katharometer in the hazardous area must have an inductance/resistance ratio not exceeding 20 μH/Ω, (for Group IIC gases). There is a further requirement that the maximum loop resistance of this interconnecting cable is limited to 1.5 Ω. This may place a limitation on the length of the total cable run.

   Single sheathed conducting cables should be twisted together to reduce their mutual inductance, and routed separately from cabling for non-intrinsically safe circuits in the safe area.

2) **Connections between Model 006540 203 or 006548 000 Katharometer Analyser Panels and Model 6553 Gas Monitor Unit.**

   Katharometer to display unit cables, carrying the output signals through zener barrier units inside the monitor unit, are subject to of a maximum inductance/resistance ratio of 20 μH/Ω (for group IIC gases). These wires are indicated by a ▲ in Fig. 5.3.

5.2.2 Recommended Cables

The choice of wiring cable is restricted due to the limitations imposed by the certification parameters – see Notes 2a, b and c in Fig. 5.1.

Cables manufactured to DEF STAN 61-12 Part 5 should comply, but care should be taken over the number or cores included in the cable. As can be seen, 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 a 2-core, and this diameter affects both the inductance and capacitance values.

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

Permanoid Ltd
Hulm Hall Lane
Manchester, M40 8HH
England
Telephone: 0161 2056161
Facimilie: 0161 2059325
E-mail: sales@permanoid.co.uk
Website: www.permanoid.co.uk

	2-core	6-core
Inductance (μH/metre)	0.325	0.467
Capacitance (pF/metre)	190	143
L/R (μH/ohm)	8.6	11.4
Test voltage	2 kV a.c. for one minute	
Rated voltage	440 V r.m.s	

5.2.3 Installing Remote Ancillary Items

Any indicator/controllers, or other electrical equipment, connected to TB1 of the Model 6553 Gas Monitor Unit must not be supplied from, nor contain, a potential source greater than 250 V d.c. or 250 V r.m.s. 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 monitor 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 gas analyser system has been correctly installed in accordance with the requirements for intrinsic safety given in Section 5.2, carry out the following setting-up in Section 6.

6 SETTING UP

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

1) Remove the drying chamber on the katharometer analyser 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.
2) Open a container of fresh granular anhydrous calcium sulphate or calcium chloride, immediately fill, and prepare to replace, the drying chamber.

Note. The capacity of the drying chamber is about 140 ml. To fill the chamber, approximately 100 g of desiccant is required.

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.

6.2 Setting Sample Flow

When all tubing interconnections have been made and external parts of the sample system checked for leaks, the suggested procedure is as follows:

1) Arrange to supply calibration quality carbon dioxide gas through the gas analyser system at the normal working pressure of the application plant and within the limits given in Section 13.

Caution. Testing for leaks with carbon dioxide may not be considered an adequate check of gas tight integrity in respect of the more penetrating hydrogen gas. Consideration may 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 150 ml min^{-1}. Do not exceed the maximum flowrate given in Section 13.
3) Set the flowrate and shut off the calibration gas external to the analyser system.
4) Repeat this procedure for each katharometer analyser panel, as required.

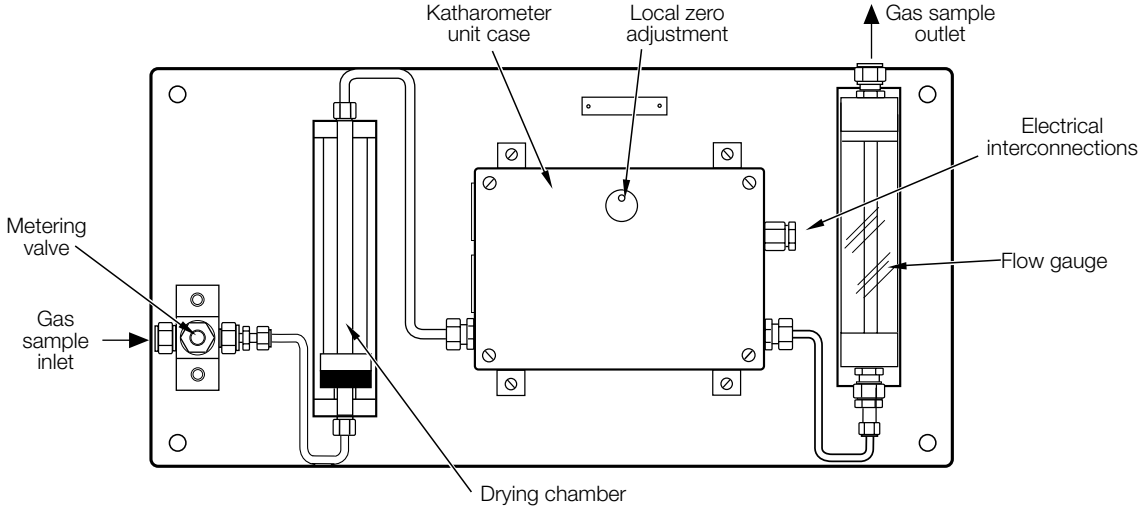


Fig. 6.1 Katharometer Analyser Panel

6.3 Electrical Checks

Carry out the following electrical checks:

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 350 mA into a 14 ohm 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 (MTL 7055ac) in the 6553 Monitor Unit are checked at the time of manufacture. To ensure absolute safety when fitting a new instrument, check that the barriers in the monitor are properly earthed by carrying out a routine test before using the analyser 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 99 ATEX 7285.

6.3.3 Checking System Earth

Check that the resistance between earth terminals on the analyser system and the application plant system safety earth does not exceed one ohm.

7 CONTROLS & DISPLAYS

7.1 Displays – Fig. 7.1

The displays comprise 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 carbon dioxide, air in carbon dioxide, alarm set points or programmable parameters. The lower display line shows the associated units or programming information.

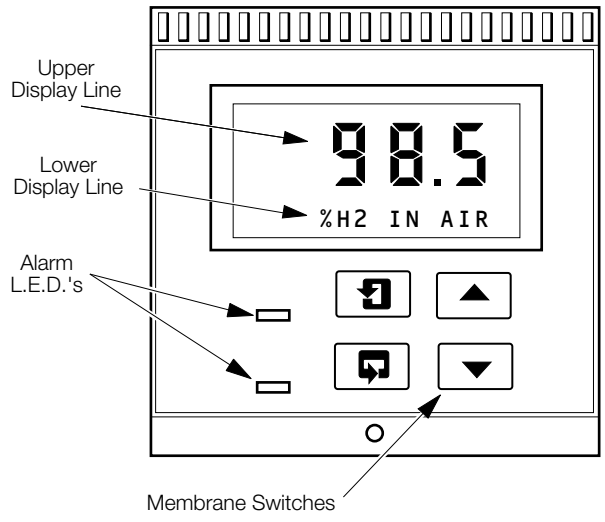
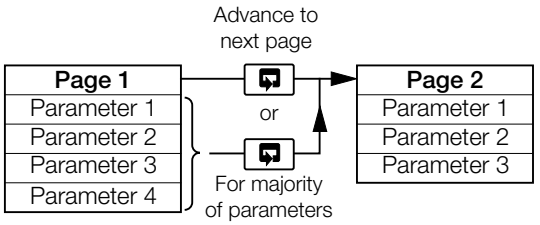
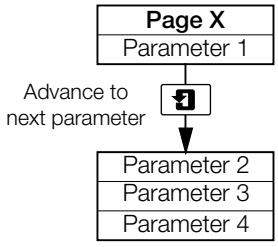


Fig. 7.1 Location of Controls and Displays

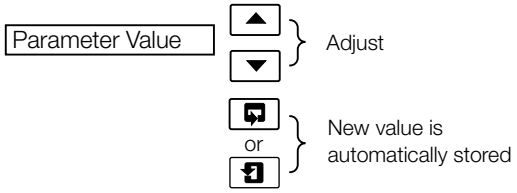
7.2 Switch Familiarization – Fig. 7.2



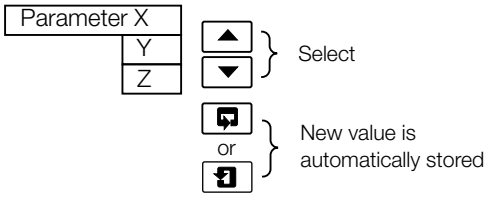
A – Advancing to Next Page



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 STARTUP

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 instrument displays the Operating Page which is a general use page in which parameters are viewed only and cannot be altered. Any changes to the operating parameters are implemented using the switches as described in 7.2 Switch Familiarisation. To alter or program a parameter refer to Section 10. A 5-digit Security Code is used to prevent unauthorised 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.

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

1) Switch on the supply voltage to the PSU.
2) Switch on the supply voltage to the 6553 Monitor unit.

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. i.e. with Alarm 1 set point = 95.0%, when the display is indicating greater than 95.0% (plus hysteresis), then Alarm Relay 1 is energized and Alarm 1 LED is OFF. When the display indicates less than 95.0% (minus hysteresis), then Alarm Relay 1 is de-energized and Alarm 1 LED is ON. This operating mode ensures that, in the event of a mains power failure, an alarm condition is signalled. Repeat process for Alarm Relay 2 set point = 90.0%.

8.2.2 Hydrogen alarm Set Point

It is suggested that the hydrogen alarm set-points should be 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 input the alarm set-points in accordance with the information given in 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 proper functioning of the purge gas monitor. If electrical calibration is required, a voltage source capable of supplying 10.00 mV and 250.00 mV is needed. The katharometer input to the monitor unit should be disconnected and the voltage source signal applied according to the instructions in the Electrical Cal programming page (see Section 10).

Note. The 4600 Series 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 permanently marked 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 the zero gas is 85% hydrogen in nitrogen mixture so that if power is lost to the katharometer, an alarm condition will occur at the monitor 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 should not be altered by users.

With the katharometer correctly adjusted using the 'zero gas' hydrogen in nitrogen mixture carbon dioxide and air mixtures are correctly displayed when the selector switch is in the appropriate position.

8.4.2 Purge Gas

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

1) Arrange to pass calibration quality carbon dioxide through the (CO2) katharometer, on the appropriate katharometer analyser panel. The gas should be at the normal working pressure of the sample gas. This gives the correct flowrate of purge/sample gas as set previously.
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 top display unit indicates NOT IN USE.
5) The bottom display unit indicates the selected measurement parameter – percentage by volume of air in carbon dioxide (%AIR IN CO2) – on its lower display line. The upper display line indicates a value for the parameter.
6) With carbon dioxide calibration gas passing through the sample system at the normal flowrate, the upper line of the bottom 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 bottom '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 top display continues to indicate NOT IN USE.

9) The bottom display indicates the selected measurement parameter – percentage by volume of hydrogen in carbon dioxide (%H2 IN CO2) – on the lower line. The upper line indicates a value for the parameter.

10) With carbon dioxide continuing to pass through the sample system, the upper line of the bottom 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 bottom zero potentiometer is necessary. As any adjustment required will already have been made while calibrating the 'air in carbon dioxide' range.

8.3.2 Hydrogen

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

1) Arrange to pass calibration quality hydrogen gas through the (H2) Katharometer Unit on the appropriate katharometer analyser panel, at the normal working pressure of the sample gas system. This should give 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 hydrogen display unit indicates the measurement parameter – percentage by volume of hydrogen in air (%H2 IN AIR) – on the lower line. The upper line indicates a value for the parameter.

5) If fitted, the purge gas display unit indicates NOT IN USE.

6) With hydrogen calibration gas passing through the sample system at the normal flowrate, the upper line of the top display should stabilize within 2 hours to read 100.0.

7) If necessary, refer to Section 10.1.3 for a full calibration sequence.

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

9 OPERATION

9.1 Normal

During normal operation the Model 6553 Gas Analyser System is used to indicate the purity of hydrogen used as a coolant. The displays shows 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 analyser system after completion of start-up procedures and putting on-line in monitoring mode. The system only requires minor adjustments to the metering valve to maintain the required flowrate and the carrying out of safety routines.

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

9.1.1 Purging of Hydrogen Coolant Gas

Initially, inert purge gas (carbon dioxide) 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 Model 6553 Gas Analyser 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 analyser system(s), the procedures are as follows:

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

1) Select position (2) of the range selector switch on the monitor unit. This causes the display units to indicate and have the functions given 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 monitor unit. This causes the display unit to indicate and have the functions given in Table 9.1.

9.1.2 Filling with Hydrogen Coolant Gas

This procedure is a reversal of the purging procedure.

Initially, inert purge gas (carbon dioxide) 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 analyser system, the procedure is as follows:

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

Note. For reasons of 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 of the monitor unit. This causes the display units to indicate and have the functions given in Table 9.1.

2) When the changeover to introduce hydrogen into the application plant is made, select range (2) of the range selector switch on the monitor unit. This causes the display units to indicate and have the functions as given in Table 9.1.

3) When the display indicates that hydrogen filling is complete, position the range selector switch at (1). The hydrogen measurement analyser system is now on-line in monitoring mode.

	Range Selector Switch Position	Display Upper Line		Display Lower Line		Alarm 1 Set Point	Alarm 2 Set Point
		Actual Display	Function	Actual Display	Function		
Upper Display	(1)	xxx.x	Variable Value	%H2 IN AIR	Hydrogen Purity	A/R	A/R
	(2)	———	Inhibit	NOT IN USE	Inhibit	Inhibit	Inhibit
	(3)	———	Inhibit	NOT IN USE	Inhibit	Inhibit	Inhibit
Lower Display	(1)	———	Inhibit	NOT IN USE	Inhibit	Inhibit	Inhibit
	(2)	xxx.x	Variable Value	%H2 IN CO2	Purge Gas Purity	A/R	N/A
	(3)	xxx.x	Variable Value	%AIR IN CO2	Purge Gas Purity	A/R	N/A

A/R – As Required N/A – Not Available

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

Note. The following programming pages apply to BOTH 4689 display units.

UPPER DISPLAY
(RANGE 1)

Note. All parameter values shown on the upper display line are the default settings.

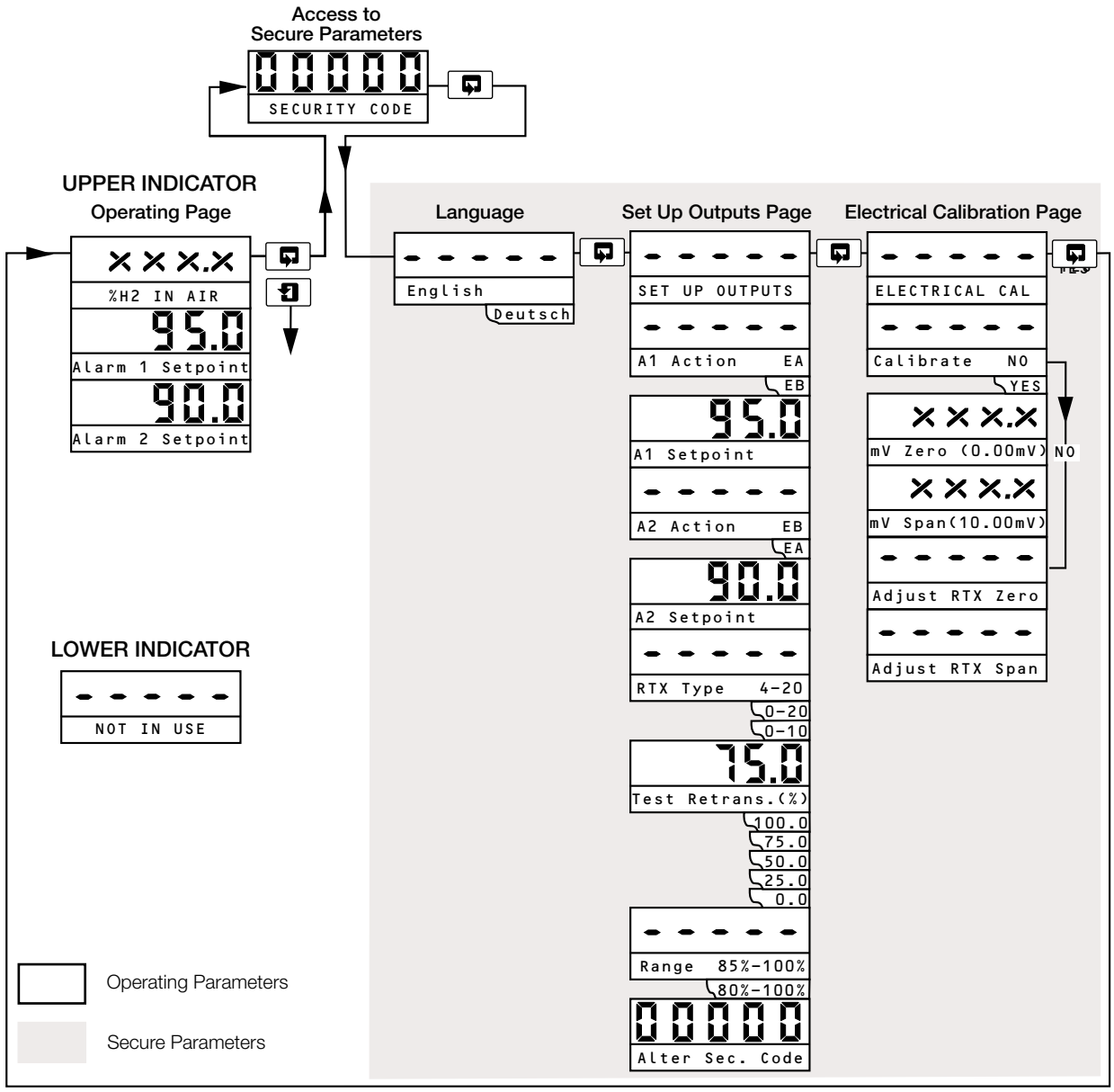


Fig. 10.1 Overall Programming Chart for Display 4689 501 and 503

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

LOWER DISPLAY
(RANGE 2)

Note. All parameter values shown on the upper display line are the default settings.

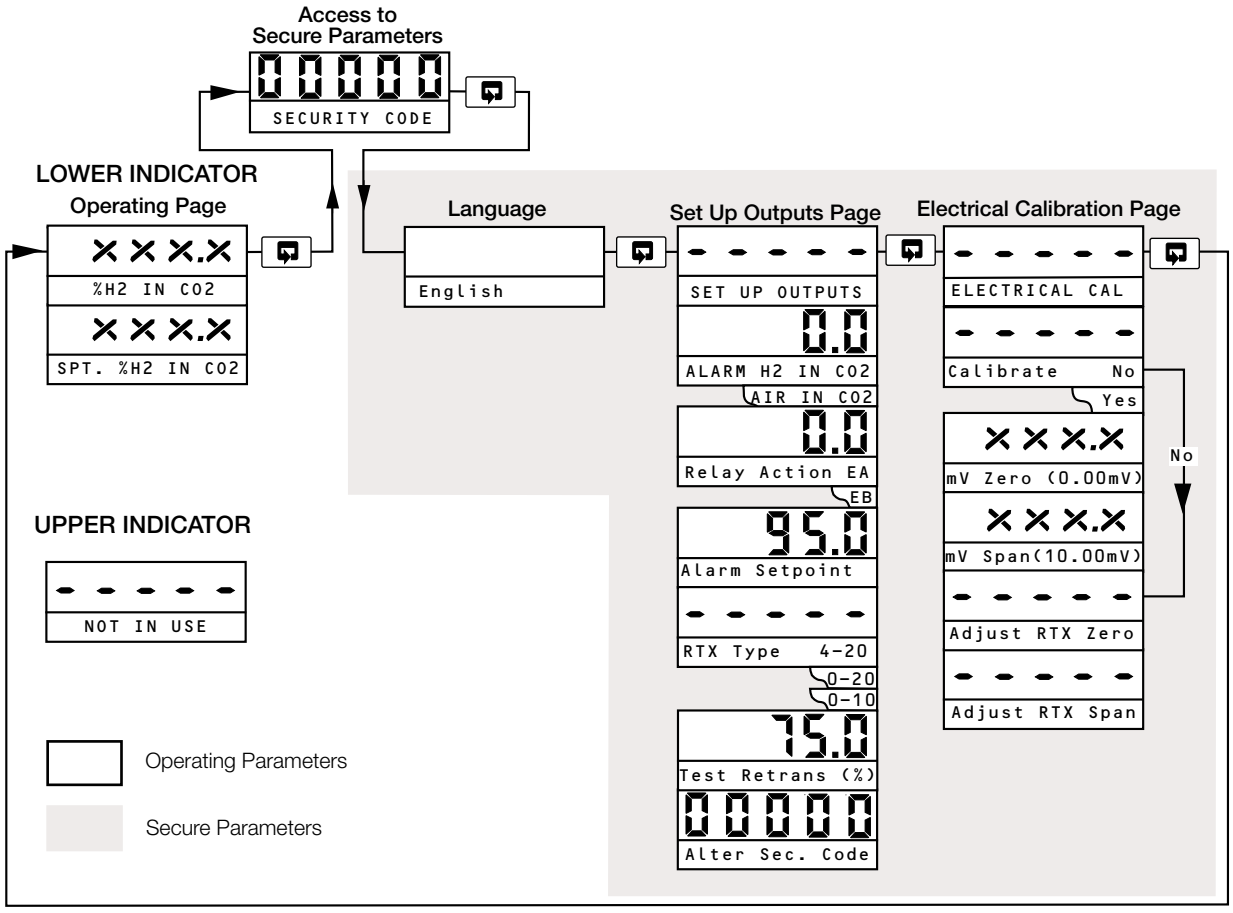


Fig. 10.2 Overall Programming Chart for Display 4689 500

LOWER DISPLAY
(RANGE 3)

Note. All parameter values shown on the upper display line are the default settings.

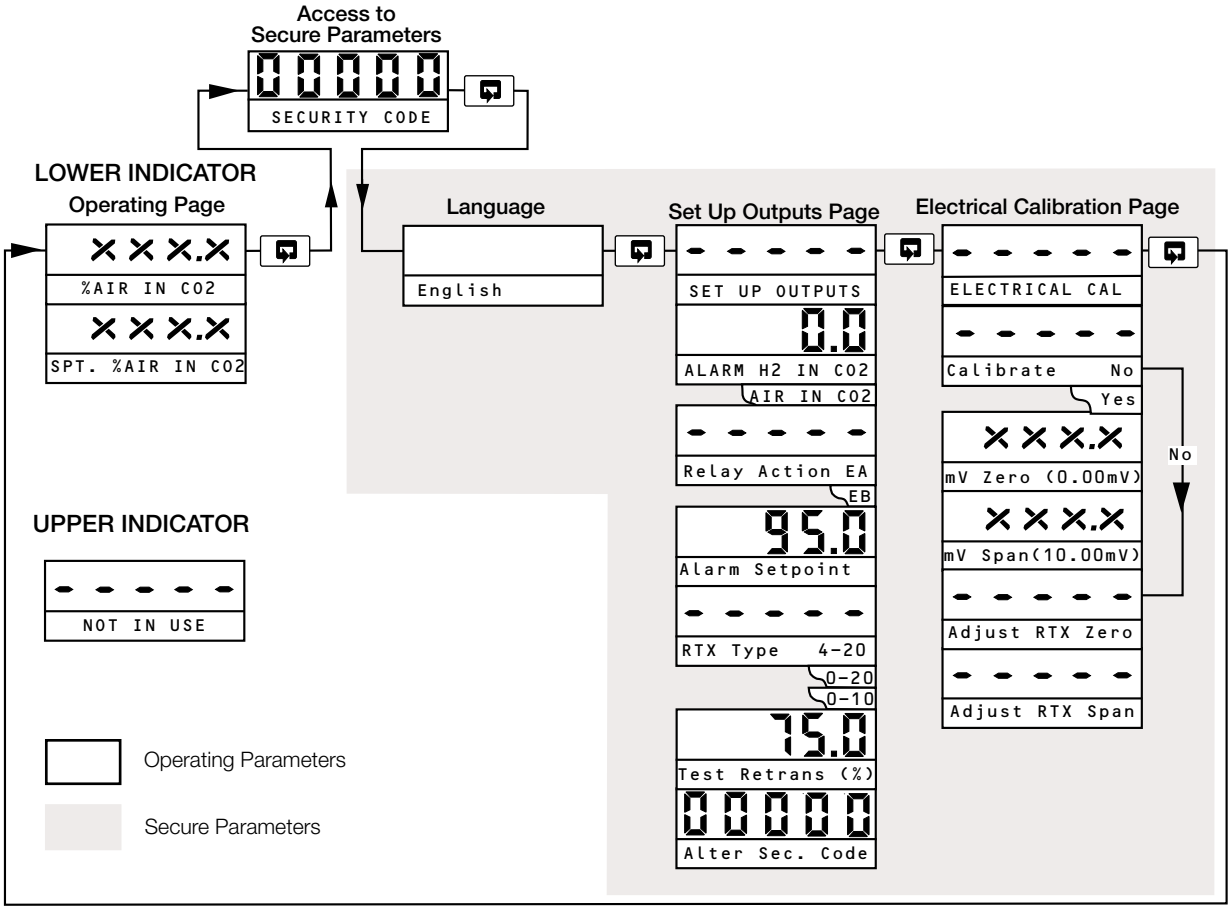
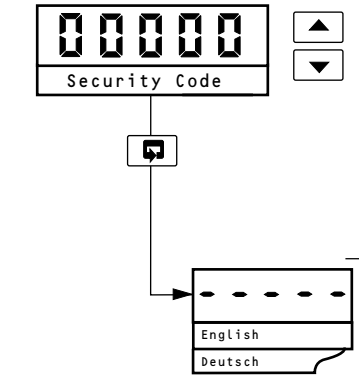


FIG. 10.3 Overall Programming Chart for Display 4689 500

10.1 Range 1

10.1.1 Access to Secure Parameters

A 5-digit code is used to control access to secure parameters.

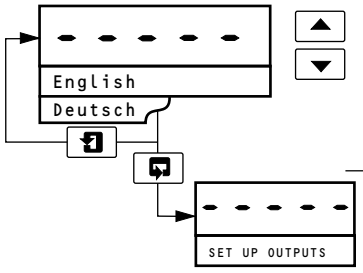


Security Code
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the Operating page.

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 Access Page.

Advance to **Language Selection**.

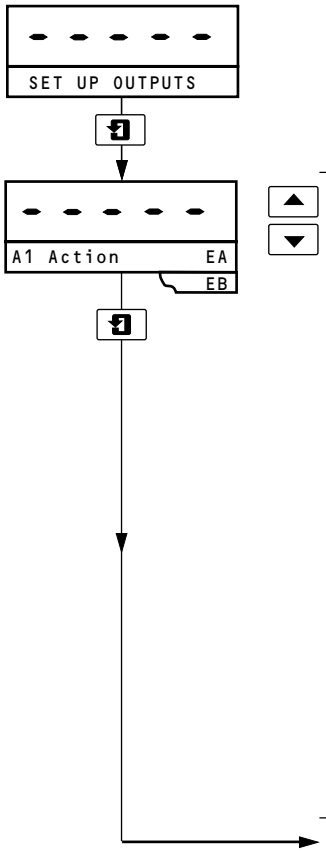
10.1.2 Language Selection



Set the language required. Subsequent displays change to the language selected.

Advance to Set up Outputs Page.

10.1.3 Set Up Outputs Page



Page Header – SET UP OUTPUTS

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 **E**nergized **B**elow the alarm set point (**EB**).

For low alarm operation the relay must be **E**nergized **A**bove the alarm set point (**EA**).

The alarm l.e.d.s 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

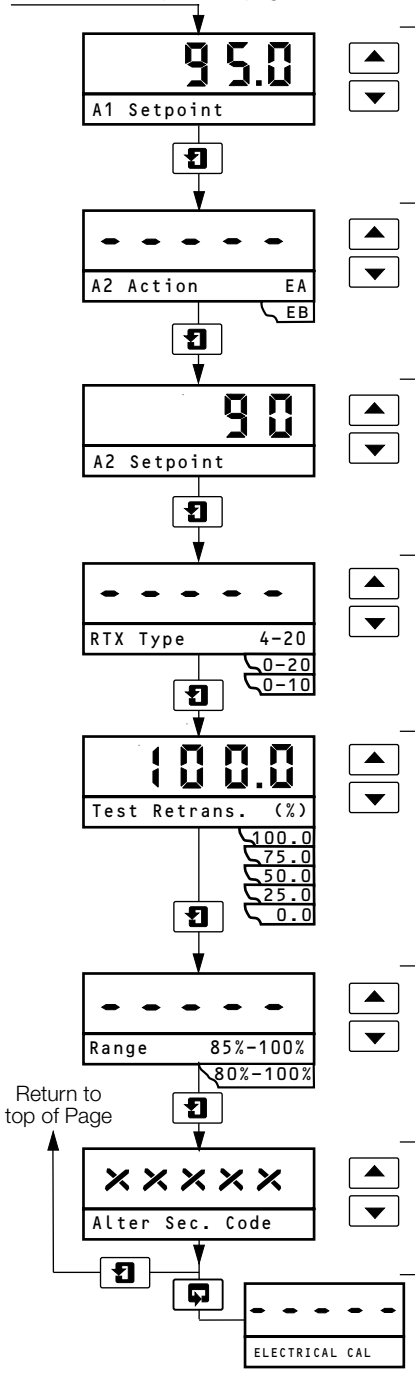
The set point band is defined as the actual value of the set point plus or minus 1% of the set point value. Alarm action occurs if the input value is above or below the set point band. If the input moves within the set point band the last alarm action is maintained.

Continued on next page…

UPPER DISPLAY

...10.1.1 Access to Secure Parameters

Continued from previous page



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.

Alarm 2 Action
Repeat as for Alarm 1 Action above.

Alarm 2 Set Point
Repeat as for Alarm 1 Set Point above.
The decimal point position is set automatically. The alarm LEDs are illuminated in the alarm condition.

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

Test Retransmission Output
The instrument automatically 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.

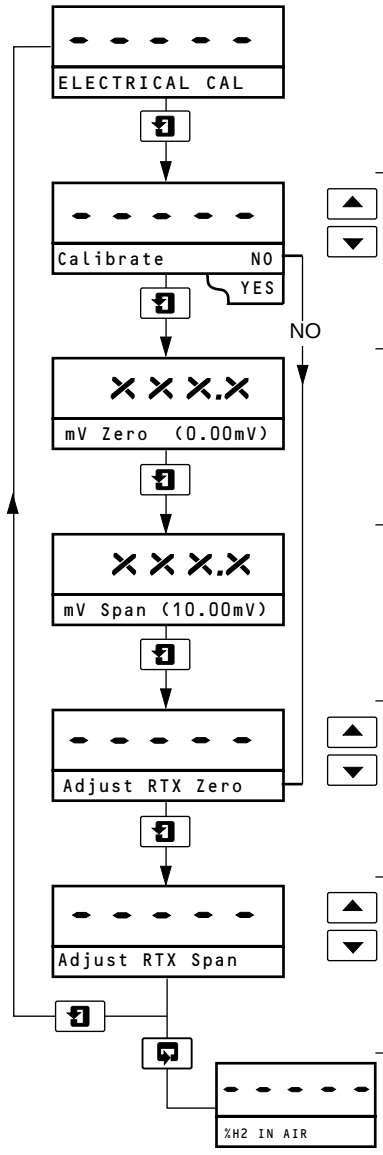
Example – for the range of 0 to 20 mA and 50% retransmission test signal, 10 mA is transmitted.

Select the required retransmission test signal.
Ranges: 4689 500/501 100–85% and 100–80%
4689 500/503 85–100% and 80–100%

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

Advance to **Electrical Calibration Page**.

10.1.4 Electrical Calibration Page



Page Header ELECTRICAL CAL

Note. The 4600 Series instruments incorporate a two point electrical calibration sequence requiring both zero and span inputs for a calibration. It is not possible to adjust either the zero or the span scale points independently.

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

Calibration Range Zero %H2 IN AIR
Proceed as described in Section 8.3, but apply a signal input equivalent to %H2 IN AIR range zero (0.00 mV) – see table below. Allow the instrument display to stabilize.

Calibration Range Span %H2 IN AIR
Apply a signal input equivalent to %H2 IN AIR range span (10.0 mV) – see table below. Allow the instrument display to stabilize.

Adjust Retransmission Zero
Set the milliammeter reading to 4 mA.

Note. 4 mA is retransmitted as 'zero' and is not affected by the retransmission type selected in Section 10.1.3.

Adjust Retransmission Span
Set the milliammeter reading to 20 mA.

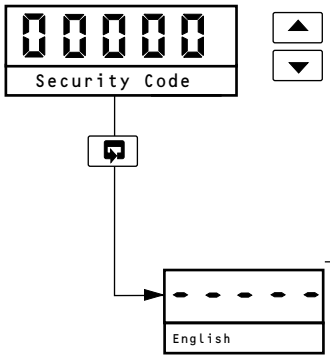
Note. 20 mA is retransmitted as 'span' and is not affected by the retransmission type selected in Section 10.1.3.

Return to **Operating Page**.

10.2 Range 2

10.2.1 Access to Secure Parameters

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

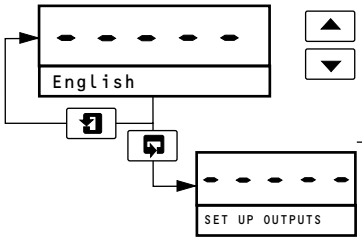


Security Code
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the Operating page.

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 Section 10.2.3 **Set Up Outputs Page**.

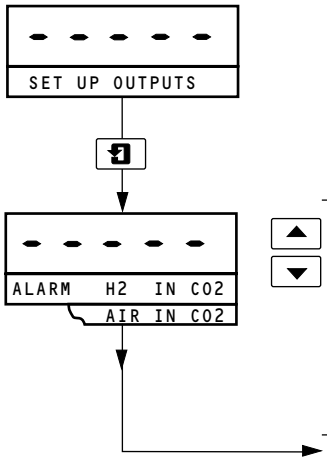
Advance to **Language Page**.

10.2.2 Language Page



Advance to **Set Up Outputs Page**.

10.2.3 Set Up Outputs Page



Page Header – SET UP OUTPUTS

Advance to next parameter.

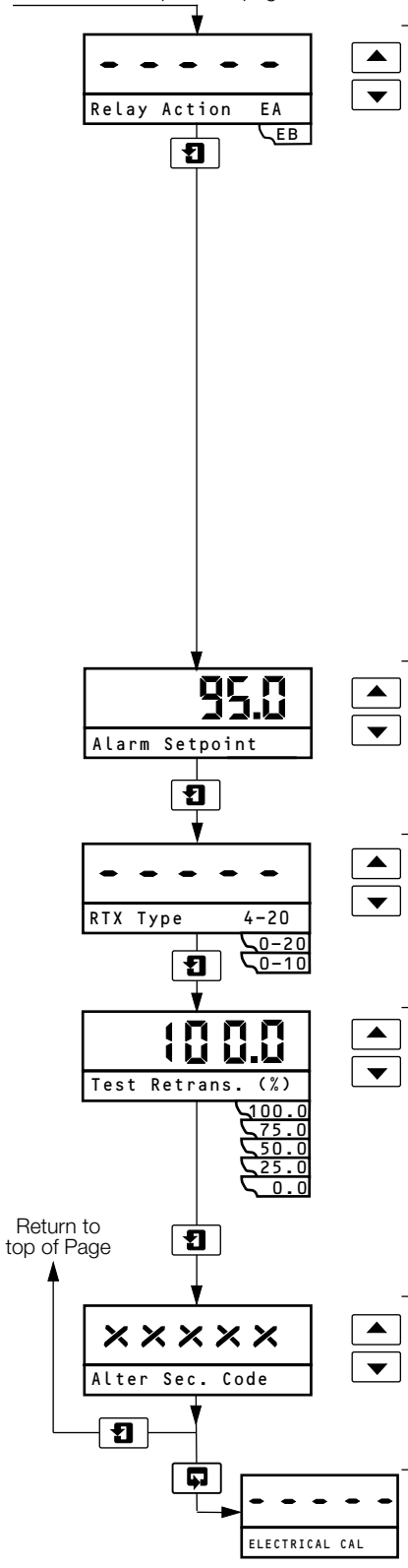
Purge Gas Alarm Select
Select the parameter on which the purge gas alarm is to operate.

Reprogram as required to agree with selected range:
i.e. for Range 2 select %H2 IN CO2
Range 3 select %AIR IN CO2.

Continued on next page…

...10.2.3 Set Up Outputs Page

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 **E**nergized **B**elow the alarm set point (**EB**).

For low alarm operation the relay must be **E**nergized **A**bove the alarm set point (**EA**).

The alarm l.e.d.s 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 plus or minus 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.

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

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

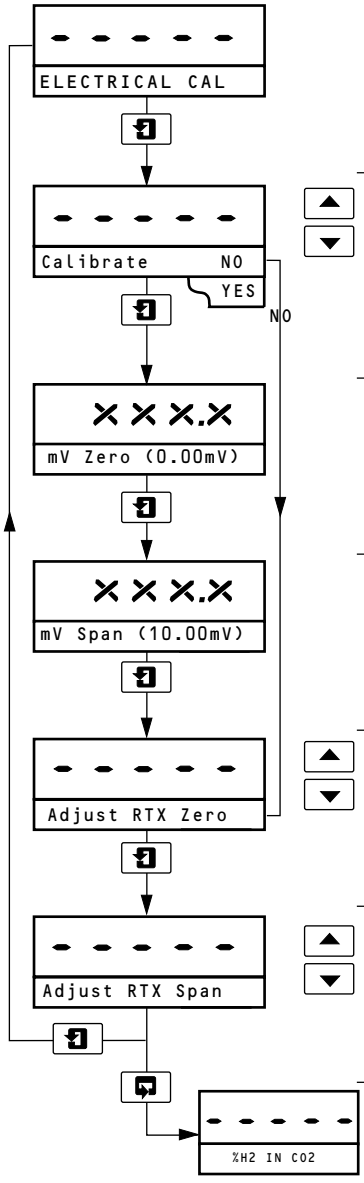
Example – for a selected range of 0 to 20 mA and 50% retransmission test signal, 10 mA is transmitted.

Select the required retransmission test signal.

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

Advance to **Electrical Calibration Page**.

10.2.4 Electrical calibration page



Page Header – ELECTRICAL CAL

Note. The 4600 Series instruments incorporate a two point electrical calibration sequence requiring both zero and span inputs for a calibration. It is not possible to adjust either the zero or the span scale points independently.

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

Advance to next parameter.

Calibration Range Zero %H2 IN CO2
Proceed as described in Section 8.3, but apply a signal input equivalent to %H2 IN AIR range zero (0.00 mV) – see table below. Allow the instrument display to stabilize.

Advance to next parameter.

Calibration Range Span %H2 IN CO2
Apply a signal input equivalent to %H2 IN CO2 range span (10.0 mV) – see table below. Allow the instrument display to stabilize.

Advance to next parameter.

Adjust Retransmission Zero
Set the milliammeter reading to 4 mA.

Note. 4 mA is retransmitted as 'zero' and is not affected by the retransmission type selected in Section 10.1.3.

Adjust Retransmission Span
Set the milliammeter reading to 20 mA.

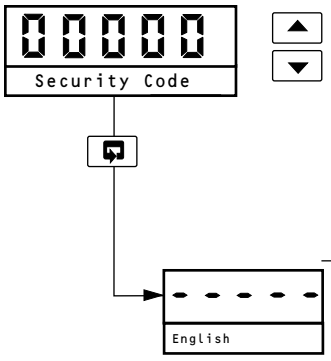
Note. 20 mA is retransmitted as 'span' and is not affected by the retransmission type selected in Section 10.1.3.

Return to **Operating Page**.

10.3 Range 3

10.3.1 Access to Secure Parameters

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

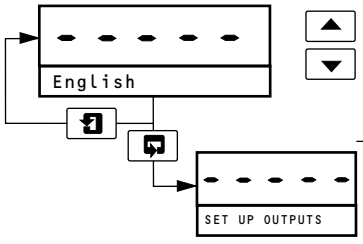


Security Code
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the Operating page.

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 Section 10.3.3 Set Up **Outputs Page**.

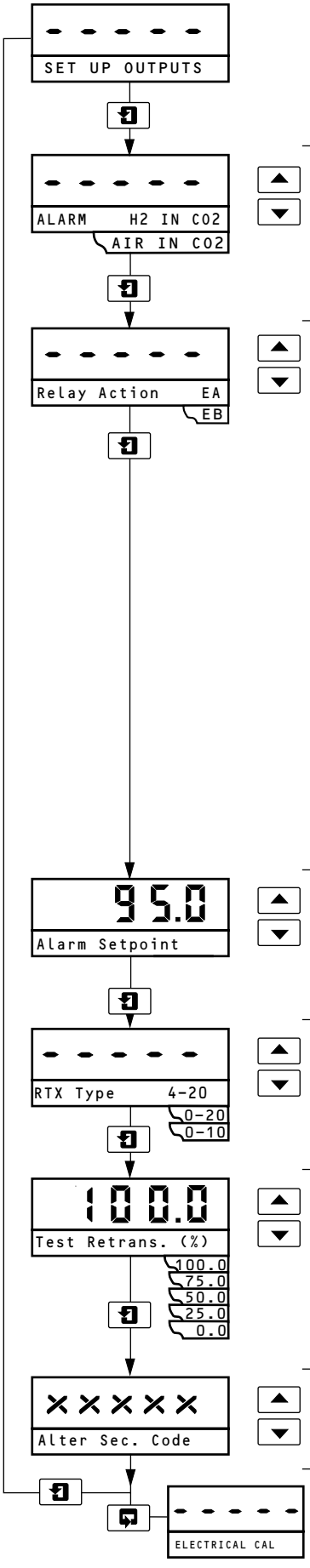
Advance to **Language Page**.

10.3.2 Language Page



Advance to **Set Up Outputs Page**.

10.3.3 Set Up Outputs Page



Page Header – 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:
i.e. for Range 2 select H2 IN CO2
Range 3 select AIR IN CO2.

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 l.e.d.s 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 plus or minus 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.

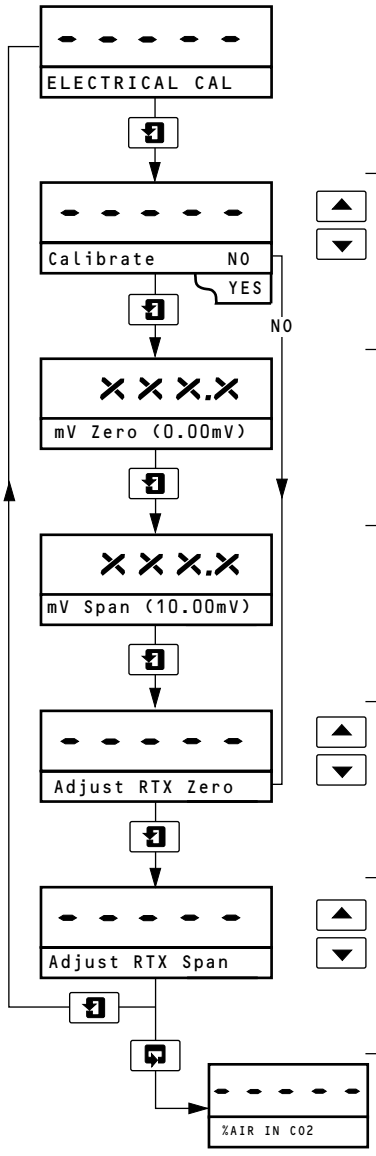
Retransmission Output Type
The retransmission output is assigned to the purge gas concentration.
Select the retransmission output current range required (4 to 20 mA, 0 to 20 mA or 0 to 10 mA).

Test Retransmission Output
The instrument automatically transmits a test signal of 0, 25, 50, 75 or 100% of the retransmission range selected above. The % test signal selected is shown on the upper display.
Example – for a selected range of 0 to 20 mA and 50% retransmission test signal, 10 mA is transmitted.
Select the required retransmission test signal.

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

Advance to **Electrical Calibration Page**.

10.3.4 Electrical Calibration Page



Page Header ELECTRICAL CAL

Note. The 4600 Series instruments incorporate a two point electrical calibration sequence requiring both zero and span inputs for a calibration. It is not possible to adjust either the zero or the span scale points independently.

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

Advance to next parameter.

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

Advance to next parameter.

Calibration Range Span %AIR IN CO2
Apply a signal input equivalent to %AIR IN CO2 range span (10.0 mV) – see table below. Allow the instrument display to stabilize.

Advance to next parameter.

Adjust Retransmission Zero
Set the milliammeter reading to 4 mA.

Note. 4 mA is retransmitted as 'zero' and is not affected by the retransmission type selected in Section 10.1.3.

Adjust Retransmission Span
Set the milliammeter reading to 20 mA.

Note. 20 mA is retransmitted as 'span' and is not affected by the retransmission type selected in Section 10.1.3.

Return to **Operating Page**.

Calibration Message	Explanation	Action
Calibrating...	Calibration of new calibration coefficients	None
Calibration Pass	The new calibration coefficients are used	None
H2-AIR Cal Fail	The new calibration coefficients are ignored and the last known good calibration coefficients are used.	Repeat procedure with a calibrated mV source. If the problem persists, contact the Company

Table 10.1 Calibration Messages for Section 10.1.4 Upper Display Unit

Calibration Message	Explanation	Action
Calibrating...	Calibration of new calibration coefficients	None
Calibration Pass	The new calibration coefficients are used	None
H2-CO2 Cal Fail AIRCO2 Cal Fail	The new calibration coefficients are ignored and the last known good calibration coefficients are used	Repeat procedure with a calibrated mV source. If the problem persists, contact the Company

Table 10.2 Calibration Messages for Sections 10.2.4 and 10.3.4 Lower Display Unit

11 MAINTENANCE

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 on a.c. mains supply voltage electricity. Suitable precautions must be taken to avoid the possibility of electric shock.
- The maximum pressure and temperature specified for particular parts of the system must not be exceeded.

The katharometer unit and its associated equipment are designed for stable and accurate operation over long periods.

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

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 given in 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 significantly affected 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 350 mA supplied from the PSU. This value must remain stable during normal operation as the katharometer output signal is approximately 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 given in Section 6.3.1.

11.2.2 Checking Integrity of Zener Diode Safety Barrier Devices
Carry out the test procedure given in Section 6.3.2.

11.2.3 Checking the Katharometer Output
a) Electrically isolate the monitor 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 4 V with 350 mA 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 2.8 V with 350 mA 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.

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.

This task 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.

This task 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 analyser panel depends on the condition of the sample gas.

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

As the desiccant degrades, the white grains can be seen to 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 will apply to the operation of the gas cooling and sample systems.

a) 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.

b) Carry out the procedure given in Section 6.1.

c) 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 task should be undertaken on the basis of instrument response or at intervals of 1 year.

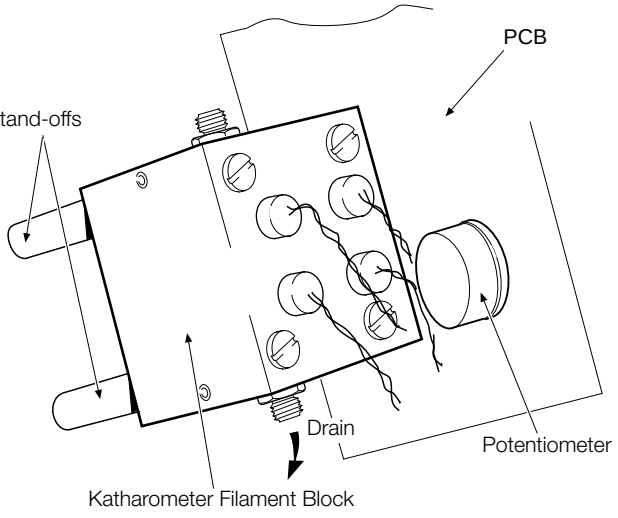


Fig. 11.1 Removing Liquid from the Katharometer Block

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, it may be removed using the following procedure:

a) Electrically isolate the defective katharometer at its PSU.

b) 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.

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

c) Remove the cover of the katharometer unit and dismantle the internal sample system pipework.

d) Remove the fixing screws which secure the mounting pillars to the case. See Fig. 5.2.

e) Disconnect the interconnecting wiring at terminal block TB1.

Caution. 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.

f) 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.

g) 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.

h) 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.

i) Fit the internal sample gas tubing.

j) Remake the sample gas tube interconnection couplings.

k) Replace the desiccant in the drying chamber in accordance with the procedure given in Section 11.3.3.

l) Carry out a leak test in accordance with the requirements of the responsible authority.

m) Power up the katharometer unit by switching on the appropriate PSU.

n) Arrange to pass dry air or another suitable dry gas through the katharometer at the normal sample flowrate for 24 hours.

o) Isolate the katharometer unit at its PSU.

p) Make the remaining electrical connections at TB1 of the katharometer unit – see Fig. 5.3.

q) Replace the cover of the katharometer unit.

r) Power up the katharometer unit from its PSU.

s) Carry out a calibration procedure in accordance with Section 8.3.

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

This task should be undertaken as required.

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.

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 monitor unit and carry out a calibration in accordance with Section 8.3.

This task should be undertaken as required.

11.4.3 Error Messages

Table 11.1 shows error message(s) which may occur, explanation(s) and corrective action(s).

Error Message	Explanation
NV Memory Error	The contents of the non-volatile memory has not been read correctly during power up. *

* To rectify fault, switch OFF, wait 10 seconds and switch ON again. If the fault persists, contact the Company.

Table 11.1 Error Messages

12 SPARE PARTS LIST

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, spare parts or incorrect assembly may render any unit unfit for use within a hazardous area.

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 or 4689 503) as shown in Fig. 3.1.

When ordering a 6539 960 or 6548 001 katharometer unit, it is necessary to specify the zero gas in association with the Company part number. See the typical identification label shown in Fig. 3.2.

12.1 Consumables

Description	Part No.
Model 006548 000 & 006548 203 Katharometer Analyser Panels	
Granular anhydrous Ca Cl_2	Locally sourced

12.2 Routine Maintenance Parts

Description		Part No.
Model 6553 Gas Monitor Unit		
Fuse, 500 mA a/s 20 x 5 mm glass cart.		0231 538
Function selector switch, 3 position, 2 wafer		0234 724
Potentiometer (1 kΩ), zero adjustment		002569 036
Katharometer Analyser 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 230 V unit		4234 500
Nominal 115 V unit		4234 501
Fuses		
F2/F3 – 250 mA/≥1500A h.b.c. cartridge		0231577
F1 – 400 mA cartridge		0231555
Katharometer Analyser Panel	**006540 203**	**006548 000**
Flowmeter	006525 460	0216 485
Valve, metering	006525 480	0216 484
Coupling seal ring	006525 130	
Katharometer unit (H_2)	006539 960K (or J)	006548 001
Katharometer unit (CO_2)	006539 960	
Model 6553 Gas Monitor Unit		
Display unit 100%–80/85% H_2 in Air		4689 501
Display unit 80/85%–100% H_2 in Air		4689 503
Display unit 0%–100% H_2 /Air in CO_2		4689 500
Zener diode safety barrier devices		0248 297

13 SPECIFICATION

(a) Model 6553 Gas Monitor Unit

Available Ranges:	(a) 100 to 80% or 100 to 85% H_2 in air or 80 to 100% or 85 to 100% H_2 in air (b) 0 to 100% hydrogen in carbon dioxide (c) 0 to 100% air in carbon dioxide
Digital Display Units:	
%H_2 in Air:	4689 501 or 4689 503
%H_2 in CO_2 / %Air in CO_2:	4689 500
Range Selector Switch Position:	(1) Percentage by volume, hydrogen in air – Upper Display (2) Percentage by volume, hydrogen in carbon dioxide – Lower Display (3) Percentage by volume, air in carbon dioxide – Lower Display
Accuracy (display units):	±0.25% of scale span
Ambient Temperature Range:	0 to 40°C
Power Supply :	115 V ac or 230 V ac, 50/60 Hz
Power Consumption :	30 VA approximately
Outline Dimensions:	290 x 362 x 272 mm
Weight :	12 kg approximately
Environment :	Sheltered interior, 0 to 90% RH

(b) Model 006540 203 & 006548 000 Katharometer Analyser Panels

Electrical Input:	350 mA d.c., from 4234 PSU
Signal Output:	0 to 10 mV for H_2 in air (85% to 100% H_2 in air)
Accuracy:	±2% fsd each range
Dead Time:	Typically 5 seconds
Response Time:	Typically 40 s for 90% step change at katharometer. Tubing and drying chamber introduce extra delays.
Ambient Temperature:	Maximum of 55°C
Sample Connections:	Compression couplings, 6540 203 8 mm outside diameter tube. 6548 000 6 mm outside diameter tube.
Sample Pressure:	
006540 203	Minimum, 125 mm H_2O Maximum, 0.35 bar (G)
006548 000	Minimum, 125 mm H_2O Maximum, 10 bar (G) static
Sample Temperature:	55°C maximum
Normal Sample Flowrate:	100 to 150 ml min^{-1}
Maximum Gas Flowrate:	250 ml min^{-1}
Minimum Gas Flowrate:	50 ml min^{-1}
Outline Dimensions:	610 x 305 x 152 mm
Weight:	8.6 kg approximately.
Environment:	Sheltered interior

(c) Model 6548 000 Katharometer Analyser Panel
Incorporating Model 6548 001 (H2 and CO2) Katharometer Unit

Power Supply:	350 mA d.c., from 4234 PSU
Signal Output:	0 to 10 mV for each range
Accuracy:	±2% of scale span, each range
Dead Time:	Typically 5 seconds
Response Time:	Typically 40 s for 90% step change at katharometer. Tubing and drying chamber introduce extra delays.
Ambient Temperature:	Maximum of 50°C
Sample Connections:	Compression couplings, 6 mm tube
Sample Pressure:	Minimum, 125 mm H_2O Maximum, 10 bar (g)
Normal Sample Flowrate:	100 to 150 ml min^{-1}
Maximum Gas Flowrate:	250 ml min^{-1}
Minimum Gas Flowrate:	50 ml min^{-1}
Outline Dimensions:	610 x 305 x 152 mm
Weight:	8.6 kg approximately
Environment:	Sheltered interior

d) Power Supply Unit

Model 4234 500 input:	230 V a.c., 50/60 Hz
Model 4234 501 input:	115 V a.c., 50/60 Hz
Fuse Ratings:	250 mA, high breaking capacity ≥1500 A, ceramic, 2 off 400 mA (F), 1 off
dc Output:	stabilized; 350 mA
Load Conditions:	0 to 14 Ω
Ambient Temperature Range:	– 20 to +55°C
Supply Variations:	±6% (V) ±4% (Hz)
Regulation:	Within ±0.8% for: (i) Load var. of ±15% (ii) Supply var. of ±6% (iii)Ambient temp. var. of ±10°C
Ripple:	Less than 17.5 mV across 10 Ω peak to peak
Stability:	Within ±0.7% of initial setting, over period of one month with load resistance, supply voltage and ambient temperature at nominal stated values
Outline Dimensions:	170 mm (L) x 111 mm (H) x 160 mm (W)
Weight:	2.1 kg approximately
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 improvement and the right is reserved to modify the information contained herein without notice.

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