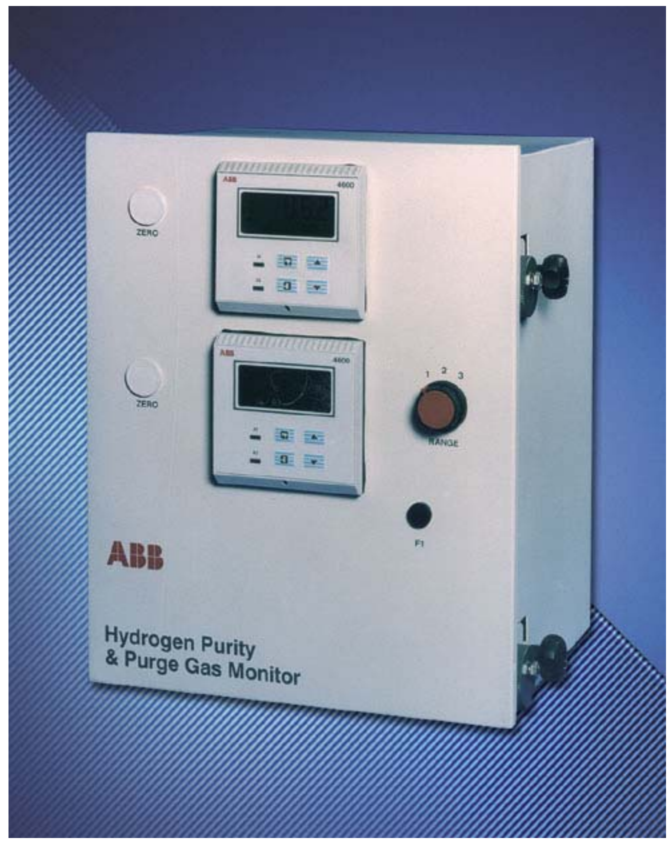
User Guide

IM/6553502–2_6

Gas Analyzer Systems for Intrinsically Safe Hydrogen & Purge Gas Purity Measurement

6553



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. Q05907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.

0255

Electrical Safety

This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use'. If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

Symbols

One or more of the following symbols may appear on the equipment 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

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 BASEEFA certificates listed. The separate units to which these certificates apply are clearly identifiable by model numbers and the data on the identification and BASEEFA certification labels fixed to them. Other combinations of similar equipment built to any earlier specifications are not covered by certificate number EX 77138. 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 Analyzer Systems, normally used with hydrogen cooled electrical power generators.

The complete 6553 analyzer system uses a combination of three different units. Each unit is independently certified by BASEEFA (EECS) for use as part of an intrinsically safe system to the standards of SFA.3012:1972 for use in association with Group IIC (hydrogen) hazardous atmospheres. 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 Ex (ia) IIC under BASEEFA certificate Ex 77124/B/S with the unit installed in the **safe** area only.

2) The Model 6548-001 Katharometer Unit which forms part of an intrinsically safe Model 6548-000 Katharometer Analyzer Panel. The 6548-001 unit is certified to code Ex (ia) IIC T5 under BASEEFA certificate Ex 76179/B for installation in the **hazardous** area.

3) The Model 4234 constant current Power Supply Unit, which provides a suitable supply for one katharometer unit. These units have their output certified to code Ex (ia) IIC under BASEEFA certificate Ex 76180/B/S for installation in the **safe** area only.

The complete gas monitoring system, if installed in accordance with the certificate schedules and the requirements given in this manual, is itself certified intrinsically safe to an overall code Ex (ia) IIC under the system certificate number Ex 77138.

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 Purge Gas Monitor

The Purge 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 or switches - see Fig. 2.1.

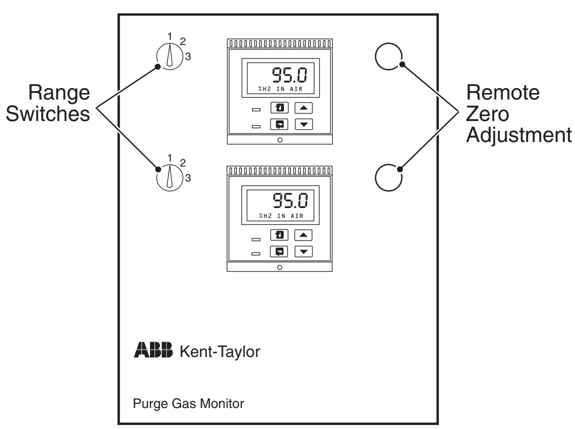


Fig. 2.1 Model 6553 Gas monitor

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.
This is the hydrogen purity measurement of the coolant gas under 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. Alarm output and a value retransmission signal (4 to 20 mA) are provided for this switch position only.

Position (2) Percentage of Hydrogen in Carbon Dioxide by volume.
This range is for use in hydrogen purging operation. Alarm and retransmission signal are inhibited in this switch position.

Position (3) Percentage of Air in Carbon Dioxide by volume.
This range is for use in carbon dioxide purging operation. Alarm and retransmission signal are inhibited in this switch position.

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

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. The relay action of the alarms is 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 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 katharometer 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 6548 000 Katharometer Analyser Panel – Fig. 2.2

Each panel comprises a metering valve, a drying chamber, a thermally lagged katharometer type 6548 001 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.

When the intrinsically safe stabilized current from the power supply unit (Model 4234) 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 4234 Power Supply Unit – Fig. 3.3

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

Caution. Ensure that the power supply unit is correct for the mains supply voltage available. A nominal 110V unit cannot be adapted for use with a nominal 240V supply, or the other way around.

In order to operate a katharometer unit in the hazardous area, one Model 4234 Power Supply Unit is required for each katharometer. The Power Supply Unit supplies a stabilized 350 mA d.c. signal, and must be mounted in the **safe** area. There are two separate versions available for either a nominal 110-120V a.c. or 200-220/240V a.c. supply voltage. The stabilized current output is current and voltage limited to restrict the energy supply into the hazardous area.

The model 4234 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 printed circuit board assembly and diode heat sink are mounted on a metal chassis and separate labelled terminal blocks are used for making electrical interconnections.

The circuit is protected by a cartridge fuse. This fuse must have a high breaking capacity (h.b.c.) rating of 4000A 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.

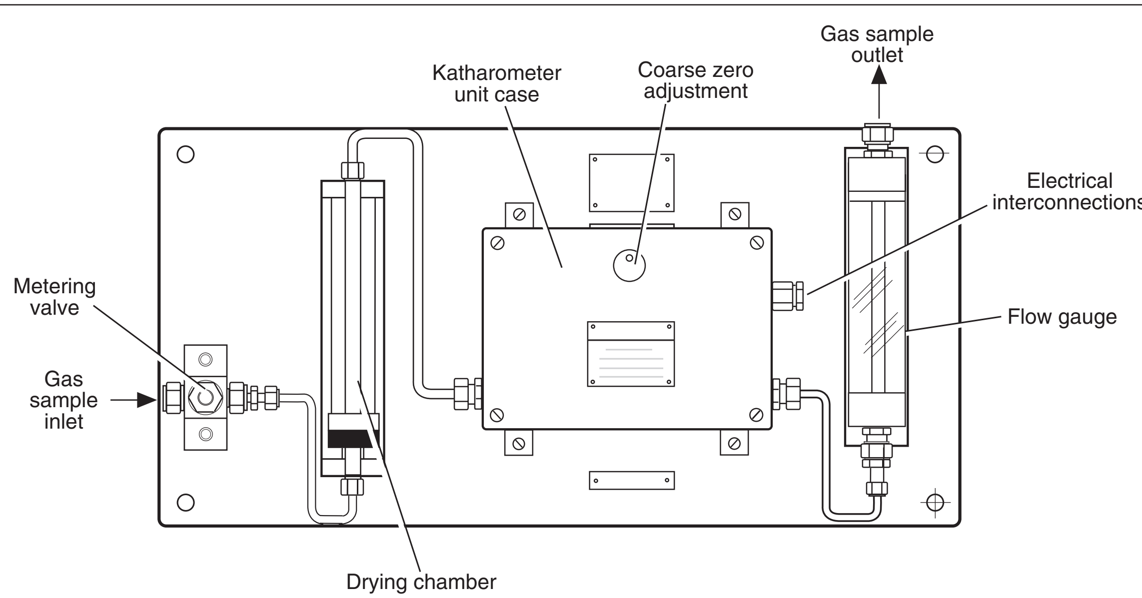


Fig. 2.2 Location of Items – Model 6548 000 Katharometer Analyzer Panel

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 shown in Section 3.1.5.

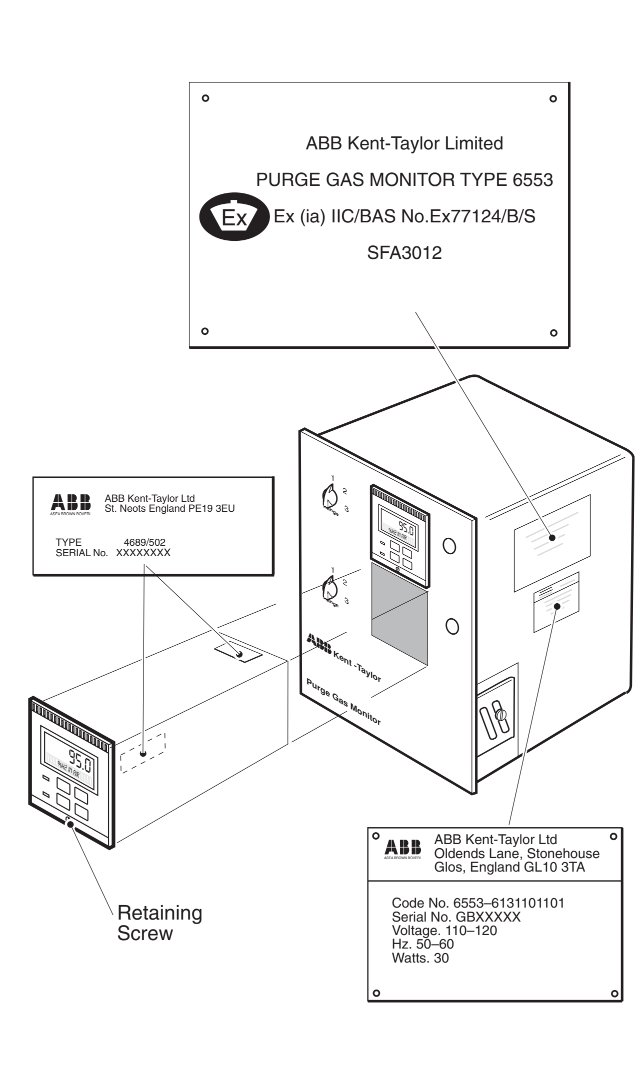


Fig. 3.1 Typical Identification Labels and Locations – Model 6553 Gas Monitor Unit with Digital Displays

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 Model 6548 000 Katharometer Analyser Panel – 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.

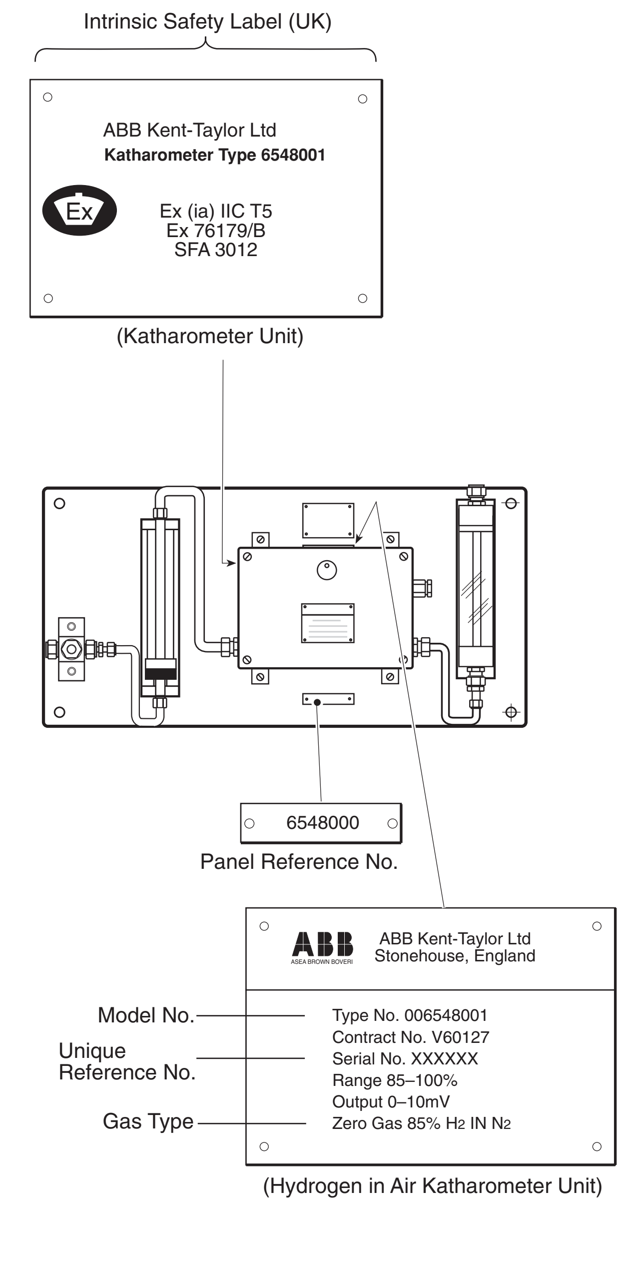


Fig. 3.2 Typical Identification Labels with Locations – Model 6548 000 Katharometer Analyzer Panel

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.

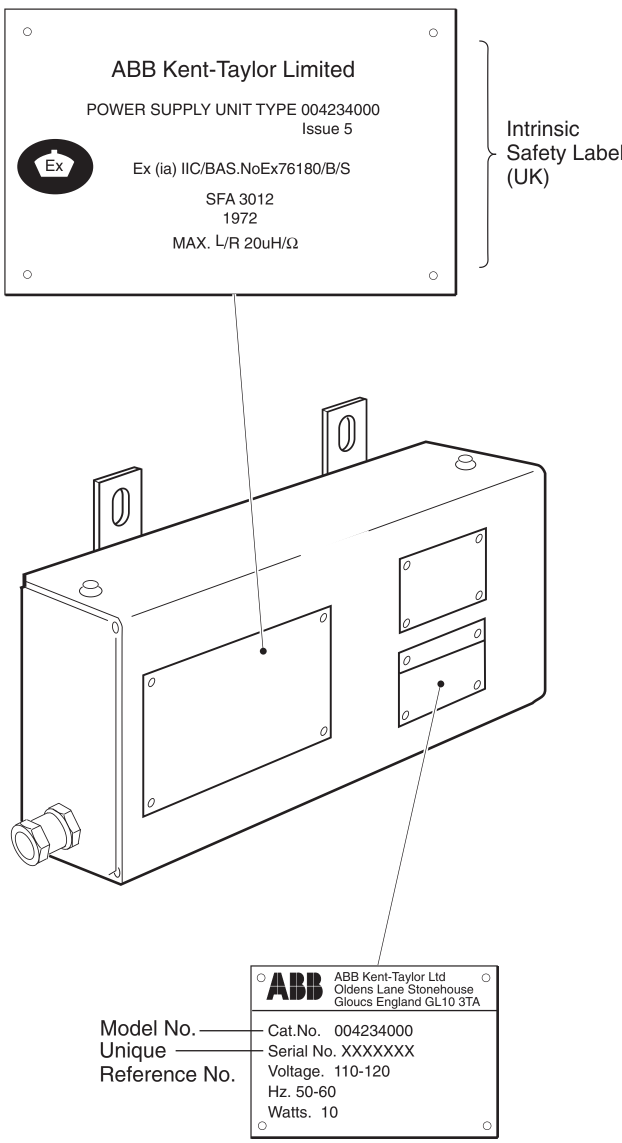


Fig. 3.3 Typical Identification Labels and Locations – Model 4234 Power Supply Unit

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 — A
- Scale of Upper Indicator — B
- Features of Lower Indicator — C
- Scale of Lower Indicator — D
- Range selector Switch — E
- Not used — F
- Fitted with Labels — G
- Cubicle Type — H
- Special Features — J
- Mains Supply — K

The equipment conforms with the requirements of SFA 3012 for class IIC gases to Code Ex (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 gas analysis panels may be mounted close to the sample point in the **hazardous** area.

3.1.5 Ordering Code – 6553 Hydrogen Purity and Purge Gas.

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

B Scale of Upper Indicator
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

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

D Scale of Lower Indicator
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

E Range Selector Switch
0 Not fitted
2 Fitted, with facilities for Remote Indication of Switch Position – upper ind.
3 Fitted with two range switches, upper and lower indicator + remote ind.

F Additional Output Signal – Not Used

G Fitted with Labels
1 English
2 French
3 German

H Type of Cubicle
1 Without Cubicle.
4 Purge Cubicle (D1)(with purity)
5 Purity Cubicle (D2 or D3)(Purity only)

J Special Features
0 None
9 Fitted

K Mains Supply
1 110V, 50/60Hz
2 220V, 50/60Hz
3 240V, 50/60Hz

3.1.6 Option Combinations (6553/[X])

The digit decode is shown in Section 3.1.5.

[X]	Purity only: top ind.	3-Range: top ind. only	Std. purge system	2 x purity display	2 x 3 ranges	Purity top : 3 ranges lower
A	6	6	6	6	6	6
B	1,2,5,6	3,4	1,2,5,6	1,2,5,6	3,4	1,2,5,6
C	0	0	3	3	3	3
D	0	0	1	2,3,6,7	4,5	4,5
E	0	2	2	0	3	3
F	0	0	0	0	0	0
G	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
H	1,5	1,5	1,4	1,5	1,4	1,4
J	0,9	0,9	0,9	0,9	0,9	0,9
K	1,3	1,3	1,3	1,3	1,3	1,3

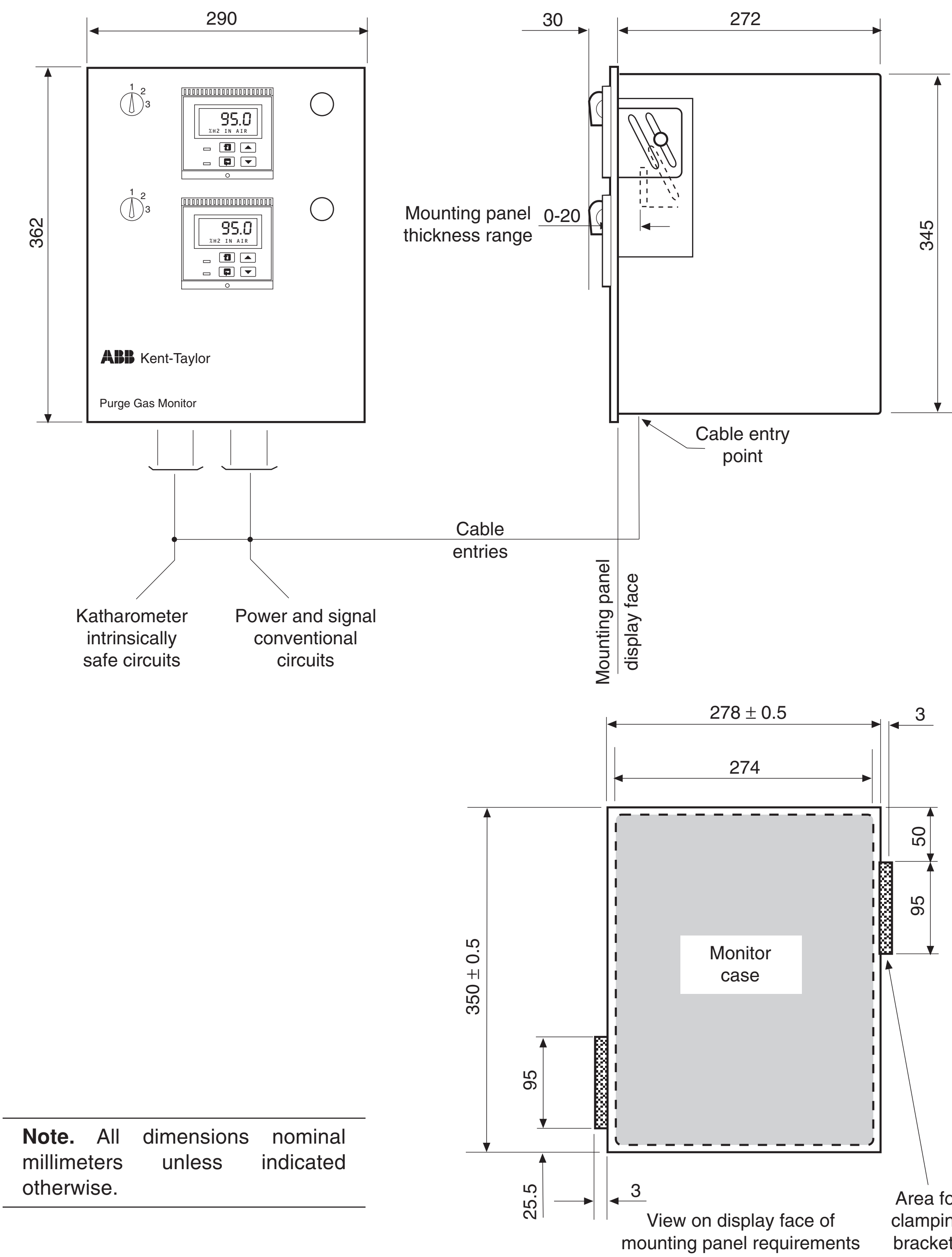
4 MECHANICAL INSTALLATION

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 two clamping brackets at opposite corners of the monitor chassis.



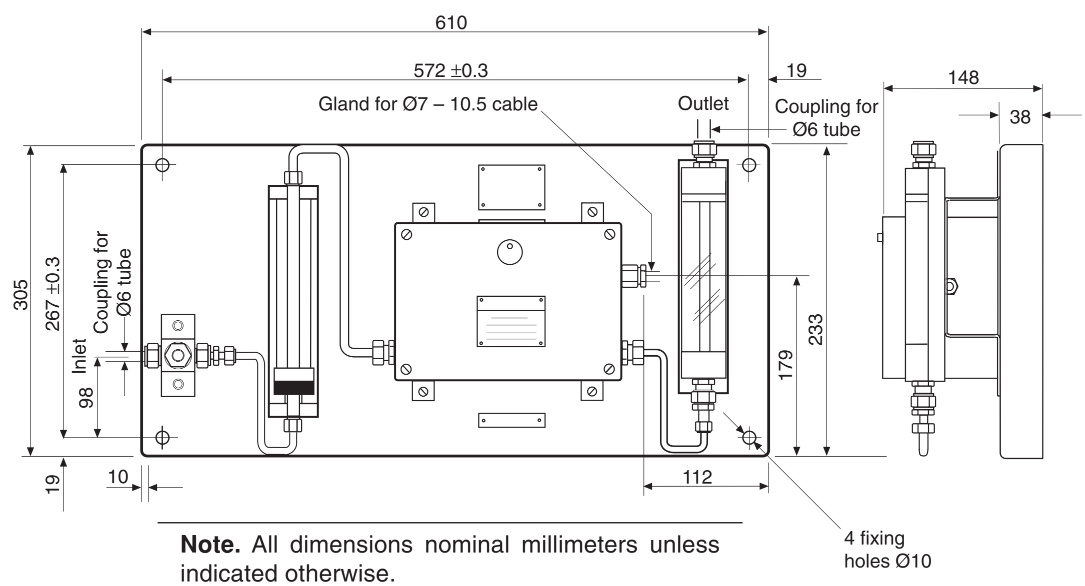
Note. All dimensions nominal millimeters unless indicated otherwise.

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

4.1.2 Katharometer Analyser Panel – Fig. 4.2

Caution. Ensure that the panel is operated at the correct gas pressure.

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.

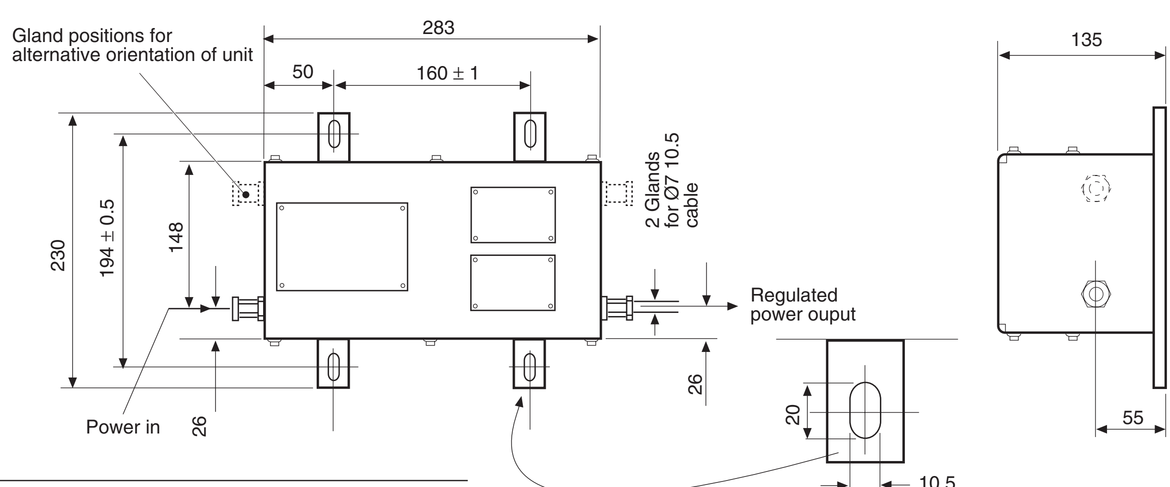


Note. All dimensions nominal millimeters unless indicated otherwise.

Fig. 4.2 Installation Dimension and Interconnection Positions – Model 6548 000 Katharometer Analyzer Panel

4.1.3 Model 4234 Power Supply Unit – Fig. 4.3

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.



Note. All dimensions nominal millimeters unless indicated otherwise.

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

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 analyzer 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.

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 analyzer system.

Compression couplings are supplied at the sample inlet and outlet to the katharometer panel. These couplings are suitable for connecting 8mm 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.

5 ELECTRICAL INSTALLATION

5.1 Electrical Interconnections

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, e.g. a 3A 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.
- The a.c. input and intrinsically safe d.c. output wiring must be routed separately from non-intrinsically safe wiring.

Fig. 5.4 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 analyzer system must be interconnected as follows:

5.1.1 Model 6553 Gas Monitor – Fig. 5.1

Warning. No connections must be made to the hazardous area terminals (Terminal Block 2) 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 cable glands and terminal blocks.

The electrical connections are made through the appropriate cable gland at the bottom of the unit into the terminal block immediately above them. There are separate cable glands for wires to the **hazardous** and **safe** areas – see Fig. 5.1.

The alarm and signal outputs on terminal block 1 (TB 1), between TB1 - 1 and TB1 - 16, 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.

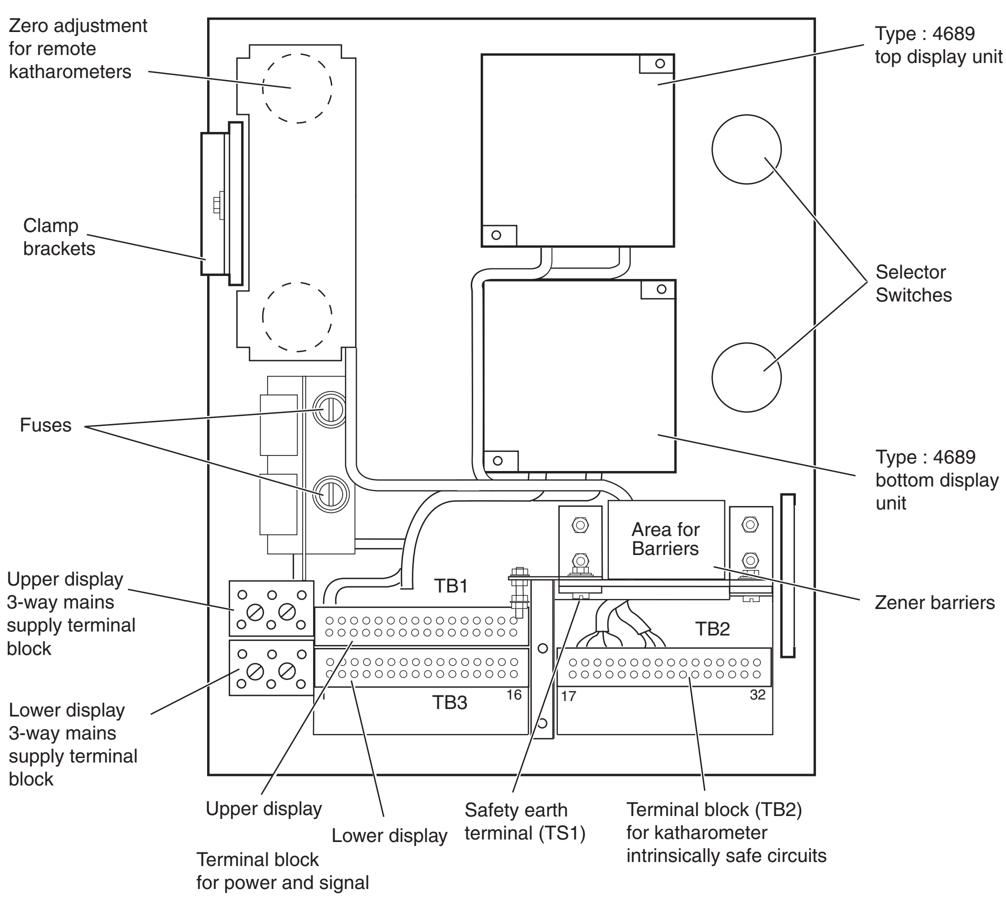


Fig. 5.1 Location of Components Inside Case (Rear View) – Model 6553 Gas Monitor Unit with Digital Displays

Caution. The integrity of the fail-safe operation of the zener barrier units 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. 5.1.

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

5.1.2 Model 6548 000 Katharometer Analyser Panel

Electrical connections are made inside the katharometer unit (6548 001) on the analyzer panel – see Fig. 5.2.

Remove the cover of the katharometer unit to gain access to the terminal block (TB1) inside.

Make the electrical connections to the Gas Monitor in accordance with the information given in wiring diagram Fig. 5.3 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 510R dummy load resistor from across terminals 9 and 10 and set the zero adjustment on the katharometer to the approximate mid-point.

Replace the cover on completion of wiring up.

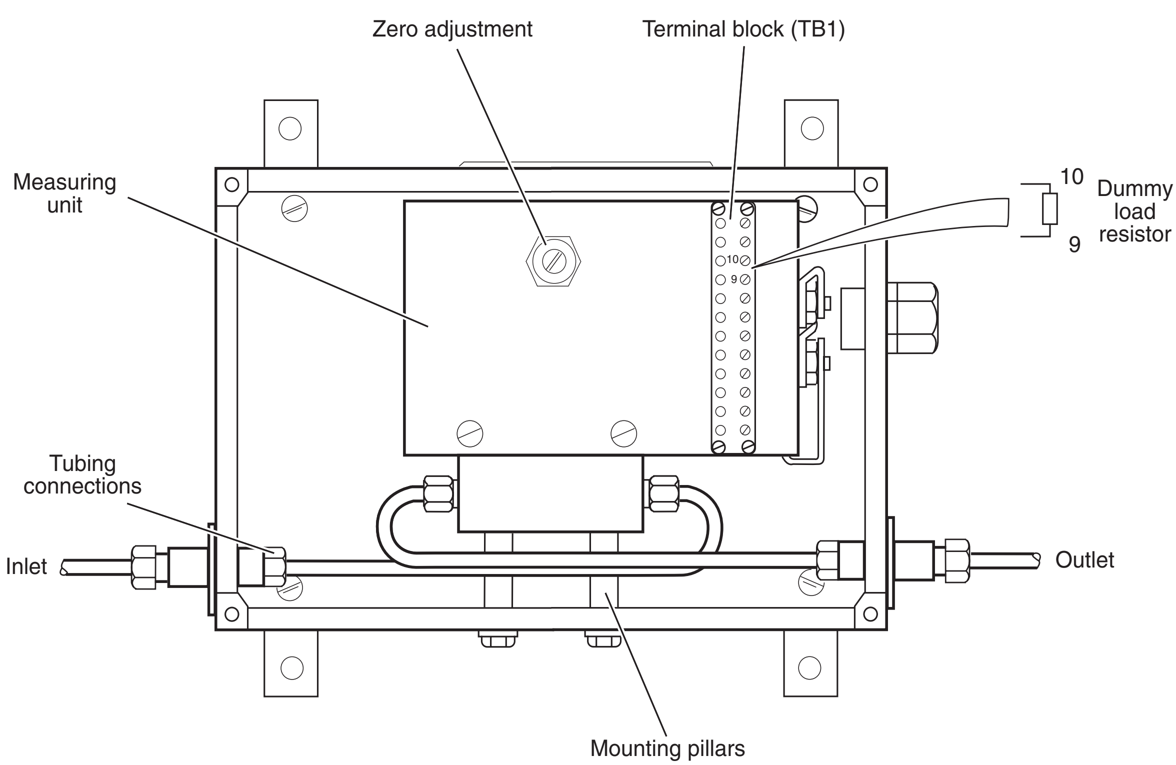
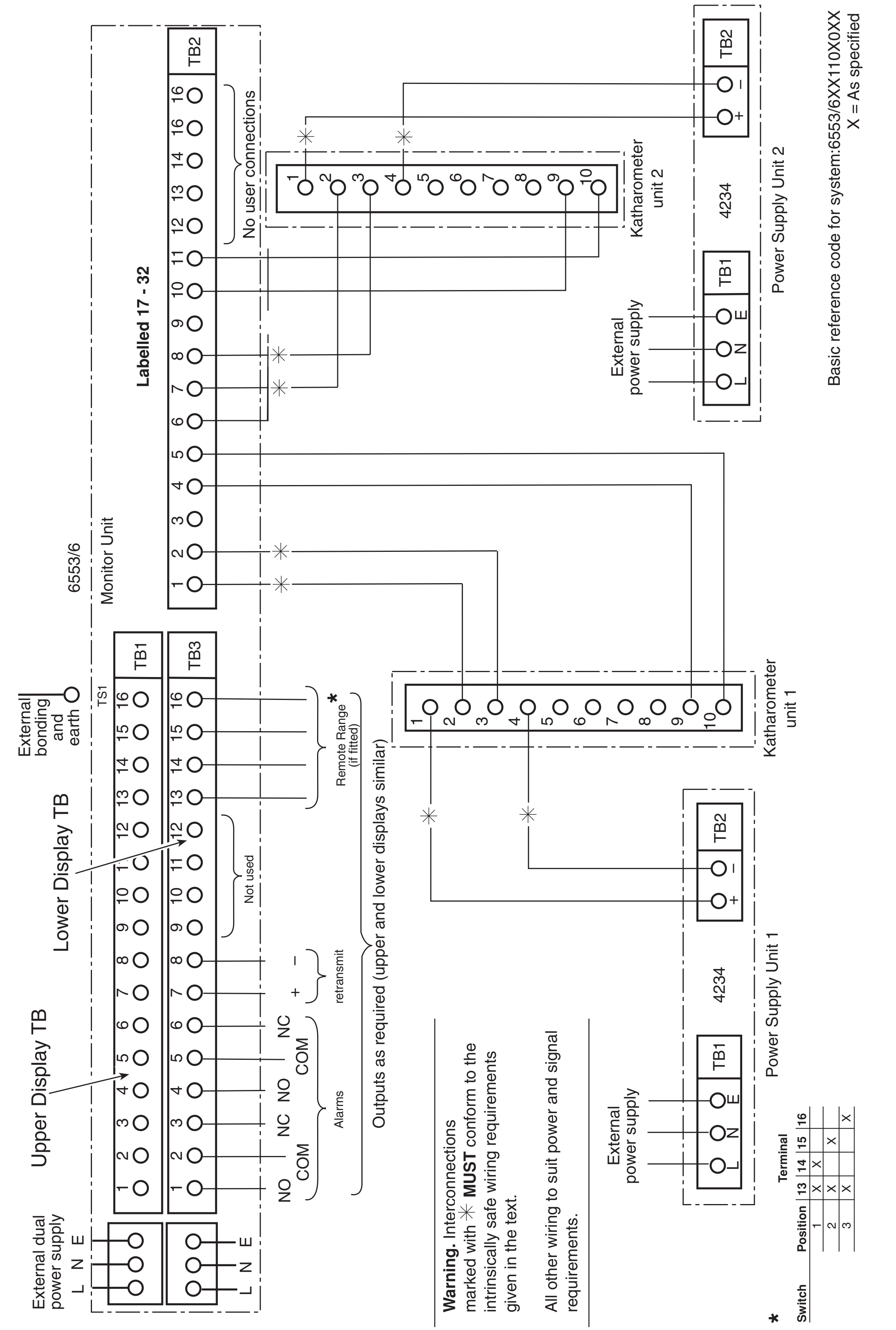


Fig. 5.2 Location of Components Inside Case – Model 6548 001 Katharometer Unit



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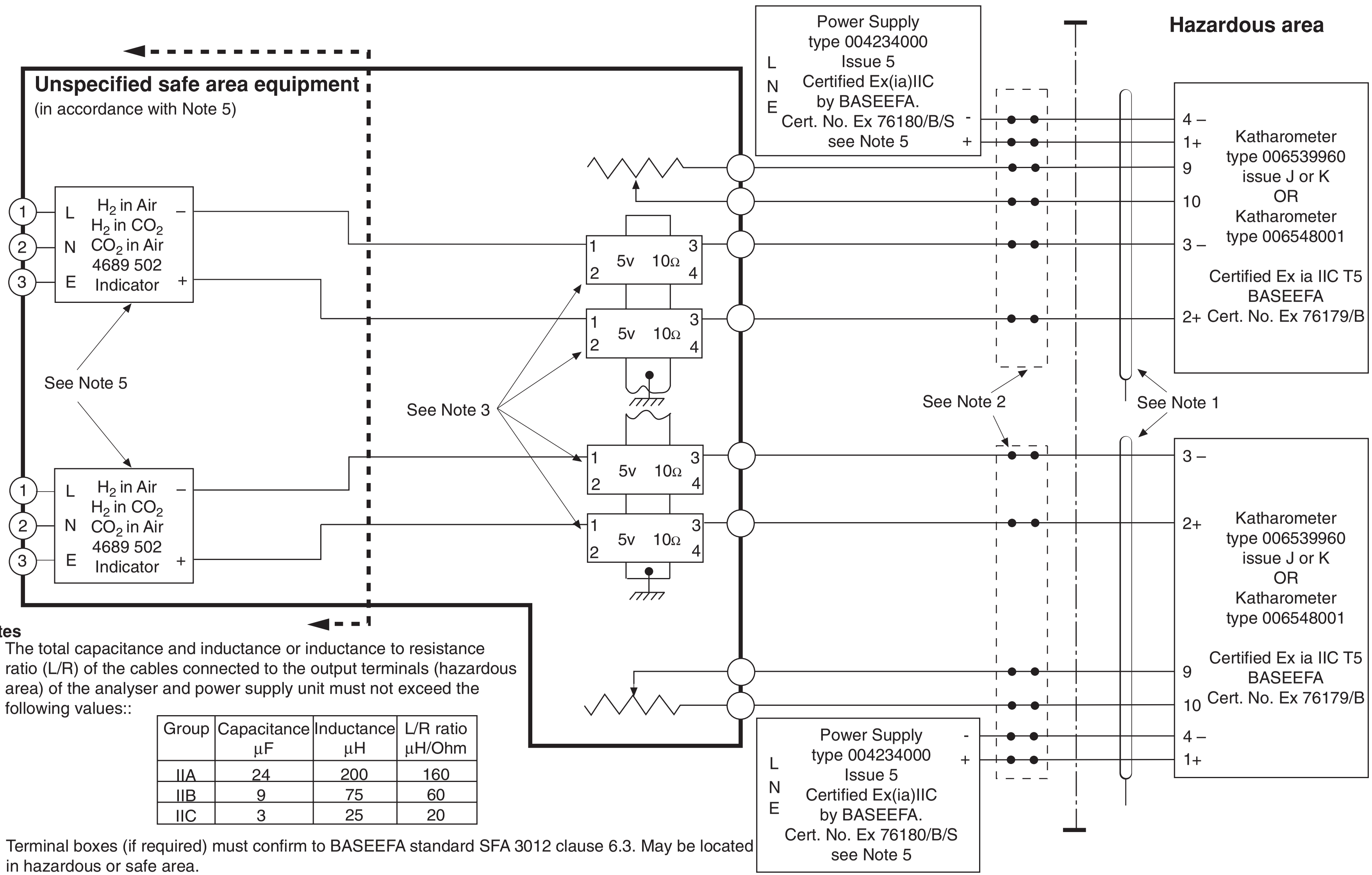
Switch Position	Terminal 13	14	15	16
1	X	X		
2	X		X	
3	X			X

Fig. 5.3 Interconnection Wiring Diagram – Model 6553 Intrinsically Safe Analyzer System using two three range displays, as separate units



Notes

1 The total capacitance and inductance or inductance to resistance ratio (L/R) of the cables connected to the output terminals (hazardous area) of the analyser and power supply unit must not exceed the following values::

Group	Capacitance µF	Inductance µH	L/R ratio µH/Ohm
IIA	24	200	160
IIB	9	75	60
IIC	3	25	20

2 Terminal boxes (if required) must confirm to BASEEFA standard SFA 3012 clause 6.3. May be located in hazardous or safe area.

3 BASEEFA certified 5v 10Ω shunt zener diode barriers of like polarity, certified Ex(ia)IIC. MTL 105+ve

4 The installation must conform to the BASEEFA Installation Conditions, issue 6 dated 1 September 1976.

5 Safe area equipment must not contain a source of potential relative to earth in excess of 250V rms or 250v d.c.

Fig. 5.4 System Diagram. System Cert. Ex76181/1 dated Dec 1988

5.1.3 Model 4234 Power Supply Unit – Fig. 5.5

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

Caution. Ensure that the power supply unit is correct for the mains supply voltage available. A nominal 110V unit cannot be adapted for use with a nominal 240V supply, or the other way around.

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

Locate the terminal block (TB3) adjacent to the transformer T1. To ensure the correct transformer tapping is used for the incoming mains supply, adjust the brown wire, if necessary, to the appropriately marked TB3 terminal to either 110 or 120V (200, 220 or 240V, for alternative power supply unit).

Make electrical connections in accordance with the information given in the wiring diagram Fig. 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.

Fit the cover on completion of wiring up.

5.2 Intrinsically Safe Requirements

These requirements relate to the interconnecting wiring made to and from Model 6548 000 Katharometer Analyzer Panel 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. 5.4.

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 6548 000 Katharometer Analyzer Panel and Model 4234 Power Supply Unit.**

   All cables from the Katharometer in the **hazardous** area must have an inductance/resistance ratio not exceeding 18μH/Ω, (for Group IIC gases). There is a further requirement that the maximum resistance of this interconnecting cable is limited to 2Ω. This may place a limitation on the length of the total cable run.

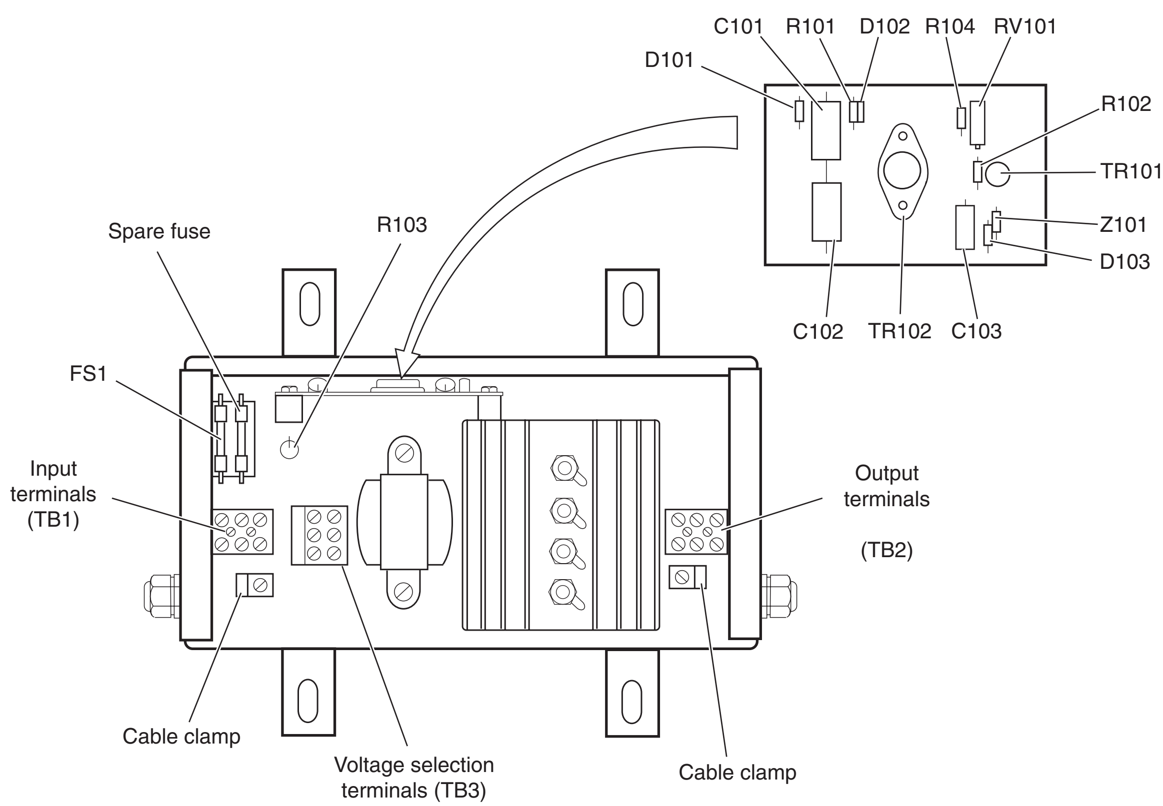


Fig. 5.5 Location of Components Inside Case – Model 4234 Power Supply Unit

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 6548 000 Katharometer Analyzer Panel 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 18µH/Ω (for group IIC gases). These wires are indicated by a ✳ in Fig. 5.3.

No special requirements are necessary to limit the choice of cable for the interconnection between the katharometer zero adjustment controls and the monitor unit.

5.2.2 Recommended Cables

The limitations imposed restrict the choice of wiring cable to a few types. 'Pyrotenax' meet the requirements of less than 18µH/Ω with their mineral insulated cable type PCC 2L1.

The Company should be consulted with information on any other cables proposed for use in the installation of this system.

Detailed cable specifications of the above mentioned type is available from:

Pyrotenax Limited
Hedgeley Road
Hebburn-on-Tyne
County Durham
Telephone: 0191 483 4123

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 250V d.c. or 250V 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 BASEEFA 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 Table 5.1.

2) Any terminal boxes used in the hazardous or safe areas must conform to BASEEFA Standard SFA.3012, Clause 6.3.

3) The overall installation must conform to the BASEEFA installation conditions, Issue 6 (September 1976) – see Fig. 5.4.

Table 5.1 6553 – Intrinsically Safe Wiring Requirements

Gas Group	Capacitance µF	Inductance mH	Inductance/ Resistance µH/Ω
IIA	4.8	0.152	144
IIB	1.8	0.057	54
IIC	0.6	0.019	18

6 SETTING UP

When the gas analyzer system has been correctly installed in accordance with the requirements for intrinsic safety given in Section 5.2, carry out the following setting-up procedures:

6.1 Katharometer Analyser 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.

2) Open a container of fresh granular calcium chloride, immediately fill, and prepare to replace, the drying chamber.

Note. The capacity of the drying chamber is about 140ml. To fill the chamber, approximately 100g of calcium chloride 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 analyzer system at the normal working pressure of the application plant and within the limits given in Section 13.

2) Gradually open the metering valve on the katharometer panel to pressurize the complete system to the maximum pressure 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.

3) Slowly open the metering valve to give a nominal flowrate of gas of 100 to 150 $ml \cdot min^{-1}$. Do not exceed the maximum flowrate given in Section 13.

4) Set the flowrate and shut off the calibration gas external to the analyzer system.

5) Repeat this procedure for each katharometer analyzer panel, as required.

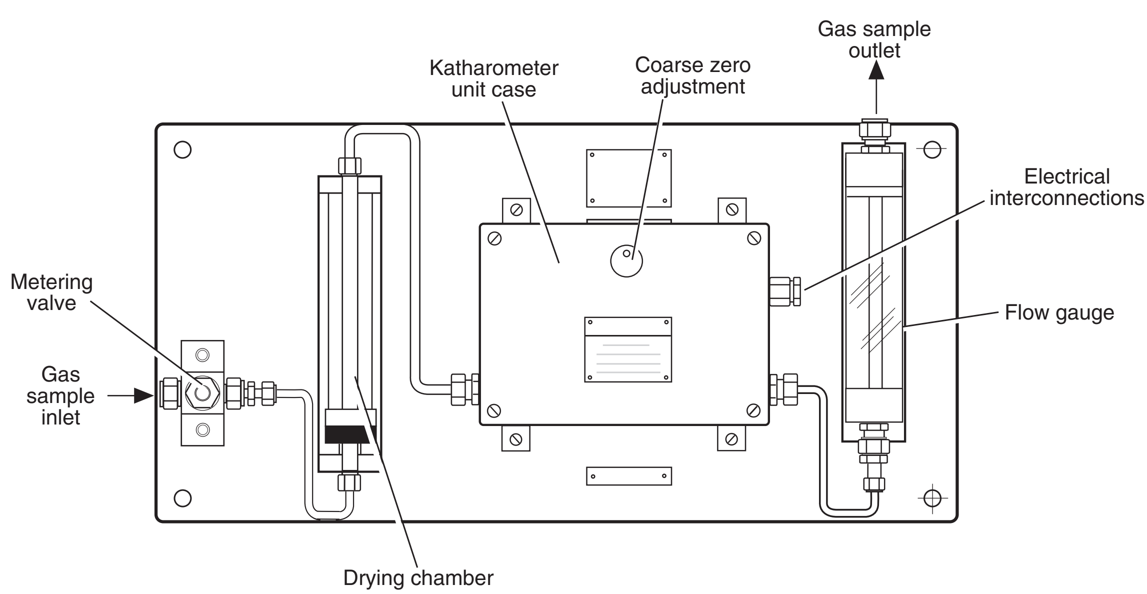


Fig. 6.1 Katharometer Analyzer Panel

6.3 Electrical Checks

Carry out the following electrical checks:

6.3.1 Model 4234 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 and a dummy load resistor fitted across the output. **Never operate the unit to supply an open circuit**.

1) Electrically isolate the power supply unit.

2) Remove the cover from the power supply unit.

3) Disconnect the output wires to the hazardous area at terminals TB2+ and TB2–.

4) Connect a 10Ω (2W ±5%) dummy load resistor across terminals TB2+ and TB2–.

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

5) Switch on the power supply unit and check that it is stable at 350mA.

6) On completion of tests isolate the unit, remove the dummy load resistor and reconnect the output wires to the hazardous area.

7) Replace the cover on the unit.

6.3.2 Zener Barrier Units

The zener barriers 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 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 to EX (ia) IIC and no other type may be substituted.

1) Electrically isolate the 6553 monitor unit.

2) Remove the outer case from the monitor.

3) Disconnect the cable connected to terminal 3 of the barrier unit.

4) Using a low voltage ohmmeter, measure the resistance between terminals 1 and 3. This must be less than 18.15Ω. If in excess of this value - **change the barrier**.

5) Using a low voltage ohmmeter, ensure that the resistance between terminals 2 and 4 of the barrier unit and the application plant safety earth is less than 1Ω.

6) Connect the wire to terminal 3 on the barrier unit.

7) Fit the outer case to the 6553 Monitor Unit.

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

7.2 Switch Familiarization Fig. 7.1 and 7.2

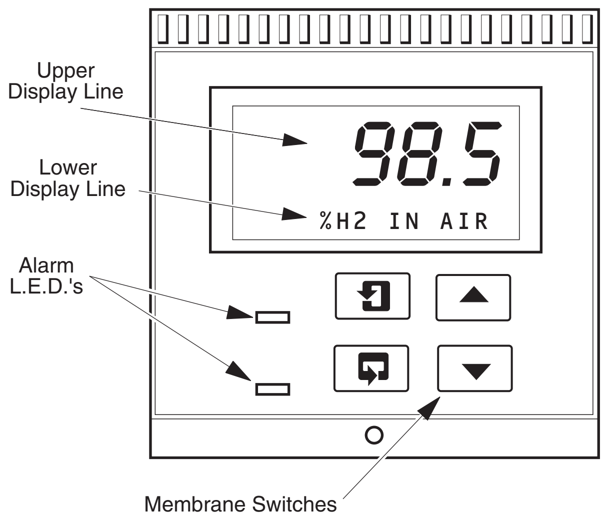


Fig. 7.1 Location of Controls and Displays

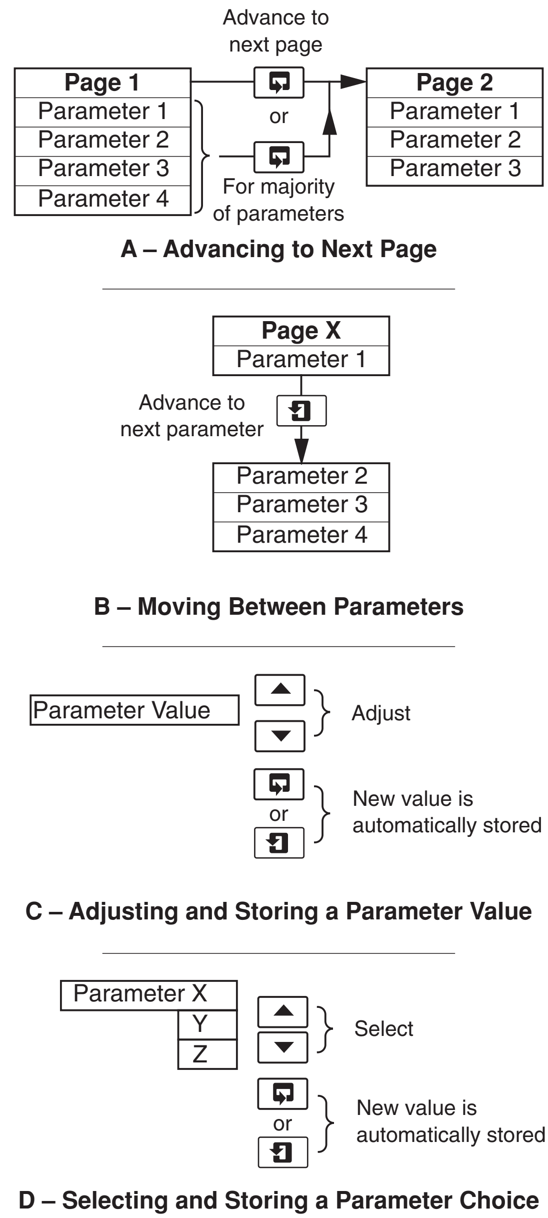


Fig. 7.2 Function of the Membrane Switches

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 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 4234 Power Supply Unit.

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.

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 (if fitted) to give ample warning of the development of a potentially explosive mixture. Factory settings are Alarm 1 = 95.0 and Alarm 2 = 90.0 (if fitted).

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 10.00mV and 250.00mV 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

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 on the 6548 001 katharometer unit. This gas when passed through the katharometer gives a zero millivolt output. To provide a fail-safe condition it is recommended that the zero gas is a 80% or 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.

8.4.1 Hydrogen Gas Calibration

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 Katharometer Unit on the appropriate katharometer analyzer 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) Set the range selector switch on the monitor unit to position (1).

4) The 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) With hydrogen calibration gas passing through the sample system at the normal flowrate, the displayed value should stabilize within 2 hours to read the correct value (80% or 85%) as appropriate.

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

8.4.2 Purge Gas Check Reading

Note. No adjustment of the zero potentiometer is necessary. As any adjustment required will already have been made while calibrating the hydrogen-in-air range.

With the calibration performed according to Section 8.4.1 the purge gas readings (carbon dioxide, air) will be correctly displayed when the selector switch is in the appropriate position.

As a check, calibration quality carbon dioxide, air (or mixtures) may be passed through the katharometer and the displayed value compared to the stated mixture.

If adjustment is required, a hydrogen gas calibration (see Section 8.4.1) must be performed to achieve the required accuracy.

9 OPERATION

9.1 Normal

During normal operation the Model 6553 Gas Analyzer 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 analyzer 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

When the hydrogen coolant has to be removed from the application plant, it would be wasteful and dangerous to release the coolant gas directly into the atmosphere. So it is necessary to ensure that the system is outside the explosive limits for air in hydrogen before allowing air into the system.

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 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:

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 analyzer system, the procedure is as follows:

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

Note. Commence the filling operation 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 analyzer system is now on-line in monitoring mode.

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

Range Selector Switch Position	Upper Display Line		Lower Display Line		Alarm 1 Set Point and Retransmission
	Actual Display	Function	Actual Display	Function	
(1)	xxx.x	Variable Value	%H2 IN AIR	Hydrogen Purity	A/R
(2)	xxx.x	Variable Value	%H2 IN CO2	Purge Gas	Inhibit
(3)	xxx.x	Variable Value	%AIR IN CO2	Purge Gas	Inhibit

A/R – As required N/A – Not available

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

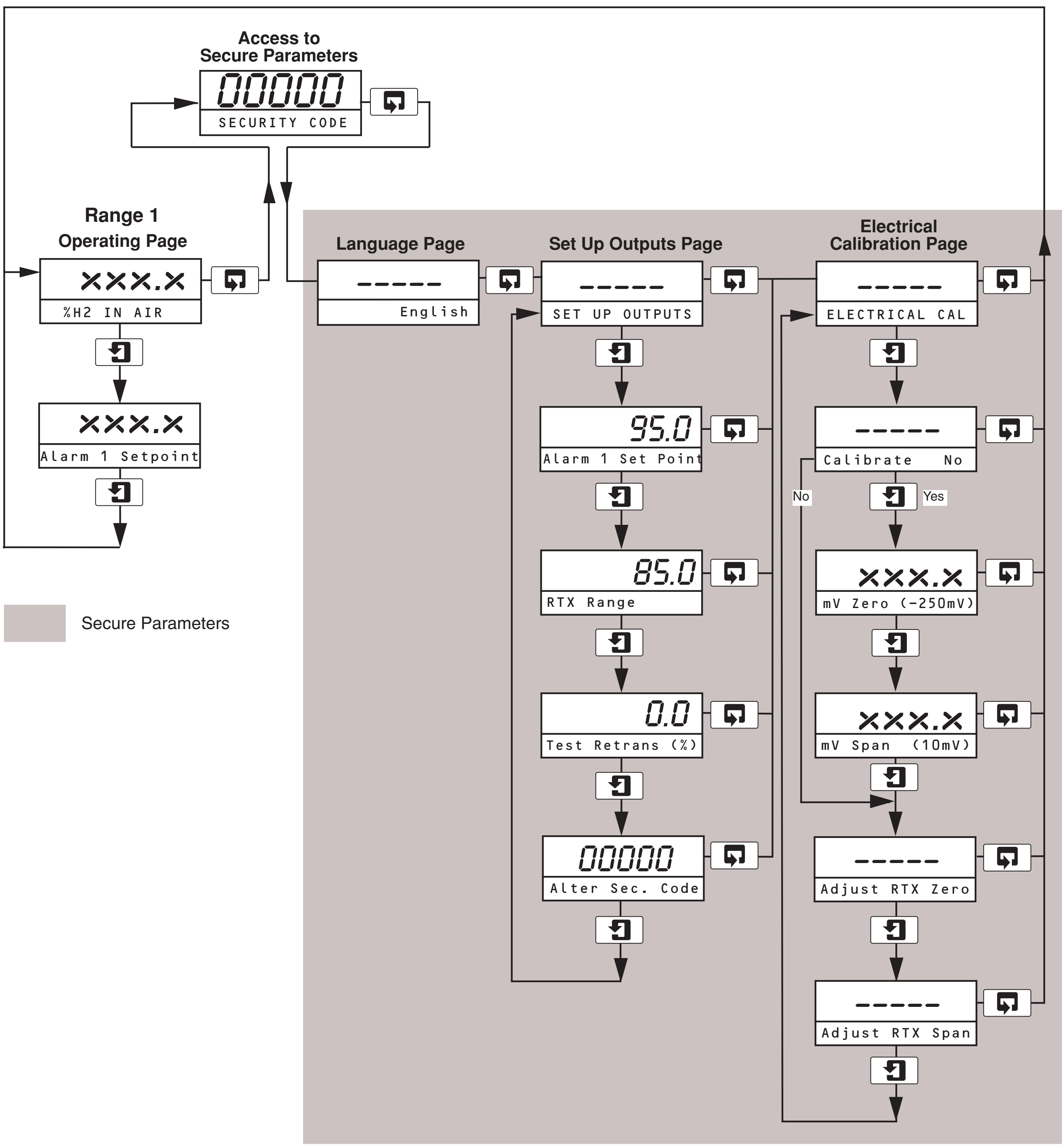


Fig. 10.1 Overall Programming Chart for Display 4689 502 (Range 1)

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

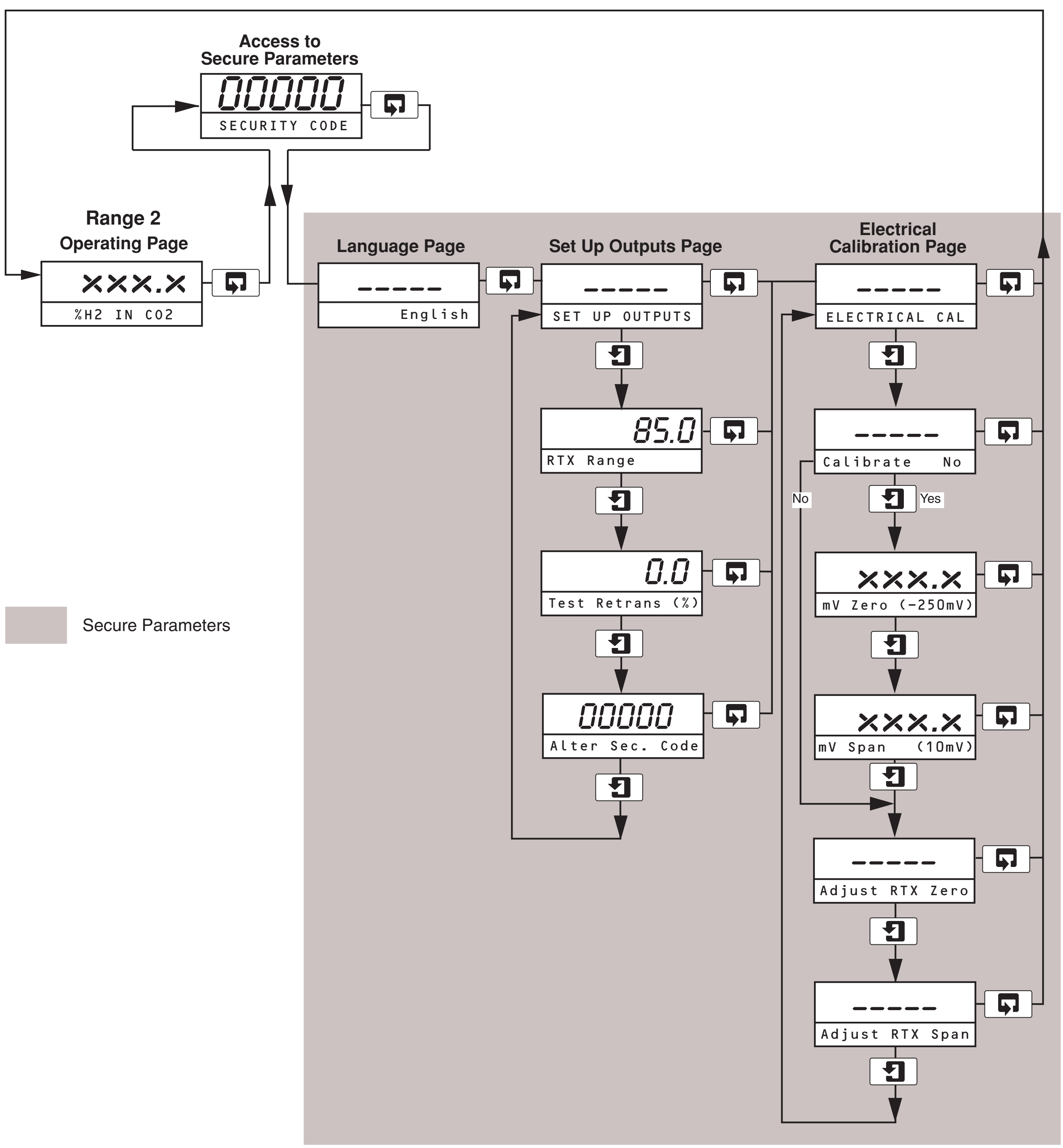


Fig. 10.2 Overall Programming Chart for Display 4689 502 (Range 2)

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

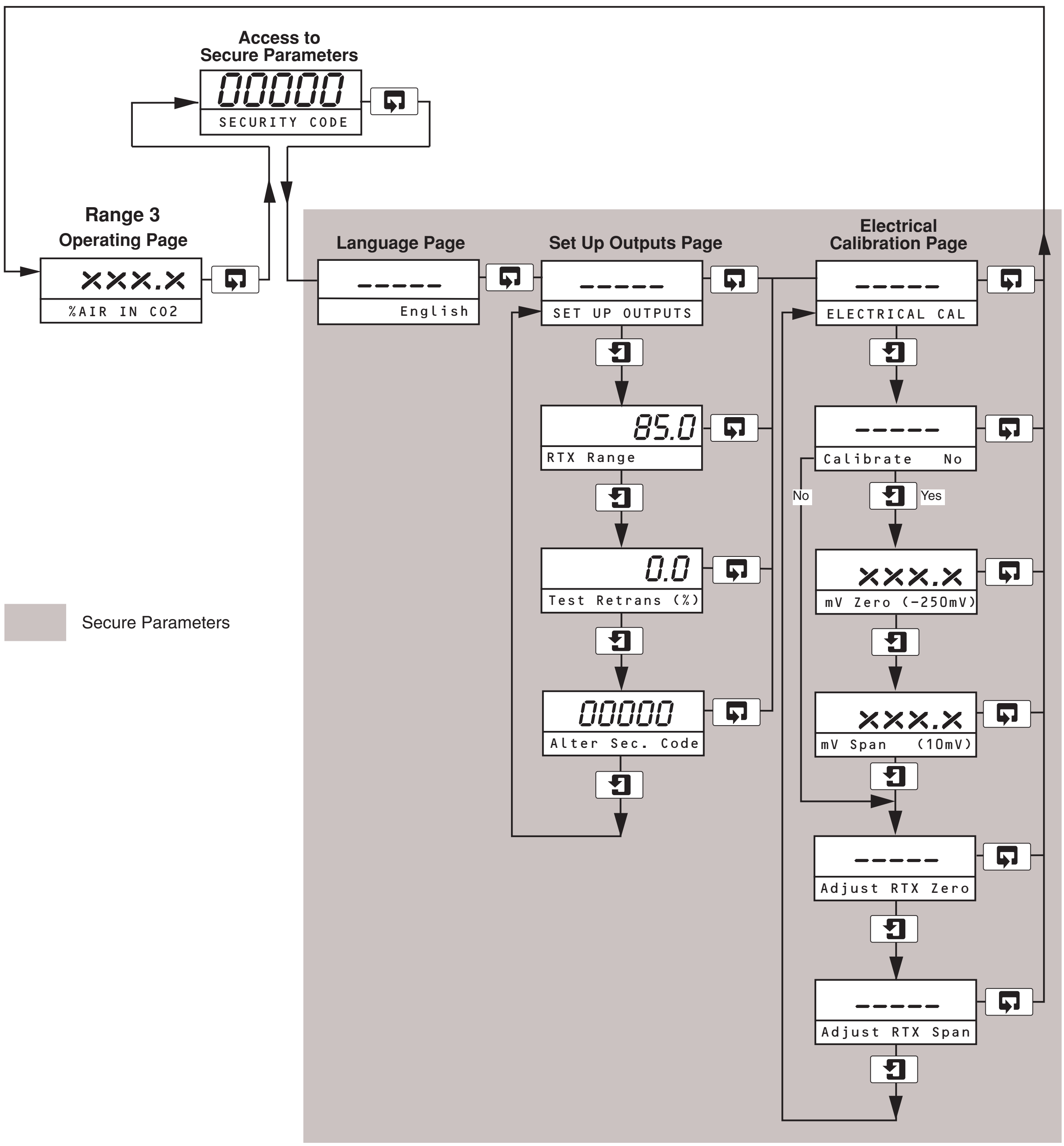
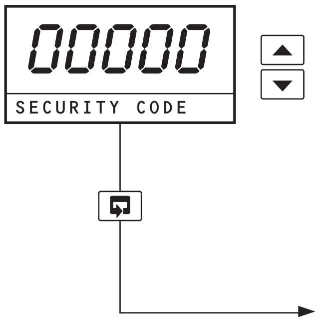


Fig. 10.3 Overall Programming Chart for Display 4689 502 (Range 3)

10.1 Range 1 (%H_2 in Air)

10.1.1 Access to Secure Parameters (Range 1)

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

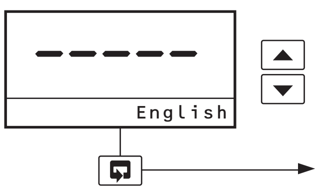


Security Code
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the **Operating page.**

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 **Set Up Outputs Page**

Advance to **Language Page.**

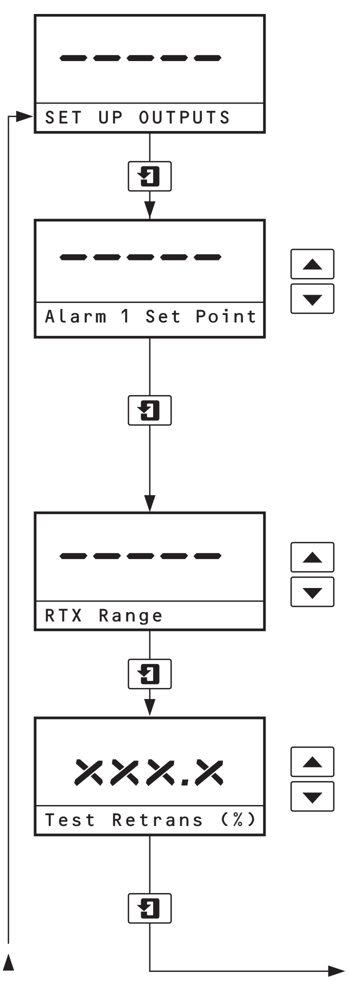
10.1.2 Language Page



Language Page
Select the required language for the display.

Advance to the **Set Up Outputs Page.**

10.1.3 Set Up Outputs Page



Page Header – **SET UP OUTPUTS**

Advance to next parameter.

Alarm 1 Set Point
The set point band is defined as the actual value of the set point plus or minus the hysteresis value. The hysteresis value is ±1% of the full span value displayed in the **Electrical Calibration Page**. 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.

The Alarm 1 Set Point can be set to any value within the input range being displayed. The decimal point position is set automatically. The alarm LEDs are illuminated in the alarm condition. This option is only available with the range switch in position 1.

RTX Range
The retransmission signal (4 to 20mA) can be selected to be ranged 85 to 100% H_2 in Air or 80 to 100% H_2 in Air. This option is only available with the range switch in position 1.

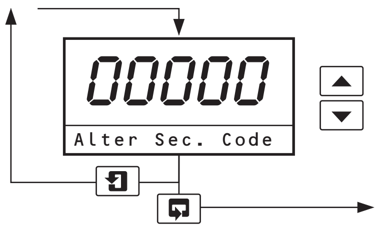
Advance to the next parameter.

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 4 to 20mA and 50% retransmission test signal, 12mA is transmitted.

Select the required retransmission test signal.

Advance to the next parameter **Alter Sec Code** (continued on next page)…

…10.1.3 Set Up Outputs Page



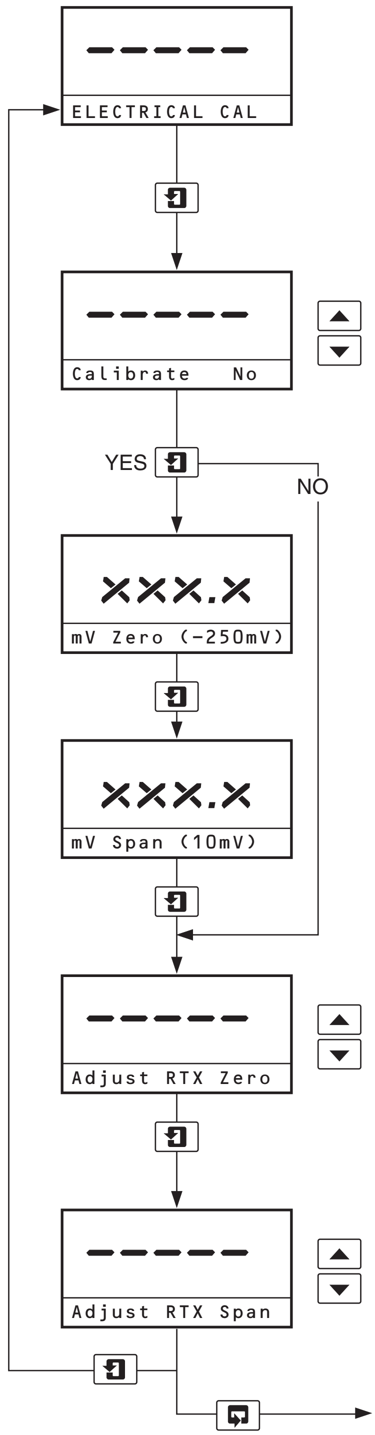
Alter Security Code
Set the security code to a value between 00000 and 19999.

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

Advance to **Electrical Calibration Page.**

10.1.4 Electrical Calibration Page

Caution. Before using this calibration menu apply a mV source to the signal input. Failure to do so will result in changes to the stored settings.



Page header – **ELECTRICAL CAL**

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 the range zero or the range span scale points independently.

The instrument is fully calibrated before despatch and should not normally require further calibration.

Select Calibration
Select the calibration requirement using the scroll up or scroll down 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
Apply a signal input equivalent to range zero (-250.00mV). Allow the instrument display to stabilize.

Advance to next parameter.

Calibration Range Span, H2–AIR
Apply a signal input equivalent to range span (+10.000mV). Allow the instrument display to stabilize.

Advance to next parameter

Adjust Retransmission Zero
Adjust the retransmission zero (4.00mA) to the correct value. The retransmission zero signal will be either 85% or 80% H_2 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(20.00mA) to the correct value. The retransmission span signal will correspond to 100% H_2 in Air.

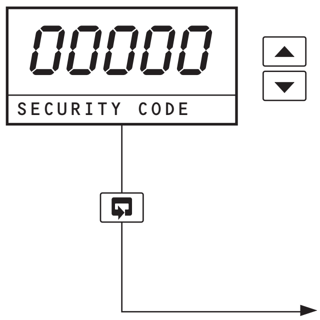
Allow the output signal to stabilize.

Return to **Operating Page.**

10.2 Range 2 (%H_2 in CO_2)

10.2.1 Access to Secure Parameters (Range 2)

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

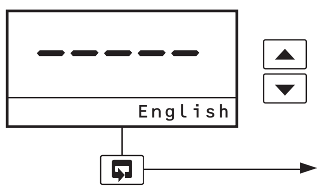


Security Code
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the **Operating page.**

> **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 **Set Up Outputs Page**

Advance to **Language Page.**

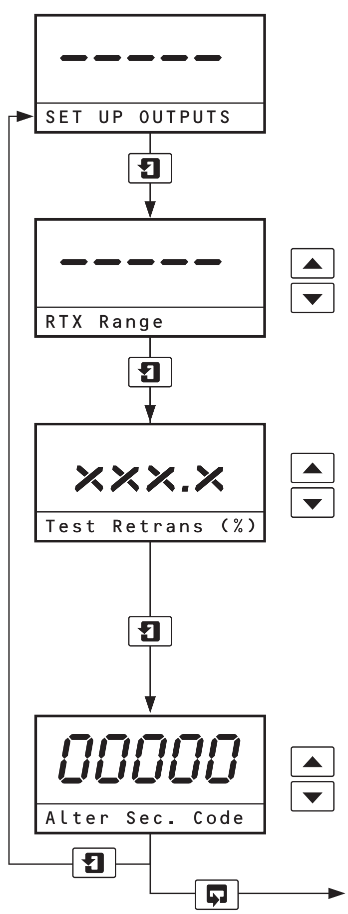
10.2.2 Language Page



Language Page
Select the required language for the display.

Advance to the **Set Up Outputs Page.**

10.2.3 Set Up Outputs Page



Page Header – **SET UP OUTPUTS**

Advance to next parameter.

RTX Range
The retransmission signal (4 to 20mA) can be selected to be ranged 85 to 100% H_2 in Air or 80 to 100% H_2 in Air.

Advance to the next parameter.

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 4 to 20mA and 50% retransmission test signal, 12mA is transmitted.
Select the required retransmission test signal.

Advance to the next parameter.

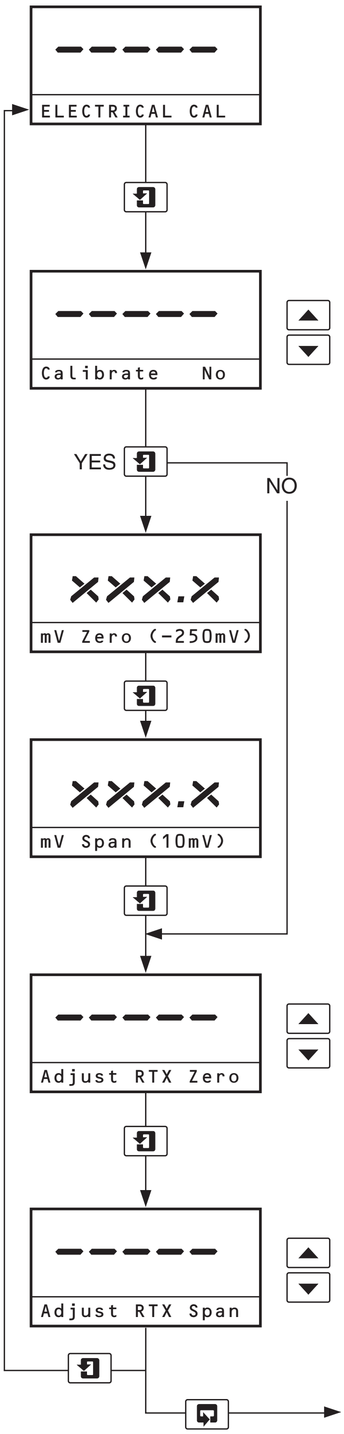
Alter Security Code
Set the security code to a value between 00000 and 19999.

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

Advance to **Electrical Calibration Page.**

10.2.4 Electrical Calibration Page

Caution. Before using this calibration menu apply a mV source to the signal input. Failure to do so will result in changes to the stored settings.



Page header – **ELECTRICAL CAL**

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.

The instrument is fully calibrated before despatch and should not normally require further calibration.

Select Calibration
Select the calibration requirement using the scroll up or scroll down keys.

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

Advance to next parameter.

Calibration Range Zero
Apply a signal input equivalent to range zero (-250.00mV). Allow the instrument display to stabilize.

Advance to next parameter.

Calibration Range Span
Apply a signal input equivalent to range span (+10.000mV). Allow the instrument display to stabilize.

Advance to next parameter

Adjust Retransmission Zero
Adjust the retransmission zero (4.00mA) to the correct value. The retransmission zero signal will be either 85% or 80% H_2 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(20.00mA) to the correct value. The retransmission span signal will correspond to 100% H_2 in Air.

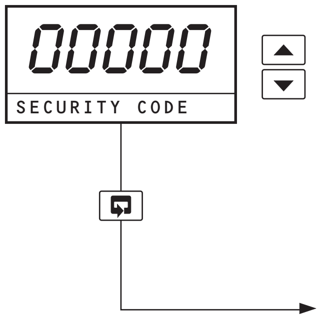
Allow the output signal to stabilize.

Return to **Operating Page.**

10.3 Range 3 (%Air in CO_2)

10.3.1 Access to Secure Parameters (Range 3)

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

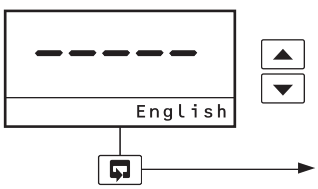


Security Code
Enter the required code number, between 00000 and 19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and the display reverts to the **Operating page.**

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 **Access Page**

Advance to **Language Page.**

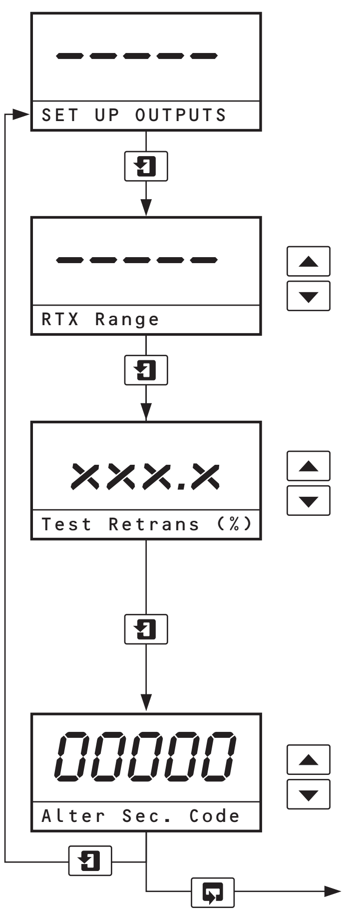
10.3.2 Language Page



Language Page
Select the required language for the display.

Advance to the **Set Up Outputs Page.**

10.3.3 Set Up Outputs Page



Page Header – **SET UP OUTPUTS**

Advance to next parameter.

RTX Range
The retransmission signal (4 to 20mA) can be selected to be ranged 85 to 100% H_2 in Air or 80 to 100% H_2 in Air.

Advance to the next parameter.

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 4 to 20mA and 50% retransmission test signal, 12mA is transmitted.

Select the required retransmission test signal.

Advance to the next parameter.

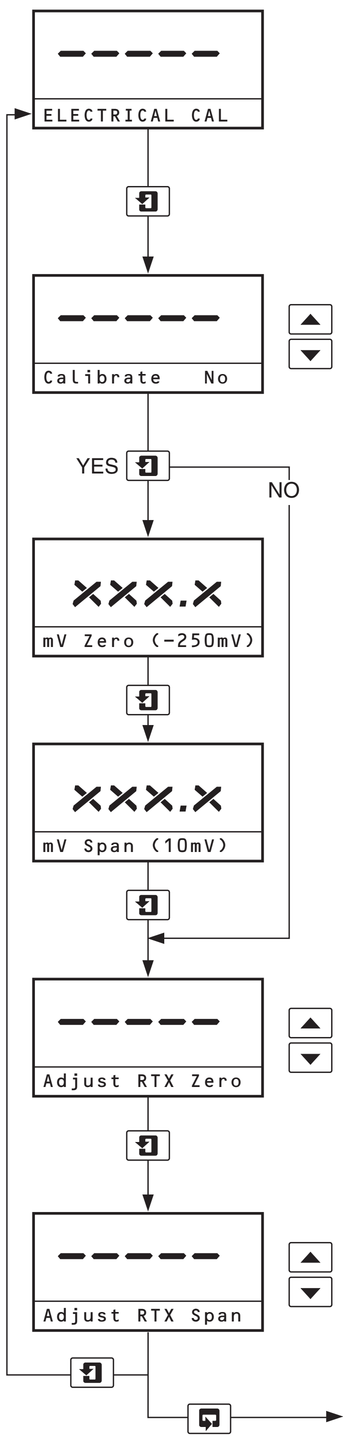
Alter Security Code
Set the security code to a value between 00000 and 19999.

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

Advance to **Electrical Calibration Page.**

10.3.4 Electrical Calibration Page

Caution. Before using this calibration menu apply a mV source to the signal input. Failure to do so will result in changes to the stored settings.



Page header – **ELECTRICAL CAL**

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.

The instrument is fully calibrated before despatch and should not normally require further calibration.

Select Calibration
Select the calibration requirement using the scroll up or scroll down keys.

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

Advance to next parameter.

Calibration Range Zero
Apply a signal input equivalent to range zero (-250.00mV). Allow the instrument display to stabilize.

Advance to next parameter.

Calibration Range Span
Apply a signal input equivalent to range span (+10.000mV). Allow the instrument display to stabilize.

Advance to next parameter

Adjust Retransmission Zero
Adjust the retransmission zero (4.00mA) to the correct value. The retransmission zero signal will be either 85% or 80% H_2 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(20.00mA) to the correct value. The retransmission zero signal will correspond to 100% H_2 in Air.

Allow the output signal to stabilize.

Return to **Operating Page.**

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. But 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 350mA supplied from the power supply unit. 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

11.2.1 Checking Output of 4234 Power Supply Unit

Carry out the test procedure given in Section 6.3.1.

11.2.2 Checking Integrity of Zener Barrier Units

Carry out the test procedure given in Section 6.3.2.

11.2.3 Checking the Katharometer 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.
- Ensure that the proper electrical safety precautions are taken at all times when undertaking this procedure.

1) Electrically isolate the monitor unit
2) Remove the outer cover from the 6548 001 katharometer unit.
3) 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.
4) 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.
5) If the reading from the test made at step 3 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 tampered with.

11.3 Routine Maintenance

11.3.1 Hydrogen Katharometer Calibration

Carry out a calibration check in accordance with Section 8.3.

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 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. 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.

1) 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.
2) Carry out the procedure given in Section 6.1.
3) 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.

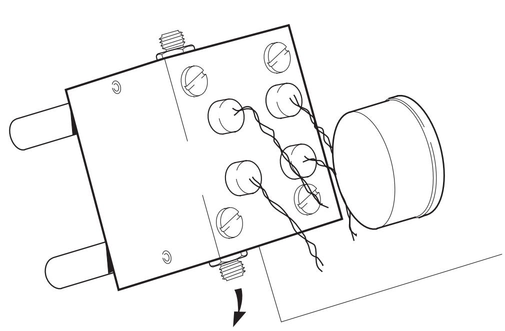


Fig. 11.1 Removing Liquid from the Katharometer Block

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 measurement block, it may be removed using the following procedure:

1) Electrically isolate the defective katharometer at its power supply unit.
2) 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.

3) Remove the cover of the katharometer unit and dismantle the internal sample system tubing.
4) Remove the fixing screws which secure the mounting pillars to the case. See Fig. 5.2.
5) Disconnect the interconnecting wiring at terminal block TB1.

Caution. Do not insert any type of probe into the gas system of the measurement block or use compressed air to blow through the system.

6) Remove the measuring unit from the case and tilt at 45° to the horizontal. This allows any liquid to drain from the measurement block. See Fig. 11.1.
7) Pour a small quantity of rectified spirit (ethanol) through the measurement 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.
8) Fit the measuring unit into its case. Replace the fixing screws and make the electrical interconnections at terminals TB1 - 1 and TB1 - 4.
9) Fit the internal sample gas tubing.
10) Remake the sample gas tube interconnection couplings.
11) Replace the desiccant in the drying chamber in accordance with the procedure given in Section 11.3.3.
12) Carry out a leak test in accordance with the requirements of the responsible authority.
13) Power up the katharometer unit by switching on the appropriate power supply unit.
14) Arrange to pass dry air or another suitable dry gas through the katharometer at the normal sample flowrate for 24 hours.

15) Isolate the katharometer unit at its power supply unit.

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

17) Replace the cover of the katharometer unit.

18) Power up the katharometer unit from its power supply unit.

19) 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 of a Display Unit Chassis

1) Electrically isolate the gas monitor unit.

2) 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.

3) Fit the chassis by carefully inserting and pressing firmly into position before tightening the retaining screw.

4) Power up the monitor unit and carry out a calibration in accordance with Section 8.3.

This task should be undertaken as required.

Table 11.1 Error Messages

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 fault persists, contact the Company.

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 502) as shown in Fig. 3.1.

When ordering a 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 6548 000 Katharometer Analyzer Panel
Granular anhydrous Ca Cl_2 .... Locally sourced

12.2 Routine Maintenance Parts

Description **Part No.**

Model 4234 Power Supply Unit
Fuse, 500 mA/≥4000A h.b.c. cartridge 002417 005

Model 6553 Gas Monitor Unit
Fuse, 500mA a/s 1.25x 0.25 in glass cart. 0231 596
Function selector switch, 3 position., 1 wafer 0234 710
Function selector switch, 3 position., 2 wafer 0234 711
Potentiometer (1kΩ), zero adjustment 002569 036

Model 6548 000 Katharometer Analyzer Panel
Seal, top of drying chamber 002310 012
Seal, bottom of drying chamber 006519 160
Gauze, drying chamber 006525 700

12.3 Repair Maintenance Parts

Description **Part No.**

Model 4234 Power Supply Unit
Nominal 110V unit 004234 000
Nominal 240V unit 004234 002

Model 6548 000 Katharometer Analyser Panel
Flowmeter, 50 to 250ml/min 006525 460
Valve, metering 006540 361
Katharometer unit .... 006548 001(H_2/CO_2)

Model 6553 Gas Monitor Unit (H_2/CO_2)
Display unit (H2/CO2) 4689 502
Zener barrier unit 0248 299

13 SPECIFICATION

(a) Model 6553 Gas Monitor Unit — BASEEFA Certificate No. Ex 77124/B/S

Available Ranges:	(1) 85 to 100% or 80 to 100% hydrogen in air (2) 0 to 100% hydrogen in carbon dioxide (3) 0 to 100% air in carbon dioxide
Digital Display Units: H2 in Air, Air in CO2 and H2 in CO2:	4689 502
Range Selector Switch Positions (when fitted):	(1) Percentage by volume, hydrogen in air (2) Percentage by volume, hydrogen in carbon dioxide (3) Percentage by volume, air in carbon dioxide
Accuracy (display units):	±2% fsd each range
Ambient Temperature Range:	0 to 45°C
Power Supply :	110/120 or 200/220/240V ac, 50/60 Hz (2 separate versions)
Power Consumption :	30 VA approximately.
Outline Dimensions:	290 x 362 x 272mm
Weight :	12 kg approximately
Environment :	Sheltered interior, 0 to 90% RH

(b) Model 6548 000 Katharometer Analyzer Panel — BASEEFA Certificate No. Ex 76179/B

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

(c) Model 6548 100 Katharometer Unit — **BASEEFA Certificate No. Ex 76179/B**

Power Supply:	350 mA d.c., from 4234 PSU
Signal Output:	0 to 10 mV for 85% H_2 in air to 100% H_2
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 50 °C
Sample Connections:	Compression couplings, 8 mm outside diameter tube
Sample Pressure:	Minimum, 12.5 mbar (G) H_2O / Maximum, 350 mbar (G) } Differential across analyser
Static Pressure (Sample)	Pressure tested to 10 bar (G)
Normal Sample Flowrate (on H_2 flow meter):	100 to 150 ml min^{-1} (H_2) 230 to 370 ml min^{-1} (CO_2 and air)
Maximum Gas Flowrate (on H_2 flow meter):	250 ml min^{-1} (H_2) 600 ml min^{-1} (CO_2 and air)
Minimum Gas Flowrate (on H_2 flow meter):	60 ml min^{-1} (H_2) 130 ml min^{-1} (CO_2 and air)
Outline Dimensions:	610 x 305 x 152 mm
Weight:	8.6 kg approximately.
Environment:	Sheltered interior

(d) Model 4234 Power Supply Unit — **BASEEFA Certificate No. Ex. 76180/B/S**

Input Voltage:	110/120V or 200/220/240V a.c., 50/60 Hz (2 separate versions)
Fuse Rating:	500mA hbc (high breaking capacity ≥4000A)
dc Output:	350mA stabilised
Load Conditions:	1 katharometer – 13Ω max. Interconnecting cable – 2Ω max.
Ambient Temperature Range:	– 5 to +50°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 1mA rms
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:	148 x 283 x 135mm
Weight:	3.8kg approximately
Environment:	Sheltered interior

APPENDIX

A1.1 Model 4234 Power Supply Unit

Two different power supply units are available to suit different supply voltages. See **Spare Parts List**.

A1.1.1 Functional Description

A circuit diagram for each type is shown in Fig. A1 (240V), Fig. A2 (110V).

A stable supply voltage is produced across zener diodes Z3 and Z4 by utilizing the forward slope resistance of zener diodes Z1 and Z2 in the full-wave rectifier bridge connected to the secondary winding of transformer T1. A reference voltage is produced across C103 by zener diode Z101 in conjunction with R101, with diode D103 providing temperature compensation. This reference voltage is applied to the base of TR101, which is used to drive the power transistor TR102 to produce a constant current output of 350mA. The small preset potentiometer RV101 is used to provide a fine adjustment for the current output.

The output current is restricted by inviolate resistors which ensure that the requirements of the intrinsic safety certification are met, even under a '2-fault' condition.

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 maintenance tasks.

A1.1.2 Fault Finding

Caution. Do not operate this unit without an electrical load on the output.

If testing indicates that this unit is defective, further fault finding may be carried out based on the typical test point values given in Table A1. There are several test points available on the unit. Reference should be made to Figs. A1, A2 and the markings on the circuit boards for the location of test points and components.

Table A1 Test Point Values - Model 4234 Power Supply Unit

Test Point	Voltage V	Form	Conditions
TP1	9.1	d.c.	With respect to 0V
TP2	3.5	d.c.	With respect to 0V
TP3	3.0	d.c.	With respect to 0V
TP4	2.4	d.c.	With respect to 0V
TP5	5.0	d.c.	With respect to 0V using 10Ω dummy load
TP6	1.7	d.c.	With respect to 0V
T1	9.1	a.c.	At secondary

Note. The primary winding of the transformer T1 incorporates a thermal cutout device to prevent overloading under fault conditions. Sufficient time must be allowed for this to cool and reset after a fault has occurred, and before continuing further testing.

A1.1.3 Parts List

Repair Maintenance Parts

Description	Part No.
Resistor	
R101, 910R, ±2%, 0.5W, metal oxide	-
R102, 3k3, ±2%. 0.5W, metal oxide	-
R103, 4R7, ±1%, 9W, wirewound	-
R104, 100R, ±2%, 0.5W, metal oxide	-
Variable resistor	
RV 101, 1k0, Spectrol Reliance, CW51	-
Capacitor	
C101, 1000µF, 16V, elect., Mullard 0175 15102	-
C102, 1000µF, 16V, elect., Mullard 0175 15102	
C103, 100µF, 16V, elect, Mullard 0165 14101	-
Transistor	
TR101, BC 108, Mullard	-
TR 102, 2N 3766, Motorola	-
Diode	
D101, BYX 36 - 600, Mullard	-
D102, BYX 36 - 600, Mullard	-
D103, AAZ - 15, Mullard	-
Zener diode	
Z1, BZY93C9V1, Mullard	-
Z2, BZY93C9V1. Mullard	-
Z3, BZY93C9V1, Mullard	-
Z4, BZY93C9V1, Mullard	-
Z101, BZY88C3V3, Mullard	-
Fuse	
FS1, 500mA, hbc cartridge, Belling Lee L693	-
Transformer	
T1, 110 - 120V primary	4234 130
T1, 200 - 220 - 240V primary	4234 140

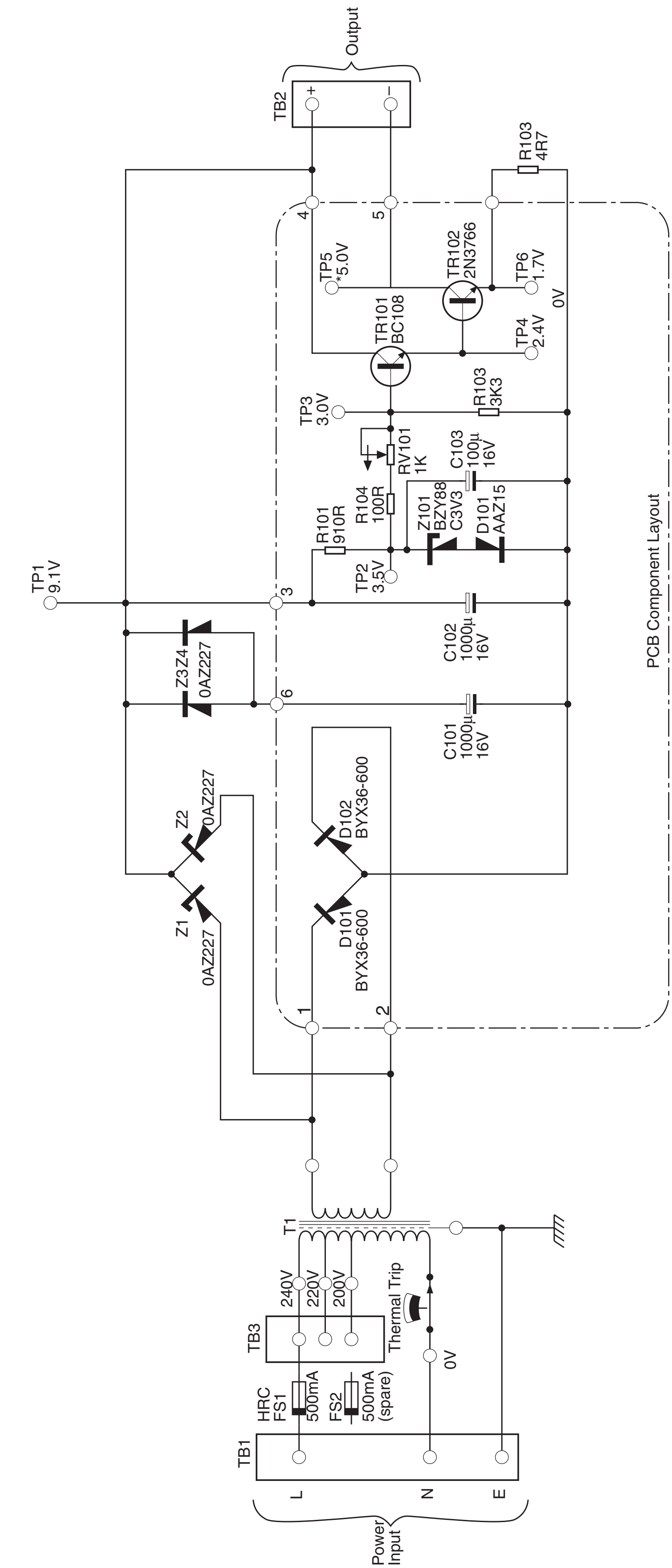


Fig. A1 Power Supply Unit Model 4234 – Overall Circuit (200/220/240V Version)

*Measured with a 10R load.

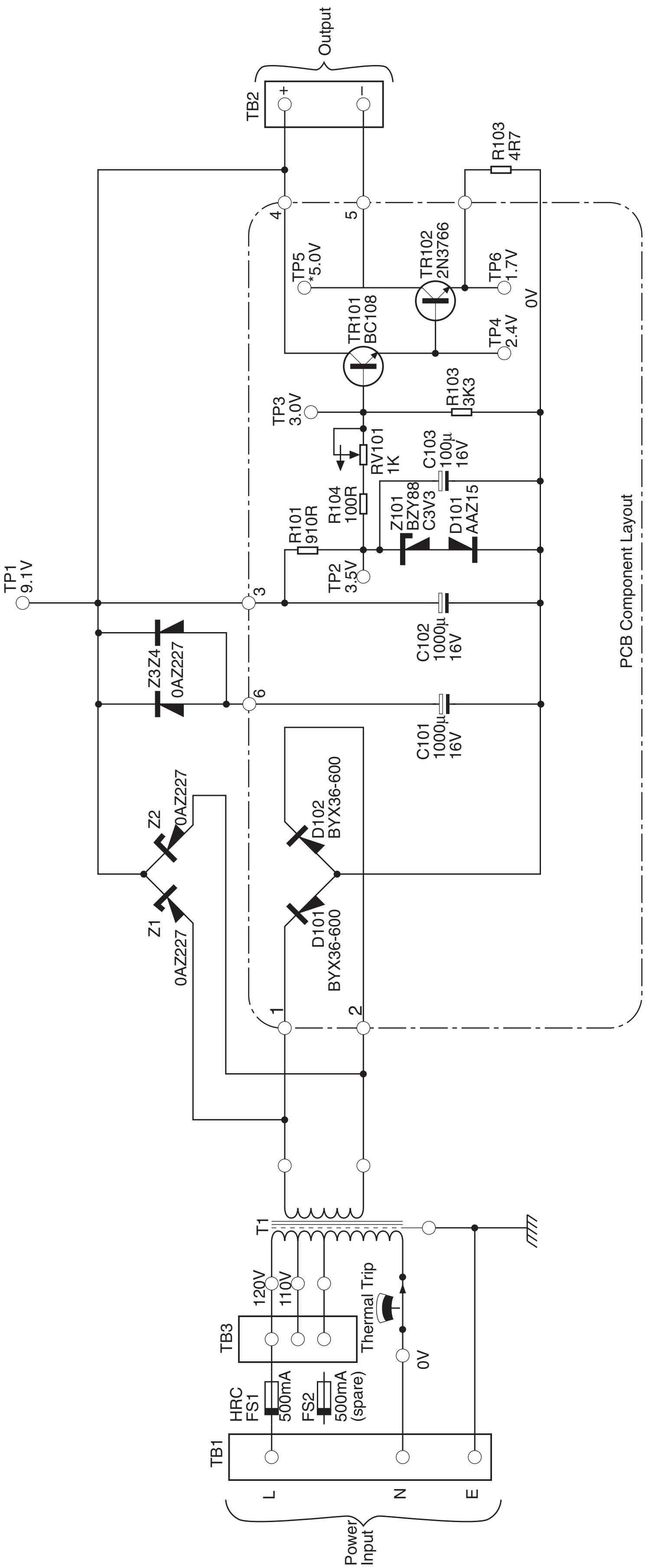


Fig. A2 Power Supply Unit Model 4234 – Overall Circuit (110/120 Version)

*Measured with a 10R load.

PRODUCTS & CUSTOMER SUPPORT

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- *for the following industries:*
  - Chemical & Pharmaceutical
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- *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.

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Fax: +1 (0) 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.

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