Operating Instructions –
Basic, Advanced and
Auto-calibration Versions

IM/ZMT_8

Zirconia Oxygen Analyzer Systems

ZMT

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

The Z-MT microprocessor-based electronics unit is designed for continuous monitoring and control of oxygen levels in boilers and flues.

All instrument functions are fully programmable via tactile membrane switches mounted on the front panel. The switches are also used for viewing the measured percentage oxygen thermocouple temperatures, efficiency values and other operational parameters.

Up to four relay outputs and three retransmission outputs can be selected for alarm/control and external recording. Each output can be independently assigned to a range of parameters such as measured percentage oxygen or thermocouple temperatures. Relay action (energized above or below set point) and retransmission ranges are also fully programmable to suit the application.

The unit is available in 'basic' and 'advanced' versions. The advanced version incorporates percentage efficiency calculations using the Siegert formula and has a facility to display the inlet air temperature and the flue gas temperature, if required.

Units supplied with Auto-calibration can be programmed to re-calibrate the probe automatically at pre-determined intervals.

The Z-MT is used in conjunction with either a Z-FG2 or Z-GP2 zirconia probe for in situ ('wet' analysis) measurement, thus eliminating the errors introduced by the sampling system used in 'dry' analysis applications.

For full installation and operation details of the probes refer to the following manuals:

Z-FG2 Probes – 008750085 Issue 9 onwards
Z-GP2 Probes – 008750082 Issue 2 onwards

For full commissioning and calibration information refer also to the operating instructions ZMT/0012.

2 PREPARATION

2.1 Accessories

The following accessories are supplied with the instrument:

Program card
Door key
Cable entry bungs

2.2 Checking the Instrument Code Number – Fig. 2.1

① Unlock and open the door, hinged at the right hand edge (turn key clockwise to open).

② Check the instrument code number against table 2.1 overleaf.

2.3 Checking the Program Card Details

The programed functions are defined on the program card which should be mounted at a convenient location close to the unit for future reference.

The settings printed on the card are those of the standard instrument program, i.e. as supplied if the user has not specified a particular dedicated program.

If the functions detailed on the card are unsuitable for the application, they can be reprogrammed – see Sections 9 to 11. Write any changed parameter details onto the card.

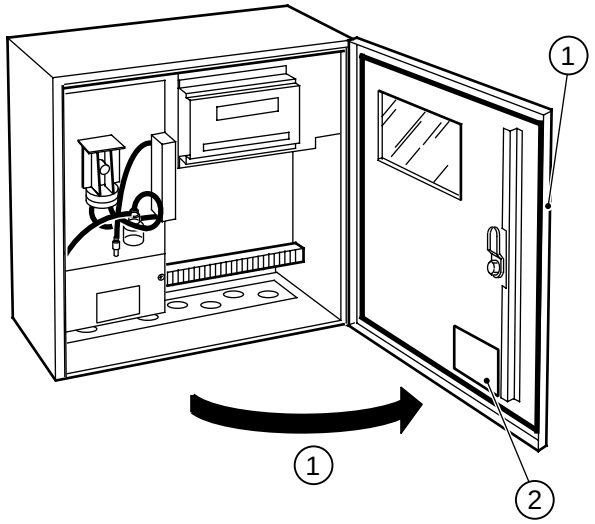


Fig. 2.1 Checking the Instrument Code Number

ZMT Zirconia Analyzer			ZMT	/ X	X	/ X	XX	XX	X	X	/ X	X	X	X
for use with **Probe Type**	EXGP/ZGP2 ZFG/ZFG2 EXFG			1 2 3										
Rererence Air Supply (See Note 2)	None Pump + Air Gauge Regulator Pump and Flow Indicator Regulator	 (not ZFG) (ZFG2 only) (ZFG2 only) (ZGP2 only)			0 1 2 3 4									
Probe Temperature Control (See Note 3)	None Temperature Control	 (ZFG/ZFG2 or EXFG only)				0 1								
1st Fuel Option (See Note 1)							00 01 ↓ 16 17							
2nd Fuel Option (See Note 1)								00 01 ↓ 16 17						
Program (See Note 4)	Basic Efficiency Humidity in air Auto-cal basic Auto-cal efficiency EXFG Basic EXFG Efficiency + Auto-cal								0 1 2 3 4 5 6					
Serial Communications	None RS485 ABB protocol									0 3				
Output Module 1	None Analog + Relay										0 4			
Output Module 2 (See Note 5)	None One Relay Two Relays for EXFG Auto-cal Analog + Relay											0 1 3 4		
Output Module 3 (See Note 6)	None One Relay Two Relays (Auto-cal or Alarms) Analog + Relay Serial O/P and/or EXFG Temp. Trip												0 1 2 4 5	
Mains Voltage	110V 50/60Hz 230V 50/60Hz													1 2

Note 1
Fuel options available:

00 No fuel specification	09 Distillate oil
01 Natural gas	10 No. 4 fuel oil
02 Propane	11 No. 5 fuel oil
03 Butane	12 No. 6 fuel oil
04 Medium oil	13 Coal (general)
05 Heavy oil	14 Bituminous coal
06 General fuel oil	15 Steam coal
07 Naphtha	16 Anthracite
08 Kerosene	17 Coke

Note 2
Reference air options 2 and 3 have the air outlet inside the enclosure to suit ZFG2 probe type. Flow rate 500 to 1000ml/min. (0.02 to 0.04 cu.ft./min approx.
Reference air options 1 and 4 for use on ZGP2 probe types have both inlet and outlet connections external to the enclosure.

Note 3
Option 1 not available for ZGP2 probe but obligatory for ZFG/ZFG2 and EXFG probes.
Note 4
Options 5 & 6 available only for EXFG probe.
Note 5
Option 3 available only for EXFG probe with Auto-cal.
Note 6
Option 5 available only and obligatory for EXFG probe.

Table 2.1 Identification

3 SITING

Select a location:

a) Within temperature and humidity limits of 0 to 55°C and 0 to 80% RH.

b) Where the IP55 protection rating is not exceeded.

c) Away from harmful vapours and/or dripping fluids.

d) Free from excessive vibration.

e) At a distance from the probe not exceeding the limitations specified in Table 5.1 on page 5 (Z-FG2 probes only):

Note. If the 6 meters of flexible conduit supplied with Z-FG2 probes is insufficient, it can be extended using a suitable junction box (part no. 003000060).

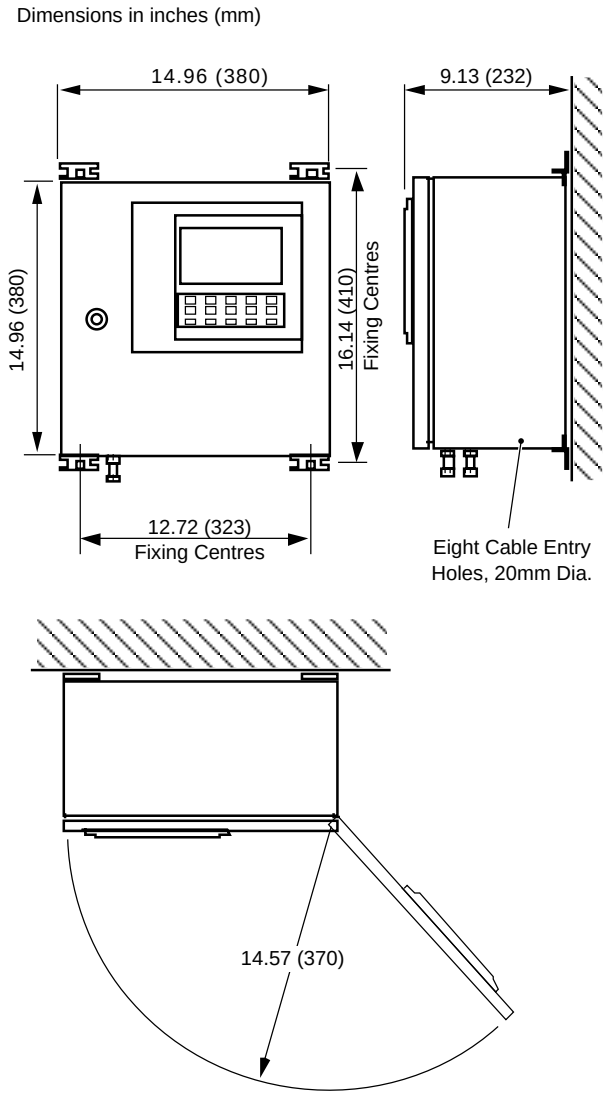


Fig. 4.1 Overall Dimensions

4 MOUNTING

The unit is designed for wall mounting and weighs approximately 16.5kg.

4.1 Overall Dimensions – Fig. 4.1

Overall dimensions, including fixing centres and door arc clearance are shown in Fig. 4.1.

4.2 Mounting Details – Fig. 4.2

① Carefully mark-out the fixing centres for the four mounting brackets.

② Drill suitable holes for the type of fixings to be used.

③ Fix the instrument securely to the wall.

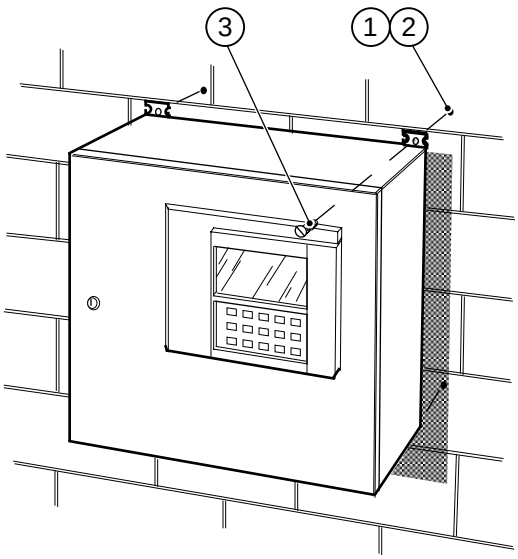


Fig. 4.2 Mounting Details

5 CONNECTIONS

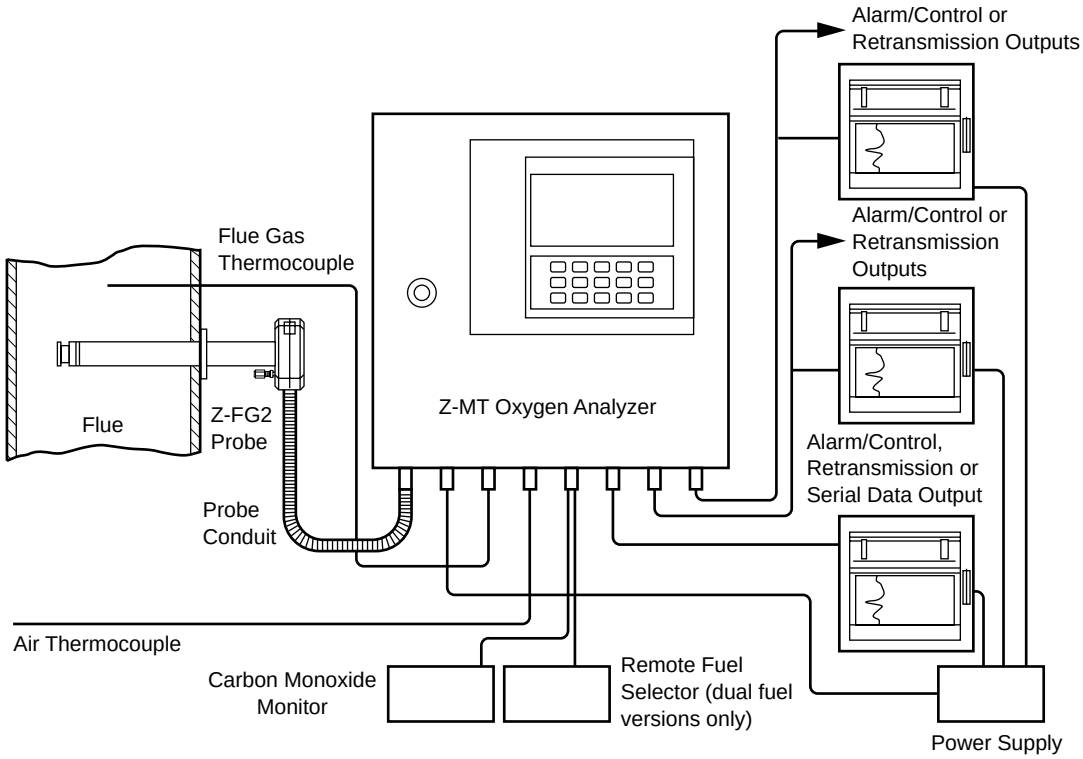


Fig. 5.1 Schematic Diagram – Z-FG2 Probe

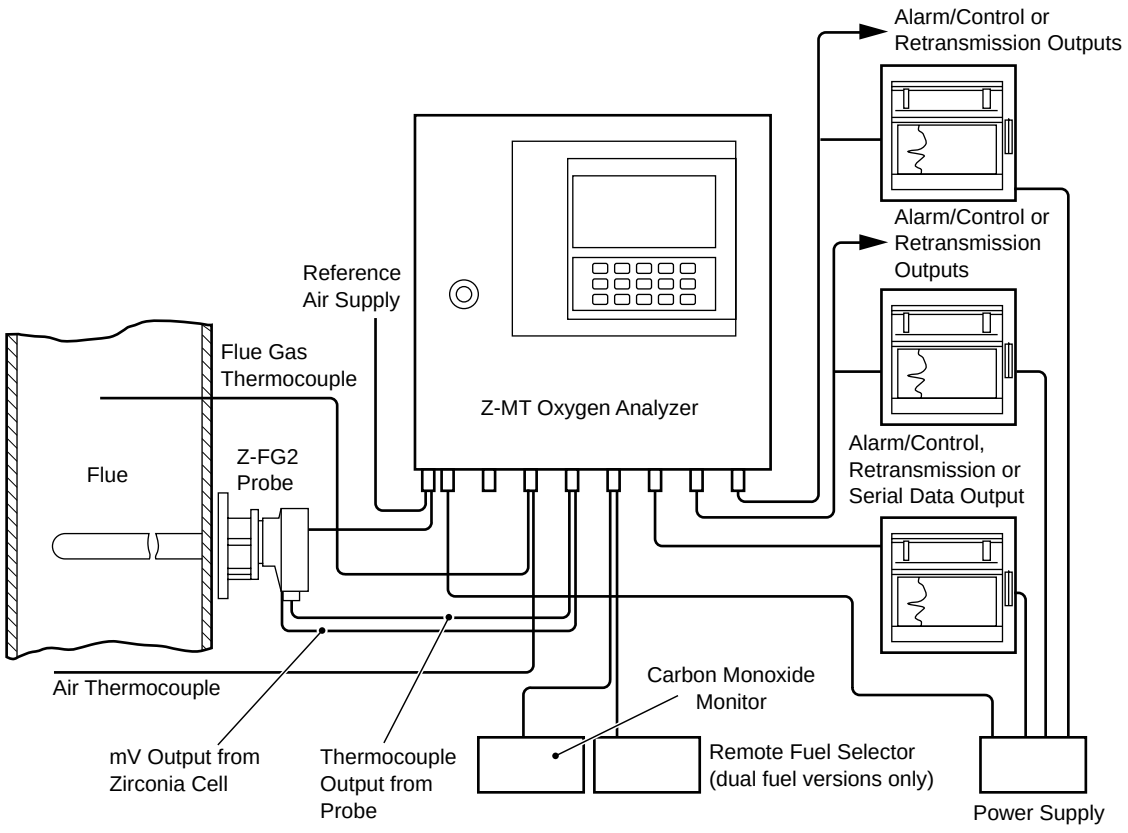


Fig. 5.2 Schematic Diagram – Z-GP2 Probe

…5 CONNECTIONS

Warning. Before making any connections ensure that the power supply and any high voltage or power-operated control circuits are switched off.

Schematic diagrams showing connection of the Z-MT to Z-FG2 and Z-GP2 probes are shown in Figs. 5.1 and 5.2 respectively.

5.1 Gas Panel – Auto-calibration Versions Only

Auto-calibration versions of the Z-MT require the zero and span calibration gases to be connected permanently to the probe's test gas inlet. This is best acheived by use of a gas panel (not supplied).

A suggested gas panel layout is shown in Appendix 1.

Caution. The information provided in the appendix is intended to highlight general gas panel requirements and must not be used as the sole basis for a detailed design.

5.2 Access to Terminals – Fig. 5.3

① Unlock and open the door, hinged at the right hand edge (turn key clockwise to open).

② Identify the signal connections terminal block.

To gain access to the mains connections terminal block:

③ Remove the two screws retaining the mains protection plate and remove the plate.

④ Identify the mains connections terminal block.

5.3 Preparation

When making connections note the following:

a) Use only the cables and air tubing specified in Table 5.1.

b) Ensure that all cables enter the instrument via the glands nearest to the appropriate screw terminals and are short and direct.

Note. Figs. 5.4 and 5.5 on page 9 show the recommended routing of cables for the most advanced instrument versions, i.e. those requiring the most cable entries. Alternative entries, nearer the appropriate screw terminals, may be used if some instrument facilities are not used.

5.4 Connection Details – Figs. 5.4 and 5.5

Connection details for Z-FG2 and Z-GP2 probes are shown on page 9 in Figs. 5.4 and 5.5 respectively and are summarized in Table 5.2.

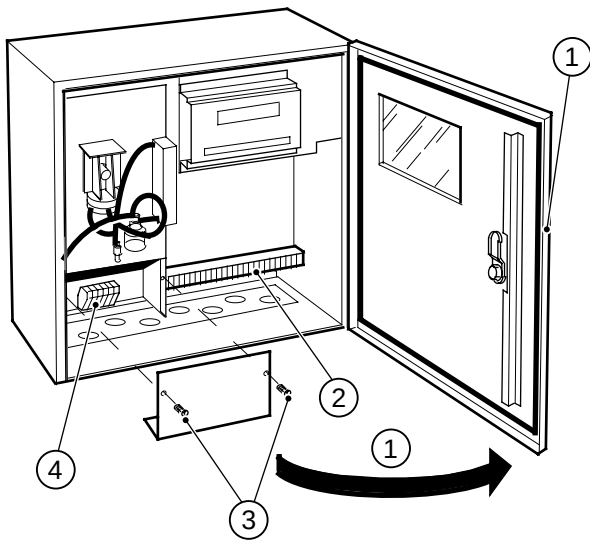


Fig. 5.3 Access to Terminals

Cable/Tubing Description	Reference
Cell output cable	16/0.2mm laid up red and blue twin copper braid with overall p.v.c. sheath
Thermocouple cable	Ni-Cr/Ni-Al BS4937 type K and DIN IEC 584 (BS part no. 4) Pt/Pt-Rh BS4937 types R and S and DIN IEC 584 (BS part nos. 1 and 2)
Heater cable (Z-FG2 probes only)	3-core 1mm2 copper (20 metres max.)* 3-core 1.5mm2 copper (32 metres max.)* 3-core 2mm2 copper (69 metres max.)*
Air Tubing (Reference Air)	1/4in. o.d. x 1/8in. i.d. stainless steel, nylon or p.v.c. tube

Caution. The total loop resistance must be less than 2Ω.

* Total run length including flexible conduit.

Table 5.1 Cable References and Air Tubing Specification

Terminal Reference		Connection
Heater		
H		Probe heater
H		supply
E		Earth
Mains Supply*		
L		Line
N		Neutral
E		Earth
Probe Cell Output		
PROBE CELL	– +	From probe cell
Thermocouples		
PROBE T/C	– +	From probe thermocouple
FLUE T/C	– +	From flue thermocouple
AIR T/C	– +	From air thermocouple
Remote Auto-calibration Request**		
BURNER	– +	Switch: Remote Auto-calibration Request / Normal Operation **or** Logic input: –5V Normal Operation, 0V Remote Auto Cal Request
Fuel Selector		
FUEL	– +	Switch: Fuel 1 / Fuel 2 **or** Logic input: –5V Fuel 2, 0V Fuel 1
Carbon Monoxide Retransmission Signal		
CO I/P	– +	4 to 20mA from external monitor

		Output 3:	**double relay**		**Analog retransmission + relay**	
	1		normally closed	Relay 4	positive	Analog retransmission 3
	2		common	(Select Zero	negative	
O/P	3		normally open	Gas**)	—	
MODULE 3	4		normally closed	Relay 3	normally closed	Relay 3
	5		common	(Select Span	common	
	6		normally open	Gas**)	normally open	

		Output 2:	**single relay**		**Analog retransmission + relay**	
	1		—		positive	Analog retransmission 2
	2		—		negative	
O/P	3		normally closed		normally closed	
MODULE 2	4		common	Relay 2	common	Relay 2
	5		normally open		normally open	

		Output 1:	**Analog retransmission + relay**	
	1		positive	Analog retransmission 1
	2		negative	
O/P	3		normally closed	
MODULE 1	4		common	Relay 1
	5		normally open	

* Refer to Section 6.1 to check the mains input voltage
** Auto-calibration Versions Only

Table 5.2 Electrical Connections

5.4.1 Z-FG2 Probes – Fig. 5.4

Fit suitable cable glands into the entries to be used (see Table 5.2 and Fig. 5.4) and blank-off any unused entries using the bungs supplied.

Make connections ① to ⑨, as applicable.

① Mains:
Live to 'L'
Neutral to 'N'
Earth to 'E'

② Flue thermocouple:
White to 'FLUE T/C +'
Blue to 'FLUE T/C –'

③ Air thermocouple:
White to 'AIR T/C +'
Blue to 'AIR T/C –'

④ Auto-calibration request:
(Auto-calibration versions only)
Switch connections, either way round to 'BURNER +' and 'BURNER –'
Logic connections, positive to 'BURNER +' and negative to 'BURNER –'

⑤ Automatic fuel selector (dual fuel versions only):
Switch connections, either way round to 'FUEL +' and 'FUEL –'
Logic connections, positive to 'FUEL +' and negative to FUEL –'

⑥ Carbon monoxide retransmission signal (4 to 20mA):
Positive to 'CO I/P +'
Negative to 'CO I/P –'

⑦ Output 3 (refer to Table 2.1 to determine the type of module fitted):

Double relay – 'O/P MODULE 3'

'1' - normally closed
'2' - common
'3' - normally open
} Relay 4 (Zero Gas Select – Auto-cal Versions Only)

'4' - normally closed
'5' - common
'6' - normally open
} Relay 3 (Span Gas Select – Auto-cal Versions Only)

Single relay + analog output – 'O/P MODULE 3'

'1' – positive
'2' – negative
} Analog retransmission 3

'3' – not connected

'4' – normally closed
'5' – common
'6' – normally open
} Relay 3

⑧ Output 2 (refer to Table 2.1 to determine the type of module fitted):

Single relay – 'O/P MODULE 2'

'1' and '2' not connected

'3' – normally closed
'4' – common
'5' – normally open
} Relay 2

Single relay + analog output – 'O/P MODULE 2'

'1' – positive
'2' – negative
} Analog retransmission 3

'3' – normally closed
'4' – common
'5' – normally open
} Relay 2

⑨ Output 1 (refer to Table 2.1 to determine the type of module fitted):

Single relay + analog output – 'O/P MODULE 1' terminals

'1' – positive
'2' – negative
} Analog retransmission 1

'3' – normally closed
'4' – common
'5' – normally open
} Relay 1

⑩ Secure the Z-FG2 conduit fitting in the gland plate and make the following connections:

Cell output	–	red to 'PROBE CELL +' blue to 'PROBE CELL –' screen to 'PROBE CELL E'
Probe thermocouple	–	white to 'PROBE T/C +' blue to 'PROBE T/C –'
Heater	–	Live to 1st 'H' terminal, Neutral to 2nd 'H' terminal (Polarity unimportant) Earth to 'E'

⑪ Connect the probe reference air tube to the pump/regulator supply spigot.

⑫ If the surrounding air is contaminated connect a length of suitable piping to the inlet compression fitting and route to an uncontaminated environment.

5.4.2 Z-GP2 Probes – Fig. 5.5

Carry out steps ① to ⑨ as detailed in Section 5.4.1. above.

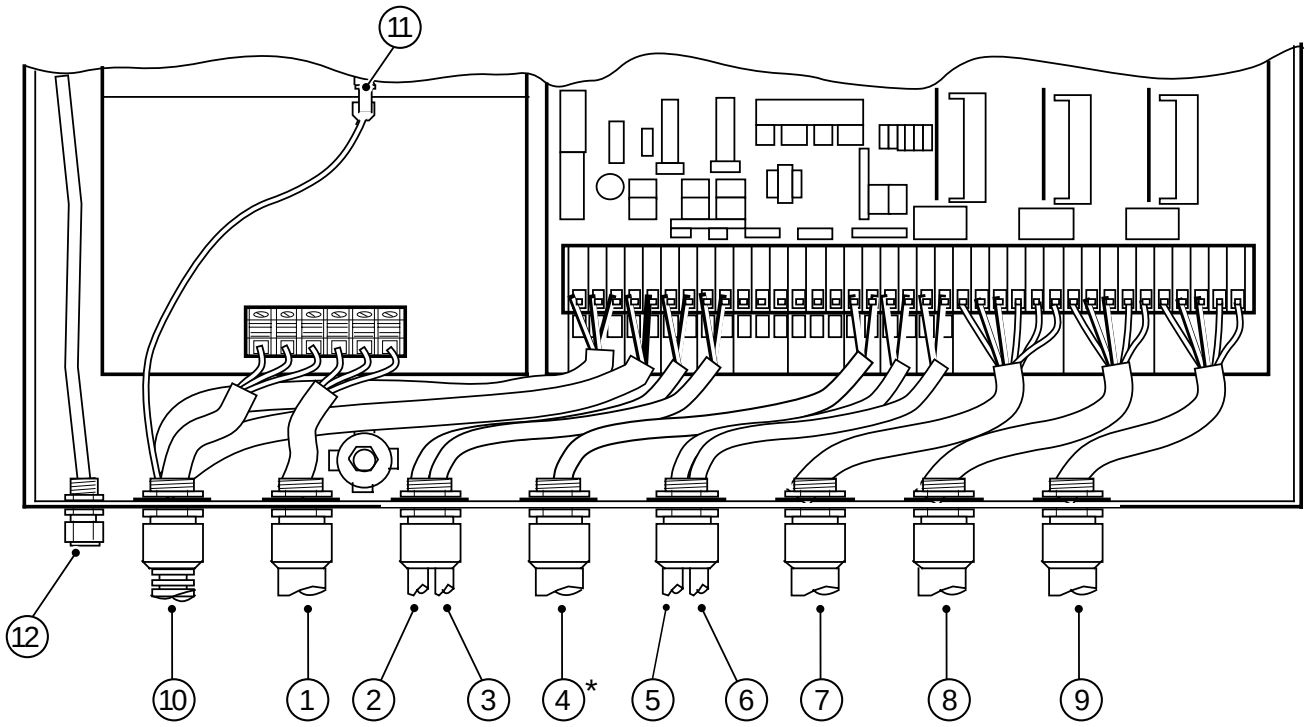
Make connections ⑩ to ⑫, as applicable.

⑩ Cell output:
Red to 'PROBE CELL+'
Blue to 'PROBE CELL –'
Screen to 'PROBE CELL E'

Cell thermocouple:
White to 'PROBE T/C +'
Blue to 'PROBE T/C –'

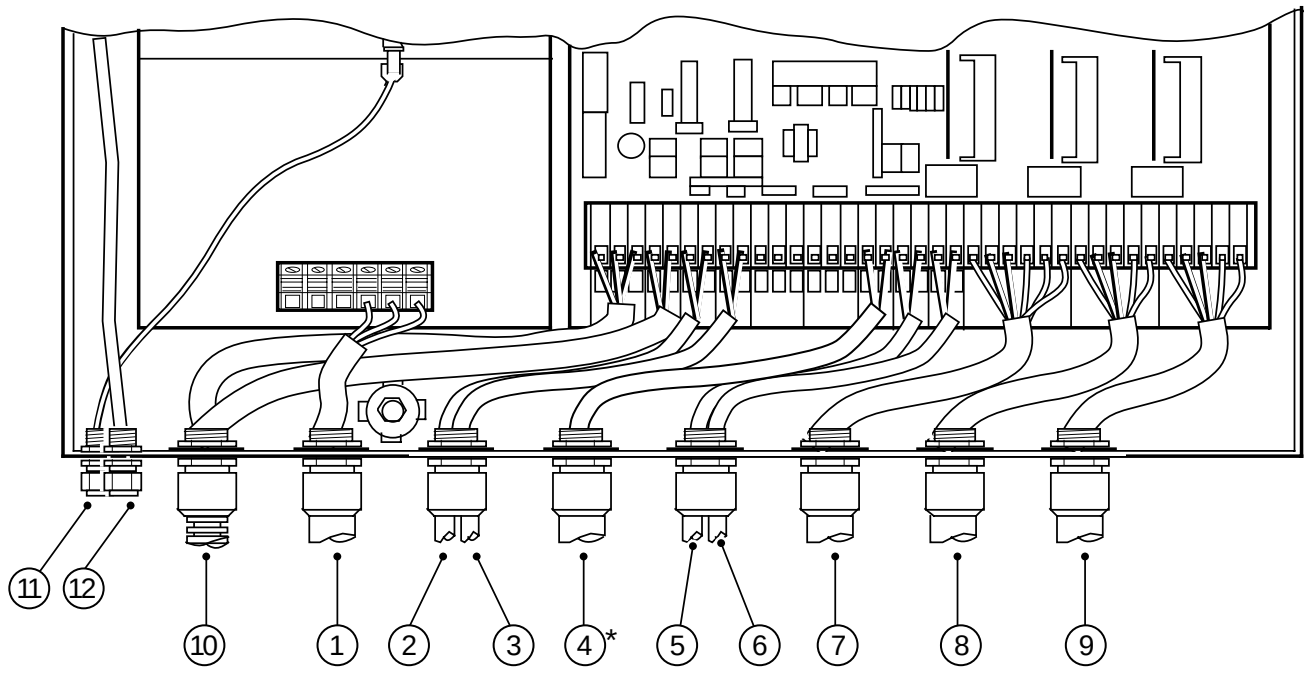
⑪ Connect the probe reference air tube to the outlet compression fitting (rear fitting).

⑫ If the surrounding air is contaminated, connect a length of suitable tubing to the inlet compression fitting (front fitting) and route to an uncontaminated environment.



*Auto-calibration Versions Only

Fig. 5.4 Connection Details – Z-FG2 Probes



*Auto-calibration Versions Only

Fig. 5.5 Connection Details – Z-GP2 Probes

6 SETTING UP

6.1 Selecting the Mains Input Voltage – Fig. 6.1

The mains input voltage (230V or 110V) is selected by repositioning three plug-in 'handbag' links on the power p.c.b.

With reference to Fig. 6.1:

① Unlock and open the door.

② Remove the four screws retaining the pump or flow gauge mounting plate and carefully lift off the plate.

Caution. If a pump is fitted take care not to stress the connections between the pump and the power board.

③ Identify the three 'handbag' links.

④ Position all three links for the mains input voltage required.

⑤ Refit the mounting plate.

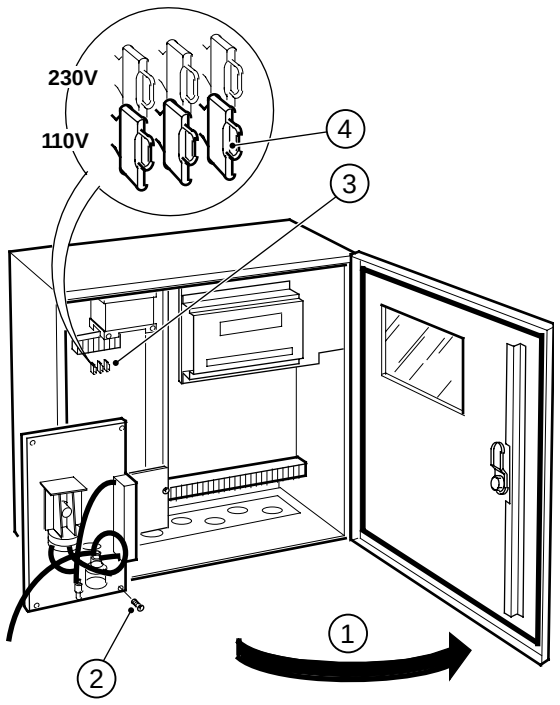


Fig. 6.1 Selecting the Mains Input Voltage

6.2 Selecting the Retransmission Output Range(s) – Fig. 6.2

The retransmission output range(s) is selected by repositioning a plug-in link on the relevant output module.

① Identify the relevant output module(s) by referring to Table 2.1.

② Identify the retransmission selector link (PL3).

③ Set the link position for the retransmission output(s) required.

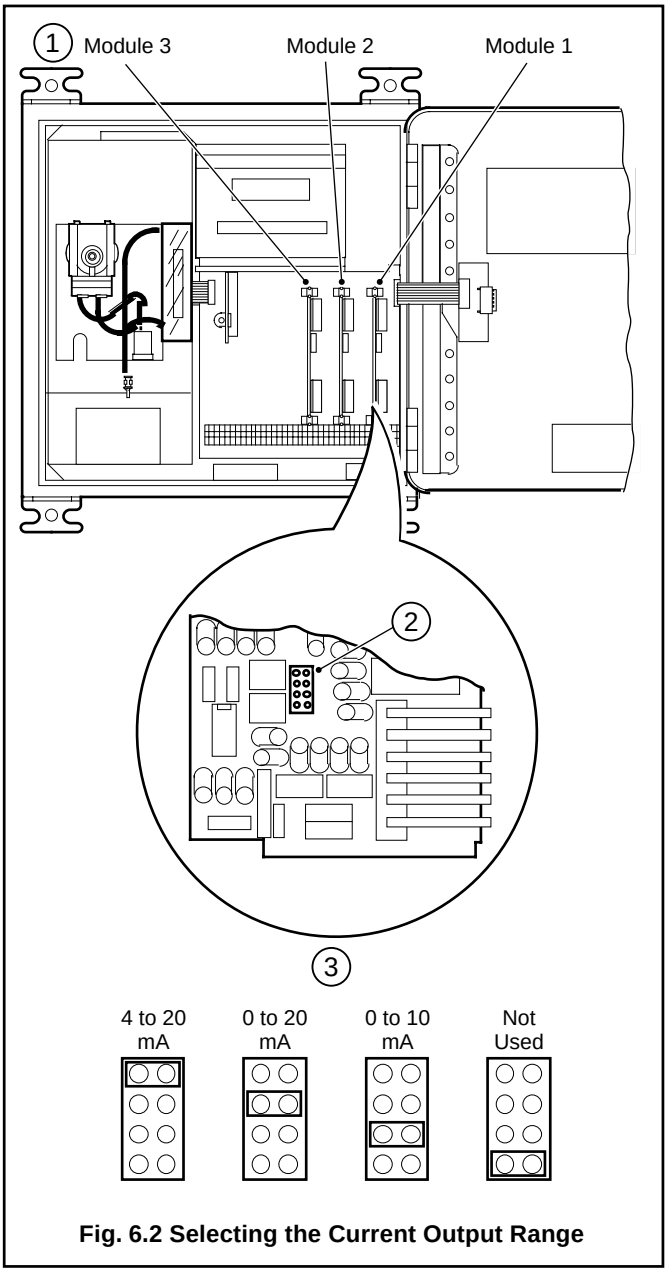


Fig. 6.2 Selecting the Current Output Range

7 DISPLAYS AND CONTROLS

7.1 Program Controls – Fig. 7.1

The program controls comprise eleven tactile membrane switches located on the front of the instrument. Four additional switches which are not used on basic or advanced analyzers have been omitted from Fig. 7.1.

The switches are used to gain access to, or sequence through, a series of **program pages** to view and/or change the **parameters** contained within the pages. Pages can contain two sets of parameters: USER PARAMETERS, accessible at any time and SECURE PARAMETERS, accessible using a security sequence – see Section 9.1.

In normal operation the switches are used to view **User Pages** i.e. the measured oxygen concentration, cell, flue and air temperatures, combustion efficiency, alarms, carbon dioxide/ monoxide content and calibration (as applicable) – see Fig. 9.1. They can also be used to access a further series of **Utility Pages** to setup relay/analog retransmission outputs and assess system performance (Diagnostics Page) – see Fig. 9.1.

$\%O_2$ 'Oxygen' switch – used for **viewing** the measured $\%O_2$ (calculated from the Nernst equation) in the **% Oxygen Page** (see Fig. 10.1).

Temp 'Temperature' switch – used for accessing the **Display Temperature Page** (see Fig. 10.2).

Comb Eff 'Combustion Efficiency' switch – used for **viewing** the combustion efficiency (calculated from the Siegert formula) in the **Combustion Efficiency Page** (see Section 10.3).

Alarm 'Alarm' switch – used for accessing the **Alarms and Indication Page** (see Fig. 10.3).

CO_2/CO 'Carbon Dioxide/Monoxide' switch – used for accessing the **Carbon Dioxide/Carbon Monoxide Page** (see Fig. 10.5).

Cal 'Calibration' switch – used for accessing the probe **Calibration Page** (see Fig. 13.1).

'Page Advance' switch – used for advancing to the next program page (see Fig. 9.1).

'Parameter Advance' switch – used for advancing to the next parameter within a program page and when calibrating, for rejecting unsatisfactory calibration values.

▲ 'Raise' switch – used for increasing a parameter value or stepping-up through a selection of parameters. Also used as a security switch for access to **SECURE PARAMETERS** within individual pages – refer to Section 9.1.

▼ 'Lower' switch – used for decreasing a parameter value or stepping-down through a selection of parameters.

Enter 'Enter' switch – used for storing the programmed parameters and values into the instrument's non-volatile memory and, when calibrating, for accepting new calibration values.

Note.

- The instrument responds instantly to any program change but the change is lost in the event of a power interruption, or during power-down, if it has not been 'Entered'.
- Continuous pressure on the 'Raise' or 'Lower' switches causes the rate of change of the displayed value to increase. To make small adjustments press the switches momentarily.

7.2 Reference Air Supply – Fig. 7.1

The instrument is fitted with one of the following to provide a reference air supply for the probe:

Dosing pump with flow indicator (Z-FG2 probe),

Pressure regulator unit with adjustable flow gauge (Z-GP2 probe),

Pump unit with adjustable flow gauge (Z-FG2 and Z-GP2 probes).

7.3 Displays – Fig. 7.1

There are two displays: a 5-digit, seven segment **digital** display and a 20-character, 9 x 7 **dot-matrix** display (lower). The digital display shows values relating to instrument parameters shown on the dot-matrix display below.

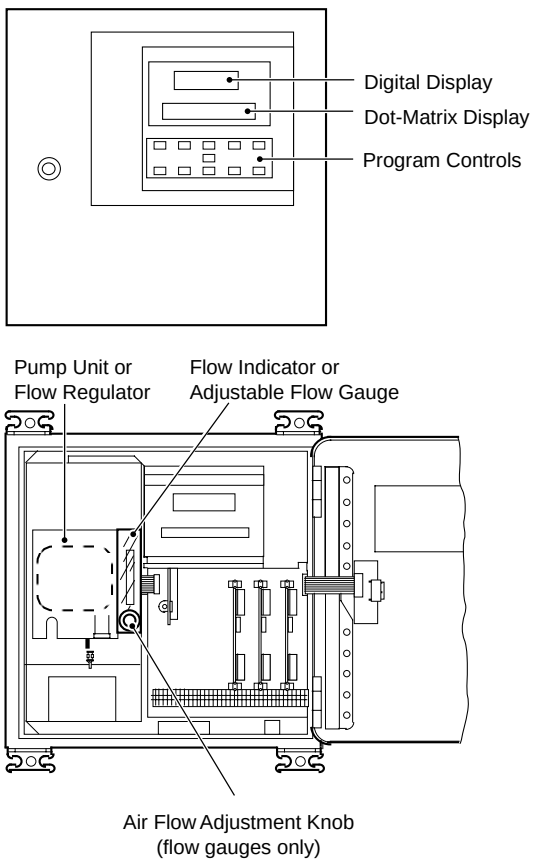


Fig. 7.1 Displays and Controls

8 INITIAL START-UP

Note. During start-up, it may be necessary to set the reference air flow to the probe. Refer to Section 8.2 for clarification.

8.1 Start-Up Procedure

When the instrument is first switched on, the upper and lower displays are illuminated for approximately three seconds as a check for failed segments/dots.

The start-up procedure is then implemented in two stages:

Cell warm-up *
Cell stabilizing

* Omitted if the cell temperature is preset – see Section 10.2.

8.1.1 Cell Warm-up

The upper display is blank and the following message is shown on the lower display at all page headers:

```
xxx Cell warming up
```

Note. x x x is a short-code page header identifying the current page – refer to Section 10.4.1 for full details.

The instrument automatically monitors the probe temperature until it exceeds the **Probe Under Temperature Alarm Point** for the probe being used; 600°C for Company probes. During the cell warm-up period all oxygen-related parameters are inaccessible or disabled to prevent erroneous readings and/or inadvertent alarm/retransmission operation – see Table 8.1.

8.1.2 Cell Stabilization

After successful completion of **Cell Warm-up** the page header displays revert automatically to the following:

```
xxx Cell stabilising
```

Notes.

a) x x x is a short-code page header identifying the current page – refer to Section 10.4.1 for full details.

b) The measured oxygen concentration is now displayed in the upper display as an indication of system operation. This value is for observation only and **must not be taken as the true oxygen concentration** until the start-up procedure is completed.

The cell output is monitored until a stable level is detected (15 minutes typ.) If the output has not stabilized after a period of approximately 30 minutes has elapsed, it is assumed that the measured oxygen concentration is fluctuating (rather than the cell output) and the instrument reverts to normal operation, i.e. all instrument features available.

During the cell stabilization period all oxygen-related parameters are inaccessible/disabled to prevent erroneous readings and/or inadvertent alarm/retransmission operation – refer to Table 8.1.

If the instrument's program is not suitable for the application, refer to Sections 9 to 11.

Availability	Parameter
Inaccessible/ Disabled (where applicable)	Calibration Page Oxygen-related retransmission outputs Oxygen-related relay outputs Deviation from O2 set point alarms Efficiency calculation Inferred carbon dioxide content
Accessible/ Enabled (where applicable)	All Pages other than Calibration Page All temperature-related retransmission outputs All temperature-related relay outputs Carbon monoxide content

Table 8.1 Parameter Availability During Cell Warm-up

8.2 Setting the Reference Air Flow

The reference air flow to the probe may require adjustment depending on the probe type and the pump/regulator configuration – see Table 8.2. For flow gauge location refer to Fig. 7.1.

Probe Type	Pump/Regulator Configuration	Adjustment
Z-FG2	Pump + flow indicator Regulator + adjustable flow gauge	None Set to 150 to 200ml/min
Z-GP2	Pump + adjustable flow gauge Regulator + adjustable flow gauge	Set to 250 to 1000ml/min Set to 250 to 1000ml/min

Table 8.2 Reference Air Flow Settings

8.3 Simple Fault Finding

Carry out the checks detailed in the following table before contacting the Service Organization.

- Are all connections made correctly? – see Section 5.
- Is there power to the instrument?
- Are the mains input selectors correctly positioned for the supply used? – see Section 6.
- Check the **Diagnostics Page** parameters to assess system performance – see Section 11.2.
- Is the reference air supply tubing blocked and/or trapped and is the flow rate correct? – see Section 8.

9 PROGRAMMING – GENERAL

The overall program chart is shown in Fig. 9.1. Refer to Figs. 10.1, 11.1 and 12.1 for summaries of the **User** Pages, **Utility Pages**, and **Auto-calibration Pages** respectively. The **Commissioning Page** parameters are programmed prior to despatch and cannot be accessed. For full commissioning procedures refer to manual IM/ZMT/0012.

9.1 Access to Secure Parameters – Figs. 10.1 and 11.1

Secure parameters in individual pages can be accessed by operating and holding the ▲ switch for approximately three seconds, at any parameter in the page prior to security access being required.

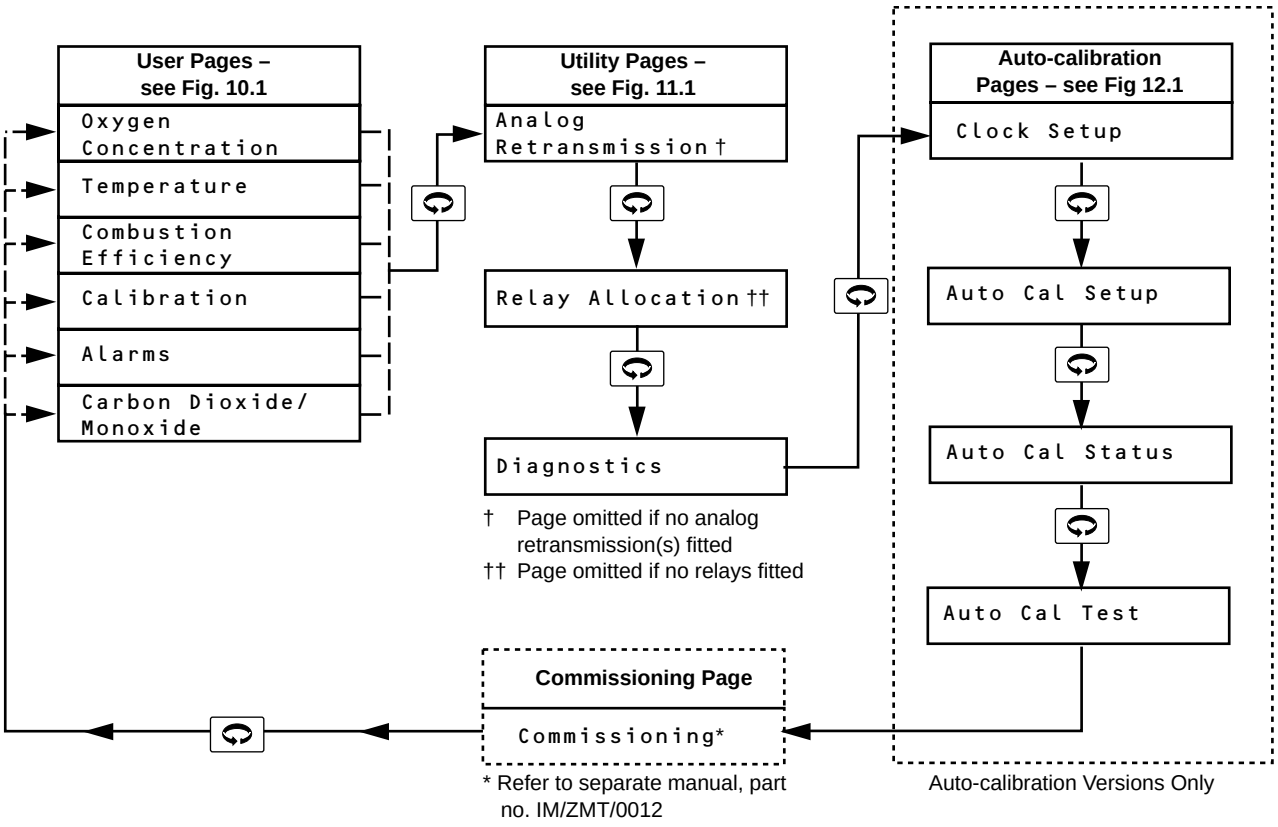


Fig. 9.1 Overall Program Chart

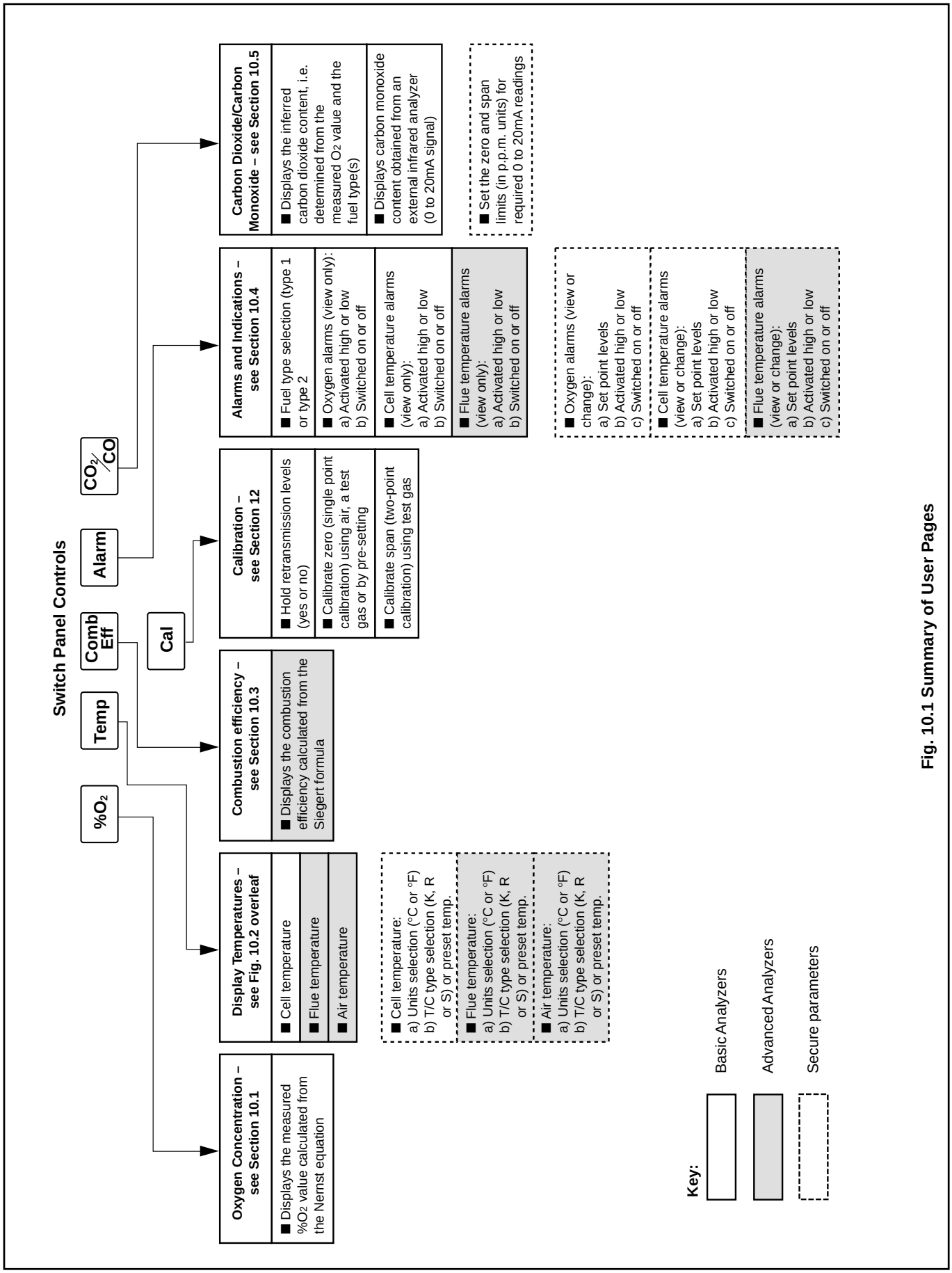
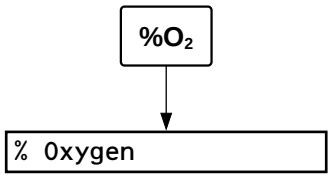


Fig. 10.1 Summary of User Pages

10.1 Oxygen Page

The % oxygen content is calculated from the Nernst equation.



Select the **oxygen** page.

% Oxygen

The calculated oxygen content (%) is shown on the upper display.

10.2 Display Temperature Page

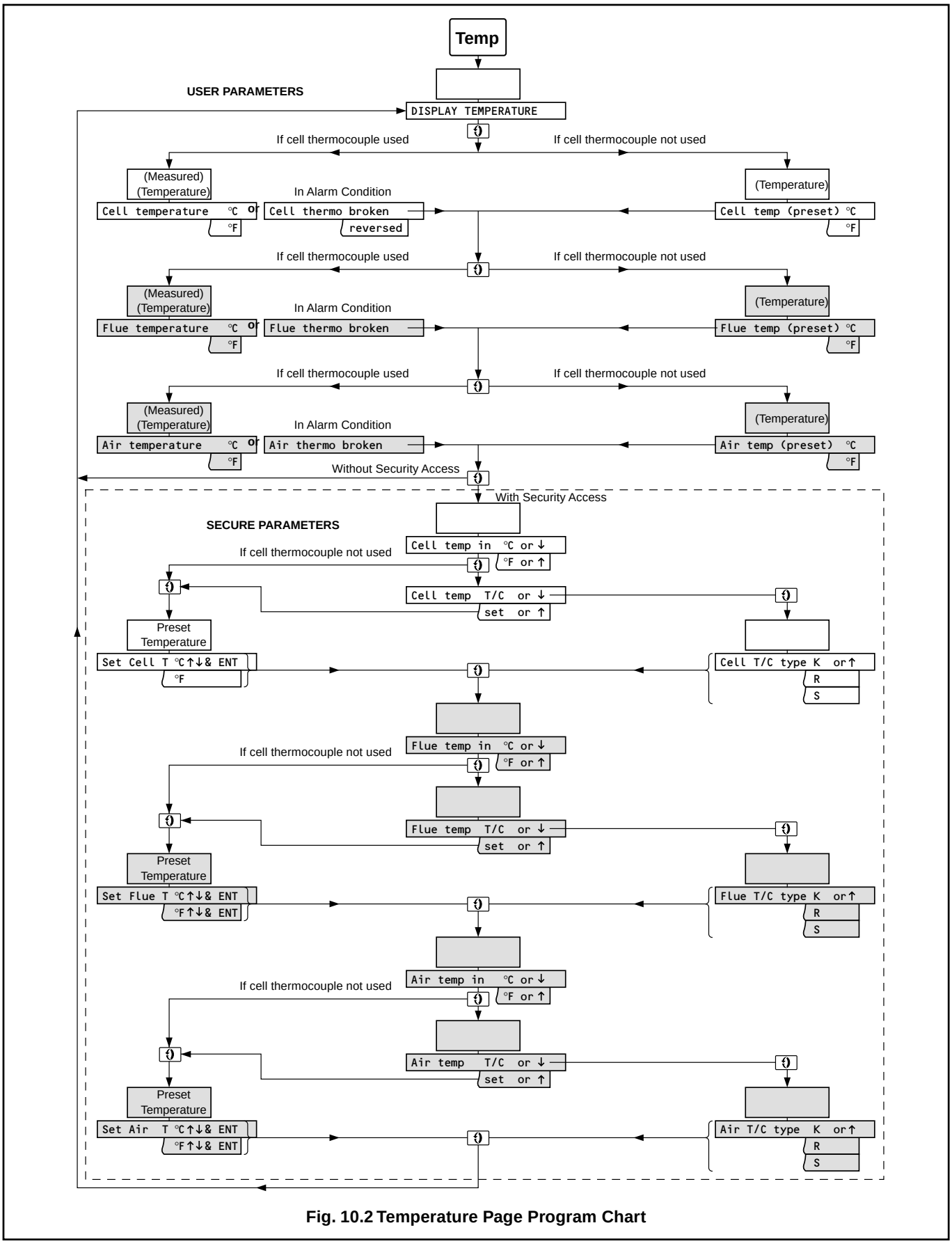
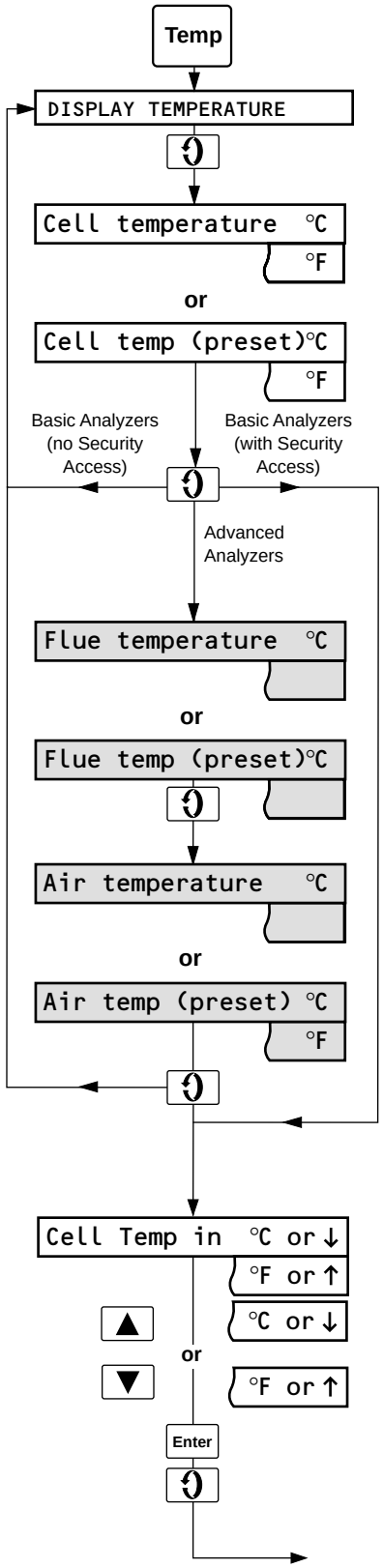


Fig. 10.2 Temperature Page Program Chart

…10.2 Display Temperature Page

Refer to Fig. 10.2 when carrying out the following procedures.

Note. The **USER PARAMETERS** in this page can only be viewed. To change any parameter, the **SECURE PARAMETERS** at the bottom of the page must be accessed – see Section 9.1.



Select the **Display Temperature Page**.

USER PARAMETERS

Measured Cell Temperature
The measured cell temperature is shown on the upper display.

or
Preset Cell Temperature
The preset cell temperature is shown on the upper display.

Advance to next parameter (advanced analyzers) ***or***
Return to top of **Temperature Page** (basic analyzers, no security access) ***or***
Advance to **SECURE PARAMETERS** (basic analyzers, with security access).

Note. A preset the cell temperature disables the probe heater supply and therefore must not be used in conjunction with Z-FG2 probes.

Measured Flue Temperature
The measured flue temperature is shown on the upper display.

or
Preset Flue Temperature
The preset flue temperature is shown on the upper display.

Measured Air Temperature
The measured air temperature is shown on the upper display.

or
Preset Air Temperature
The preset air temperature is shown on the upper display.

Return to top of **Display Temperature Page** (without security access) ***or***
Advance to next parameter (with security access).

SECURE PARAMETERS

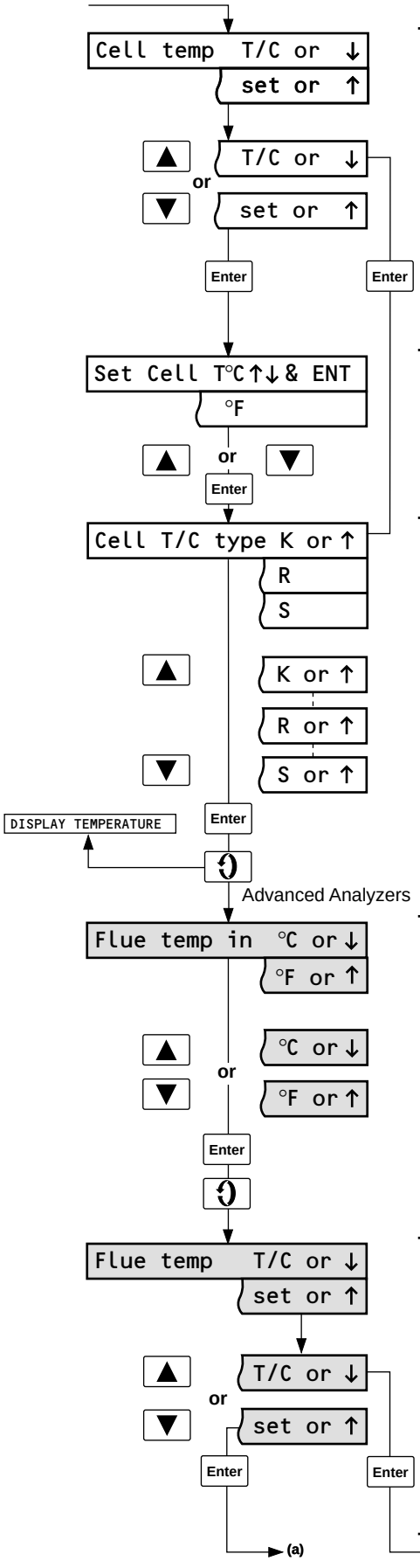
Cell Temperature, Display Units
Select the cell temperature display units.

°C display units.
or
°F display units.

Note. Any analog retransmission outputs, relay outputs or diagnostic checks relating to the cell thermocouple input are displayed automatically in the units selected – see Figs. 11.2, 11.3 and 11.4

Continued on next page.

…10.2 Display Temperature Page



Cell Temperature, Thermocouple or Preset Temperature

Select whether the cell temperature is to be preset or measured using a thermocouple.

Use thermocouple to measure cell temperature.
or
Use preset cell temperature.

Note. The preset temperature is a reference value for calculation of oxygen concentration using the Nernst equation and is not a temperature control setting for the probe.

Presetting the Cell Temperature

The preset temperature is shown on the upper display.

Set the temperature to that at which the probe is operated (must be greater than 600°C).

Cell Temperature Thermocouple Type

Select the thermocouple being used for cell temperature measurement.

Type K thermocouple.

Type R thermocouple.

Type S thermocouple.

Return to top of **Display Temperature Page** (basic analyzers) ***or***
Advance to next parameter (advanced analyzers).

Flue Temperature, Display Units

Select the flue temperature display units.

°C display units.
or
°F display units.

Note. Any analog retransmission outputs, relay outputs or diagnostic checks relating to the flue thermocouple input are displayed automatically in the units selected – see Figs. 11.2, 11.3 and 11.4.

Flue Temperature, Thermocouple or Preset Temperature

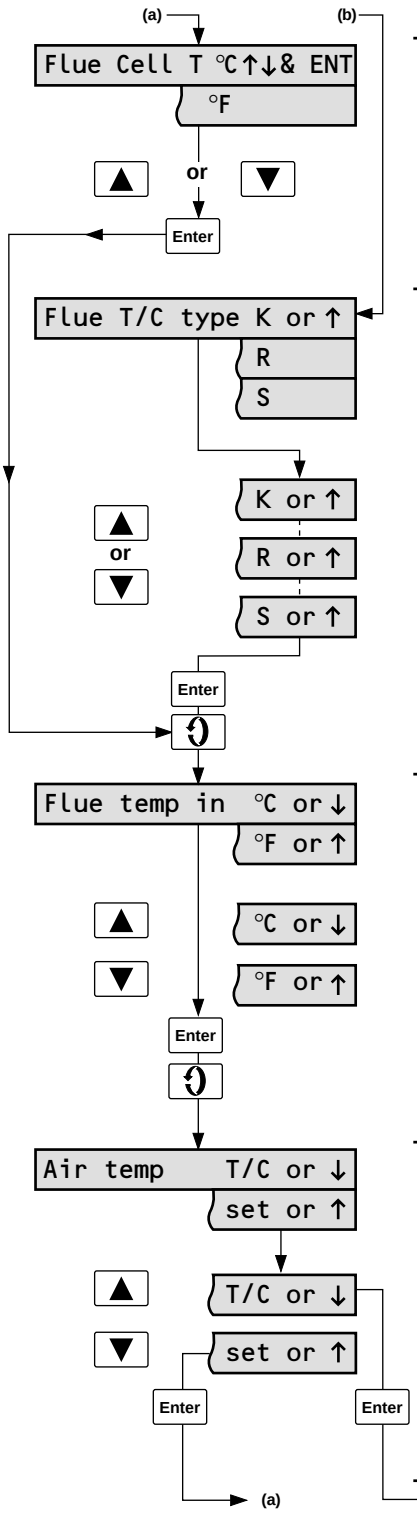
Select whether the flue temperature is to be preset or measured using a thermocouple.

Use thermocouple to measure flue temperature.
or
Use preset flue temperature.

Note. The preset temperature is a reference value for calculation of the combustion efficiency and is not a temperature control setting for the flue.

(a) (b) Continued on next page.

…10.2 Display Temperature Page



Presetting the Flue Temperature

The preset temperature is shown on the upper display.

Set the temperature at which the flue is maintained.

Flue Temperature Thermocouple Type

Select the thermocouple being used for flue temperature measurement:

Type K thermocouple.

Type R thermocouple.

Type S thermocouple.

Air Temperature, Display Units

Select the air temperature display units.

°C display units.
or
°F display units.

Note. Any analog retransmission outputs or diagnostic checks relating to the air thermocouple input are displayed automatically in the units selected – see Figs. 11.2 and 11.4.

Air Temperature, Thermocouple or Preset Temperature

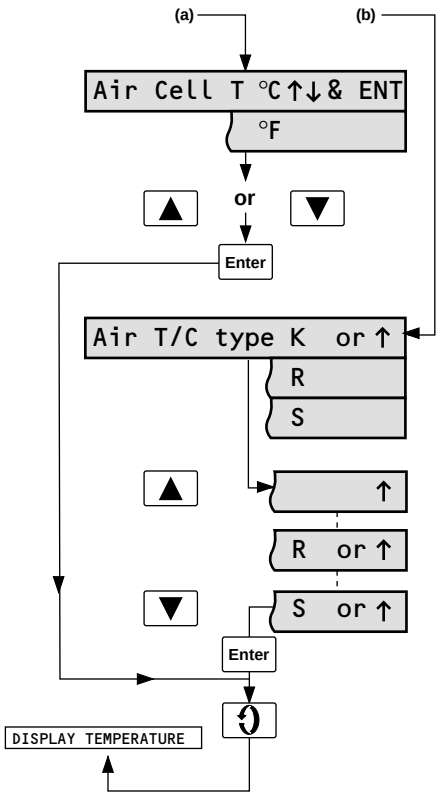
Select whether the air temperature is to be preset or measured using a thermocouple.

Use thermocouple to measure air temperature.
or
Use preset air temperature.

Note. The preset temperature is a reference value for calculation of the combustion efficiency and is not a temperature control setting for the air.

(b) Continued on next page.

…10.2 Display Temperature Page



Presetting the Air Temperature

The preset temperature is shown on the upper display.

Set the temperature at which the air is maintained.

Air Temperature Thermocouple Type

Select the thermocouple being used for air temperature measurement.

Type K thermocouple.

Type R thermocouple.

Type S thermocouple.

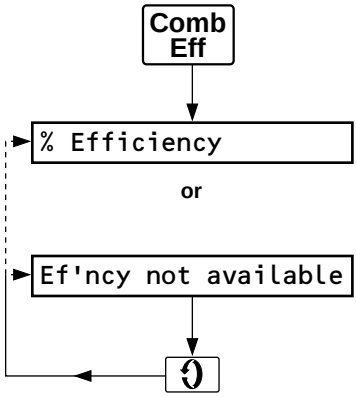
Return to top of **Display Temperature Page**.

10.3 Combustion Efficiency Page

The combustion efficiency is calculated from the Siegert formula using the:

- Flue temperature
- Air temperature
- Measured oxygen concentration
- Fuel constant K

If any of the above are unavailable or unreliable, e.g. in the event of an alarm, the efficiency calculation cannot be carried out and 'Ef'ncy not available' is shown on the lower display.



Select the **Combustion Efficiency Page**.

Calculated % Efficiency

The calculated combustion efficiency (%) is shown on the upper display.

Calculated % Efficiency Not Available

The combustion efficiency cannot be calculated.

Return to top of **Combustion Efficiency Page**.

10.4 Alarms and Indications Page

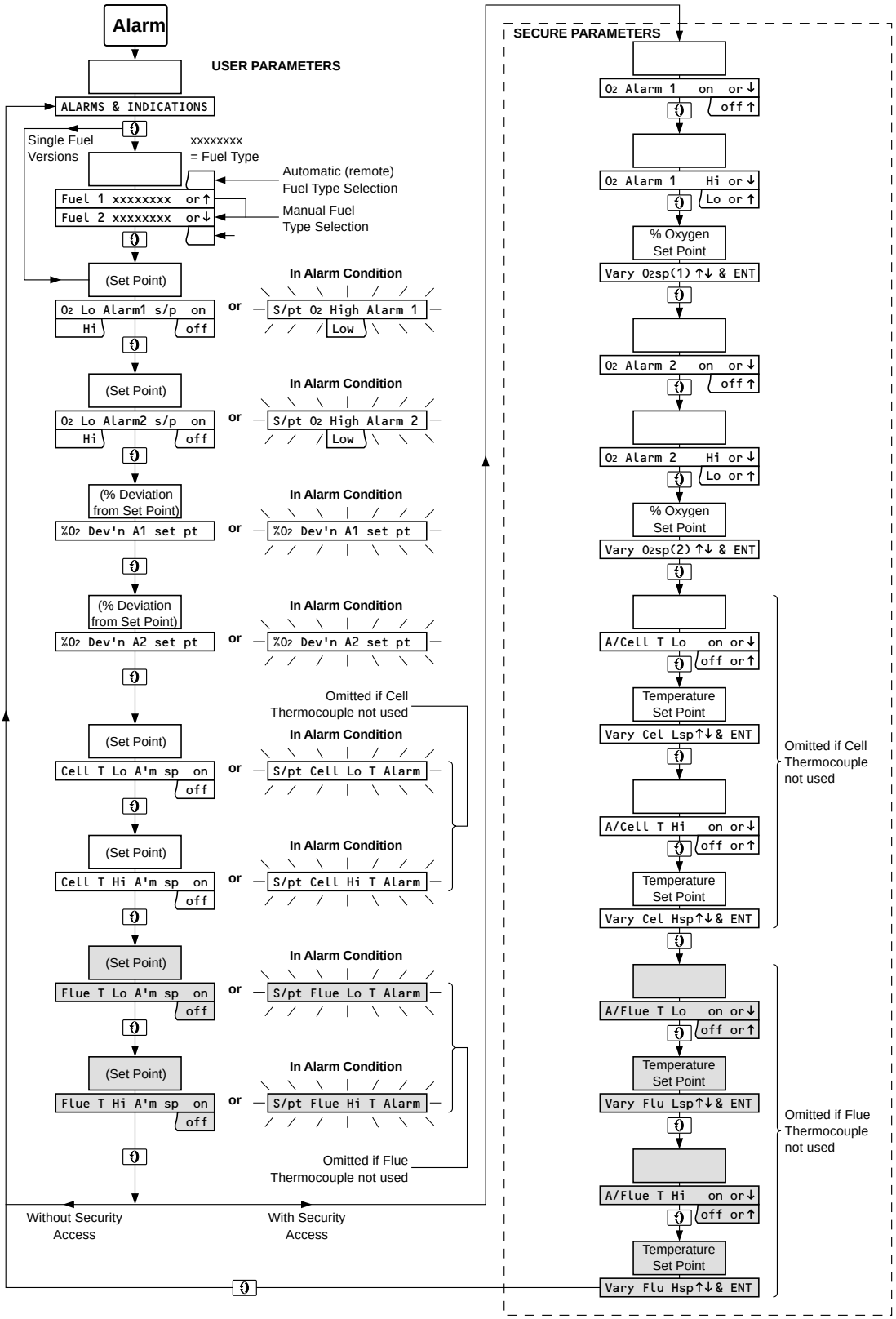
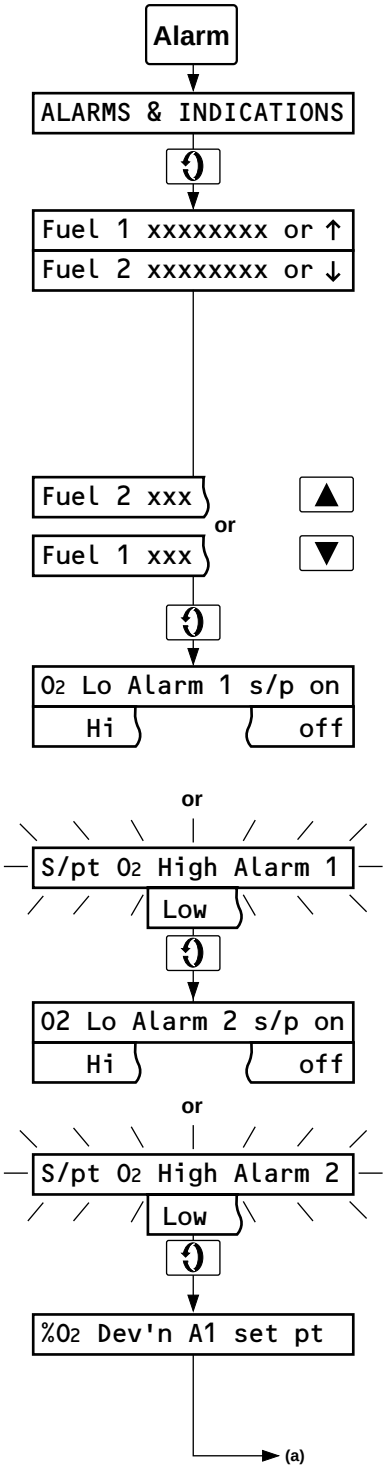


Fig. 10.3 Alarm Page Program Chart

…10.4 Alarms and Indications Page

Refer to Fig. 10.3 when carrying out the following procedures.

Note. The **USER PARAMETERS** in this page can only be viewed. To change any parameter, the **SECURE PARAMETERS** at the bottom of the page must be accessed – see Section 9.1.



Select **Alarms and Indications Page**.

USER PARAMETERS

Advance to next parameter.

Fuel Type Changeover (dual fuel versions only)

The two fuel types may be changed over either manually (using the front panel controls) or automatically (using a remote switch) – see manual IM/ZMT/0012.

For **manual** changeover the 'Up' or 'Down' symbol is shown at the end of the display and fuel 1/2 selection is implemented using the 'Up' or 'Down' switch, as appropriate. For **automatic** changeover the 'Up' and, 'Down' symbols are omitted and fuel changeover can be implemented using an external switch at any time.

Select fuel 2.
or
Select fuel 1.

Advance to next parameter.

Oxygen Alarm 1 Set Point

The set point is shown on the upper display. The alarm may be either on or off and activated either high or low:

High – alarm activated above set point.
Low – alarm activated below set point.

In alarm condition (display flashing).

Oxygen Alarm 2 Set Point

As for Oxygen Alarm 1 Set Point, above.

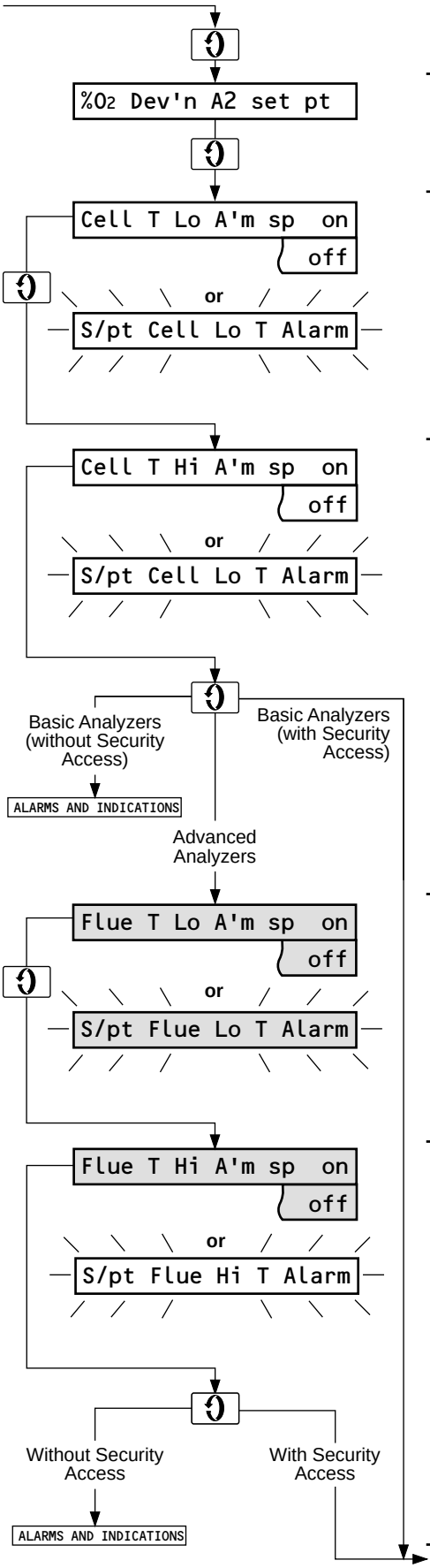
In alarm condition (display flashing).

Oxygen 1, Deviation from Set Point

The deviation of the measured oxygen concentration from that of the **Oxygen Alarm 1 Set Point** is shown on the upper display.

Continued on next page.

…10.4 Alarms and Indications Page



Oxygen Alarm 2, Deviation from Set Point

The deviation of the measured oxygen concentration from that of the **Oxygen Alarm 2 Set Point** is shown on the upper display.

Cell Temperature Low Alarm Set Point

The set point is shown on the upper display and the alarm may be on or off.

or

In alarm condition (display flashing).

Note. This parameter is omitted if the cell temperature is preset in the **Display Temperature Page** – see Section 10.2.

Cell Temperature High Alarm Set Point

The set point is shown on the upper display and the alarm may be on or off.

or

In alarm condition (display flashing).

Note. The high alarm set point may be set at a lower value than that of the low alarm set point, if required.

Advance to next parameter (advanced analyzers).
or
Return to top of **Alarms and Indications Page** (basic analyzers without security access).
or
Advance to **SECURE PARAMETERS** section (basic analyzers with security access).

Flue Temperature Low Alarm Set Point

The set point is shown on the upper display and the alarm may be on or off.

or

In alarm condition (display flashing).

Note. This parameter is omitted if the flue temperature is preset in the **Display Temperature Page** – see Section 10.2.

Flue Temperature High Alarm Set Point

The set point is shown on the upper display and the alarm may be on or off.

or

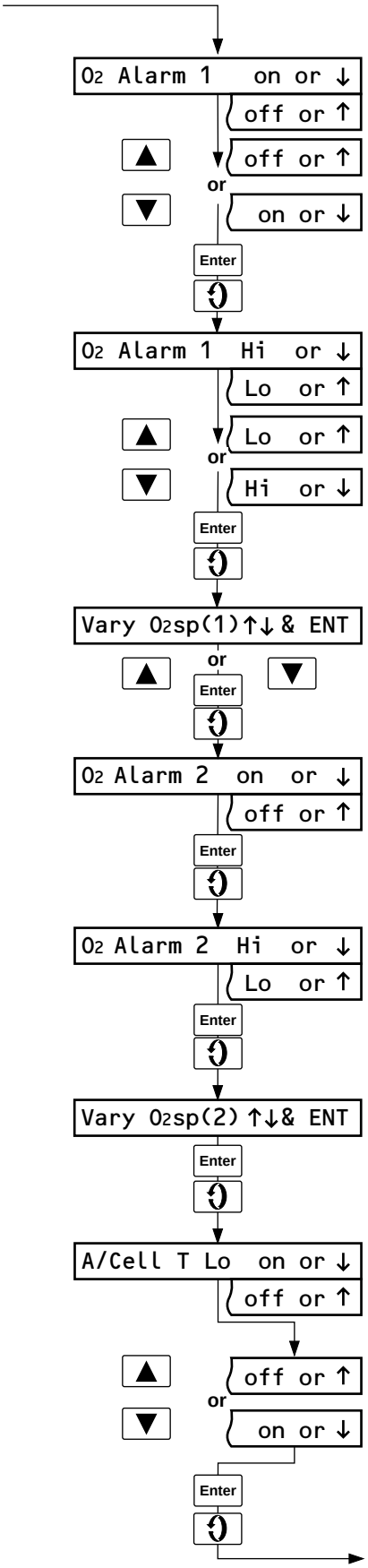
In alarm condition (display flashing).

Note. This parameter is omitted if the flue temperature is preset in the **Display Temperature Page** – see Section 10.2.

Return to top of **Alarms and Indications Page** (without security access).
or
Advance to next parameter (with security access).

Continued on next page.

…10.4 Alarms and Indications Page



SECURE PARAMETERS

Oxygen Alarm 1, On or Off

Switch off.
or
Switch on.

Oxygen Alarm 1, Activated High or Low

Activate low (below set point).
or
Activate high (above set point).

Adjust Oxygen Alarm 1 Set Point

Set the value on the upper display to that of the set point required.

Oxygen Alarm 2, On or Off

Repeat as for **Oxygen Alarm 1, On or Off**, above.

Oxygen Alarm 2, Activated High or Low

Repeat as for **Oxygen Alarm 1, Activated High or Low**, above.

Adjust Oxygen Alarm 2 Set Point

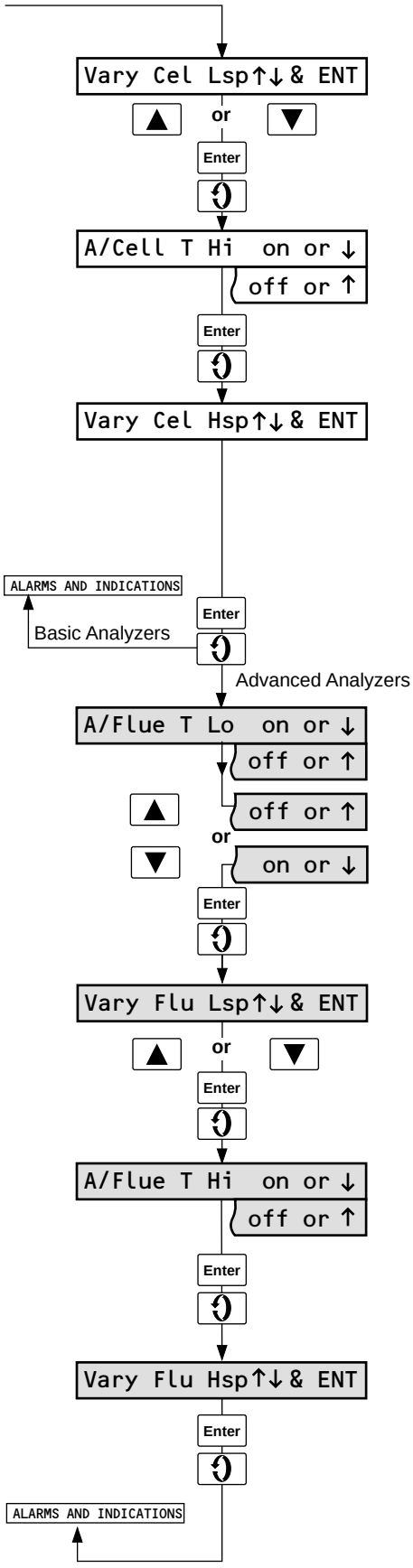
Repeat as for **Adjust Oxygen Alarm 1 Set Point**, above.

Cell Temperature Low Alarm Set Point, On or Off

Switch off.
or
Switch on.

Continued on next page.

…10.4 Alarms and Indications Page



Adjust Cell Temperature Low Alarm Set Point

Set the value on the upper display to that of the set point required.

Cell Temperature High Alarm Set Point, On or Off

Repeat as for **Cell Temperature Low Alarm Set Point, On or Off**, on previous page.

Adjust Cell Temperature High Alarm Set Point

Repeat as for **Adjust Cell Temperature Low Alarm Set Point**, above.

Note. The low alarm set point may be set to a higher value than that of the high alarm set point, if required.

Return to top of **Alarms and Indications Page** (basic analyzers).
or
Advance to next parameter (advanced analyzers).

Flue Temperature Low Alarm Set Point, On or Off

Switch off.
or
Switch on.

Adjust Flue Temperature Low Alarm Set Point

Set the value on the upper display to that of the set point required.

Flue Temperature High Alarm Set Point, On or Off

Repeat as for **Flue Temperature Low Alarm Set Point, On or Off**, above.

Adjust Flue Temperature High Alarm Set Point

Repeat as for **Adjust Flue Temperature Low Alarm Set Point**, above.

Note. The low alarm set point may be set to a higher value than that of the high alarm set point, if required.

Return to top of **Alarms and Indications Page**.

10.4.1 Alarm Indication – Fig. 10.4

In the event of an alarm, a short-code page header description and abbreviated alarm description are shown on the lower display – see Fig. 10.4.

If an alarm(s) occurs while a parameter in any particular page is being viewed, the lower display reverts automatically to the top of that page to show the alarm description, i.e. to prevent an alarm being overlooked.

Note. If an alarm(s) occurs while a calibration procedure is being implemented, any relays assigned to the alarm are activated but the alarm description is not displayed until the calibration is complete, in order to prevent interruption of a calibration procedure.

Once the alarm condition has been indicated, all user/programming pages can be viewed to assess the action required to clear the alarm. In the **Alarm and Indications Page** any activated alarm parameter reverts to a flashing alarm message; non-activated alarm parameters are unchanged.

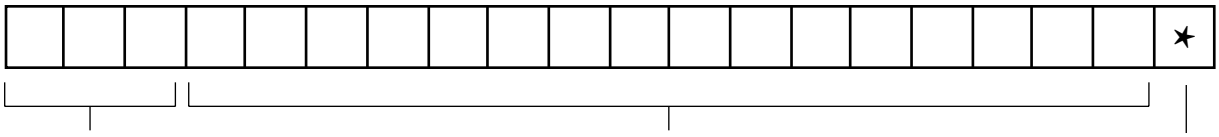
10.4.2 Multiple Alarm Indication

In the event of more than one alarm being activated the alarm of highest priority for accurate instrument operation is shown on the lower display i.e. fault alarms have priority over user alarms. An asterisk at the end of the display signifies that an additional alarm, or alarms, has occurred.

Alarm priorities, in descending order, are as follows:

Cell thermocouple reversed
Cell thermocouple broken
Cell warming up } See Section 8.1, Setting Up
Cell stabilizing }
Cell under temperature
Flue thermocouple broken
Air thermocouple broken
High cell temperature
Low cell temperature
Low flue temperature
High flue temperature
Oxygen 1
Oxygen 2
Auto-calibration failed
Auto-calibration in progress

Any additional alarm(s) can be located by viewing the **Alarms and Indications Page** and **Display Temperature Page**.



Short-code Page Header:

%O2	– Oxygen
T	– Temperature
EFF	– Combustion Efficiency
ALM	– Alarms and Indications
CO2	– Carbon Dioxide/Monoxide
CAL	– Calibration
AN	– Analog Retransmission
RLY	– Relay Allocation
DIA	– Diagnostics
CS	– Clock Setup
CSU	– Auto-calibration Setup
CST	– Auto-calibration Status
CTS	– Auto-calibration Tests

Abbreviated Alarm Description

cell T/C reversed	– Cell thermocouple reversed
broken cell T/C	– Broken cell thermocouple
cell warming up	– Cell warming up*
cell stabilising	– Cell stabilizing*
cell under temp	– Cell under temperature
broken flue T/C	– Broken flue thermocouple
broken air T/C	– Broken air thermocouple
cell Lo T alarm	– Low cell temperature alarm
cell Hi T alarm	– High cell temperature alarm
flue Hi T alarm	– Low flue temperature alarm
flue Lo T alarm	– High flue temperature alarm
Hi O2 alarm 1	– High Oxygen alarm 1
Lo O2 alarm 1	– Low Oxygen alarm 1
Hi O2 alarm 2	– High Oxygen alarm 2
Lo O2 alarm 2	– Low Oxygen alarm 2
Auto cal failed	– Auto-calibration sequence failed
In auto cal	– Auto-calibration sequence in progress

Multiple Alarm Indicator

* Applicable only on initial start-up – see Section 8.1

Fig. 10.4 Alarm Indication

10.4.3 Instrument Response in Event of Fault Alarm(s)

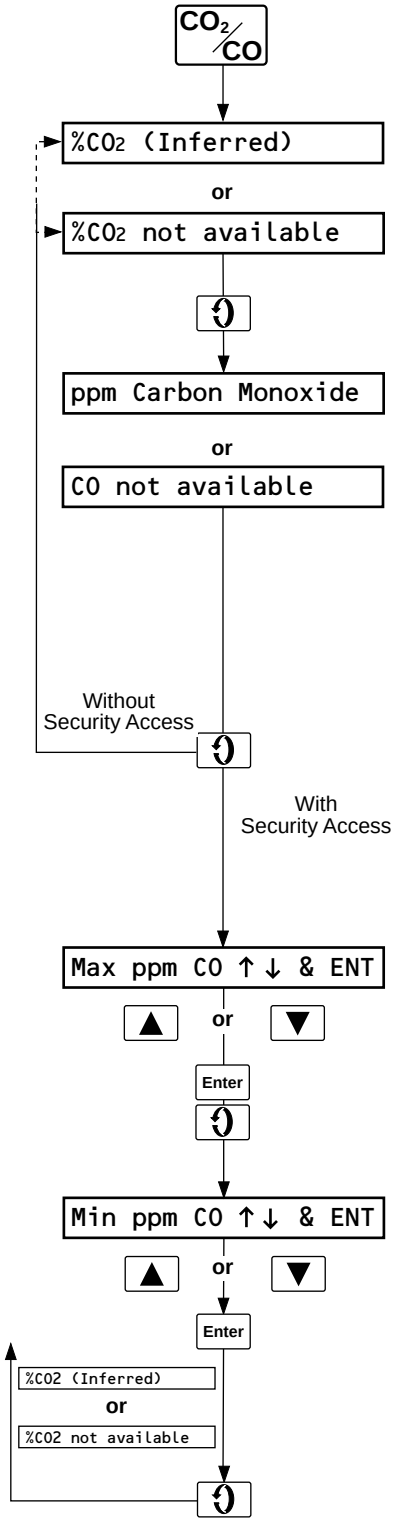
If a fault alarm(s) occurs the instrument controls specific parameters automatically to prevent use of unreliable information and/or to prevent damage to the probe. Activation of user alarms have no effect on instrument operation.

Alarm	Pages Affected	Instrument Response
Cell Thermocouple Reversed	Oxygen Page	%O not available (top display blank)
	Temperature Page	Measured cell temperature is replaced by '`Cell thermo reversed`'
	Combustion Efficiency Page	% efficiency not available (top display blank)
	Carbon Dioxide/Monoxide Page	% carbon dioxide not available (top display blank)
	Alarms and Indications Page	Oxygen alarms 1 and 2 are disabled
		Deviation alarms revert to flashing alarm description '`S/pt 0 High/Low Alarm 1/2`'
	Relay Allocation Page	Any relay with cell temperature alarm assigned is disabled
		Any relay with oxygen alarm assigned is disabled
	Analog Retransmission Page	Any retransmission with % oxygen assigned is set to minimum output
		Any retransmission with cell temperature assigned is set to minimum output
		Any retransmission with % efficiency assigned is set to minimum output
	Calibration Page	Not available
Cell Thermocouple Broken	Temperature Page	Measured cell temperature is replaced by '`Cell thermo broken`'
As for Cell Thermocouple Reversed, except for:	Analog Retransmission Page	Any retransmission with cell temperature assigned is set to maximum output
Cell Under Temperature	Oxygen Page	%O not available (top display blank)
	Temperature Page	Measured cell temperature is replaced by '`Cell thermo broken`'
	Combustion Efficiency Page	% efficiency not available (top display blank)
	Carbon Dioxide/Monoxide Page	% carbon dioxide not available (top display blank)
	Alarms and Indications Page	Oxygen alarms 1 and 2 are disabled
		Deviation alarms revert to flashing alarm description '`S/pt 0 High/Low Alarm 1/2`'
	Relay Allocation Page	Any relay with oxygen alarm(s) assigned is disabled
	Analog Retransmission Page	Any retransmission with % oxygen assigned is set to minimum output
		Any retransmission with % efficiency assigned is set to minimum output
	Calibration Page	Not available
Broken Flue Thermocouple	Temperature Page	Measured flue temperature is replaced by '`flue thermo reversed`'
	Combustion Efficiency Page	% efficiency not available (top display blank)
	Relay Allocation Page	Any relay with flue temperature alarm assigned is disabled
	Analog Retransmission Page	Any retransmission with flue temperature assigned is set to maximum output
		Any retransmission with % efficiency assigned is set to minimum output
Broken Air Thermocouple	Temperature Page	Measured air temperature is replaced by '`Air thermo reversed`'
		% efficiency not available (top display blank)
	Combustion Efficiency Page	Any relay with air temperature alarm assigned is disabled
	Relay Allocation Page	Any retransmission with air temperature assigned is set to maximum output
	Analog Retransmission Page	Any retransmission with % efficiency assigned is set to minimum output

Table 10.1 Instrument Response In Event of Fault Alarm(s)

10.5 Carbon Dioxide/Carbon Monoxide Page

The percentage carbon dioxide content is calculated on a 'dry' basis from the measured oxygen concentration and the fuel type (usually specified at the time of ordering).



Select the **Carbon Dioxide/Carbon Monoxide Page**.

USER PARAMETERS

Inferred (calculated) Carbon Dioxide

The carbon dioxide content (%) is shown on the upper display.

or

Carbon Dioxide Content Not Available

The carbon dioxide content cannot be calculated, e.g. if 'Unknown' or 'Special' fuel of unspecified composition is selected in the **Commissioning Page** – see manual IM/ZMT/0012.

Carbon Monoxide Content

The carbon monoxide content (p.p.m.) is shown on the upper display.

or

Carbon Monoxide Content Not Available

If the signal input from an external monitor is disabled in the **Commissioning Page**, display of carbon monoxide content is not available.

Note. If an external monitor is not connected, the monitor input must be disabled in the **Commissioning Page**. Failure to do this results in a fluctuating value being shown on the upper display.

Return to top of **Carbon Dioxide/Carbon Monoxide Page** (without security access).

or

Advance to next parameter (with security access).

SECURE PARAMETERS

Maximum Carbon Monoxide Range Value

Set the maximum carbon monoxide range value of the monitor (refer to Section 10.5.1 for full procedure).

Minimum Carbon Monoxide Range Value

Set the minimum Carbon Monoxide range value of the monitor (refer to Section 10.5.1 for full procedure).

Return to top of **Carbon Dioxide/Carbon Monoxide Page**.

10.5.1 Standardizing Z-MT Unit to External Carbon Monoxide Monitor

These procedures relate to the **SECURE PARAMETERS** in Section 10.5, above.

Note. It is recommended that the Z-MT unit is standardized whenever the CO monitor is recalibrated.

Method 1 – Using Current Simulator

This method involves simulating the current retransmission output from the monitor using a calibrated current source and setting the corresponding maximum/minimum range values (in p.p.m.) on the Z-MT unit.

a) Connect an accurate current source (range 0 to 20mA) in place of the 'CO I/P' connections – see Fig. 5.4 or 5.5.

With reference to the monitor's instruction manual, make a note of the following – b) to e):

b) The minimum CO range value of the monitor (in p.p.m.)

c) The corresponding current output level for b) (in mA).

d) The maximum CO range value of the monitor (in p.p.m.).

e) The corresponding current output level for d) (in mA).

Example. A measurement range of 0 to 4000 p.p.m. may have minimum and maximum retransmission levels of 4 and 20mA, respectively.

f) Set the current source to the current level noted at e) and adjust the **Maximum CO Range Value** (See Section 10.5) on the upper display to the value noted at d). Store.

g) Set the current source to the current level noted at c) and adjust the **Minimum CO Range Value** (see Section 10.5) on the upper display to the value noted at b). Store.

Re-make original CO monitor connections (disconnected at a), above).

Method 2 – Using Known Test Gases

This method involves injecting two known test gases into the CO sensor and setting their equivalent values (in p.p.m.) on the Z-MT unit.

a) Select the test gases, ideally with values as close as possible to the operating page limits of the carbon monoxide monitor, e.g. for an operating range of 0 to 4000 p.p.m. test gases of 0 to 400 and 2000 to 4000 p.p.m.and are permissible.

b) Inject the higher of the test gases into the sensor (see manufacturer's instruction manual) and allow a suitable time for the measured CO level to stabilize.

c) Note the CO level and set the same value at **Maximum CO Range Value** (see Section 10.5) on the upper display. Store.

Disconnect the test gas.

d) Inject the lower of the test gases into the sensor (see manufacturer's instruction manual) and allow a suitable time for the measured CO level to stabilize.

e) Note the CO level and set the same value at **Minimum CO Range Value** (see Section 10.5) on the upper display. Store.

f) Disconnect the test gas.

Note.

a) Neither the carbon dioxide or carbon monoxide measurement can be retransmitted.

b) The carbon monoxide measurement is obtained directly from a current retransmission signal from an external carbon monoxide monitor.

c) For any **Commissioning Page** information refer to manual IM/ZMT/0012.

d) If a 'Special' fuel type is selected in the **Commissioning Page** the relevant fuel combustion data must be programmed.

10.6 Calibration Page

The calibration page is used for probe calibration – refer to Section 13.

11 PROGRAMMING – UTILITY PAGES

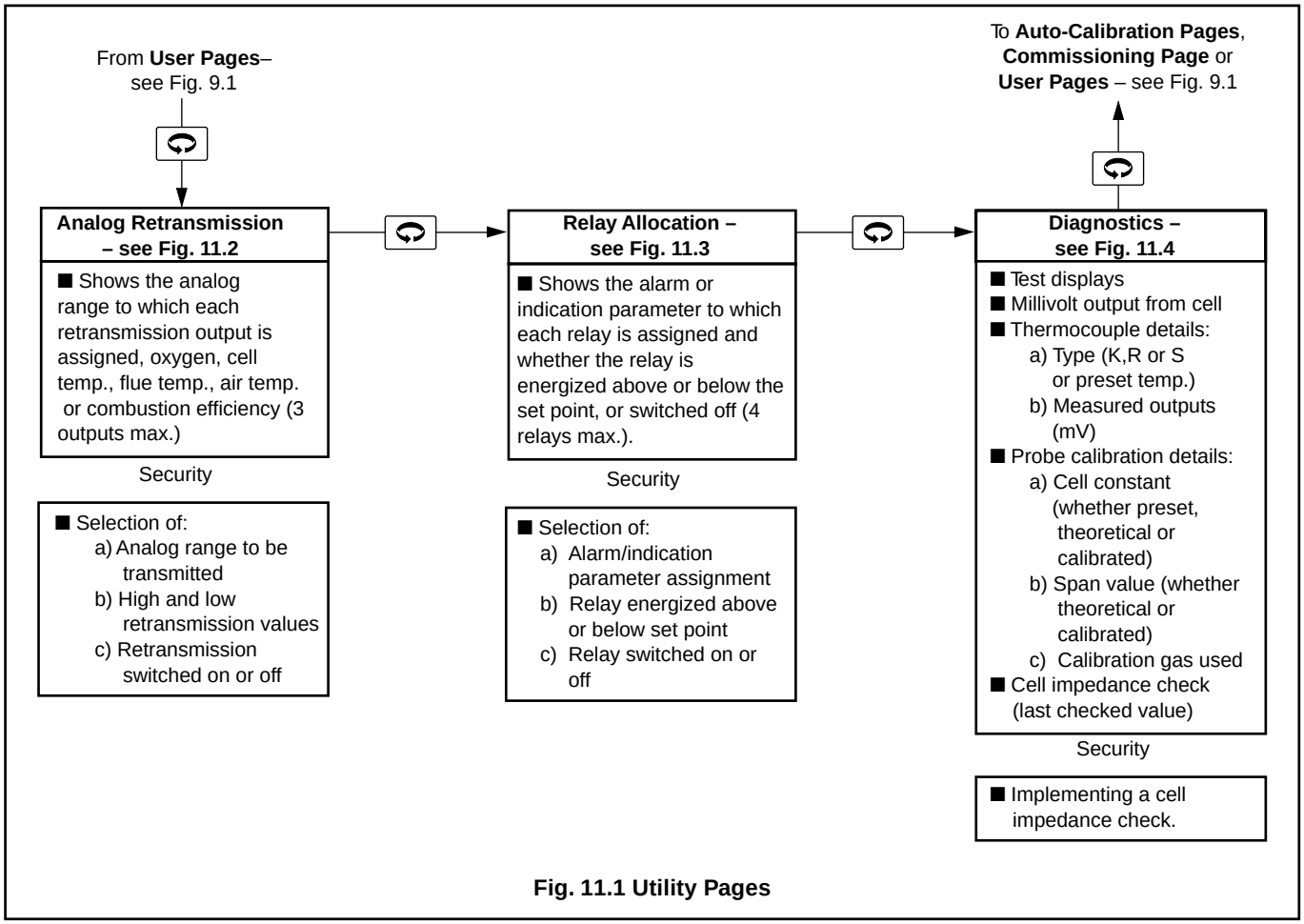


Fig. 11.1 Utility Pages

11.1 Analog Retransmission Page

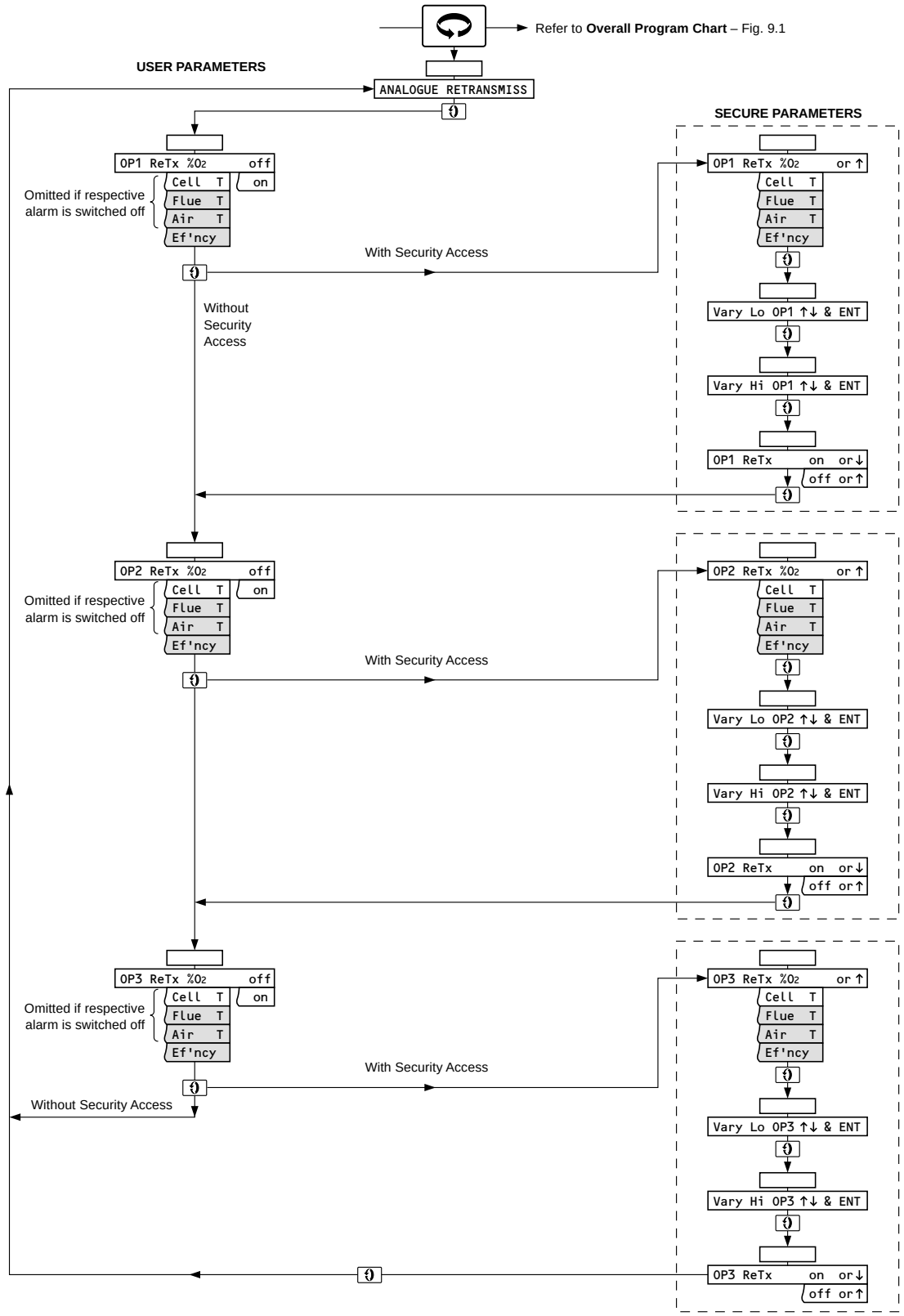


Fig. 11.2 Analog Retransmission Page Program Chart

…11.1 Analog Retransmission Page

Note.
- The **USER PARAMETERS** in this page can only be viewed. To change any parameter the **SECURE PARAMETERS** section must be accessed for **each individual retransmission output** – see Section 9.1.
- This page is omitted if there are no retransmission outputs.

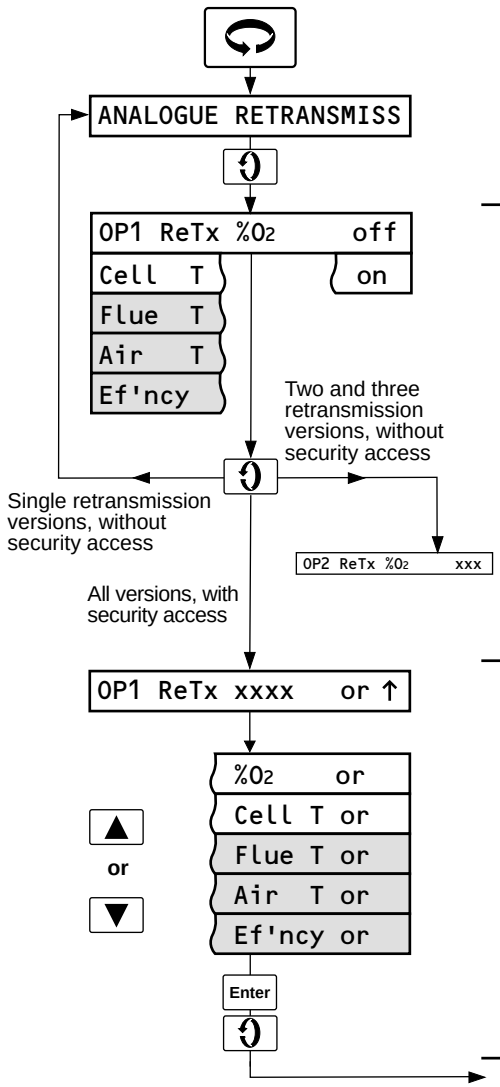
The number of retransmission outputs is selected on the Commissioning Page (see manual IM/ZMT/0012):
1 or 2 – basic analyzers
1, 2 or 3 – advanced analyzers

The following parameter ranges may be assigned to any of the retransmission outputs:
Measured oxygen concentration
Measured cell temperature *
Measured flue temperature *
Measured air temperature *
Calculated combustion efficiency

* Cannot be retransmitted if utilizing a preset temperature – refer to Section 10.2.

Refer to Section 6.2 to identify the retransmission signal output range.

Refer to Fig. 11.2 when carrying out the following procedures.



Select the **Analog Retransmission Page**.

USER PARAMETER

Retransmission Output 1
The parameter range assigned to Retransmission Output 1 is displayed. The output may be either on or off.

Return to top of **Analog Retransmission Page** (1 retransmission versions).
or
Advance to next parameter (2 and 3 retransmission versions without security access).
or
Advance to **SECURE PARAMETERS (retransmission 1)** section (all versions, with security access).

SECURE PARAMETERS (retransmission 1)

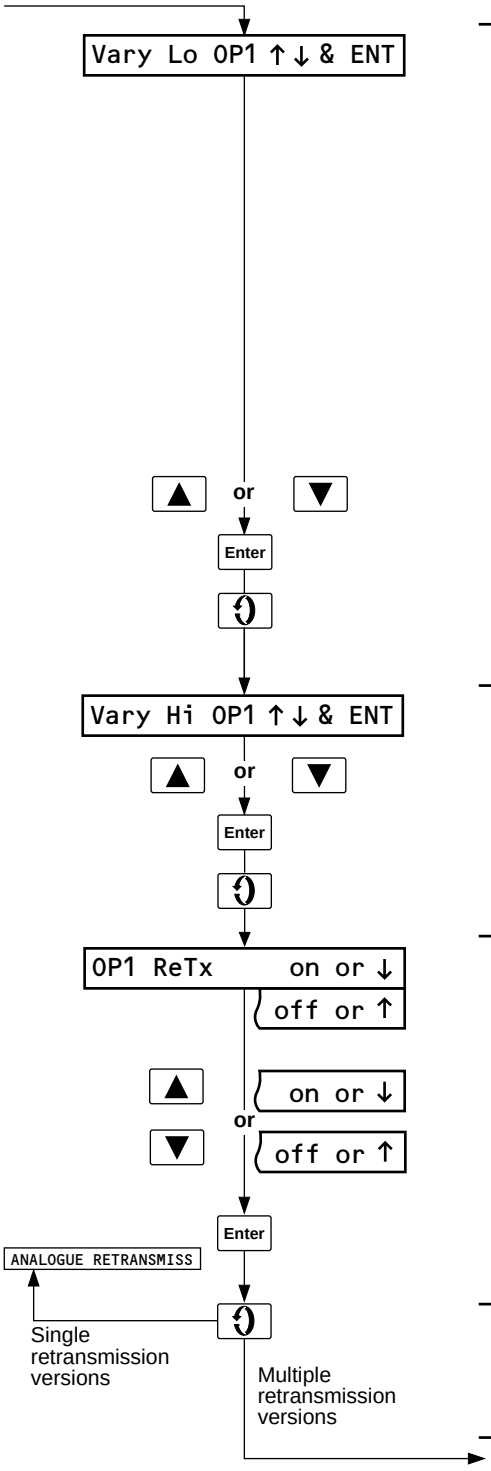
Retransmission Output 1, Parameter Range

Select the parameter range to be assigned to Retransmission Output 1.

Note. The temperature ranges cannot be retransmitted if utilizing a preset temperature – refer to Section 10.2.

Continued on next page.

…11.1 Analog Retransmission Page



Retransmission Output 1, Lower Retransmission Value

The retransmission output can operate over any portion of the assigned parameter range, with minimum span limits, as follows:

Oxygen concentration – 5% O_2 min.
Temperature measurement ranges – 200°C (360°F) min.
Efficiency range – 20% min.

It is not possible to set the lower retransmission value too close to the upper retransmission value, since the upper value is raised automatically to maintain the minimum retransmission span.

Example – If the lower retransmission value on a 10 to 18% O_2 range is increased to 15% O_2, the new higher retransmission value is raised automatically to 20% O_2, i.e. maintaining a minimum retransmission span of 5% O_2.

Set the lower retransmission value required (shown on the upper display), i.e. the parameter range value at which minimum output current is required. The value is set in the units of assigned parameter range (% O_2, °C, °F or %).

Note. The lower retransmission value is unaffected by any alteration of the higher retransmission value, following.

Retransmission Output 1, Higher Retransmission Value

Set the high retransmission level required (shown on the upper display), i.e. the parameter range value at which maximum current output is required.

Note. The higher retransmission value cannot be set closer to the lower retransmission value than the minimum span limit.

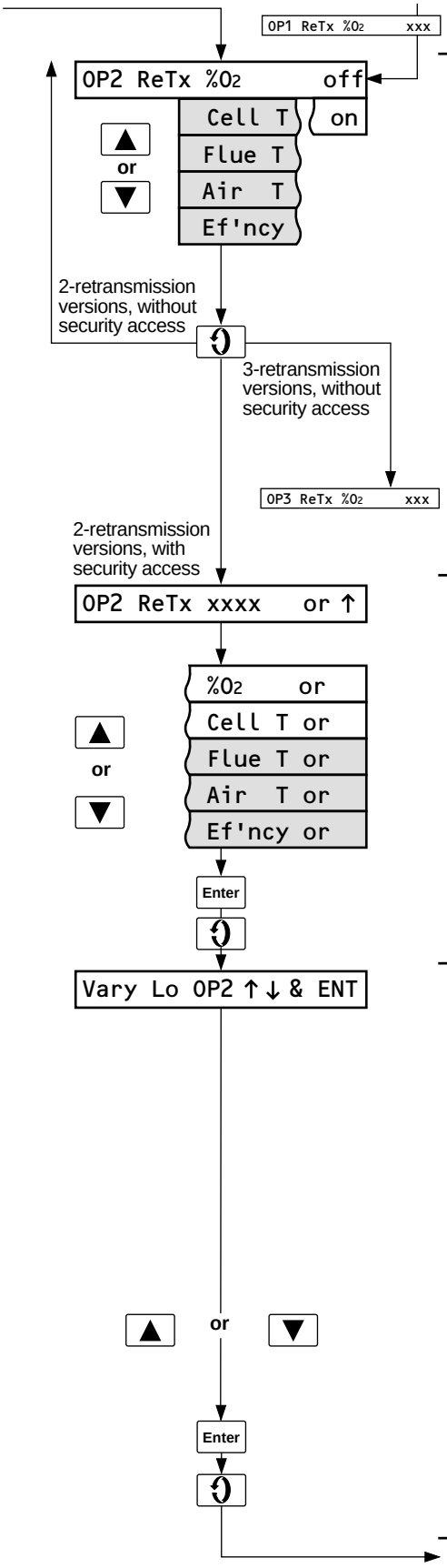
Retransmission Output 1, On or Off

Switch on.
or
Switch off.

Return to top of **Analog Retransmission Page** (single retransmission versions).
or
Advance to next parameter (multiple retransmission versions).

Continued on next page.

…11.1 Analog Retransmission Page



USER PARAMETER

Retransmission Output 2

The parameter range assigned to Retransmission Output 2 is displayed. The output may be either on or off.

Return to top of **Analog Retransmission Page** (2-retransmission versions).

or

Advance to next parameter (multiple retransmission versions without security access).

or

Advance to **SECURE PARAMETERS (retransmission 2)** section (2- and 3-retransmission versions with security access) – see Section 9.1.

SECURE PARAMETERS (retransmission 2)

Retransmission Output 2, Parameter Range

Select the parameter range to be assigned to Retransmission Output 2.

Note. The temperature ranges cannot be retransmitted if utilizing a preset temperature – refer to Section 10.2.

Retransmission Output 2, Lower Retransmission Value

The retransmission output can operate over any portion of the assigned parameter range, with minimum span limits, as follows:

Oxygen concentration – 5% O_2 min.
Temperature measurement ranges – 200 °C (360°F) min.
Efficiency range – 20% min.

It is not possible to set the lower retransmission value too close to the upper retransmission value, since the upper value is raised automatically to maintain the minimum retransmission span.

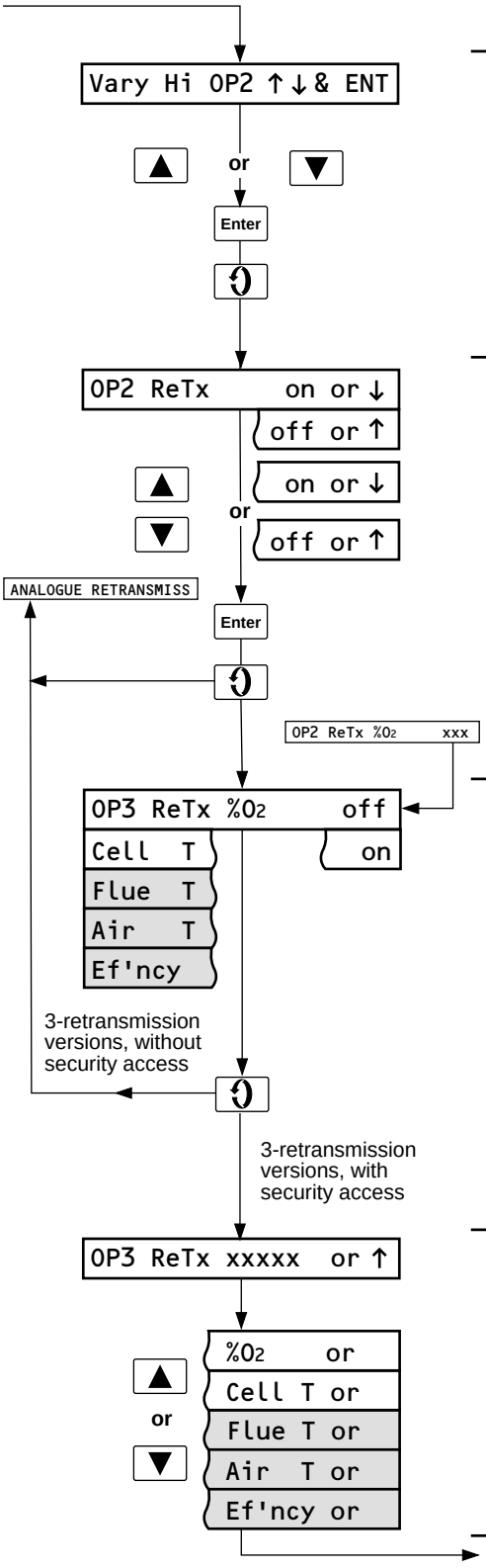
Example – If the lower retransmission value on a 10 to 18% O_2 range is increased to 15% O_2, the new higher retransmission value is raised automatically to 20% O_2, i.e. maintaining a minimum retransmission span of 5% O_2.

Set the lower retransmission value required (shown on the upper display), i.e. the parameter range value at which minimum output current is required. The value is set in the units of assigned parameter range (% O_2, °C, °F or %).

Note. The lower retransmission value is unaffected by any alteration of the higher retransmission value, following.

Continued on next page.

…11.1 Analog Retransmission Page



Retransmission Output 2, Higher Retransmission Value

Set the high retransmission level required (shown on the upper display), i.e. the parameter range value at which maximum current output is required.

Note. The higher retransmission value cannot be set closer to the lower retransmission value than the minimum span limit.

Retransmission Output 2, On or Off

Switch on.
or
Switch off.

Return to top of **Analog Retransmission Page** (2-retransmission versions).
or
Advance to next parameter (3-retransmission versions).

USER PARAMETER

Retransmission Output 3

The parameter range assigned to Retransmission Output 3 is displayed. The output may be either on or off.

Return to top of **Analog Retransmission Page** (3-retransmission versions, without security access).
or
Advance to **SECURE PARAMETERS (retransmission 2)** section (3- retransmission versions with security access) – see Section 9.1

SECURE PARAMETERS (retransmission 3)

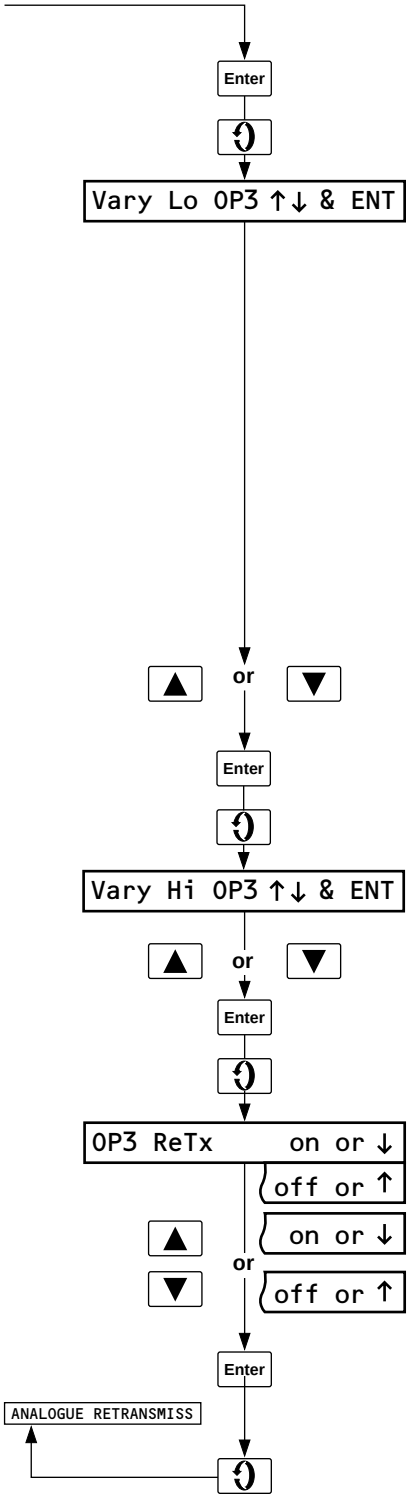
Retransmission Output 3, Parameter Range

Select the parameter range to be assigned to Retransmission Output 3.

Note. The temperature ranges cannot be retransmitted if utilizing a preset temperature – refer to Section 10.2.

Continued on next page.

…11.1 Analog Retransmission Page



Retransmission Output 3, Lower Retransmission Value

The retransmission output can operate over any portion of the assigned parameter range, with minimum span limits, as follows:

Oxygen concentration – 5% O_2 min.
Temperature measurement ranges – 200 °C (360°F) min.
Efficiency range – 20% min.

It is not possible to set the lower retransmission value too close to the upper retransmission value, since the upper value is raised automatically to maintain the minimum retransmission span.

Example – If the lower retransmission value on a 10 to 18% O_2 range is increased to 15% O_2, the new higher retransmission value is raised automatically to 20% O_2, i.e. maintaining a minimum retransmission span of 5% O_2.

Set the lower retransmission value required (shown on the upper display), i.e. the parameter range value at which minimum output current is required. The value is set in the units of assigned parameter range (% O_2, °C, °F or %).

Note. The lower retransmission value is unaffected by any alteration of the higher retransmission value, following.

Retransmission Output 3, Higher Retransmission Value

Set the high retransmission level required (shown on the upper display), i.e. the parameter range value at which maximum current output is required.

Note. The higher retransmission value cannot be set closer to the lower retransmission value than the minimum span limit.

Retransmission Output 3, On or Off

Switch on.
or
Switch off.

Return to top of **Analog Retransmission Page**.

11.2 Relay Allocation Page

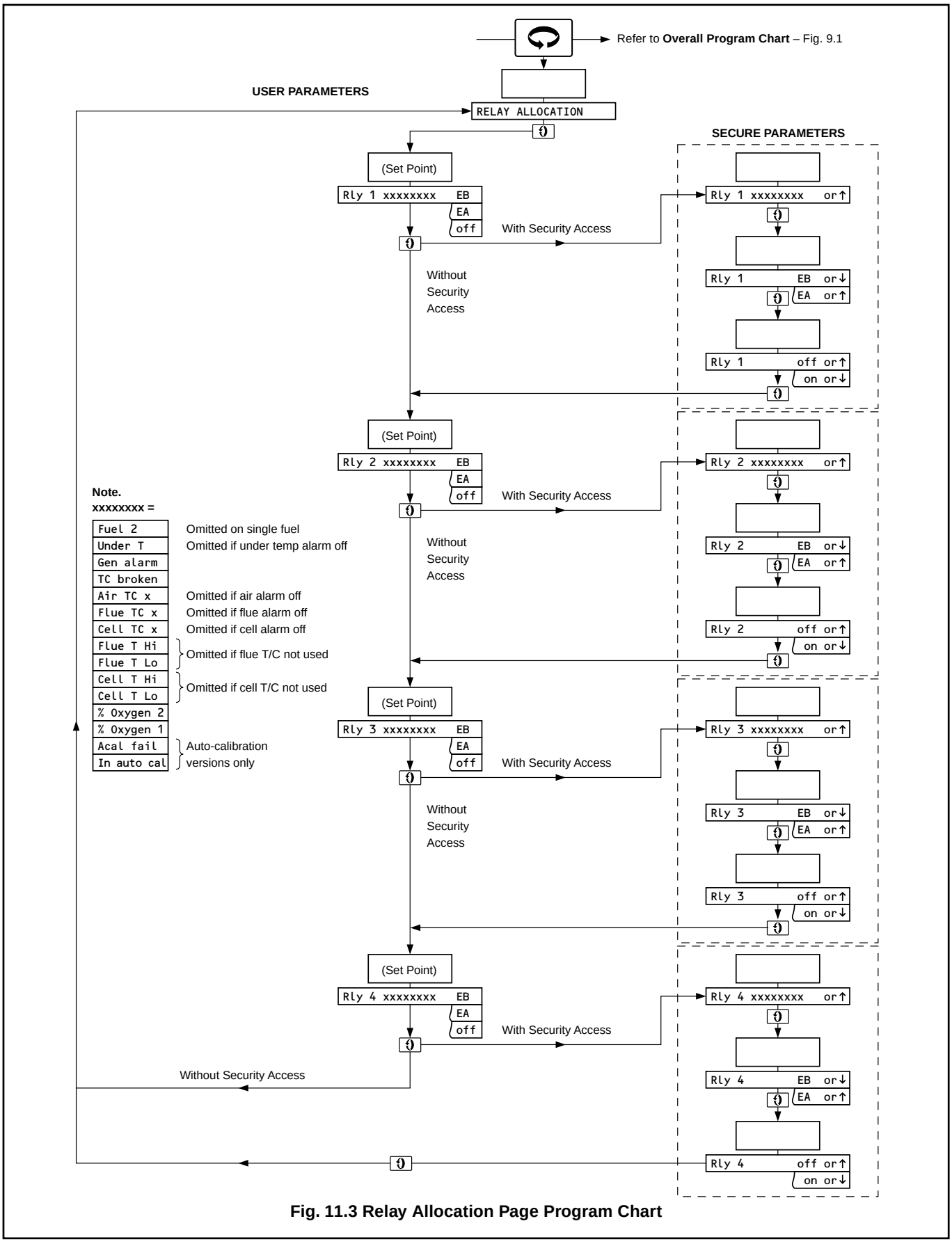


Fig. 11.3 Relay Allocation Page Program Chart

…11.2 Relay Allocation Page

The following parameters/parameter ranges may be assigned to any of the relay outputs:

- Flue 2 (for indication of fuel changeover)
- General alarm (for any alarm)
- Cell under temperature alarm
- Thermocouple alarm (for any thermocouple)
- Broken air thermocouple
- Broken flue thermocouple
- Broken cell thermocouple

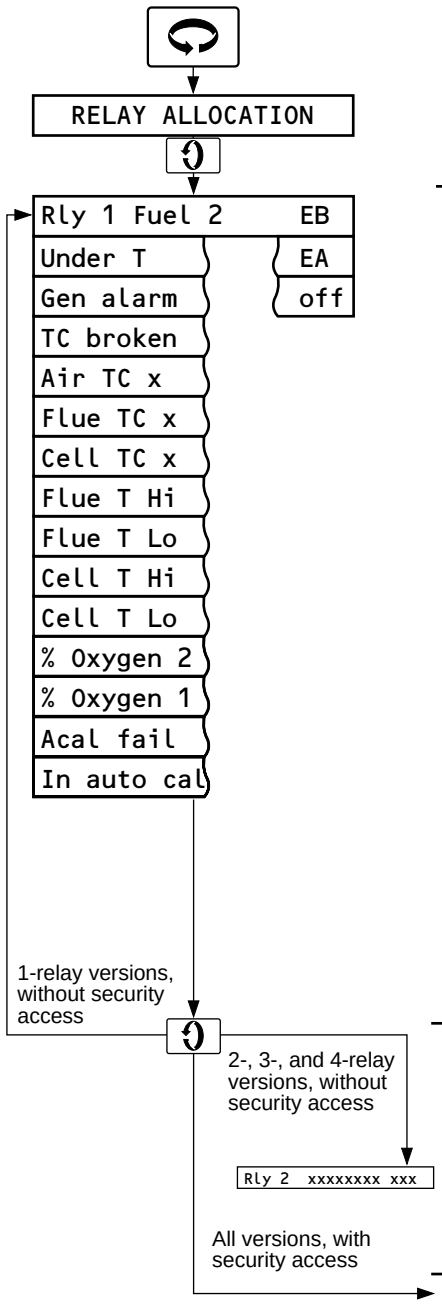
} Fault Alarms

- Flue temperature too high
- Flue temperature too low
- Cell temperature too high
- Cell temperature too low
- Oxygen alarm 1
- Oxygen alarm 2
- Auto cal failed
- In Auto Calibration

} User Alarms

Note.

- The **USER PARAMETERS** in this page can only be viewed. To change any parameter the **SECURE PARAMETERS** section must be accessed for **each individual retransmission output** – see Section 9.1.
- This page is omitted if there are no relay outputs. The number of relay outputs (0 to 4) is selected in the **Commissioning Page** – see manual IM/ZMT/0012.



Select **Relay Allocation Page**.

USER PARAMETER

Relay 1

The parameter assigned to relay 1 is displayed. The relay may be energized above or below the set point/changeover point depending on the parameter, or switched off, as follows:

Parameter	EA (Energized Above)	EB (Energized Below	Off
Fuel 2	Energized on fuel 2	Energized on fuel 1	Off
General alarm	Energized in alarm condition	Energized in normal condition	Off
Cell under temperature	Energized in fault condition	Energized in normal condition	Off
Broken thermocouple	Energized in fault condition	Energized in normal condition	Off
Broken air thermocouple	Energized in fault condition	Energized in normal condition	Off
Broken flue thermocouple	Energized in fault condition	Energized in normal condition	Off
Broken cell thermocouple	Energized in fault condition	Energized in normal condition	Off
Flue temperature high	Energized in fault condition	Energized in normal condition	Off
Flue temperature low	Energized in fault condition	Energized in normal condition	Off
Cell temperature high	Energized in alarm condition	Energized in normal condition	Off
Cell temperature low	Energized in alarm condition	Energized in normal condition	Off
Oxygen alarm 1	Energized in alarm condition	Energized in normal condition	Off
Oxygen alarm 2	Energized in alarm condition	Energized in normal condition	Off
Auto cal failed	Energized in alarm condition	Energized in normal condition	Off
In auto cal	Energized in alarm condition	Energized in normal condition	Off

Return to top of **Relay Allocation Page** (1-relay versions, without security access).

or

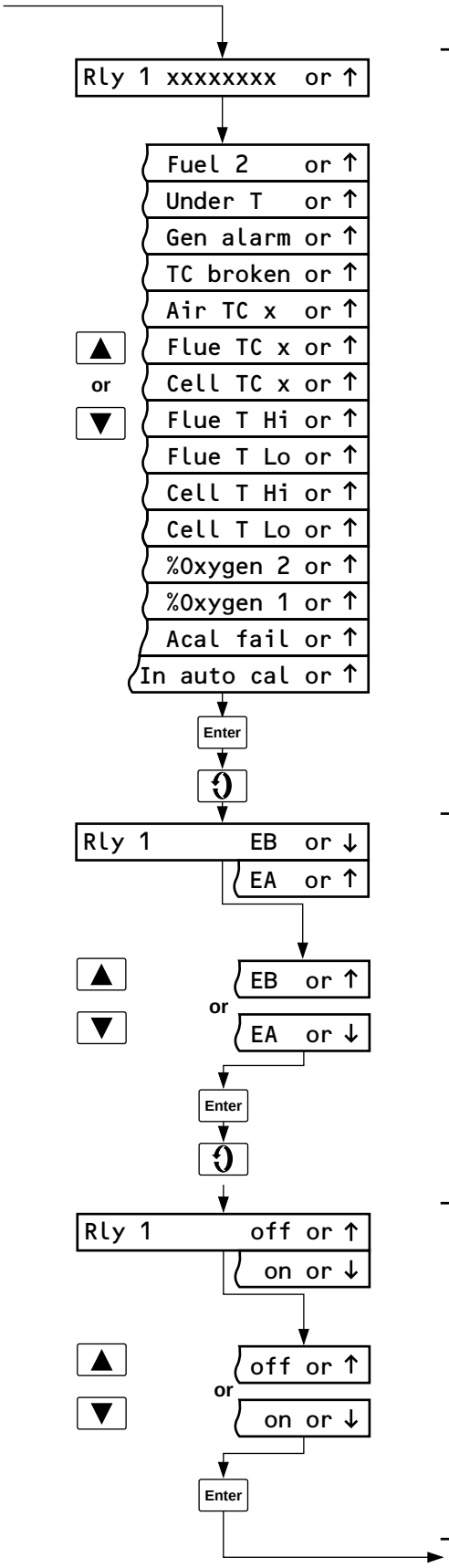
Advance to next parameter (2-, 3- and 4-relay versions, without security access).

or

Advance to **SECURE PARAMETERS (relay 1)** section (all versions, with security access).

Continued on next page.

…11.2 Relay Allocation Page



SECURE PARAMETERS (Relay 1)

Relay 1, Parameter

Select the parameter to be assigned to Relay 1.

Relay 1, Operation

The relay can be energized above or below the set point/changeover point (depending on the parameter) – see **Relay 1, Parameter** above.

Select the relay operation required:
Energize below the set point/changeover point.
or
Energize above the set point/changeover point.

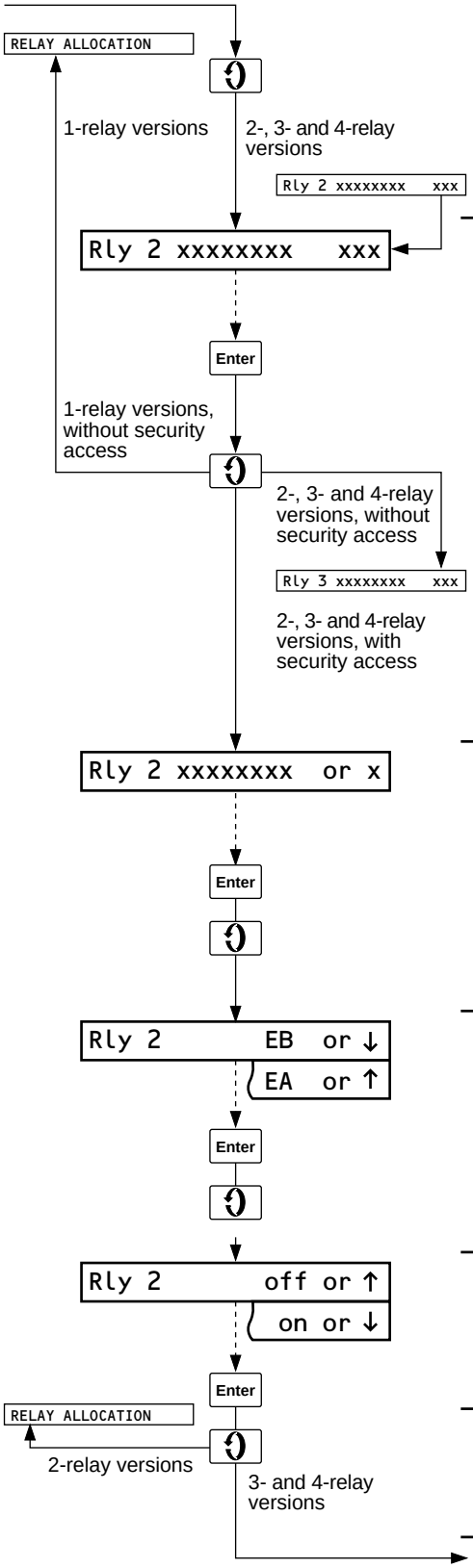
Relay 1, On or Off

Switch on.
or
Switch off.

Note. Only the relay itself can be switched off in this page. The set point, where applicable, may be switched on or off in the **Alarms and Indications Page**.

Continued on next page.

…11.2 Relay Allocation Page



Return to top of **Relay Allocation Page** (1-relay versions).
or
Advance to next parameter (2-, 3- and 4-relay versions.

USER PARAMETER

Relay 2

The parameter assigned to Relay 2 is displayed. Repeat as for **Relay 1**.

Return to top of **Relay Allocation Page** (2-relay versions, without security access).
or
Advance to next parameter (3 and 4 relay versions, without security access).
or
Advance to **SECURE PARAMETERS (Relay 2)** section (2-, 3- and 4-relay versions, with security access).

SECURE PARAMETERS (Relay 2)

Relay 2, Parameter

Repeat as for **Relay 1, Parameter**

Relay 2, Operation

Repeat as for **Relay 1, Operation**

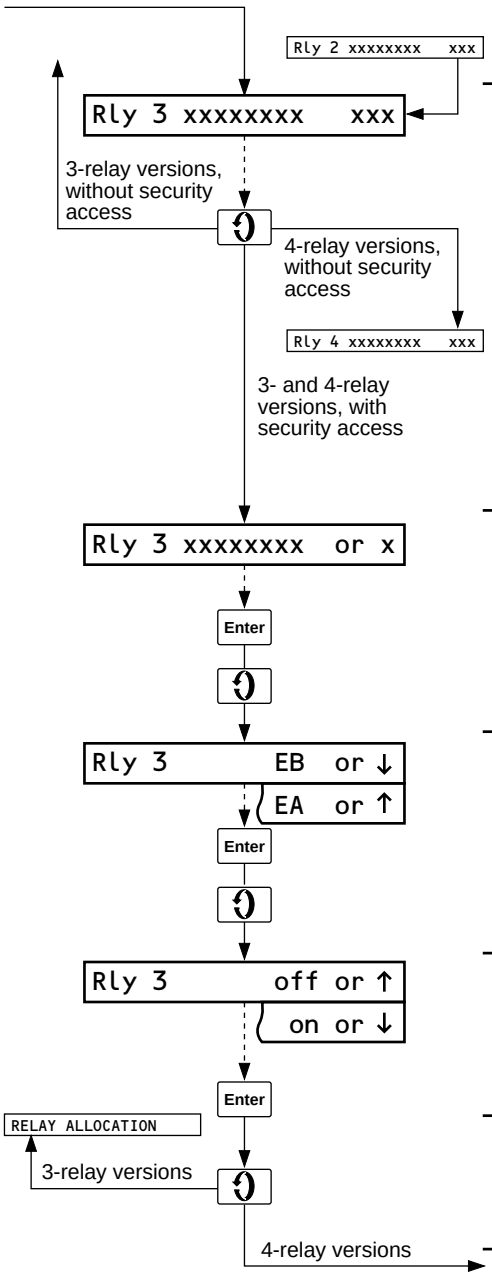
Relay 2, On or Off

Repeat as for **Relay 1, On or Off**

Return to top of **Relay Allocation Page** (2-relay versions).
or
Advance to next parameter (3- and 4-relay versions).

Continued on next page.

…11.2 Relay Allocation Page



USER PARAMETER

Relay 3

The parameter assigned to Relay 3 is displayed. Repeat as for **Relay 1**.

Return to top of **Relay Allocation Page** (3-relay versions, without security access).
or
Advance to next parameter (4-relay versions, without security access).
or
Advance to **SECURE PARAMETERS (Relay 3)** section (3- and 4-relay versions, with security access).

SECURE PARAMETERS (Relay 3)

Relay 3, Parameter

Repeat as for **Relay 1, Parameter**.

Relay 3, Operation

Repeat as for **Relay 1, Operation**.

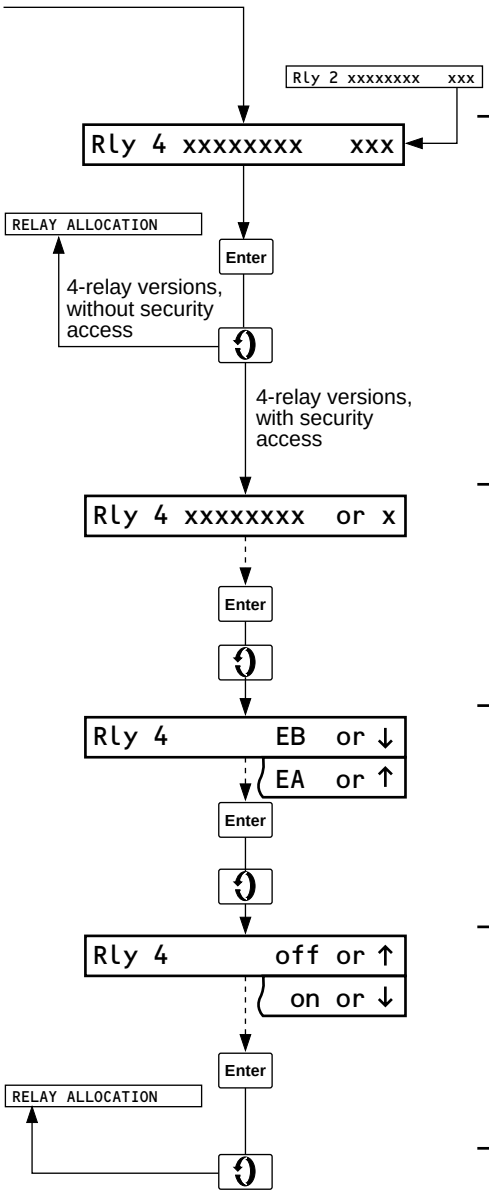
Relay 3, On or Off

Repeat as for **Relay 1, On or Off**.

Return to top of **Relay Allocation Page** (3-relay versions).
or
Advance to next parameter (4-relay versions).

Continued on next page.

…11.2 Relay Allocation Page



USER PARAMETER

Relay 4

The parameter assigned to Relay 4 is displayed. Repeat as for **Relay 1**.

Return to top of **Relay Allocation Page** (4 relay versions, without security access).
or
Advance to **SECURE PARAMETERS (Relay 4)** section (4 relay versions, with security access).

SECURE PARAMETERS (Relay 4)

Relay 4, Parameter

Repeat as for **Relay 1, Parameter.**

Relay 4, Operation

Repeat as for **Relay 1, Operation.**

Relay 4, On or Off

Repeat as for **Relay 1, On or Off.**

Return to top of **Relay Allocation Page**.

11.3 Diagnostics Page

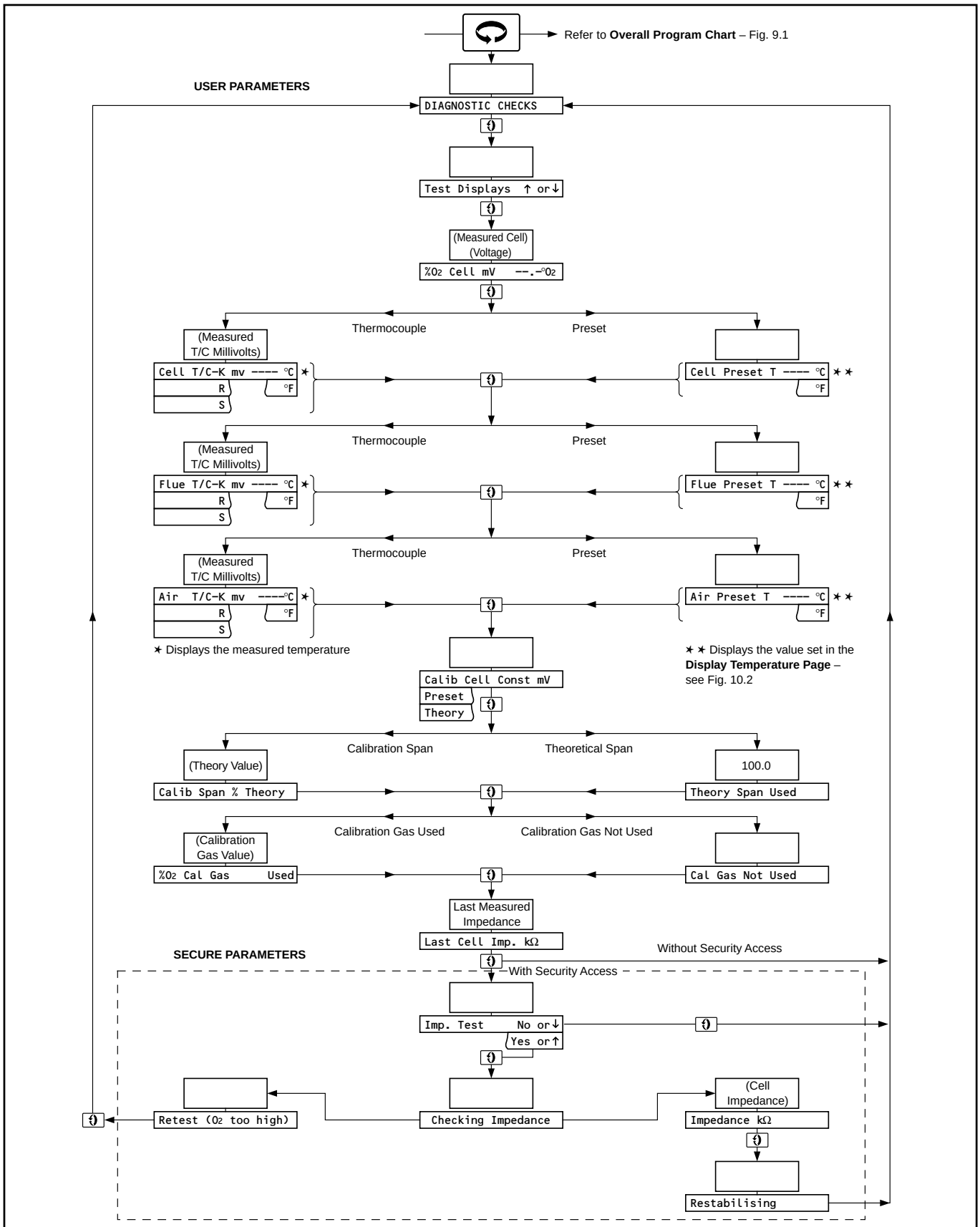
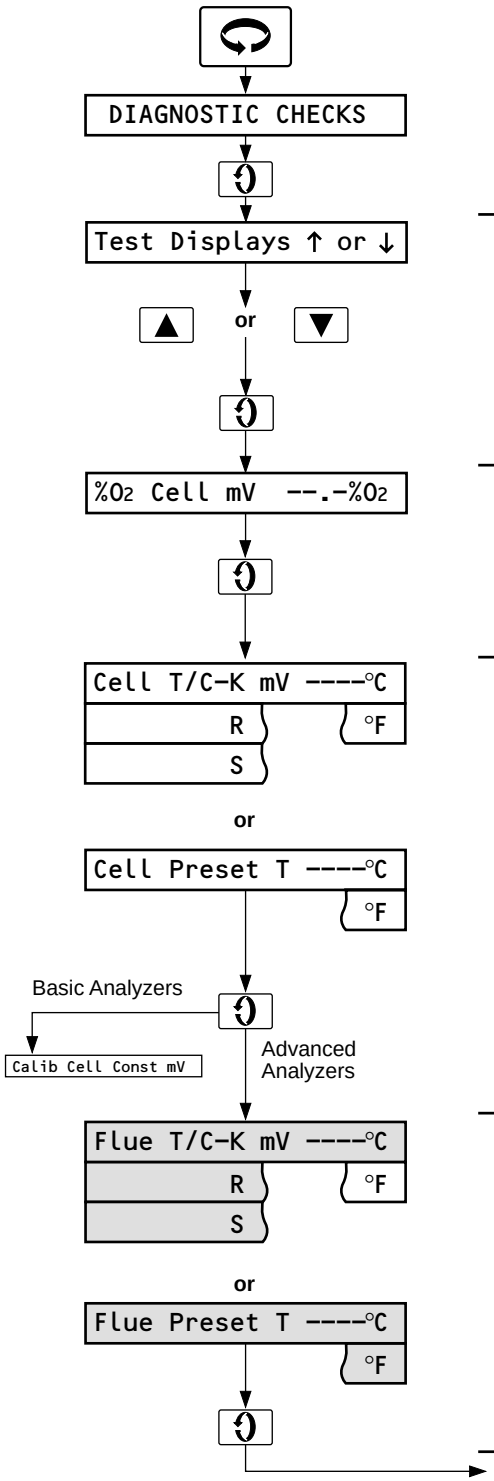


Fig. 11.4 Diagnostics Page Program Chart

…11.3 Diagnostics Page

This page is used for simple fault finding and monitoring the system performance.

Refer to Fig. 11.4 when carrying out the following procedures



Select **Diagnostics Page**.

USER PARAMETER

Display Test

Both the upper and lower displays are illuminated as a check for failed segments/dots.

Cell Output

The measured cell output (in millivolts) is shown on the upper display and the calculated oxygen concentration, based on this value, is shown on the lower display.

Cell Thermocouple Information

The measured cell thermocouple output (in millivolts) is shown on the upper display and the calculated temperature, based on this value, is shown on the lower display. The display units (°C or °F) and the thermocouple type are as programmed in the **Display Temperature Page** – see Section 10.2.

or

Preset Cell Temperature Information

The lower display shows the preset cell temperature and the display units (°C or °F) which have been programmed in the **Display Temperature Page** – see Section 10.2.

Advance to next parameter (advanced analyzers).

or

Advance to **Cell Constant (calibration zero) Information** (basic analyzers).

Flue Thermocouple Information

The measured flue thermocouple output (in millivolts) is shown on the upper display and the calculated temperature, based on this value, is shown on the lower display. The display units (°C or °F) and thermocouple type are as programmed in the **Display Temperature Page** – see Section 10.2.

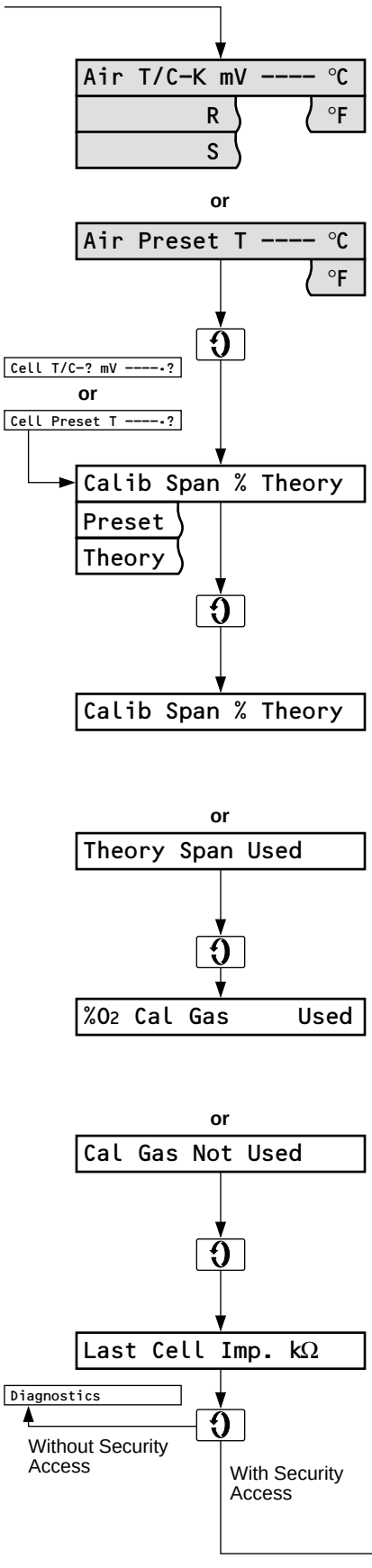
or

Preset Flue Temperature Information

The lower display shows the preset flue temperature and the display units (°C or °F) which have been programmed in the **Display Temperature Page** – see Section 10.2.

Continued on next page.

…11.3 Diagnostics Page



Air Thermocouple Information

The measured Air thermocouple output (in millivolts) is shown on the upper display and the calculated temperature, based on this value, is shown on the lower display. The display units (°C or °F) and thermocouple type are as programmed in the **Display Temperature Page** – see Section 10.2.

or

Preset Air Temperature Information

The lower display shows the preset air temperature and the display units (°C or °F) which have been programmed in the **Display Temperature Page** – see Section 10.2.

Cell Constant (calibration zero) Information

The upper display shows the cell constant obtained from the last zero calibration procedure. The lower display indicates whether the constant was calibrated, preset or obtained theoretically.

Span Calibration Information

The upper display shows the calibrated span value as a percentage of theoretical response; 100% being the optimum value.

or

Theoretical Span Information

The upper display shows the theoretical response value used for span calibration (100%).

Gas Calibration Information (zero or span)

The upper display shows the Calibration Gas Value which was programmed when implementing either a zero or span calibration procedure – see Section 13.4 or 13.5.

or

Gas Calibration Not Used

The lower display shows that a gas calibration procedure has not been used; i.e. calibration was either preset or theoretical.

Last Cell Impedance Test

The last impedance test value (in kΩ) is shown on the upper display.

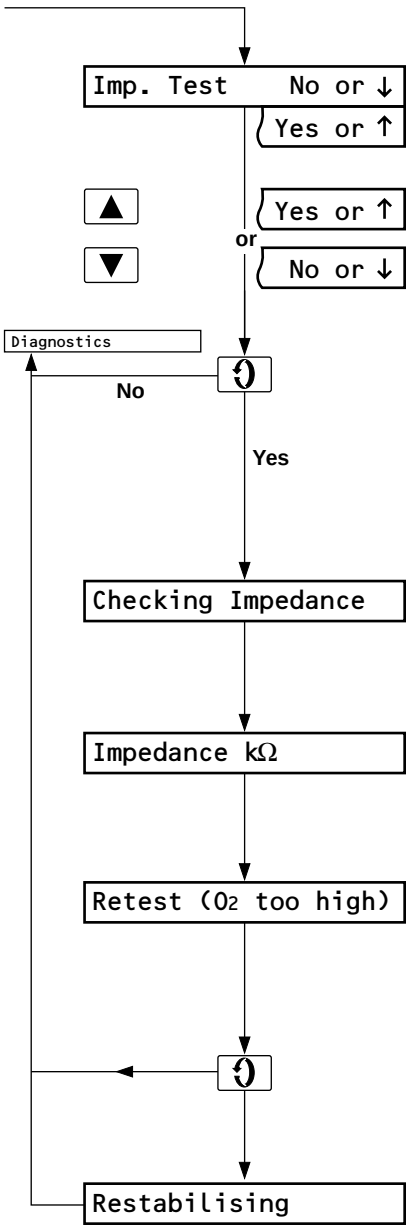
Return to top of **Diagnostics Page** (without security access).

or

Advance to next parameter (with security access).

Continued on next page.

…11.3 Diagnostics Page



SECURE PARAMETERS

Cell Impedance Test Required

Yes
or
No

Return to top of **Diagnostics Page** (if `No` selected).

or

Initiate impedance check (if `Yes` selected). The display reverts automatically to the following:

Checking Impedance
Allow approximately three minutes for completion of cell impedance test.

The display reverts automatically to either of the following:

Measured Cell Impedance
The measured impedance (in kΩ) is shown on the upper display.

or

Retest (test not possible)
The cell output was insufficient for the impedance check to be implemented, i.e. measured oxygen concentration was too high.

Repeat the test after connecting a test gas of less than 3% O_2 to the probe.

Return to top of **Diagnostics Page** if 'Retest (O_2 too high)' is displayed.
or
Advance to next parameter if 'Impedance in kΩ' is displayed.

Cell Output Restabilizing
Allow approximately three minutes for the cell output to stabilize.

The display reverts automatically to the top of the **Diagnostics Page**.

12 AUTO-CALIBRATION

This section describes the operation of the auto-calibration facility. Units which do not have the auto-calibration facility must be calibrated as detailed in Section 13.

12.1 Auto-calibration, General

The auto-calibration facility enables probe calibration to be carried out automatically at pre-programmed intervals without the need for user intervention.

The analyzer can be calibrated using single- or two-point methods as follows:

a) Single-point (cell zero) calibration.

Test gas value: Air (20.9% O_2) or > 10% O_2 in N_2

b) Two-point (zero and span) calibration

Test gas values: Zero – Air (20.9% O_2) or > 10% O_2 in N_2

Span – < 10% O_2 in N_2 (Typically 1%)

During automatic calibration, the measuring cell is supplied with gas of known oxygen content. After an initial delay period to allow the calibration gas to reach the probe, the cell output is monitored. Once the cell output has stabilized, the Z-MT uses the value obtained to adjust the derived oxygen content to that of the test gas.

When a successful calibration has been completed, the measured values are retained in non-volatile memory and can be read in the **Diagnostics Page** – see Section 11.3

If calibration fails, the Z-MT reverts to the values obtained during the previous calibration and an 'Auto-calibration failed' alarm is initiated.

An auto-calibration sequence can be carried out on demand at any time by initiation from the **AUTOCAL SETUP** page.

If necessary, for test purposes and when an auto-calibration sequence is not in progress, the zero and span test gas valves can be manually cycled from the Z-MT. The test gas valve relay outputs in the Z-MT are interlocked to prevent both being opened simultaneously.

Note. To enable remote indication of alarms, the 'Auto-calibration failed' and 'In auto-calibration' alarms must first be allocated to a relay output – see Section 11.2.

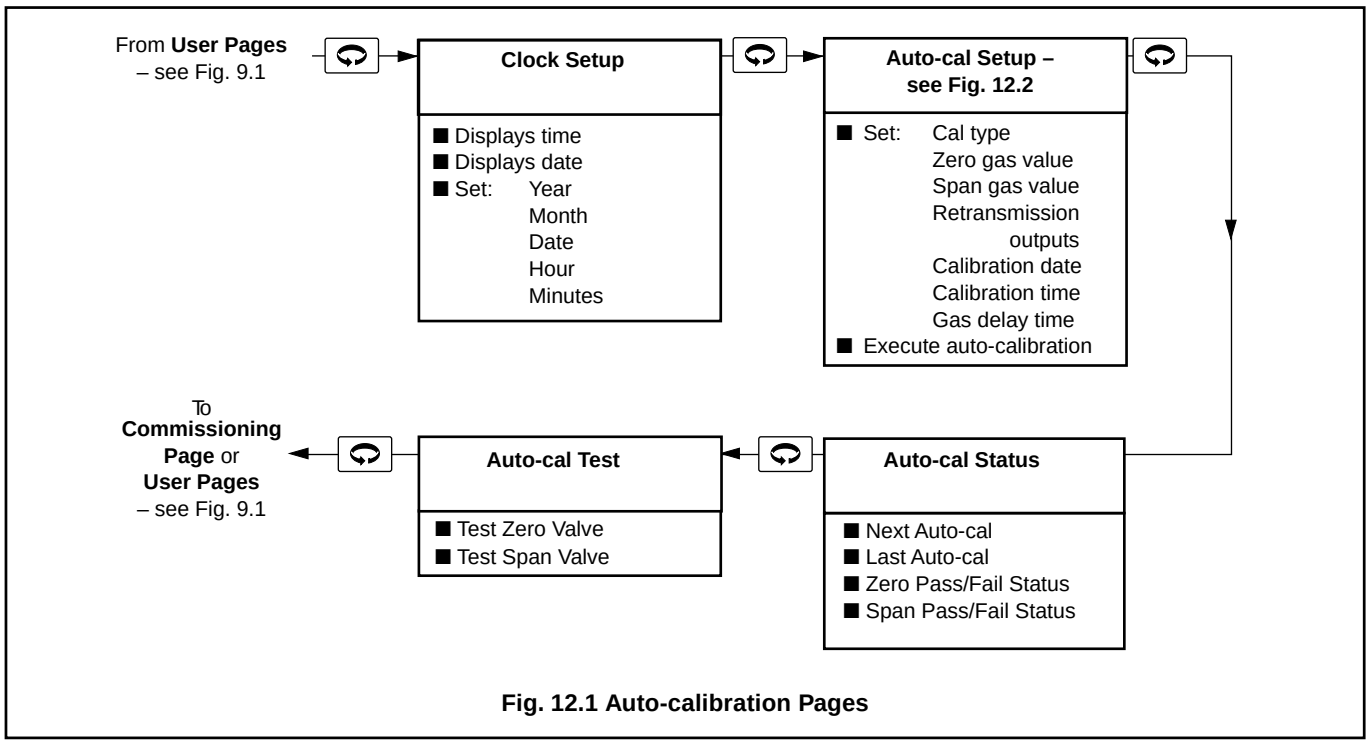
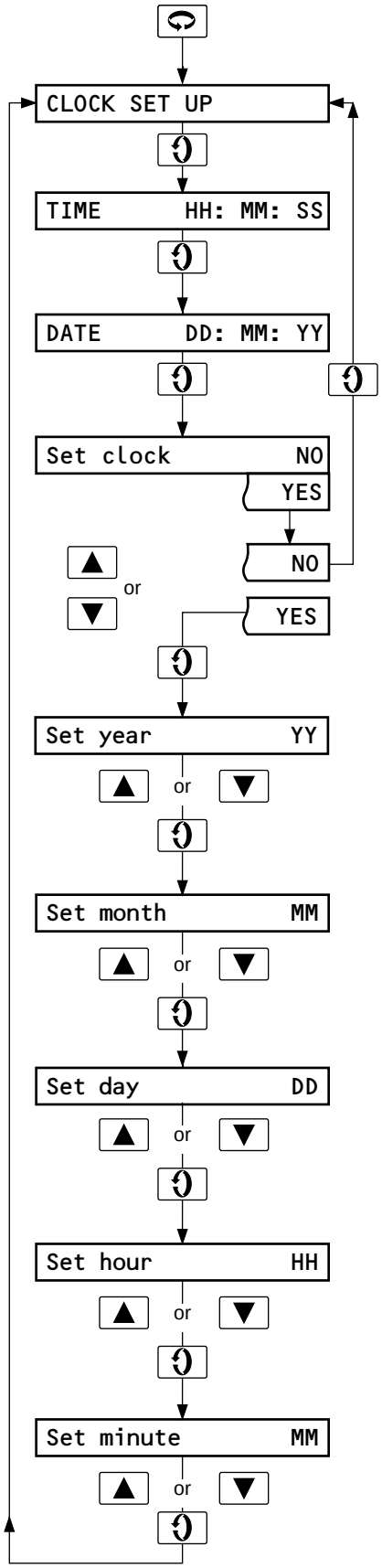


Fig. 12.1 Auto-calibration Pages

12.2 Clock Setup Page

The Clock Setup Page is used to view and set the current time and date of the unit's internal clock. The clock is used to schedule and advance through auto-calibration sequences.



Select **Clock Setup Page**

Display Time

The current time is displayed in 24-hour format.

Display Date

The current date is displayed in day, month and year format.

Set Clock

Return to top of **Clock Setup Page.**
or
Set year, month, day, hour, minute and second of internal real-time clock.

Set Year

Set the current year (0 to 99).

Set Month

Set the current month (1 to 12).

Set Day

Set the current date (1 to 31).

Set Hour

Set the current hour in 24-hour format (0 to 23).

Set Minute

Set the current minute (0 to 59).

12.3 Auto-calibration Setup

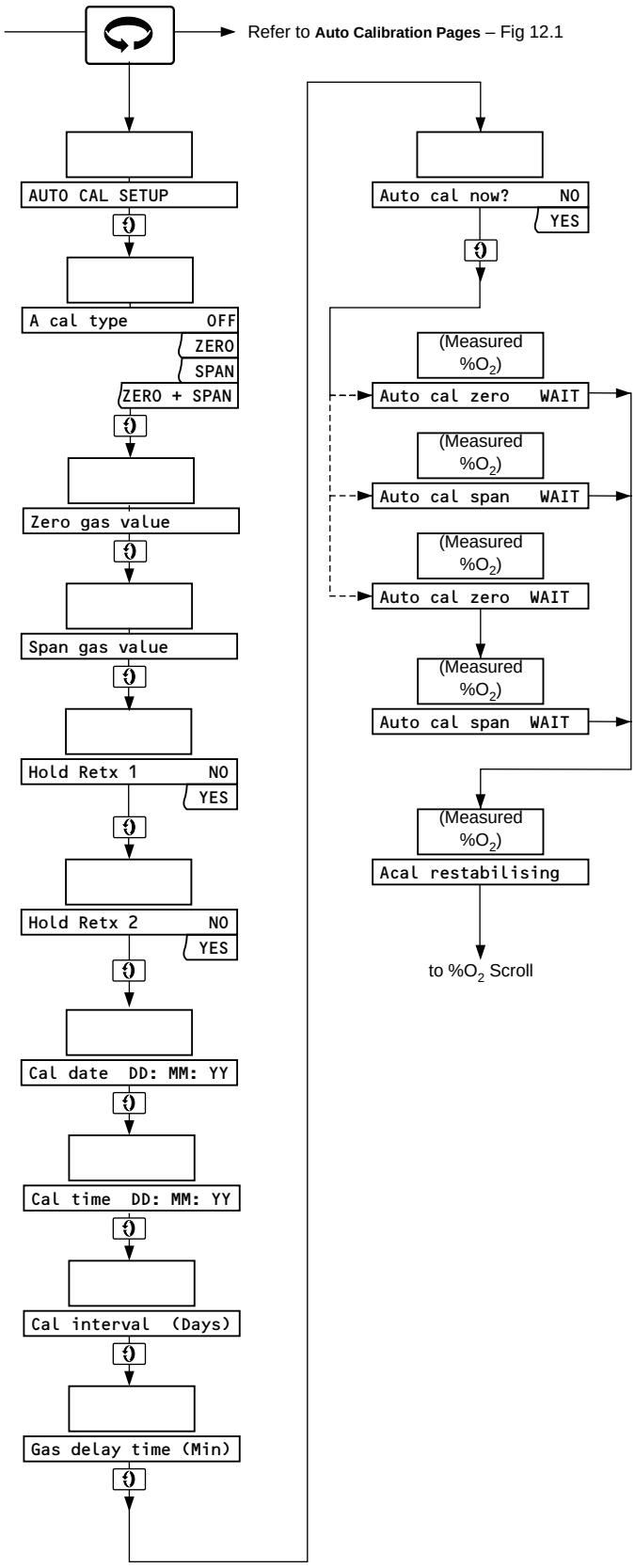
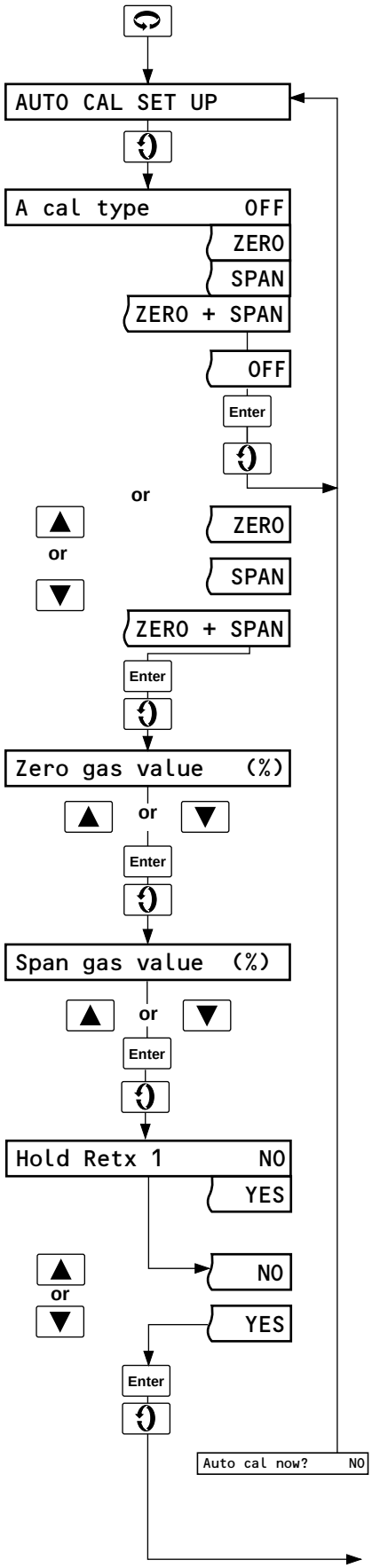


Fig. 12.2 Auto-calibration Setup Pages

…12.3 Auto-calibration Setup



Select **Auto-calibration Setup Page**

USER PARAMETERS

Auto-calibration Type

Set the type of Auto-calibration required.

Disable the auto-calibration feature.

or

Select single-point zero auto-calibration.

or

Select single-point span auto-calibration.

or

Select two-point zero and span auto-calibration.

Zero Gas Value

The known $\%O_2$ of the gas used to calibrate the cell zero must be entered.

Adjust the $\%O_2$ reading shown on the upper display to the $\%O_2$ content of the zero gas.

Span Gas Value

The known $\%O_2$ of the gas used to calibrate the probe span must be entered.

Adjust the $\%O_2$ reading shown on the upper display to the $\%O_2$ content of the span gas.

Hold Retransmission Output 1 Level

The value assigned to retransmission output 1 can be held at it's present level or set to zero.

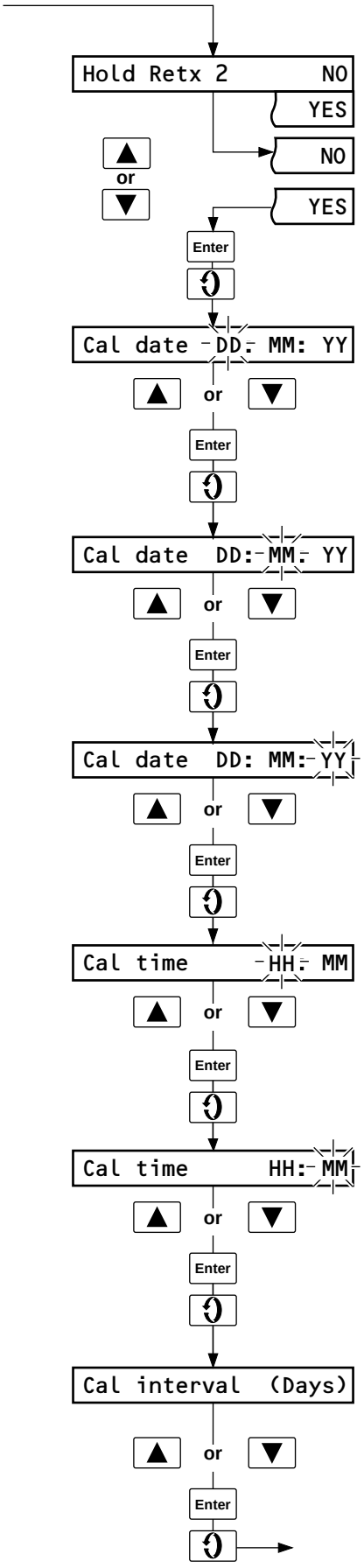
Set retransmission output 1 to zero.

or

Hold retransmission output 1 at current value.

Continued on next page.

…12.2 Auto-calibration Setup



Hold Retransmission Output 2 Level

The value assigned to retransmission output 2 can be held at it's present level or set to zero
Set retransmission output 2 to zero.
or
Hold retransmission output 2 at current value.

Calibration date

Set the time and date of the next auto-calibration.
Set day of next auto-calibration.

Set month of next Auto-calibration.

Set year of next Auto-calibration.

Set hour of next Auto-calibration.

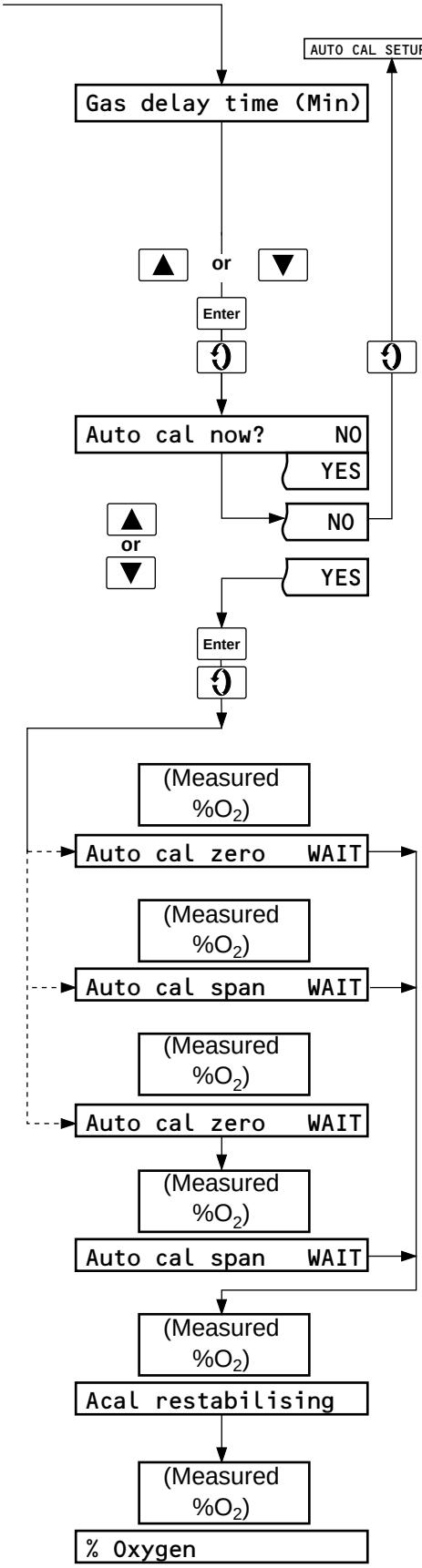
Set minute of next Auto-calibration.

Calibration Interval

The current calibration interval, adjustable between 1 and 200 days is shown on the upper display.
Set the interval (in days) between successive auto-calibration operations.

Continued on next page.

…12.2 Auto-calibration Setup



Gas Delay Time

Once a calibration gas has been switched on at the gas supply panel, a period of time (the gas delay time) must be allowed for the gas to travel to the cell. The current delay time is shown on the upper display.

Set the delay time (between 1 and 10 minutes).

Start Auto-calibration Sequence Now

Option to start an auto-calibration sequence on completion of the auto-calibration setup routine.
Do not start auto-calibration and return to top of **Auto-calibration Setup Page**
or
Start auto-calibration sequence now

Note. At this point in the calibration sequence the appropriate calibration gas valve is opened. Once the gas delay time has expired the instrument waits for a stable cell reading. If no stable reading has been detected after five minutes, the instrument proceeds to the next stage of the calibration.

Single-point zero calibration – the zero gas valve has been opened and the instrument is waiting for the zero calibration gas to reach the cell and for a stable $\%O_2$ reading to be obtained.

Single-point span calibration – the span gas valve has been opened and the instrument is waiting for the span calibration gas to reach the cell and for a stable $\%O_2$ reading to be obtained.

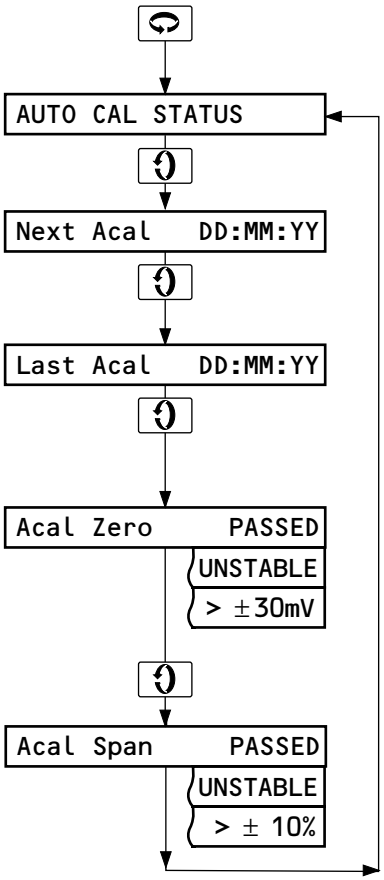
Two-point calibration – the zero gas valve has been opened and the instrument is waiting for the zero calibration gas to reach the cell and for a stable $\%O_2$ reading to be obtained.

Two-point calibration – the zero gas valve has been closed and the span gas valve has been opened. The instrument is waiting for the span calibration gas to reach the cell and for a stable $\%O_2$ reading to be obtained.

The zero and/or span valves have been closed and the instrument is waiting for the gas delay time to expire.

The display reverts to the $\%O_2$ scroll.

12.4 Auto-calibration Status



Select **Auto-calibration Status Page.**

USER PARAMETERS

Next Auto-calibration

The date of the next scheduled auto-calibration is shown in days, months and years.

Last Auto-calibration

The date on which the most recently completed auto-calibration took place is shown in days, months and years.

Auto-calibration Zero

The upper display shows the cell output in mV when exposed to the zero gas:

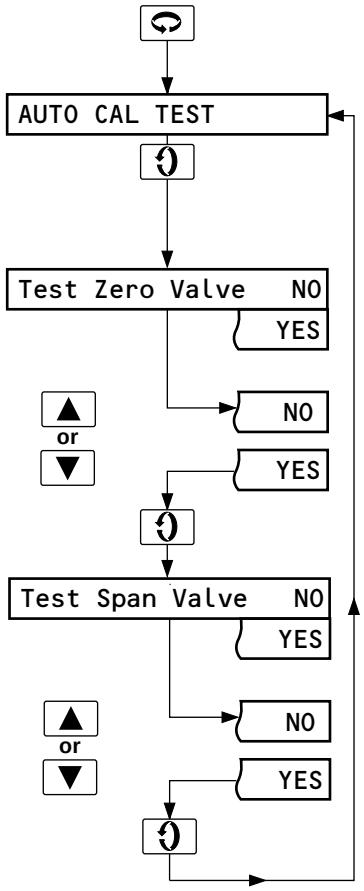
Calibration passed – valid stable cell output obtained within time limit
Calibration failed – unstable cell output
Calibration failed – cell output > ± 30mV zero error

Auto-calibration Span

The upper display shows the slope of the cell output between the zero and span readings, expressed as a percentage of the theoretical slope:

Calibration passed – valid slope reading obtained within time limit
Calibration failed – unstable cell output
Calibration failed – slope > ± 10% from theoretical value

12.5 Auto-calibration Test



Select **Auto-calibration Test page.**

USER PARAMETERS

Note. The solenoid valves on the gas panel cannot operate under control of the Z-MT if selected for local operation at the gas panel.

Test Zero Valve

Open or close the zero gas valve. The $\%O_2$ reading derived from the cell output is shown on the upper display.

Close zero gas valve.
or
Open zero gas valve.

Test Span Valve

Open or close the span gas valve. The $\%O_2$ reading derived from the cell output is shown on the upper display.

Close span gas valve.
or
Open span gas valve.

Notes.

1) The zero and span valve relay outputs are interlocked to prevent both being open simultaneously.

2) The solenoid valves on the gas panel do not operate under the control of the Z-MT if selected for local operation at the gas panel.

13 SEMI-AUTO CALIBRATION

13.1 Semi-auto Calibration, General

It is not necessary to remove the probe from the flue to carry out the calibration procedures detailed in this section.

The analyzer may be calibrated using single- or two-point procedures, as follows:

a) **Single-point** (zero) calibration
Preset zero using known cell constant (limits of ±30mV)
Air calibration (20.95% O_2 nom.)

Gas calibration using certified test gas (1 to 25% O_2)

b) **Two-point** (span) calibration
Preset zero + certified test gas (1 to 10% O_2)
Air calibration + certified test gas (1 to 10% O_2)

Notes.

a) Two-point calibration using air and a test gas is the most accurate procedure.

b) Single-point calibration using air is the most common and easily implemented procedure.

c) Two-point calibration using a preset zero value has a similar accuracy to single-point calibration.

d) For specialized technique of calibrating against a certified instrument contact the Company.

e) For a preset zero calibration the probe's cell constant must be known i.e. from certified information supplied by the Company or from a previous calibration procedure – see **Diagnostics Page** overleaf.

13.2 Equipment Required

Test gas connector kit, part no. 003000212 (Z-FG2 probes only):

Uncontaminated air supply
and/or
Certified test gas
} See Section 13.1

13.3 Preparation

a) Ensure that the probe is within its operating temperature limits:

Z-FG2 probes – 20 to 600°C

Z-GP2 probes – 600 to 900°C (type K T/C)
600 to 1200°C (type R T/C)

b) Ensure that the **Start-up Procedure** has been carried out – see Section 8.

Note. Once the **Calibration Page** has been accessed and the calibration sequence invoked by operation of the ◊ switch when `CALIBRATION SEQUENCE` is displayed, it is not possible to exit the sequence until calibration is complete. Theoretical values may be manually entered during calibration to facilitate an exit path or to provide a calibration reference for the probe in the event of an unsuccessful calibration.

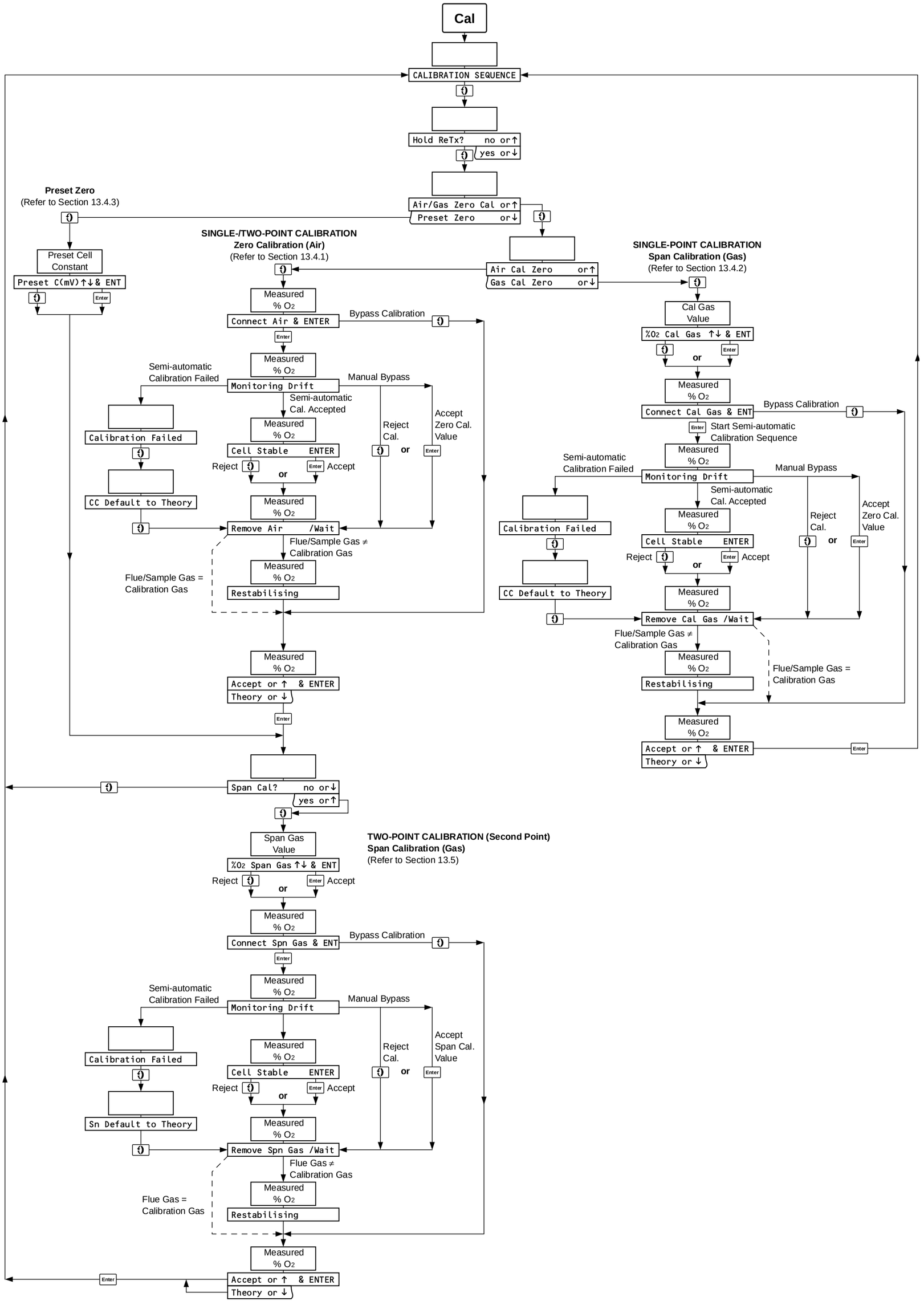
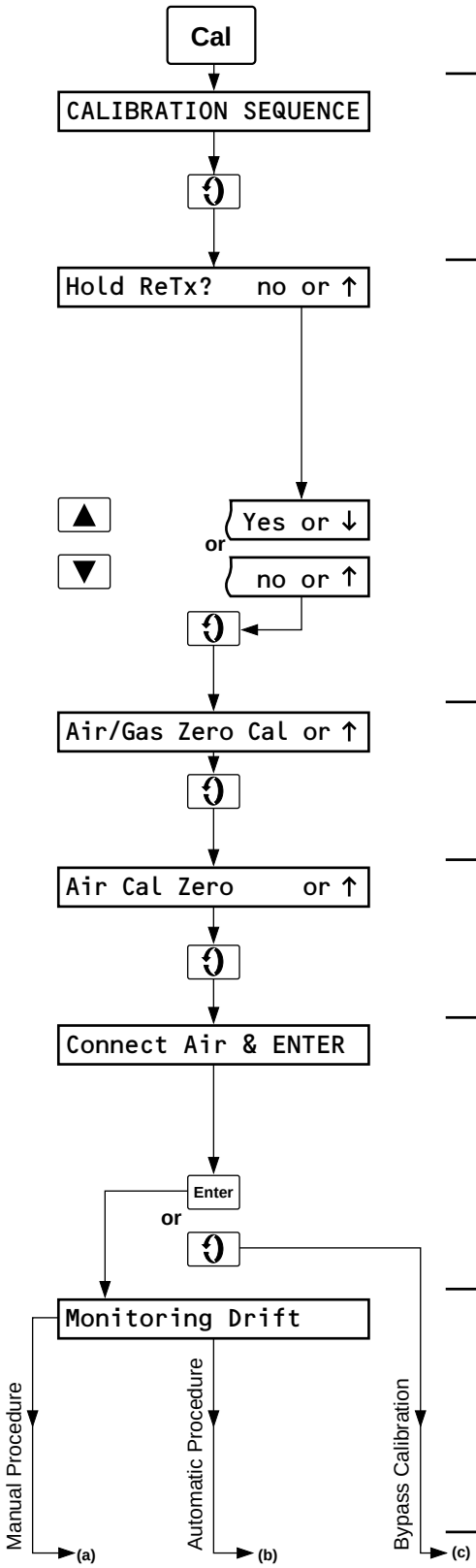


Fig. 13.1 Calibration Page Program Chart

13.4 Single-Point (Zero) Calibration

13.4.1 Air Calibration

Refer to Fig. 13.1 when carrying out the following procedure.



Select **Calibration Page**.

Note. Any relays which are allocated to either oxygen Alarm 1 or Alarm 2 are now disabled to prevent inadvertent alarms occurring during calibration – see Fig. 11.3.

Hold Retransmission Level(s)

Any retransmission output which is assigned to the oxygen range can be held at its present level (e.g. if being used for control) or set to zero – see Fig. 11.2.

Note. Any retransmission output which is assigned to the efficiency calculation is set automatically to zero.

Hold oxygen retransmission output(s) at present level(s).
or
(If not already selected.) Set oxygen retransmission output(s) to zero.

Advance to next parameter (the retransmission level is now held if 'yes' was selected).

Air or Gas Zero Calibration

Advance to next parameter (retransmission is now held if 'yes' was selected above).

Calibrate Zero Using Air

Note. The upper display shows the measured oxygen concentration value for the remainder of the zero calibration procedure.

Air Connection

Remove the test gas blanking screw or plug from the test gas connector on the probe and connect an uncontaminated air supply to the connector – refer to the appropriate probe operating instructions.

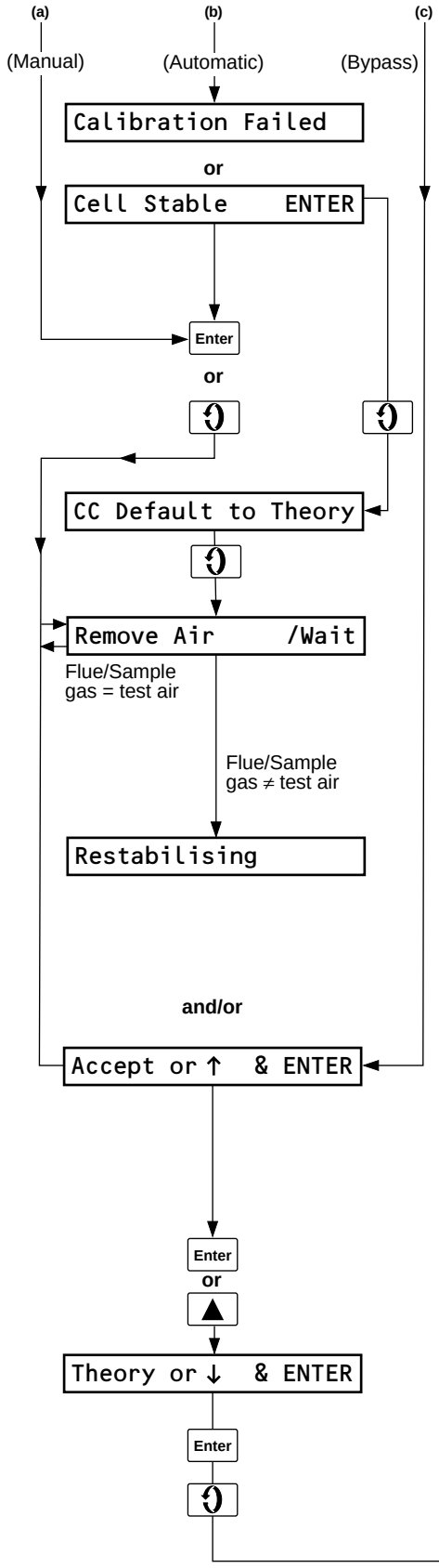
Initiate automatic zero calibration.
or
Bypass zero calibration procedure.

Monitor Cell Output

The cell output is monitored until a stable output is detected. The measured oxygen concentration (calibration) value shown on the upper display may be manually accepted or rejected at any time prior to completion of automatic calibration (5 minutes approx.), e.g. in the event of the cell stabilizing rapidly (or its output fluctuating marginally) or if it is evident that the output will not stabilize.

(c) Continued on next page.

…13.4.1 Air Calibration



If a stable output is detected the display reverts automatically to either of the following:

Calibration Failed
Cell output has stabilized but is outside operational limits.
or
Cell Stable (Calibration Passed)
Cell output has stabilized at a value within acceptable limits. With the cell output in a stable state, the new zero calibration value can either be accepted or rejected, depending on the accuracy required.

Accept or Reject Zero Calibration Value
Accept new zero calibration value.
or
Reject new zero calibration value (previous calibration value is retained) or, if calibration has failed, advance to next parameter.

Set Cell Constant to Theoretical Value
The cell constant is set automatically to a theoretical (reference) value of 0mV to enable continued use of the probe in the event of a failed calibration.

Air Removal
Disconnect the air supply from the probe and refit the blanking plug/ screw to the connector.

The cell output is monitored for approximately one minute to check for any change in oxygen concentration due to the transition from air to flue gas measurement. The display reverts automatically to either of the following:

Cell Output Restabilizing
Allow a suitable time for the cell output to stabilize.

Note. The display reverts automatically to the next parameter after approximately three minutes, irrespective of cell output stability.

and/or

Accept Zero Calibration or Default to Theoretical Cell Constant
The zero calibration value obtained can be either accepted or set to the theoretical (reference) value of 0mV, if unsatisfactory.

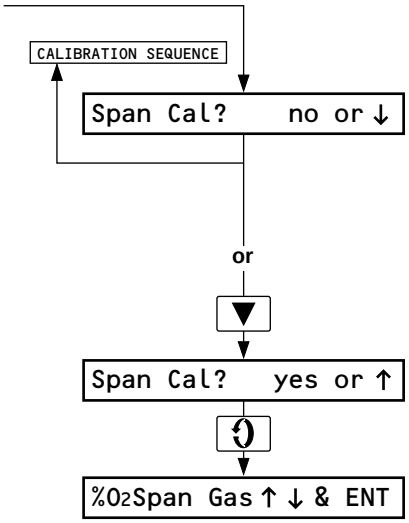
Note. If the calibration procedure was bypassed at Air Connection, above, the 'Accepted' value is that of the previous calibration procedure.

Accept zero calibration value.
or
Select alternative option.

Set cell constant to 0mV (i.e. if calibration was unsatisfactory) and advance to next parameter.

Continued on next page.

…13.4.1 Air Calibration



Calibrate Span (Two-point Calibration)

Span (second point) calibration not required (return to top of **Calibration Page**).

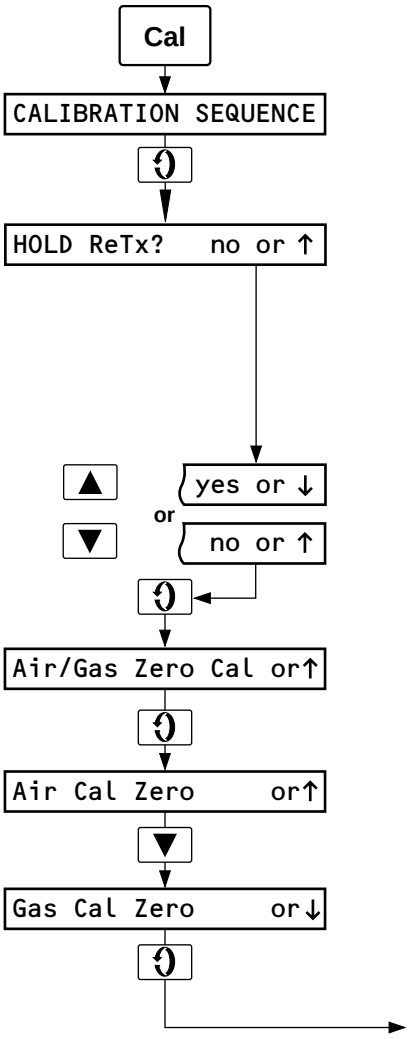
Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

or

Span (second set point) calibration required.

Refer to Section 13.5.

13.4.2 Gas Calibration



Select **Calibration Page**.

Note. Any relays which are allocated to either Oxygen Alarm 1 or Alarm 2 are now disabled to prevent inadvertent alarms occurring during calibration – see Fig. 11.3.

Hold Retransmission Level(s)

Any retransmission output which is assigned to the oxygen range can be held at its present level (e.g. if being used for control) or set to zero – see Fig. 11.2.

Note. Any retransmission output which is assigned to the efficiency calculation is set automatically to zero.

Hold oxygen retransmission output(s) at present level(s).

or

(If not already selected.) Set oxygen retransmission output(s) to zero.

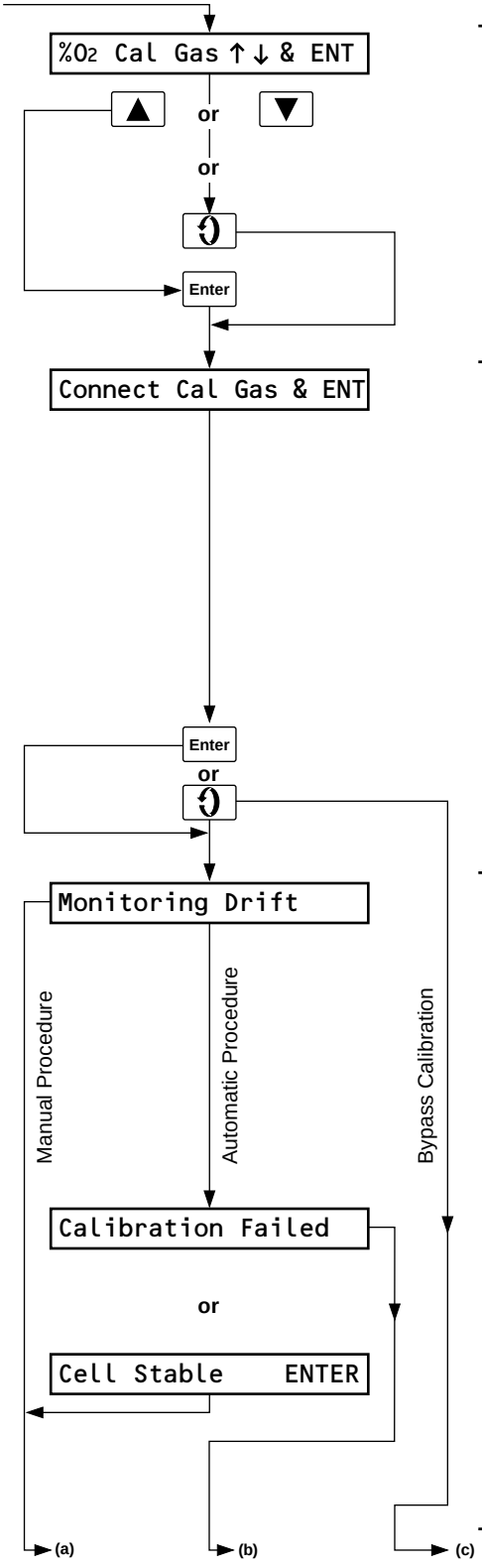
Air or Gas Zero Calibration

Calibrate Zero Using Air

Calibrate Zero Using Gas

Continued on next page.

…13.4.2 Gas Calibration



Zero Calibration Gas Value

Set the value shown on the upper display to that of the zero calibration gas to be used (1 to 25% O_2).
or

Advance to next parameter if the displayed value is already correct.

Accept new calibration gas value.

Gas Connection

Note. The upper display shows the measured oxygen concentration value for the remainder of the zero calibration procedure.

Remove the test gas blanking screw or plug from the test gas connector on the probe and connect the calibration gas (1 to 10% O_2) to the connector – refer to the appropriate probe operating instructions.

Note. Ensure that the gas connected is equivalent to that setup at **Calibration Gas Value**, above.

Initiate automatic zero calibration.
or
Bypass zero calibration procedure.

Monitor Cell Output

The cell output is monitored until a stable output is detected. The measured oxygen concentration (calibration) value shown on the upper display may be manually accepted or rejected at any time prior to completion of automatic calibration (five minutes approx.), e.g. in the event of the cell stabilizing rapidly (or its output fluctuating marginally) or if it is evident that the output will not stabilize.

If a stable output is detected the display reverts automatically to either of the following:

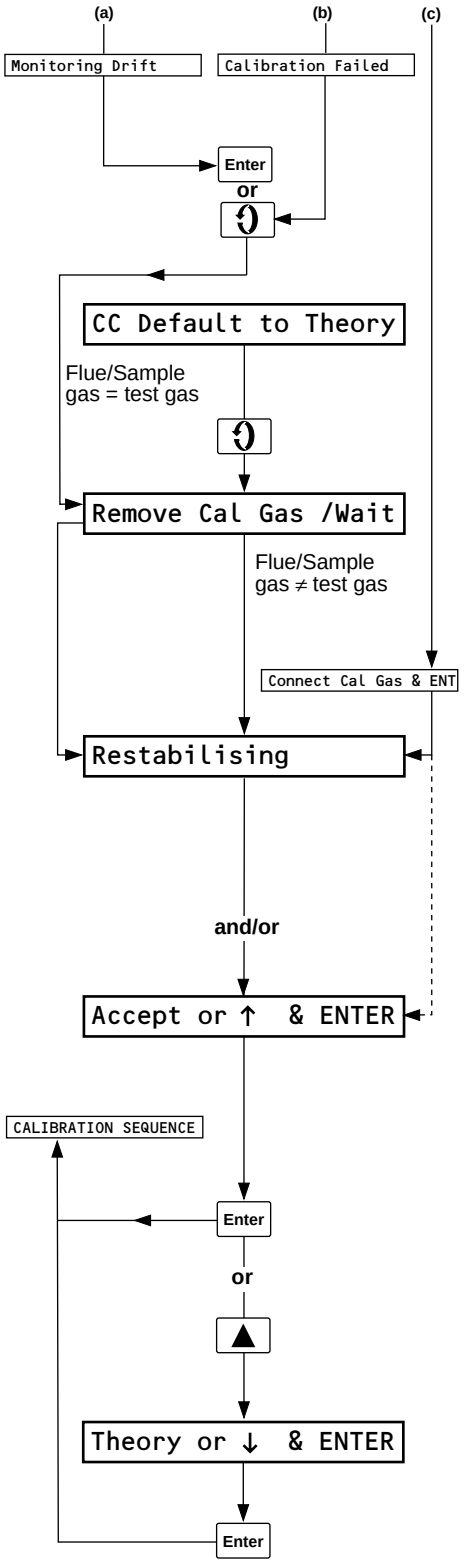
Calibration Failed
Cell output has stabilized but is outside operational limits.

or

Cell Stable (Calibration Passed)
Cell output has stabilized at a value within acceptable limits. With the cell output in a stable state, the new zero calibration value can either be accepted or rejected, depending on the accuracy of the value on the upper display to that of the calibration gas.

Continued on next page.

…13.4.2 Gas Calibration



Accept or Reject Zero Calibration Value

Accept new zero calibration value.
or
Reject new zero calibration value (previous calibration value is retained) or, if calibration has failed, advance to next parameter.

Set Cell Constant to Theoretical Value

The cell constant is set automatically to a theoretical (reference) value of 0mV to enable continued use of the probe in the event of a failed calibration.

Gas Removal

Disconnect the calibration gas from the probe and refit the blanking plug/ screw to the connector.

The cell output is monitored for approximately one minute to check for any change in oxygen concentration due to the transition from calibration gas to flue gas measurement. The display automatically reverts to either of the following:

Cell Output Restabilizing
Allows a suitable time for the cell output to stabilize.

Note. The display reverts automatically to the next parameter after approximately three minutes, irrespective of cell output stability.

and/or

Accept Zero Calibration or Default to Theoretical Value
The zero calibration value obtained can be either accepted or set to the theoretical (reference) value of 0mV, if unsatisfactory.

Note. If the calibration procedure was bypassed at **Gas Connection**, above, the 'Accepted' value is that of the previous calibration procedure.

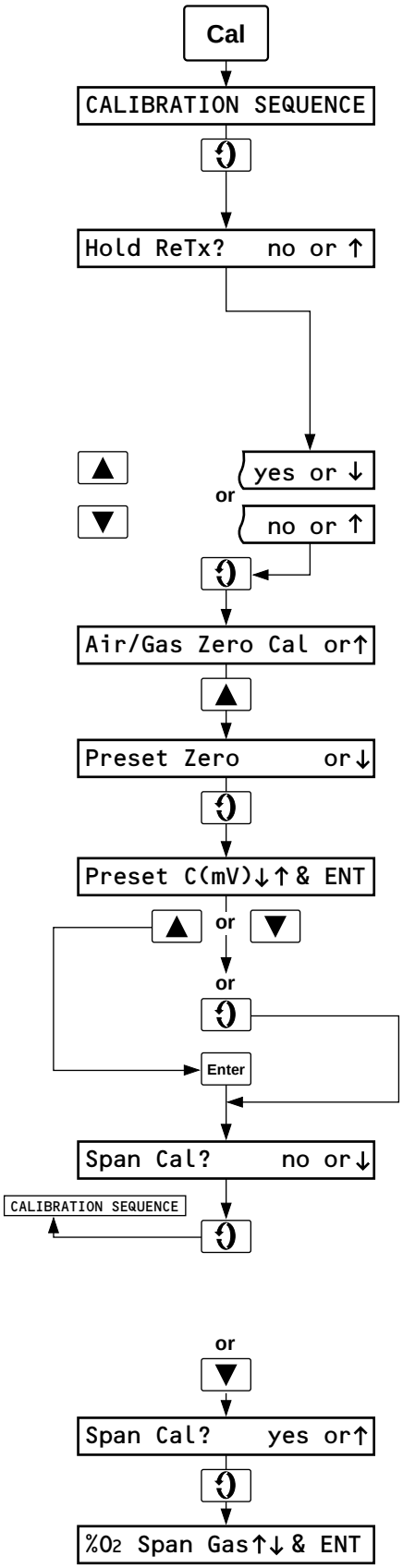
Accept zero calibration value and return to top of **Calibration Page**.

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

Set cell constant to 0mV (i.e. calibration unacceptable) and return to top of **Calibration Page**.

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

13.4.3 Preset Calibration



Select **Calibration Page**.

Note. Any relays which are allocated to either Oxygen Alarm 1 or Alarm 2 are now disabled to prevent inadvertent alarms occurring during calibration – see Fig. 11.3.

Hold Retransmission Level(s)

Any retransmission output which is assigned to the oxygen range can be held at its present level (e.g. if being used for control) or set to zero – see Fig. 11.2.

Note. Any retransmission output which is assigned to the efficiency calculation is automatically set to zero.

Hold oxygen retransmission output(s) at present level(s).
or
(If not already selected.) Set oxygen retransmission output(s) to zero.

Air or Gas Zero Calibration

Use Preset Zero (Cell Constant) Value

Preset Zero (Cell Constant) Value

Set the probe's cell constant on the upper display.

or
Advance to next parameter if the displayed value is already correct.

Accept new cell constant.

Calibrate Span (Two-point Calibration)

Span (second point) calibration not required (return to top of **Calibration Page**).

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

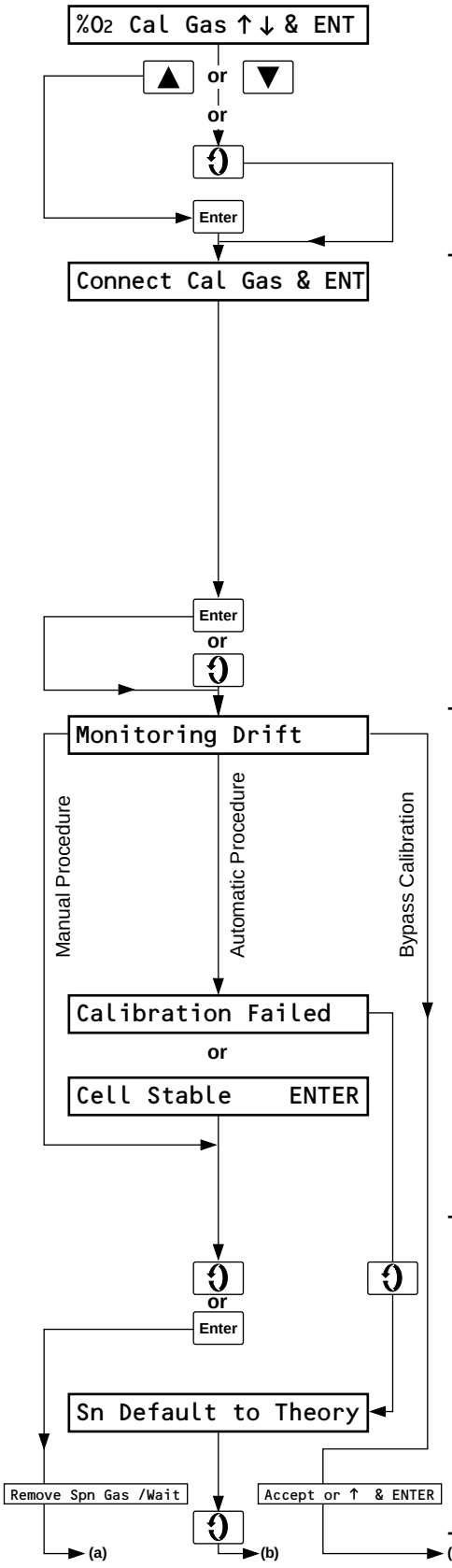
or

Span (second point) calibration required.

Refer to Section 13.5.

13.5 Second-point (Span) Calibration

Carry out an air or gas zero calibration procedure – see Section 13.4.1 or 13.4.2.



Span Calibration Gas Value

Set the value shown on the upper display to that of the span calibration gas to be used (1 to 10% O_2).
or
Advance to next parameter if the displayed value is already correct.

Accept new calibration gas value.

Gas Connection

Note. The upper display shows the measured oxygen concentration value for the remainder of the span calibration procedure.

Remove the test gas blanking screw or plug from the test gas connector on the probe and connect the calibration gas (1 to 10% O_2) to the connector – refer to the appropriate probe operating instructions.

Note. Ensure that the gas connected is equivalent to that setup at **Span Calibration Gas Value**, above.

Initiate automatic span calibration.
or
Bypass zero calibration procedure.

Monitor Cell Output

The cell output is monitored until a stable output is detected. The measured oxygen concentration (calibration) value shown on the upper display may be manually accepted or rejected at any time prior to completion of automatic calibration (five mins. approx.), e.g. in the event of the cell stabilizing rapidly (or its output fluctuating marginally) or if it is evident that the output will not stabilize.

If a stable output is detected the display reverts automatically to either of the following:

Calibration Failed
Cell output has stabilized but is outside operational limits.
or
Cell Stable (Calibration Passed)
Cell output has stabilized at a value within acceptable limits. With the cell output in a stable state, the new zero calibration value can either be accepted or rejected, depending on the accuracy required.

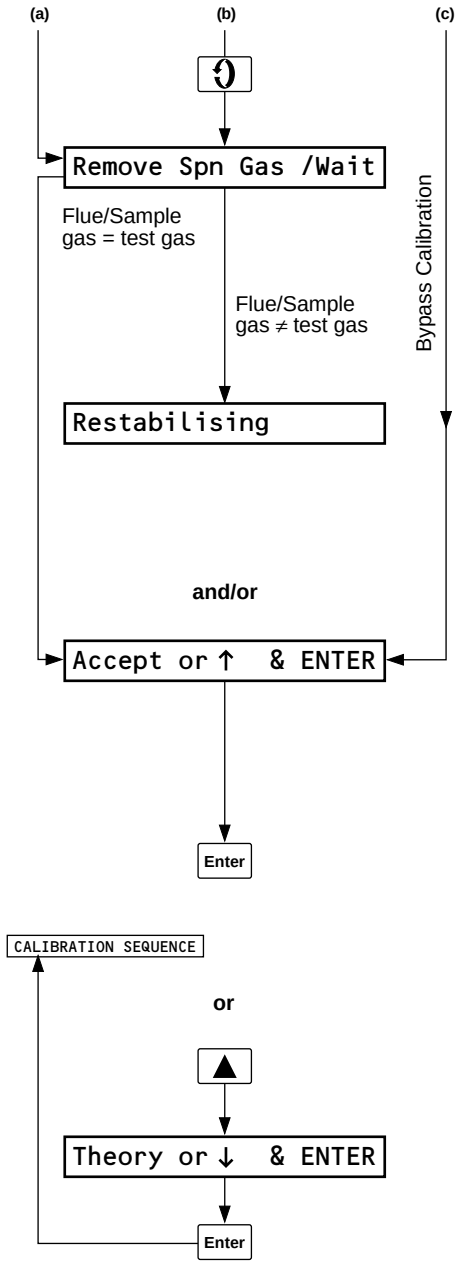
Accept or Reject Span Calibration Value

Accept new span calibration value.
or
Reject new span calibration value (previous calibration value is retained) or, if calibration has failed, advance to next parameter.

Set Span to Theoretical Value
The span is automatically set to a theoretical (reference) value to allow continued use of the probe in the event of a failed calibration.

Continued on next page.

…13.5 Second-point (Span) Calibration



Gas Removal

Disconnect the calibration gas from the probe and refit the blanking plug/ screw to the connector.

The cell output is monitored for approximately one minute to check for any change in oxygen concentration due to the transition from calibration gas to flue gas measurement. The display automatically reverts to either of the following:

Cell Output Restabilizing

Allow a suitable time for the cell output to stabilize.

Note. The display reverts automatically to the next parameter after approximately three minutes, irrespective of cell output stability.

and/or

Accept Span Calibration or Default to Theoretical Value

The span calibration value obtained can be either accepted or set to the theoretical (reference) value, if unsatisfactory.

Note. If the calibration procedure was bypassed at **Gas Connection**, above, the 'Accepted' value is that of the previous span calibration procedure.

Accept span calibration value and return to top of **Calibration Page**.

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

or

Select alternative option.

Set span calibration value to theoretical (reference) value, i.e. calibration unacceptable, and return to top of **Calibration Page**.

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

14 SPECIFICATION

Accuracies (ZMT Unit only)

Oxygen Concentration (display and retransmission)	≤2% of reading or ±0.1% O_2 whichever is greater
Display Resolution	±1 digit
System Accuracy*	
Display	≤ ±2% of reading (Z-FG2 probe) ≤ ±5% of reading (Z-GP2 probe) } or ±0.1% O_2 whichever is greater
Retransmission	≤ ±2% of reading (Z-FG2 probe) ≤ ±5% of reading (Z-GP2 probe)
Error Due to Ambient Temperature Variation	±0.02% span/°C typical.
Error Due to Power Supply Voltage Variation	None for ±15% variation
Interference Suppression	10V/metre over frequency range 27MHz to 1GHz in accordance with BS6667
Line Interruption	<50ms loss, no effect >50ms loss, instrument returns to operation after automatic reset
Line Interference	<500V, input pulse width up to 125µs, no effect and as indicated in BS 6667

Outputs and Set Points

Analog Outputs	0 to 10mA, 0 to 20mA or 4 to 20mA – up to three max. into 1kΩ max. load
Output Modules:	
Oxygen	Programmable for any range within 0 to 25%O_2 (5% minimum span)
Temperature	
Cell	Programmable for any range within 0 to 1400°C (200°C minimum span)
Flue	Programmable for any range within 0 to 700°C (200°C minimum span)
Air	Programmable for any range within –40 to 400°C (200°C minimum span)
Combustion Efficiency	0 to 100%
Relay Outputs	4 max.
Set Point Adjustment	Programmable
Relay Contacts:	Single pole changeover
Voltage	250V a.c. 250V d.c. Max.
Current	3A a.c. 3A d.c. Max.

Environmental Data

Operating Temperature Limits	0 to 55°C
Operating Humidity Limits	0 to 80%RH
Protection Rating	IP55

Power Supply

Voltage Requirement	110 or 230V (±15%) 50/60Hz
Power Consumption	150VA
Insulation, Mains to Earth	2kV r.m.s.

Displays

Measured Value	5-digit, 7 segment, blue filtered vacuum fluorescent
Information	20-character, single line, dot matrix, blue filtered vacuum fluorescent
Measuring Ranges:	
Oxygen	0 to 25% O_2 (programmable to a minimum span of 5% O_2 linear)
Probe Temperature	0 to 1400°C (200°C span min. for retransmission)

* Z-MT with either a Z-FG2 or Z-GP2 probe when calibrated against a certified test gas

APPENDIX

A1 Gas Panel – Auto-Calibration Versions Only

Caution. The following paragraphs highlight general gas panel requirements and must not be used as the sole basis for a detailed design.

Auto-calibration versions of the Z-MT require the zero and span calibration gases to be connected permanently to the probe's test gas inlet. This is best acheived by use of a gas panel (not supplied).

An example of a gas panel is shown in Fig. A1.1. Two separately controlled gas streams for the zero and span calibration gases. Each stream contains an in-line solenoid valve controlled from the ZMT and a manually-operated needle valve to set the flow. The two streams join and pass through a common flowmeter which provides visual indication of gas flow to the probe. The flow meter outlet is connected to the probe's test gas inlet.

Note. Where the pipe run between probe head and the gas panel exceeds 10m, it is recommended that a solenoid valve is installed close to the probe test gas inlet. This reduces susceptability to corrosion caused by pressure and temperature fluctuations in the sample gas.

During auto-calibration the solenoid valves SV1 and SV2 are controlled remotely from the ZMT. SV1 and SV2 can also be switched manually at the gas panel. Needle valves NE1 and NE2 provide for manual flow control isolation of each gas stream.

A remote 'No gas' alarm can also be incorporated by adding a pressure switch to both gas streams.

Where a solenoid valve is used to switch the gas supply at the probe head, a slave relay must be connected in parallel across each solenoid valve. Normally open contacts from these relays are used to energise the solenoid valve at the probe head when either gas supply is enabled.

A suggested electrical schematic connection diagram is shown in Appendix A1.1, overleaf.

Note. All gas panel components must have a gas-tight shut-off action.

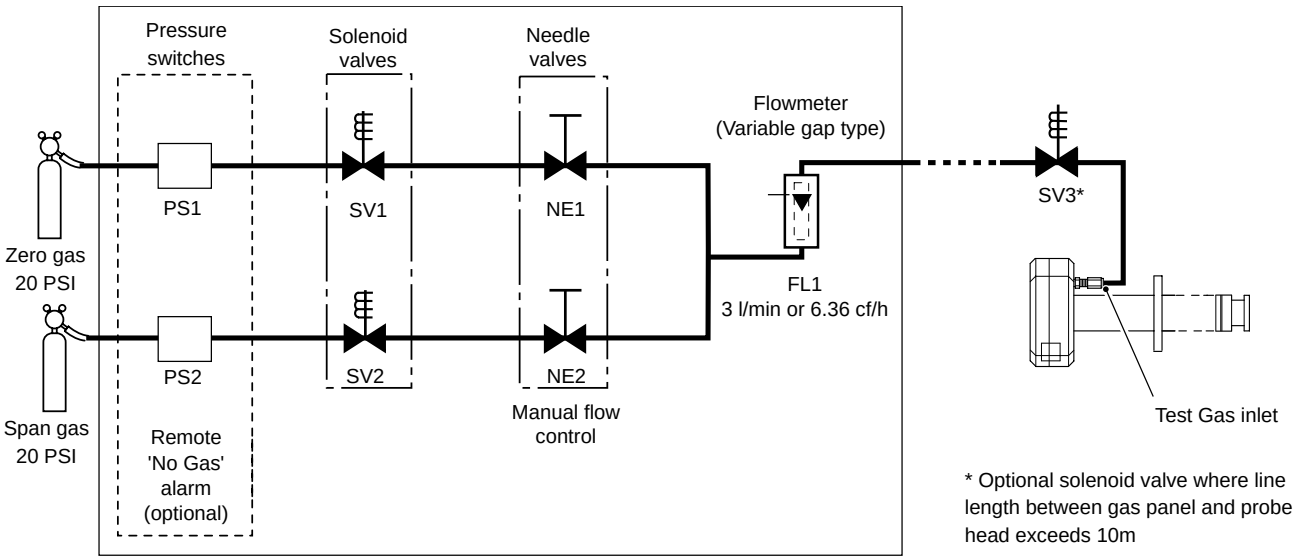


Fig. A1.1 Schematic Diagram – Auto-calibration

A1.1 Gas Panel – Electrical Control Features

Fig. A1.2 shows an example of the control features required on a gas panel intended for use with the auto-calibration facility. The gas panel must be designed in accordance with relevant, current legislation.

The circuit provides remote control of the zero and span gases during auto-calibration sequences, with the facility for a manual override at the gas panel.

When switch SW1 is set to 'Remote', control of solenoid valves SV1 and SV2 is from the Z-MT via relay output module 3.

When switch SW1 is set to 'Local', SV1 and SV2 are controlled by switch SW2. SW2 has three positions – 'Zero Gas', 'Span Gas' and a centre 'Off' position. Thus, under manual control at the gas panel, it is not possible for both valves to be open at the same time.

If the line length between the gas panel and the probe head exceeds 10m, it is recommended that an additional valve, SV3 is added close to the probe head. SV3 is operated from slave relays connected in parallel across SV1 and SV2.

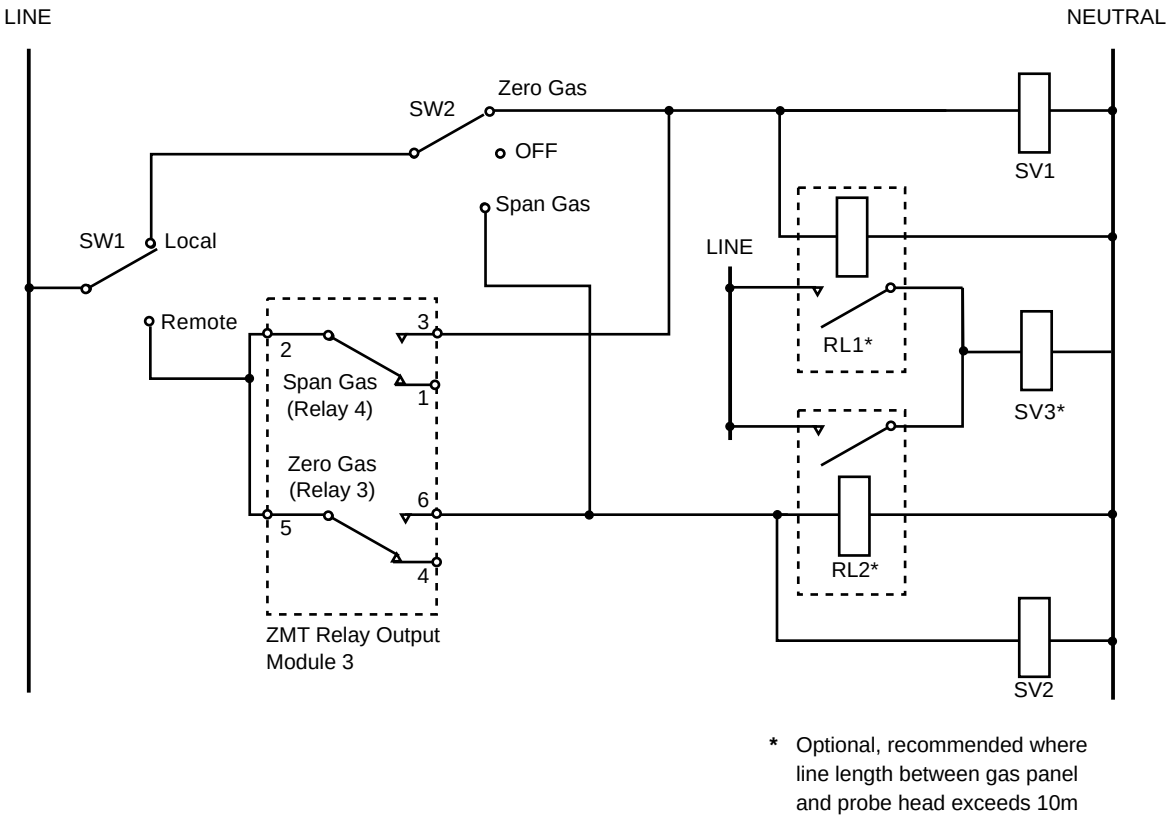


Fig A1.2 Suggested Circuit – Gas Panel

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