The Company

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

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

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

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

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

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

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

Health and Safety

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

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

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

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>2</td>
</tr>
<tr>
<td>PREPARATION</td>
<td>2</td>
</tr>
<tr>
<td>2.1 Accessories</td>
<td>2</td>
</tr>
<tr>
<td>2.2 Checking the Instrument Code Number</td>
<td>2</td>
</tr>
<tr>
<td>2.3 Checking the Program Card Details</td>
<td>2</td>
</tr>
<tr>
<td>SITING</td>
<td>4</td>
</tr>
<tr>
<td>MOUNTING</td>
<td>4</td>
</tr>
<tr>
<td>4.1 Overall Dimensions</td>
<td>4</td>
</tr>
<tr>
<td>4.2 Mounting Details</td>
<td>4</td>
</tr>
<tr>
<td>CONNECTIONS</td>
<td>6</td>
</tr>
<tr>
<td>5.1 Gas Panel – Auto-calibration Versions Only</td>
<td>6</td>
</tr>
<tr>
<td>5.2 Access to Terminals</td>
<td>6</td>
</tr>
<tr>
<td>5.3 Preparation</td>
<td>6</td>
</tr>
<tr>
<td>5.4 Connection Details</td>
<td>6</td>
</tr>
<tr>
<td>5.4.1 Z-FG2 Probes</td>
<td>8</td>
</tr>
<tr>
<td>5.4.2 Z-GP2 Probes</td>
<td>8</td>
</tr>
<tr>
<td>SETTING UP</td>
<td>10</td>
</tr>
<tr>
<td>6.1 Selecting the Mains Input Voltage</td>
<td>10</td>
</tr>
<tr>
<td>6.2 Selecting the Retransmission Output Range(s)</td>
<td>10</td>
</tr>
<tr>
<td>DISPLAYS AND CONTROLS</td>
<td>11</td>
</tr>
<tr>
<td>7.1 Program Controls</td>
<td>11</td>
</tr>
<tr>
<td>7.2 Reference Air Supply</td>
<td>11</td>
</tr>
<tr>
<td>7.3 Displays</td>
<td>11</td>
</tr>
<tr>
<td>INITIAL START-UP</td>
<td>12</td>
</tr>
<tr>
<td>8.1 Start-Up Procedure</td>
<td>12</td>
</tr>
<tr>
<td>8.1.1 Cell Warm-up</td>
<td>12</td>
</tr>
<tr>
<td>8.1.2 Cell Stabilization</td>
<td>12</td>
</tr>
<tr>
<td>8.2 Setting the Reference Air Flow</td>
<td>12</td>
</tr>
<tr>
<td>8.3 Simple Fault Finding</td>
<td>12</td>
</tr>
<tr>
<td>PROGRAMMING – GENERAL</td>
<td>13</td>
</tr>
<tr>
<td>9.1 Access to Secure Parameters</td>
<td>13</td>
</tr>
<tr>
<td>PROGRAMMING – USER PAGES</td>
<td>14</td>
</tr>
<tr>
<td>10.1 Oxygen Page</td>
<td>15</td>
</tr>
<tr>
<td>10.2 Display Temperature Page</td>
<td>16</td>
</tr>
<tr>
<td>10.3 Combustion Efficiency Page</td>
<td>21</td>
</tr>
<tr>
<td>10.4 Alarms and Indications Page</td>
<td>22</td>
</tr>
<tr>
<td>10.4.1 Alarm Indication</td>
<td>27</td>
</tr>
<tr>
<td>10.4.2 Multiple Alarm Indication</td>
<td>27</td>
</tr>
<tr>
<td>10.4.3 Instrument Response in Event of Fault Alarm(s)</td>
<td>28</td>
</tr>
<tr>
<td>10.5 Carbon Dioxide/Carbon Monoxide Page</td>
<td>29</td>
</tr>
<tr>
<td>10.5.1 Standardizing Z-MT Unit to External Carbon Monoxide Monitor</td>
<td>30</td>
</tr>
<tr>
<td>10.6 Calibration Page</td>
<td>30</td>
</tr>
<tr>
<td>PROGRAMMING – UTILITY PAGES</td>
<td>31</td>
</tr>
<tr>
<td>11.1 Analog Retransmission Page</td>
<td>32</td>
</tr>
<tr>
<td>11.2 Relay Allocation Page</td>
<td>38</td>
</tr>
<tr>
<td>11.3 Diagnostics Page</td>
<td>44</td>
</tr>
<tr>
<td>AUTO-CALIBRATION</td>
<td>48</td>
</tr>
<tr>
<td>12.1 Auto-calibration, General</td>
<td>48</td>
</tr>
<tr>
<td>12.2 Clock Setup Page</td>
<td>49</td>
</tr>
<tr>
<td>12.3 Auto-calibration Setup</td>
<td>50</td>
</tr>
<tr>
<td>12.4 Auto-calibration Status</td>
<td>54</td>
</tr>
<tr>
<td>12.5 Auto-calibration Test</td>
<td>55</td>
</tr>
<tr>
<td>SEMI-AUTO CALIBRATION</td>
<td>56</td>
</tr>
<tr>
<td>13.1 Semi-auto Calibration, General</td>
<td>56</td>
</tr>
<tr>
<td>13.2 Equipment Required</td>
<td>56</td>
</tr>
<tr>
<td>13.3 Preparation</td>
<td>56</td>
</tr>
<tr>
<td>13.4 Single-Point (Zero) Calibration</td>
<td>58</td>
</tr>
<tr>
<td>13.4.1 Air Calibration</td>
<td>58</td>
</tr>
<tr>
<td>13.4.2 Gas Calibration</td>
<td>60</td>
</tr>
<tr>
<td>13.4.3 Preset Calibration</td>
<td>63</td>
</tr>
<tr>
<td>13.5 Second-point (Span) Calibration</td>
<td>64</td>
</tr>
<tr>
<td>SPECIFICATION</td>
<td>66</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>67</td>
</tr>
<tr>
<td>A1 Gas Panel – Auto-Calibration Versions Only</td>
<td>67</td>
</tr>
<tr>
<td>A1.1 Gas Panel – Electrical Control Features</td>
<td>68</td>
</tr>
</tbody>
</table>
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 programmed 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
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(See Note 5)</td>
<td>One Relay</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two Relays for EXFG Auto-cal</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analog + Relay</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Module 3</td>
<td>None</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(See Note 6)</td>
<td>One Relay</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Two Relays (Auto-cal or Alarms)</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analog + Relay</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Serial O/P and/or EXFG Temp. Trip</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mains Voltage</td>
<td>110V 50/60Hz</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>230V 50/60Hz</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 1**
Fuel options available: 00 No fuel specification
01 Natural gas
02 Propane
03 Butane
04 Medium oil
05 Heavy oil
06 General fuel oil
07 Naphtha
08 Kerosene
09 Distillate oil
10 No. 4 fuel oil
11 No. 5 fuel oil
12 No. 6 fuel oil
13 Coal (general)
14 Bituminous coal
15 Steam coal
16 Anthracite
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...

**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.
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).

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. 5.1 Schematic Diagram – Z-FG2 Probe

Fig. 5.2 Schematic Diagram – Z-GP2 Probe
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 achieved 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.

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

Table 5.1 Cable References and Air Tubing Specification

<table>
<thead>
<tr>
<th>Cable/Tubing Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell output cable</td>
<td>16/0.2mm laid up red and blue twin copper braid with overall p.v.c. sheath</td>
</tr>
<tr>
<td>Thermocouple cable</td>
<td>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)</td>
</tr>
<tr>
<td>Heater cable (Z-FG2 probes only)</td>
<td>3-core 1mm2 copper (20 metres max.)* 3-core 1.5mm2 copper (32 metres max.)* 3-core 2mm2 copper (69 metres max.)*</td>
</tr>
<tr>
<td>Air Tubing (Reference Air)</td>
<td>1/4in. o.d. x 1/8in. i.d. stainless steel, nylon or p.v.c. tube</td>
</tr>
</tbody>
</table>

* Total run length including flexible conduit.

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.
<table>
<thead>
<tr>
<th>Terminal Reference</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heater</strong></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Probe heater</td>
</tr>
<tr>
<td>H</td>
<td>supply</td>
</tr>
<tr>
<td>E</td>
<td>Earth</td>
</tr>
<tr>
<td><strong>Mains Supply</strong></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Line</td>
</tr>
<tr>
<td>N</td>
<td>Neutral</td>
</tr>
<tr>
<td>E</td>
<td>Earth</td>
</tr>
<tr>
<td><strong>Probe Cell Output</strong></td>
<td></td>
</tr>
<tr>
<td>PROBE –</td>
<td>From probe cell</td>
</tr>
<tr>
<td>CELL +</td>
<td></td>
</tr>
<tr>
<td><strong>Thermocouples</strong></td>
<td></td>
</tr>
<tr>
<td>PROBE –</td>
<td>From probe thermocouple</td>
</tr>
<tr>
<td>T/C +</td>
<td></td>
</tr>
<tr>
<td>FLUE –</td>
<td>From flue thermocouple</td>
</tr>
<tr>
<td>T/C +</td>
<td></td>
</tr>
<tr>
<td>AIR –</td>
<td>From air thermocouple</td>
</tr>
<tr>
<td>T/C +</td>
<td></td>
</tr>
<tr>
<td><strong>Remote Auto-calibration Request</strong></td>
<td></td>
</tr>
<tr>
<td>BURNER –</td>
<td>Switch [Remote Auto-calibration Request] or Logic input [Normal Operation]</td>
</tr>
<tr>
<td>FUEL –</td>
<td>Switch [Fuel 1] or Logic input [0V Fuel 2]</td>
</tr>
</tbody>
</table>

**Carbon Monoxide Retransmission Signal**

| CO I/P –            | 4 to 20mA from external monitor |
| CO I/P +            |            |

**Output 3:**

- **Double relay**
  - 1: normally closed
  - 2: common
  - 3: normally open
  - 4: normally closed
  - 5: common
  - 6: normally open

| O/P MODULE 3        | Relay 4                     |
|                    | Analog retransmission + relay |
|                    | 1: positive                  |
|                    | 2: negative                  |
|                    | 3: common                    |
|                    | 4: normally closed           |
|                    | 5: common                    |
|                    | 6: normally open             |

**Output 2:**

- **Single relay**
  - 1: —
  - 2: —
  - 3: normally closed
  - 4: common
  - 5: normally open

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

**Output 1:**

- **Analog retransmission + relay**
  - 1: positive
  - 2: negative
  - 3: normally closed
  - 4: common
  - 5: normally open

| O/P MODULE 1        | Relay 1                     |

**Table 5.2 Electrical Connections**

* Refer to Section 6.1 to check the mains input voltage
** Auto-calibration Versions Only
5 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:
   Switch connections, either way round to '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 +'
   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
   '4' - normally closed
   '5' - common
   '6' - normally open

   **Single relay + analog output − ‘O/P MODULE 3’**
   
   '1' – positive
   '2' – negative
   '3' – not connected
   '4' – normally closed
   '5' – common
   '6' – normally open

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

   **Single relay + analog output − ‘O/P MODULE 2’**
   
   '1' – positive
   '2' – negative
   '3' – normally closed
   '4' – common
   '5' – normally open

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
   '3' – normally closed
   '4' – common
   '5' – normally open

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 tubing 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.
Fig. 5.4 Connection Details – Z-FG2 Probes

Fig. 5.5 Connection Details – Z-GP2 Probes
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.

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.
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. 7.1. 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.

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.
**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.

### 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.

<table>
<thead>
<tr>
<th>Probe Type</th>
<th>Pump/Regulator Configuration</th>
<th>Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-FG2</td>
<td>Pump + flow indicator Regulator + adjustable flow gauge</td>
<td>None Set to 150 to 200ml/min</td>
</tr>
<tr>
<td>Z-GP2</td>
<td>Pump + adjustable flow gauge Regulator + adjustable flow gauge</td>
<td>Set to 250 to 1000ml/min Set to 250 to 1000ml/min</td>
</tr>
</tbody>
</table>

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.
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 PROGRAMMING – USER PAGES...

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 PROGRAMMING – USER PAGES

...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.

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.

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 PROGRAMMING – USER PAGES

...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
- 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.

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.

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

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.

**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.

**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

Analog Retransmission – see Fig. 11.2

- Shows the analog range to which each retransmission output is assigned, oxygen, cell temp., flue temp., air temp. or combustion efficiency (3 outputs max.)

Security

Selection of:
- a) Analog range to be transmitted
- b) High and low retransmission values
- c) Retransmission switched on or off

Fig. 11.1 Utility Pages

Relay Allocation – see Fig. 11.3

- Shows the alarm or indication parameter to which each relay is assigned and whether the relay is energized above or below the set point, or switched off (4 relays max.).

Security

Selection of:
- a) Alarm/indication parameter assignment
- b) Relay energized above or below set point
- c) Relay switched on or off

Diagnosics – see Fig. 11.4

- Test displays:
- Millivolt output from cell
- Millivolt output from cell
- Thermocouple details:
  - a) Type (K, R or S or preset temp.)
  - b) Measured outputs (mV)
- Probe calibration details:
  - a) Cell constant (whether preset, theoretical or calibrated)
  - b) Span value (whether theoretical or calibrated)
  - c) Calibration gas used
- Cell impedance check (last checked value)

Security

Implementation of a cell impedance check.
11.1 Analog Retransmission Page

Refer to Overall Program Chart – Fig. 9.1

Fig. 11.2 Analog Retransmission Page Program Chart
11 PROGRAMMING – UTILITY PAGES...

...11.1 Analog Retransmission Page

<table>
<thead>
<tr>
<th>Note.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 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.</td>
</tr>
<tr>
<td>• This page is omitted if there are no retransmission outputs.</td>
</tr>
</tbody>
</table>

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.
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% O₂ 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% O₂ range is increased to 15% O₂, the new higher retransmission value is raised automatically to 20% O₂, i.e. maintaining a minimum retransmission span of 5% O₂.

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 (% O₂, °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.

**Note.** Return to top of Analog Retransmission Page (single retransmission versions).

**or**
Advance to next parameter (multiple retransmission versions).
11 PROGRAMMING – UTILITY PAGES...

...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% O₂ 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% O₂ range is increased to 15% O₂, the new higher retransmission value is raised automatically to 20% O₂, i.e. maintaining a minimum retransmission span of 5% O₂.

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 (% O₂, °C, °F or %).

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

Continued on next page.
...11 PROGRAMMING – UTILITY PAGES

...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% O₂ 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% O₂ range is increased to 15% O₂, the new higher retransmission value is raised automatically to 20% O₂, i.e. maintaining a minimum retransmission span of 5% O₂.

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 (% O₂, °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

**USER PARAMETERS**

- Rly 1
  - EB
  - EA
- Rly 2
  - EB
  - EA
- Rly 3
  - EB
  - EA
- Rly 4
  - EB
  - EA

**SECURE PARAMETERS**

- Rly 1
  - EB or
  - EA or
- Rly 2
  - EB or
  - EA or
- Rly 3
  - EB or
  - EA or
- Rly 4
  - EB or
  - EA or

**Note.**

- xxxxxxx = Omitted on single fuel
- Omitted if under temp alarm off
- Omitted if air alarm off
- Omitted if flue alarm off
- Omitted if cell alarm off
- Omitted if flue T/C not used
- Omitted if cell T/C not used

Auto-calibration versions only

**Fig. 11.3 Relay Allocation Page Program Chart**
11 PROGRAMMING – UTILITY PAGES...

...11.2 Relay Allocation Page

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Relay Allocation Page</th>
<th>EB (Energized Below)</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flue 2 (for indication of fuel changeover)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General alarm (for any alarm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell under temperature alarm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermocouple alarm (for any thermocouple)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broken air thermocouple</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broken flue thermocouple</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broken cell thermocouple</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen alarm 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen alarm 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto cal failed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Auto Cal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

NOTE 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:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>EA (Energized Above)</th>
<th>EB (Energized Below)</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel 2</td>
<td>Energized on fuel 2</td>
<td>Energized on fuel 1</td>
<td>Off</td>
</tr>
<tr>
<td>General alarm</td>
<td>Energized in alarm condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Cell under temperature</td>
<td>Energized in normal condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Broken thermocouple</td>
<td>Energized in fault condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Broken air thermocouple</td>
<td>Energized in fault condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Broken flue thermocouple</td>
<td>Energized in fault condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Broken cell thermocouple</td>
<td>Energized in fault condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Flue temperature high</td>
<td>Energized in fault condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Cell temperature high</td>
<td>Energized in fault condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Cell temperature high</td>
<td>Energized in alarm condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Oxygen alarm 1</td>
<td>Energized in alarm condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Oxygen alarm 2</td>
<td>Energized in alarm condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>Auto cal failed</td>
<td>Energized in alarm condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
<tr>
<td>In Auto Cal</td>
<td>Energized in alarm condition</td>
<td>Energized in normal condition</td>
<td>Off</td>
</tr>
</tbody>
</table>

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 PROGRAMMING – UTILITY PAGES

...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.

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.

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 PROGRAMMING – UTILITY PAGES

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.
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% O₂ to the probe.

Return to top of Diagnostics Page if ‘Retest (O₂ 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% O₂) or > 10% O₂ in N₂

b) Two-point (zero and span) calibration

   Test gas values: Zero — Air (20.9% O₂) or > 10% O₂ in N₂
   Span — < 10% O₂ in N₂ (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.
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

Refer to Auto Calibration Pages – Fig 12.1

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.

Select single-point span auto-calibration.

or
Select two-point zero and span auto-calibration.

Zero Gas Value
The known %O\textsubscript{2} of the gas used to calibrate the cell zero must be entered.

Adjust the %O\textsubscript{2} reading shown on the upper display to the %O\textsubscript{2} content of the zero gas.

Span Gas Value
The known %O\textsubscript{2} of the gas used to calibrate the probe span must be entered.

Adjust the %O\textsubscript{2} reading shown on the upper display to the %O\textsubscript{2} content of the span gas.

Hold Retransmission Output 1 Level
The value assigned to retransmission output 1 can be held at its 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 its 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 %O₂ 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 %O₂ 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 %O₂ 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 %O₂ 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 %O₂ 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 %O₂ 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 %O₂ 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.
...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.

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.

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.

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.

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% O₂).

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% O₂) 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 SEMI-AUTO CALIBRATION

...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% O₂).

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% O₂) 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.

(c) Continued on next page.
13 SEMI-AUTO CALIBRATION

...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.
<table>
<thead>
<tr>
<th><strong>Accuracies (ZMT Unit only)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen Concentration (display and retransmission)</td>
<td>≤2% of reading or ±0.1% O₂ whichever is greater</td>
</tr>
<tr>
<td>Display Resolution</td>
<td>±1 digit</td>
</tr>
<tr>
<td>System Accuracy*</td>
<td></td>
</tr>
<tr>
<td>Display</td>
<td>≤ ±2% of reading (Z-FG2 probe) or ≤ ±5% of reading (Z-GP2 probe)</td>
</tr>
<tr>
<td>Retransmission</td>
<td>≤ ±2% of reading (Z-FG2 probe) or ≤ ±5% of reading (Z-GP2 probe)</td>
</tr>
<tr>
<td>Error Due to Ambient Temperature Variation</td>
<td>±0.02% span/°C typical.</td>
</tr>
<tr>
<td>Error Due to Power Supply Voltage Variation</td>
<td>None for ±15% variation</td>
</tr>
<tr>
<td>Interference Suppression</td>
<td>10V/metre over frequency range 27MHz to 1GHz in accordance with BS6667</td>
</tr>
<tr>
<td>Line Interruption</td>
<td>&lt;50ms loss, no effect</td>
</tr>
<tr>
<td>Line Interference</td>
<td>&gt;50ms loss, instrument returns to operation after automatic reset</td>
</tr>
<tr>
<td><strong>Outputs and Set Points</strong></td>
<td></td>
</tr>
<tr>
<td>Analog Outputs</td>
<td>0 to 10mA, 0 to 20mA or 4 to 20mA – up to three max. into 1kΩ max. load</td>
</tr>
<tr>
<td>Output Modules: Oxygen</td>
<td>Programmable for any range within 0 to 25%O₂ (5% minimum span)</td>
</tr>
<tr>
<td>Temperature Cell</td>
<td>Programmable for any range within 0 to 1400°C (200°C minimum span)</td>
</tr>
<tr>
<td>Flue</td>
<td>Programmable for any range within 0 to 700°C (200°C minimum span)</td>
</tr>
<tr>
<td>Air</td>
<td>Programmable for any range within −40 to 400°C (200°C minimum span)</td>
</tr>
<tr>
<td>Combustion Efficiency</td>
<td>0 to 100%</td>
</tr>
<tr>
<td>Relay Outputs</td>
<td>4 max.</td>
</tr>
<tr>
<td>Set Point Adjustment</td>
<td>Programmable</td>
</tr>
<tr>
<td>Relay Contacts: Voltage</td>
<td>Single pole changeover</td>
</tr>
<tr>
<td>Current</td>
<td>250V a.c. 250V d.c. 3A a.c. 3A d.c. Max.</td>
</tr>
<tr>
<td><strong>Environmental Data</strong></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Limits</td>
<td>0 to 55°C</td>
</tr>
<tr>
<td>Operating Humidity Limits</td>
<td>0 to 80%RH</td>
</tr>
<tr>
<td>Protection Rating</td>
<td>IP55</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td></td>
</tr>
<tr>
<td>Voltage Requirement</td>
<td>110 or 230V (±15%) 50/60Hz</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>150VA</td>
</tr>
<tr>
<td>Insulation, Mains to Earth</td>
<td>2kV r.m.s.</td>
</tr>
<tr>
<td><strong>Displays</strong></td>
<td></td>
</tr>
<tr>
<td>Measured Value</td>
<td>5-digit, 7 segment, blue filtered vacuum fluorescent</td>
</tr>
<tr>
<td>Information</td>
<td>20-character, single line, dot matrix, blue filtered vacuum fluorescent</td>
</tr>
<tr>
<td>Measuring Ranges: Oxygen</td>
<td>0 to 25% O₂ (programmable to a minimum span of 5% O₂ linear)</td>
</tr>
<tr>
<td>Probe Temperature</td>
<td>0 to 1400°C (200°C span min. for retransmission)</td>
</tr>
</tbody>
</table>

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

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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Fax: +1 775 850 4808

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

Periodic checks must be made on the equipment’s condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:
1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.