ABB MEASUREMENT & ANALYTICS | USER GUIDE | IM/AZ20E-EN REV. F

Endura AZ series integral and remote transmitter
Combustion oxygen monitor

Measurement made easy

Superior technology and quality from the world leader in oxygen measurement

Introduction

The Endura AZ20 is the latest in a long line of high-quality, combustion gas analyzers from ABB.

The sensor, based on a zirconium oxide cell, is mounted at the tip of the probe that is inserted in the flue duct. The resulting direct, in situ measurement provides accurate and rapid oxygen reading for combustion control optimization and emissions monitoring.

This User Guide is intended for use on the following analyzer systems:

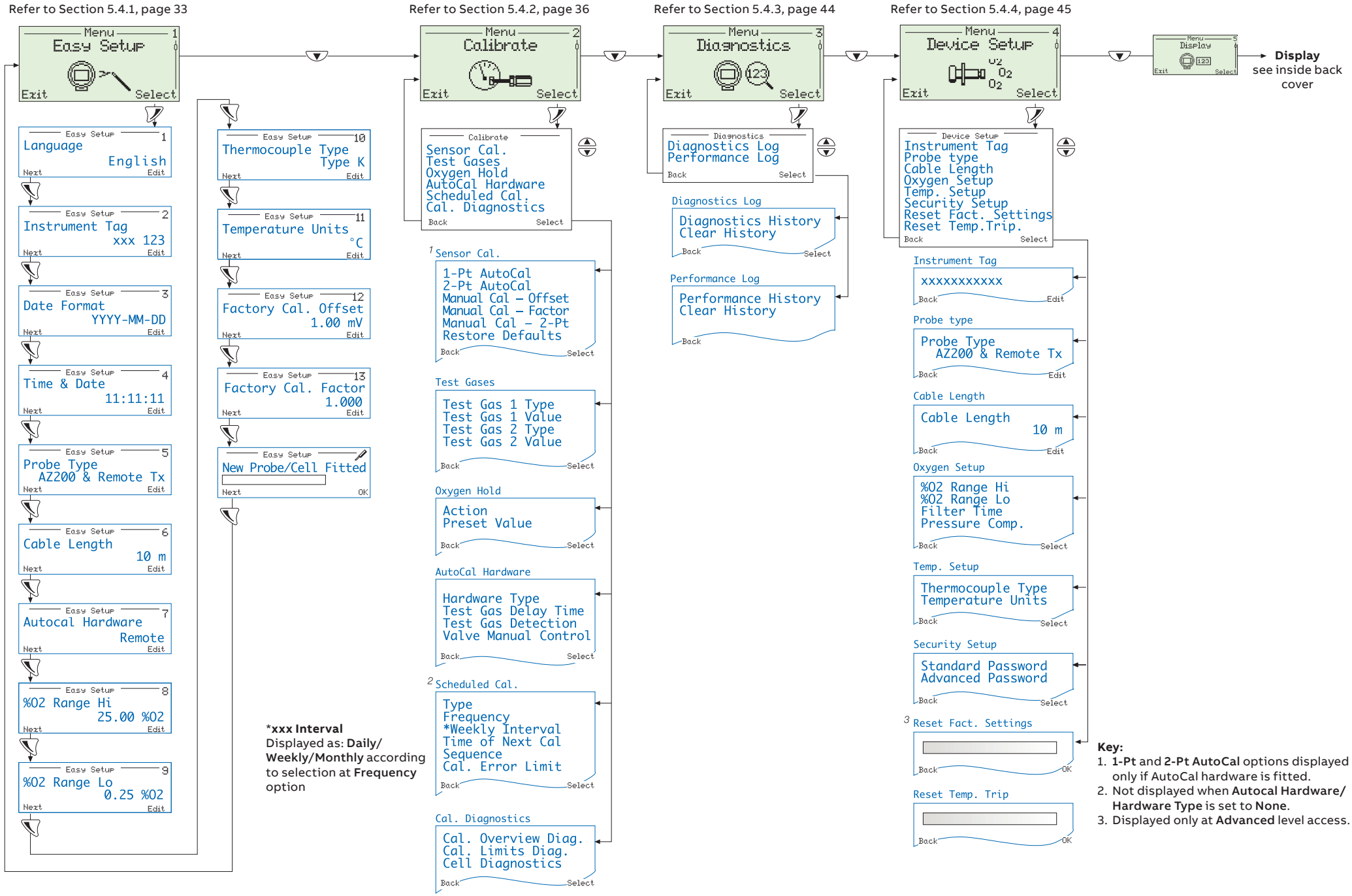
- Endura AZ10
- Endura AZ20
- Endura AZ25

For more information

Further publications for the Endura AZ series analyzers are available for free download from:
www.abb.com/measurement

or by scanning this code:

	Search for or click on
Data sheet Endura AZ20 oxygen monitor Combustion gas analysis	DS/AZ20-EN
Data sheet Endura AZ25 oxygen analyzer Combustion gas analysis	DS/AZ25-EN
Maintenance guide Endura AZ20 series probe Combustion oxygen monitor	IM/AZ20M-EN
User guide Endura AZ20 series probe Combustion oxygen monitor	IM/AZ20P-EN
User guide Endura AZ25 series probe Combustion oxygen monitor	OI/AZ25P-EN


Refer to Section 5.4.1, page 33
Refer to Section 5.4.2, page 36
Refer to Section 5.4.3, page 44
Refer to Section 5.4.4, page 45
Menu 1 Easy Setup Exit Select
Easy Setup 1 Language English Next Edit
Easy Setup 2 Instrument Tag xxx 123 Next Edit
Easy Setup 3 Date Format YYYY-MM-DD Next Edit
Easy Setup 4 Time & Date 11:11:11 Next Edit
Easy Setup 5 Probe Type AZ200 & Remote Tx Next Edit
Easy Setup 6 Cable Length 10 m Next Edit
Easy Setup 7 Autocal Hardware Remote Next Edit
Easy Setup 8 %O2 Range Hi 25.00 %O2 Next Edit
Easy Setup 9 %O2 Range Lo 0.25 %O2 Next Edit
Easy Setup 10 Thermocouple Type Type K Next Edit
Easy Setup 11 Temperature Units °C Next Edit
Easy Setup 12 Factory Cal. Offset 1.00 mV Next Edit
Easy Setup 13 Factory Cal. Factor 1.000 Next Edit
Easy Setup New Probe/Cell Fitted Next OK
*xxx Interval
Displayed as: Daily/ Weekly/Monthly according to selection at Frequency option
Menu 2 Calibrate Exit Select
Calibrate Sensor Cal. Test Gases Oxygen Hold AutoCal Hardware Scheduled Cal. Cal. Diagnostics Back Select
1 Sensor Cal. 1-Pt AutoCal 2-Pt AutoCal Manual Cal – Offset Manual Cal – Factor Manual Cal – 2-Pt Restore Defaults Back Select
Test Gases Test Gas 1 Type Test Gas 1 Value Test Gas 2 Type Test Gas 2 Value Back Select
Oxygen Hold Action Preset Value Back Select
AutoCal Hardware Hardware Type Test Gas Delay Time Test Gas Detection Valve Manual Control Back Select
2 Scheduled Cal. Type Frequency *Weekly Interval Time of Next Cal Sequence Cal. Error Limit Back Select
Cal. Diagnostics Cal. Overview Diag. Cal. Limits Diag. Cell Diagnostics Back Select
Menu 3 Diagnostics Exit Select
Diagnostics Diagnostics Log Performance Log Back Select
Diagnostics Log Diagnostics History Clear History Back Select
Performance Log Performance History Clear History Back
Menu 4 Device Setup Exit Select
Device Setup Instrument Tag Probe type Cable Length Oxygen Setup Temp. Setup Security Setup Reset Fact. Settings Reset Temp.Trip. Back Select
Instrument Tag xxxxxxxxxxx Back Edit
Probe type Probe Type AZ200 & Remote Tx Back Edit
Cable Length Cable Length 10 m Back Edit
Oxygen Setup %O2 Range Hi %O2 Range Lo Filter Time Pressure Comp. Back Select
Temp. Setup Thermocouple Type Temperature Units Back Select
Security Setup Standard Password Advanced Password Back Select
3 Reset Fact. Settings Back OK
Reset Temp. Trip Back OK
Menu 5 Display Exit Select
Display see inside back cover
Key:
1. 1-Pt and 2-Pt AutoCal options displayed only if AutoCal hardware is fitted.
2. Not displayed when Autocal Hardware/ Hardware Type is set to None.
3. Displayed only at Advanced level access.

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1 Safety

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.

1.1 Health & Safety

Health and Safety

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

- The relevant sections of these instructions must be read carefully before proceeding.
- Warning labels on containers and packages must be observed.
- Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
- Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and / or temperature.
- Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
- 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 Material Safety Data Sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

1.2 Electrical Safety – CEI / IEC 61010-1:2001-2

This equipment complies with the requirements of CEI / IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use' and complies with US NEC 500, NIST and OSHA.

If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

1.3 Symbols – CEI / IEC 61010-1:2001-2

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

	Protective earth (ground) terminal.
	Functional earth (ground) terminal.
	Direct current supply only.
	Alternating current supply only.
	Both direct and alternating current supply.

	The equipment is protected through double insulation.
	This symbol, when noted on a product, indicates a potential hazard which could cause serious personal injury and / or death. The user should reference this instruction manual for operation and / or safety information.
	This symbol, when noted on a product enclosure or barrier, indicates that a risk of electrical shock and / or electrocution exists and indicates that only individuals qualified to work with hazardous voltages should open the enclosure or remove the barrier.
	This symbol indicates that the marked item can be hot and should not be touched without care.
	This symbol indicates the presence of devices sensitive to electrostatic discharge and indicates that care must be taken to prevent damage to them.
	This symbol identifies a risk of chemical harm and indicates that only individuals qualified and trained to work with chemicals should handle chemicals or perform maintenance on chemical delivery systems associated with the equipment.
	This symbol indicates the need for protective eye wear.
	This symbol indicates the need for protective hand wear.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems. In conformity with European local and national regulations, European electrical equipment users must now return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.
15	Products marked with this symbol indicates that the product contains toxic or hazardous substances or elements. The number inside the symbol indicates the environmental protection use period in years.

1.4 Product Recycling Information

	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August 2005. In conformity with European local and national regulations (EU Directive 2002 / 96 / EC), European electrical equipment users must now return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

Note. For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment for proper disposal.

1.5 Product Disposal

Note. The following only applies to European customers.

	ABB is committed to ensuring that the risk of any environmental damage or pollution caused by any of its products is minimized as far as possible. The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002 / 96 / EC) that came into force on August 13 2005 aims to reduce the waste arising from electrical and electronic equipment; and improve the environmental performance of all those involved in the life cycle of electrical and electronic equipment. In conformity with European local and national regulations (EU Directive 2002 / 96 / EC stated above), electrical equipment marked with the above symbol may not be disposed of in European public disposal systems after 12 August 2005.

1.6 Restriction of Hazardous Substances (RoHS)

	The European Union RoHS Directive and subsequent regulations introduced in member states and other countries limits the use of six hazardous substances used in the manufacturing of electrical and electronic equipment. Currently, monitoring and control instruments do not fall within the scope of the RoHS Directive, however ABB has taken the decision to adopt the recommendations in the Directive as the target for all future product design and component purchasing.

1.7 REACH directive

The candidate list according to Article 59 of the Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of chemicals (REACH) continues to expand. Article 33 places a legal obligation on an article producer to inform recipients of the information requirements when a candidate list substance is contained within an article at percentage of greater than 0.1% W/W.

The AZ25 probe, product number AZ25/ all variants, aluminosilicates (CAS, 142844-00-6) a class 2 carcinogen, is contained at a percentage marginally greater than 0.1% of the weight of the product. The material is totally enclosed within the product and should pose no risk to the user during installation, use and decommissioning providing the probe is handled in accordance with the instructions defined in the user manual. The probe should be disposed of as hazardous waste.

Further information on refractory ceramic fibers can be found at Fiberfrax, www.Fiberfrax.com and on the ECHA (European Chemicals Hazards Agency) websites.

1.8 Safety Precautions

Please read the entire manual before unpacking, setting up, or operating this instrument.

Pay particular attention to all warning and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that which is specified in this manual.

1.9 Safety Conventions

Warning. In this manual, a warning is used to indicate a condition which, if not met, could cause serious personal injury and / or death. Do not move beyond a warning until all conditions have been met.

If a warning sign appears on the instrument itself, refer to Precautionary Labels – UL Certification and Electrical Safety – CEI / IEC 61010-1:2001-2 for an explanation.

Caution. A caution is used to indicate a condition which, if not met, could cause minor or moderate personal injury and / or damage to the equipment. Do not move beyond a caution until all conditions have been met.

Note. A note is used to indicate important information or instructions that should be considered before operating the equipment.

1.10 Safety Recommendations

For safe operation, it is imperative that these service instructions be read before use and that the safety recommendations mentioned herein be scrupulously respected. If danger warnings are not heeded to, serious material or bodily injury could occur.

Warning. The installation of the instrument should be performed exclusively by personnel specialized and authorized to work on electrical installations, in accordance with relevant local regulations.

1.11 Service and Repairs

Other than the serviceable items listed in IM/AZ20P–EN, none of the instrument's components can be serviced by the user. Only personnel from ABB or its approved representative(s) is (are) authorized to attempt repairs to the system and only components formally approved by the manufacturer should be used. Any attempt at repairing the instrument in contravention of these principles could cause damage to the instrument and corporal injury to the person carrying out the repair. It renders the warranty null and void and could compromise the correct working of the instrument and the electrical integrity or the CE compliance of the instrument.

If you have any problems with installation, starting, or using the instrument please contact the company that sold it to you. If this is not possible, or if the results of this approach are not satisfactory, please contact the manufacturer's Customer Service.

1.12 Potential Safety Hazards

The following potential safety hazards are associated with operating the system:

- Electrical (line voltage)
- Potentially hazardous chemicals

2 Introduction

The new Endura AZ20 is the latest in a long line of high-quality, combustion gas analyzers from ABB and provides continuous monitoring of oxygen content in applications using in situ probes.

Operation and programming of the Endura AZ20 is via four capacitive switches and a digital display located on the front of the transmitter.

In operation, the transmitter can display measured % oxygen, cell mV, cell temperature or probe heater output. Set-up of alarm, retransmission and calibration parameters is achieved in programming mode, where key parameters are protected by security codes.

Measured oxygen values can be retransmitted to remote equipment using the retransmission output facility. The range of values retransmitted can be set anywhere within the transmitter's display range of 0 to 100 % O_2.

Remote alarm indication is provided by two relay outputs. Relays are programmed to activate when the oxygen level moves either above or below a pre-defined set point. The alarm relay can also be used as a 'general alarm' that is activated in the event of a transmitter or system fault.

This User Guide provides the following information:

- installation details for a remote AZ20 transmitter – see Section 3, page 8
- probe cable, power supply and output connection details for remote and integral AZ20 transmitters – see Section 4, page 11
- programming, calibration and troubleshooting information for remote and integral AZ20 transmitters

Warning.

- System configuration must be carried out only by users or personnel with approved access rights (user privileges).
- Read all relevant sections of this guide before configuring the system or modifying system parameters.
- Install and use this equipment as detailed in this guide. Install and use associated equipment in accordance with the relevant national and local standards.

3 Mechanical Installation

3.1 Unpacking

Caution. Visually inspect equipment for damage before installing. Do not install damaged or faulty equipment.

3.2 End of Life Disposal

The transmitter contains a small lithium battery that must be removed and disposed of responsibly in accordance with local environmental regulations.

The remainder of the transmitter does not contain any substance that causes undue harm to the environment and must be disposed of in accordance with the Directive on Waste Electrical and Electronic Equipment (WEEE). It must not be disposed of in Municipal Waste Collection.

3.3 Cleaning

The transmitter can be hosed down if it has been installed to IP66 / NEMA 4 standards, (cable glands are fitted correctly and all unused cable entry holes are blanked off – see Section 4.1.1, page 12 [remote transmitter] or see Section 4.9, page 22 [integral transmitter]).

Warm water and a mild detergent can be used.

3.4 Installation Conditions – Transmitter

Caution. Remote transmitter shown. Refer to IM/AZ20P–EN for integral transmitter installation conditions.

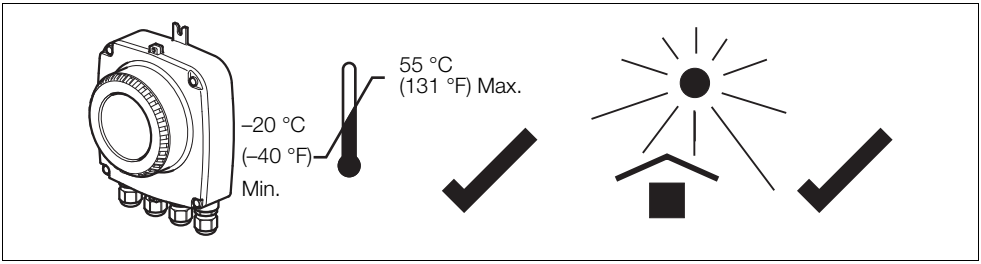


Fig. 3.1 Within Temperature Limits and in a Shaded Environment

Warning.

- Locate the transmitter in a position where its temperature and humidity specification are not exceeded and ensure it is protected from direct sunlight, rain, snow and hail.
- Select a location away from strong electrical and magnetic fields. If this is not possible, particularly in applications where mobile communications equipment is expected to be used, screened cables within flexible, earthed metal conduit must be used.

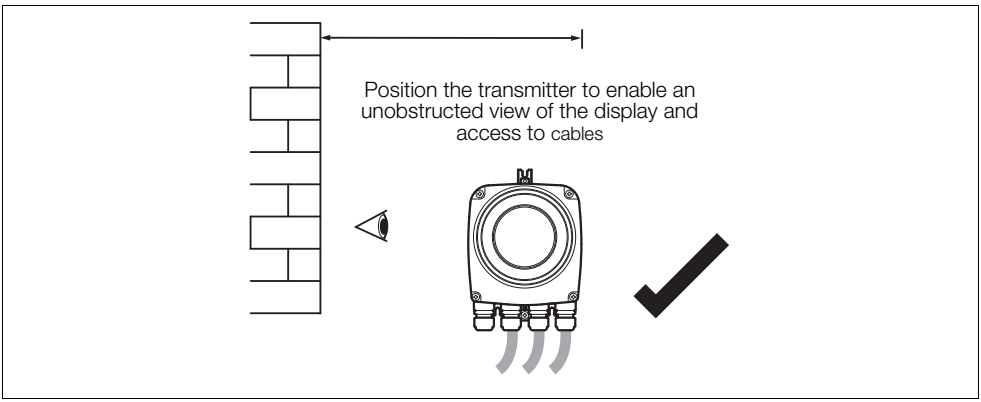


Fig. 3.2 Access to Transmitter

3.5 Overall Dimensions

3.5.1 Remote Transmitter Dimensions

Fix remote transmitter to a secure surface using 3 x M5 screws (not supplied).

Dimensions in mm (ft.)

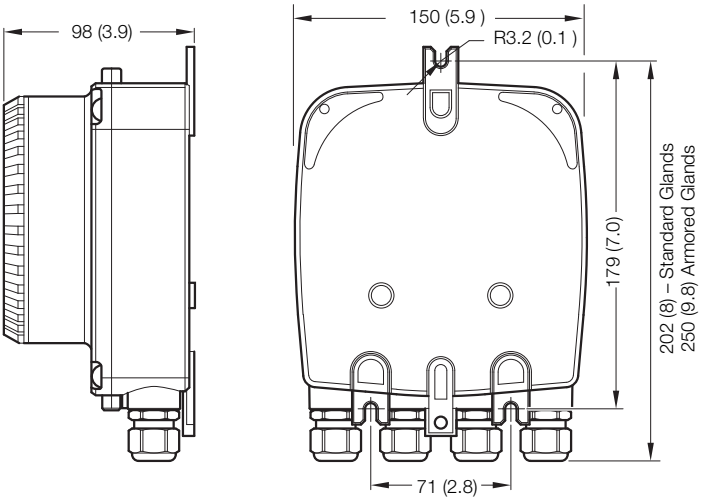


Fig. 3.3 Remote Transmitter Dimensions (Standard Glands Shown)

3.5.2 Probe Dimensions

Refer to IM/AZ20P–EN for probe and integral system dimensions.

4 Electrical Installation

4.1 Electrical Safety

Warning.

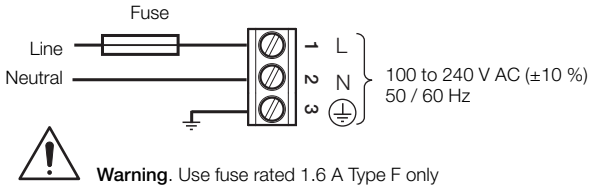
- The transmitter is not fitted with a switch therefore a disconnecting device such as a switch or circuit breaker conforming to local safety standards must be fitted to the final installation. It must be fitted in close proximity to the transmitter within easy reach of the operator and must be marked clearly as the disconnection device for the transmitter – see Fig. 4.1, page 12.
- Electrical installation and earthing (grounding) must be in accordance with relevant national and local standards.
- Remove all power from supply, relay and any powered control circuits and high common mode voltages before accessing or making any connections.
- Use cable appropriate for the load currents: 3-core cable rated 5 A and 90 °C (194 °F) minimum, that conform to either IEC 60227 or IEC 60245. The terminals accept cables from 0.8 to 2.5 mm^2 (18 to 14 AWG).
- The equipment conforms to Installation Category II of IEC 61010.
- All connections to secondary circuits must have basic insulation.
- After installation, there must be no access to live parts, for example, terminals.
- Terminals for external circuits are for use only with equipment with no accessible live parts.
- If the equipment is used in a manner not specified by the Company, the protection provided by the equipment may be impaired.
- All equipment connected to the transmitter's terminals must comply with local safety standards (IEC 60950, EN61010-1).

Caution.

- Always route signal leads and power cables separately, preferably in earthed (grounded) metal conduit.
- Make connections only as shown.
- Maintain Environmental Protection at all times.
- Ensure the seal and mating surfaces are clean to maintain environmental rating.
- Conduit connections must provide cable entry sealing.
- Ensure cable glands are tightened after wiring. Do not overtighten the plastic cable glands to avoid destroying their sealing properties. Initially, tighten finger-tight, then a further $^1/_2$ to $^3/_4$ turn using a suitable spanner or wrench.
- Fit blanking plugs where required.
- Inductive loads must be suppressed or clamped to limit voltage swings.
- Operation of outputs is programmable.

4.1.1 AC Power Supply Connections

Note. Tighten power supply terminal screws to a torque of 0.8 Nm (7 lbf.in).



Warning. Use fuse rated 1.6 A Type F only

Fig. 4.1 AC Power Supply Connections

4.2 Remote Transmitter – Access to Terminals

Warning. Isolate the transmitter from power supplies before removing the cover.

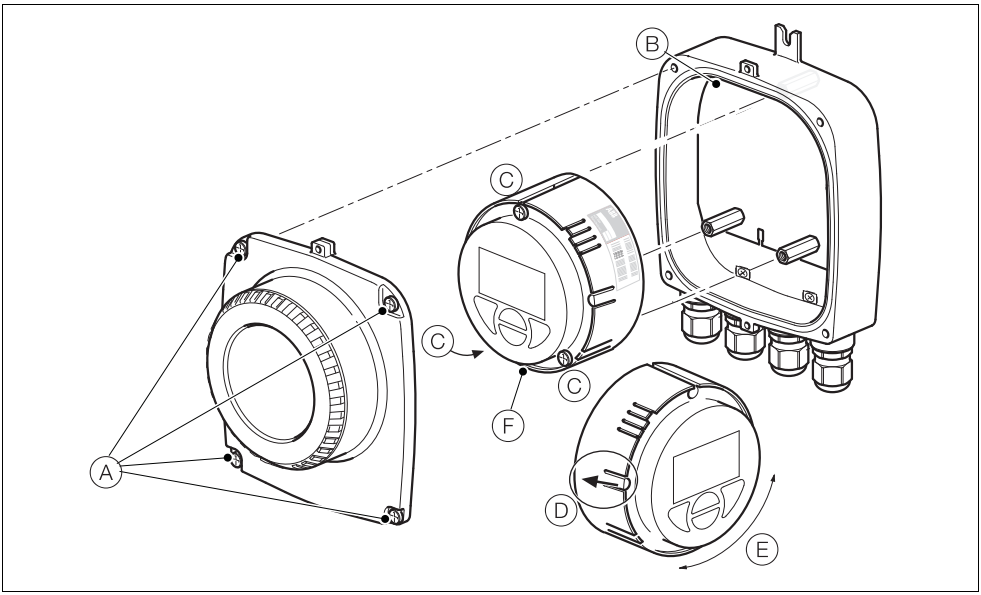


Fig. 4.2 Accessing Remote Transmitter Terminals

Referring to Fig. 4.2:

1. Slacken (but do not remove) the four front cover screws (A).
2. Remove the cover.
3. Check that the power indicator LED (B) on the backplane is **not** lit.

   Warning. If the power indicator LED (B) is lit, the transmitter is still powered up. Before continuing, isolate the transmitter power supply.

4. If screws C are not visible, access them by gently pulling the rotation lock D back and rotating the cartridge E until the cartridge screw access holes align with the cartridge screw heads.
5. Slacken the three cartridge screws and lift the cartridge F away from the housing.
6. To refit the cover, reverse the actions in steps 1 to 5.

4.3 Remote Transmitter – Cable Gland Entries and Main Board Connections

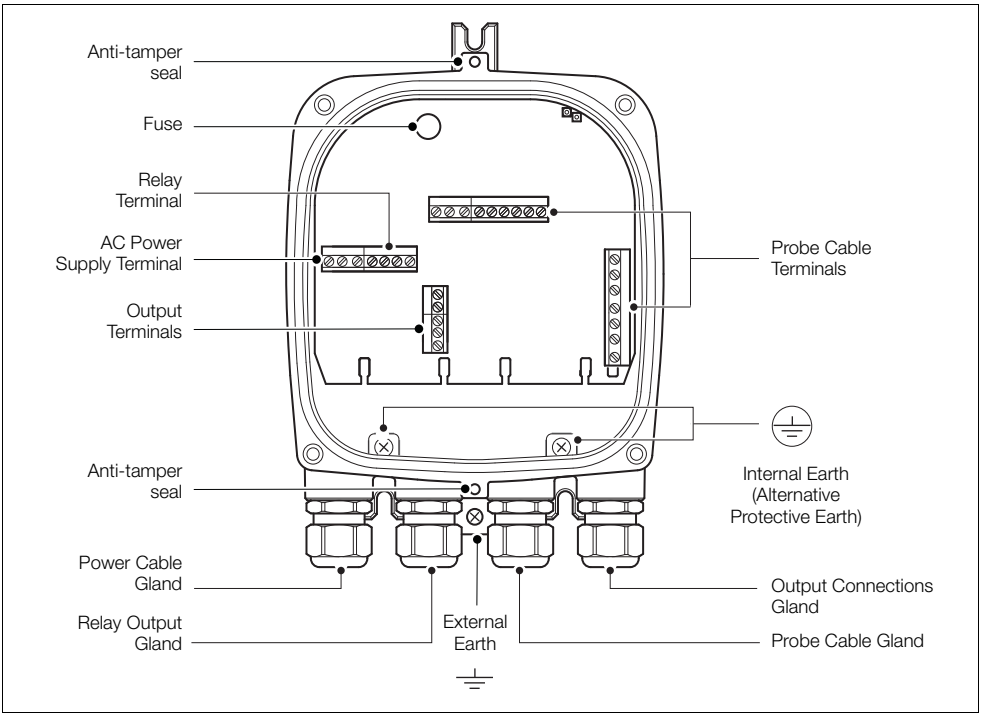


Fig. 4.3 Cable Gland / Conduit Entries (Remote Transmitter) and Main Board

4.4 Remote Transmitter – Remote AZ10 Sensor Cable Connections

4.4.1 Systems with ≤5 m (≤18 ft) Cable Length

Sensor connection	Transmitter Connection	Cable Color	Connection / Note
White / Yellow (not used) White / Black (not used) White / Orange (not used) White / Green (not used) White / Red (not used) White / Blue (not used)	White / Yellow (not used) White / Black (not used) White / Orange (not used) White / Green (not used) White / Red (not used) White / Blue (not used)	White / Yellow (not used) White / Black (not used) White / Orange (not used) White / Green (not used) White / Red (not used) White / Blue (not used)	**NOT USED** Cut wires back at both ends of cable
Red	Red	Red	Cell + (oxygen input)
Black	Black	Black	Cell – (oxygen input)
Violet	Violet	Violet	ACJC
Grey	Grey	Grey	ACJC
Green	Green	Green	T/C +
White	White	White	T/C –
Earth stud (Screen 1 and 2)	SCN (not used)	Screen 1 and 2 (sleeved)	See Fig. 4.4
Brown	Brown	Brown	Heater 1
Blue	Blue	Blue	Heater 2

Table 4.1 Systems with ≤5 m (≤18 ft) Cable Length

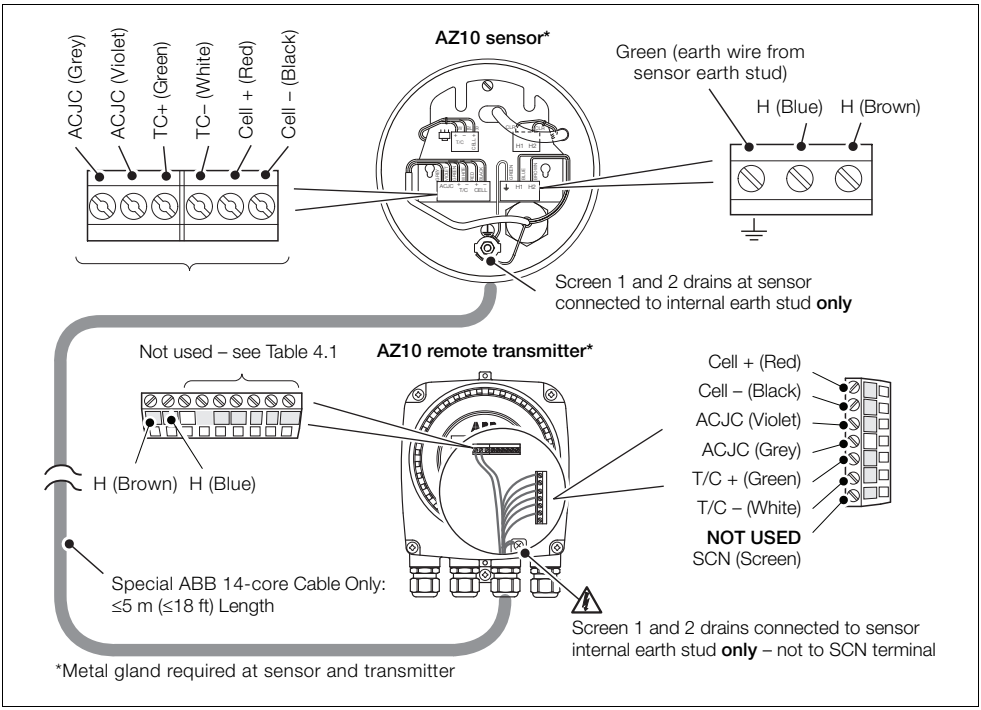


Fig. 4.4 Systems with ≤5 m (≤18 ft) Cable Length

4.4.2 Systems with ≥5 m (≥18 ft) Cable Length

Sensor connection	Transmitter Connection	Cable Color	Connection / Note
White / Yellow (not used) White / Black (not used) White / Orange (not used) White / Green (not used) White / Red (not used) White / Blue (not used)	White / Yellow (not used) White / Black (not used) White / Orange (not used) White / Green (not used) White / Red (not used) White / Blue (not used)	White / Yellow (not used) White / Black (not used) White / Orange (not used) White / Green (not used) White / Red (not used) White / Blue (not used)	**NOT USED** Cut wires back at both ends of cable
Red	Red	Red	Cell + (oxygen input)
Black	Black	Black	Cell – (oxygen input)
Violet	Violet	Violet	ACJC
Grey	Grey	Grey	ACJC
Green	Green	Green	T/C +
White	White	White	T/C –
Earth stud (Screen 1 and 2)	SCN (Screen 1 and 2)	Screen 1 and 2 (sleeved drains)	See Fig. 4.5
Brown	Brown	Brown	Heater 1
Blue	Blue	Blue	Heater 2

Table 4.2 Systems with ≥5 m (≥18 ft) Cable Length

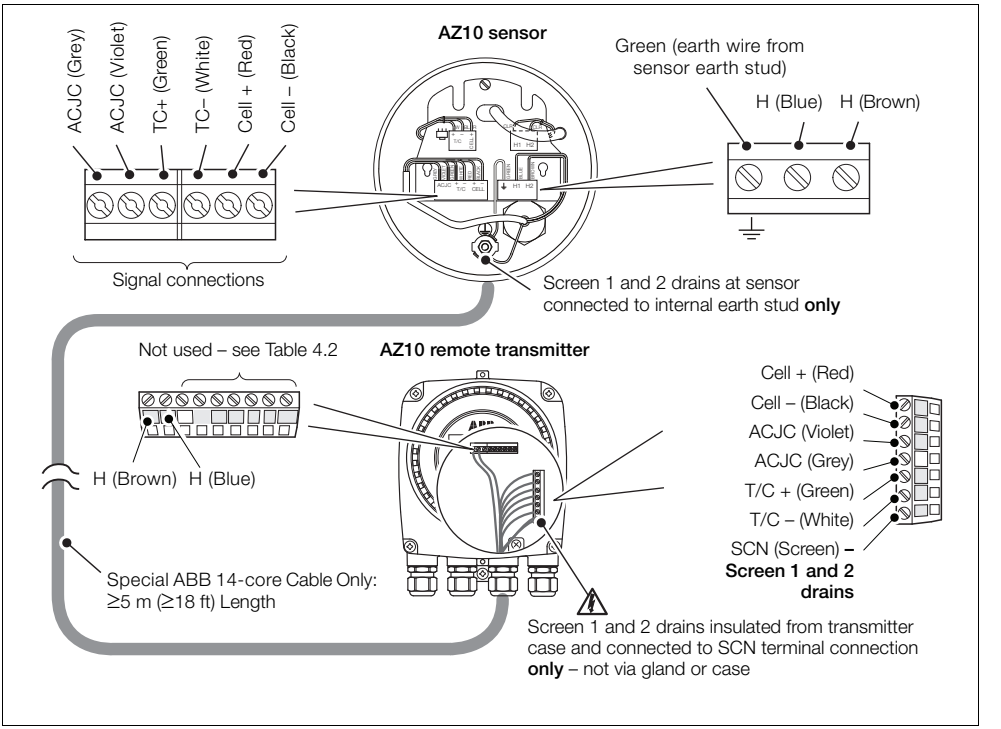


Fig. 4.5 Systems with ≥5 m (≥18 ft) Cable Length

4.5 Remote Transmitter – Remote AZ20 Probe Cable Connections

Terminal Number	Tag ID	Connection Type	Cable Color Code
1	H	Heater	Brown
2	H	Heater	Blue
3	SCN	Screen	Screens
4	T / C –	Thermocouple (–ve)	White
5	T / C+	Thermocouple (+ve)	Green
6	ACJC	PT1000 Cold Junction Compensation	Grey
7	ACJC	PT1000 Cold Junction Compensation	Violet
8	CELL –	Oxygen Input (–ve)	Black
9	CELL +	Oxygen Input (+ve)	Red
10	PS2	Pressure Switch – Gas 2	White / Yellow
11	P COM	Pressure Switch – Common	White / Black
12	PS1	Pressure Switch – Gas 1	White / Orange
13	SV2	Solenoid Valve – Gas 2	White / Blue
14	SV COM	Solenoid Valve – Common	White / Red
15	SV1	Solenoid Valve – Gas 1	White / Green

Table 4.3 Remote Transmitter – Remote AZ20 Probe Cable Connections

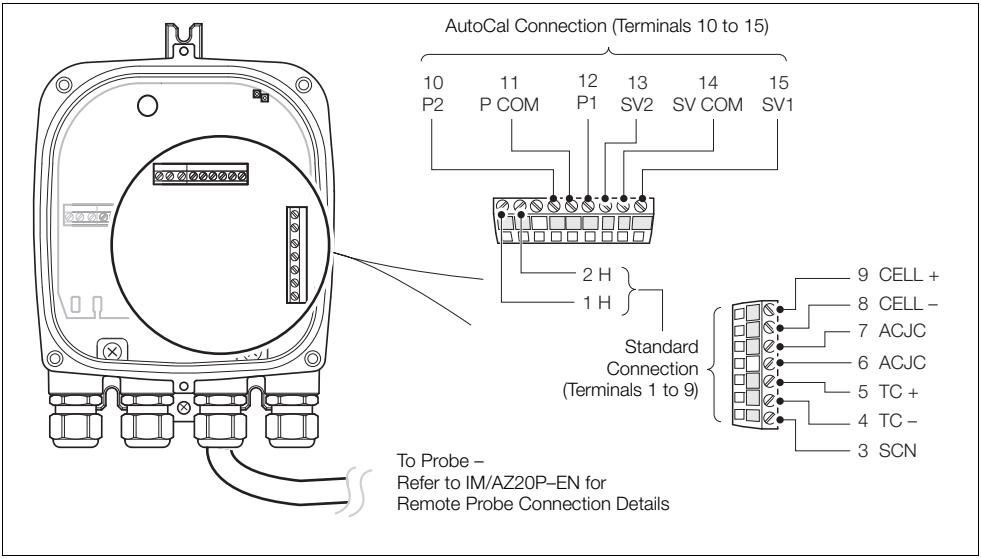


Fig. 4.6 Remote Transmitter – Remote AZ20 Probe Cable Connections

4.6 Remote Transmitter – Remote AZ25 Probe Connections

Transmitter terminal block color	Remote transmitter to probe cable – wire colors	Probe / remote transmitter connection
Green	Green	TC +
White	White	TC –
Red	Red	Cell +
Black	Black	Cell –
Orange	Orange	ACJC
Blue	Blue	ACJC
SCN (not used) – see Fig. 4.7 sensor cable screen (drain) connected at transmitter internal earth stud only	Screen (drain) – see Fig. 4.7 for sensor cable screen connections	Screen / drain – see Fig. 4.7 for screen connection at transmitter

Table 4.4 Remote Transmitter to Remote AZ25 Probe Connections

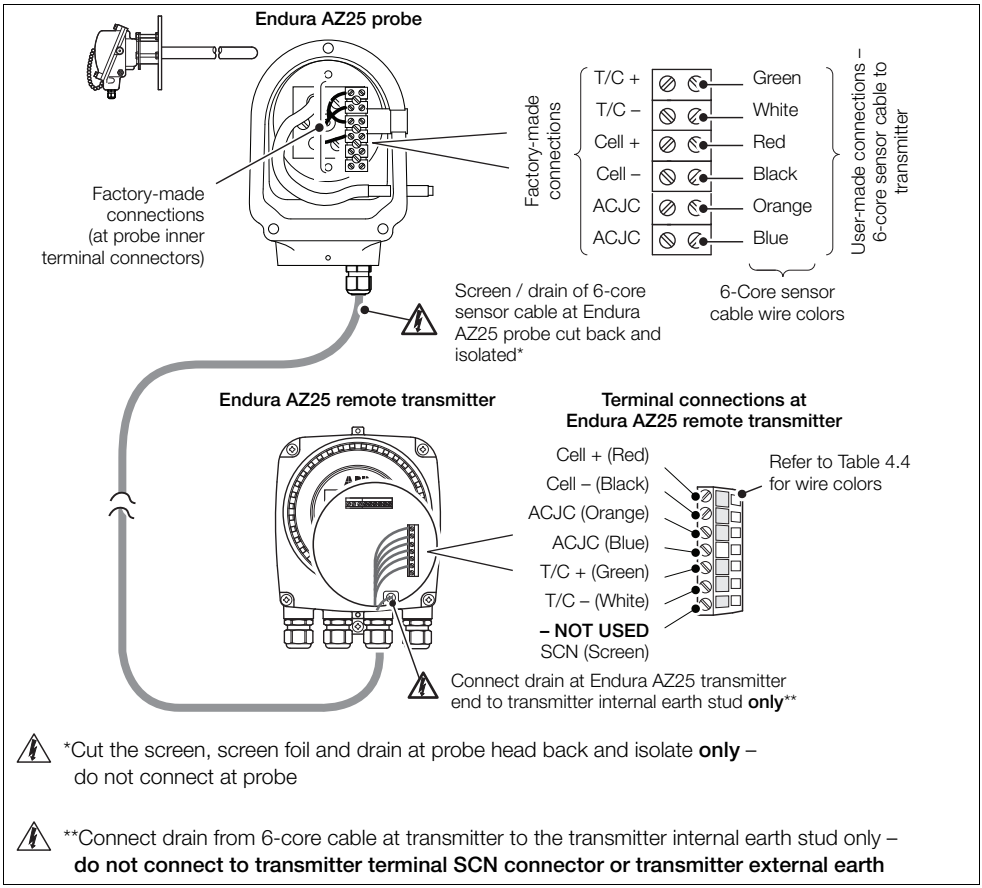


Fig. 4.7 Remote Transmitter to Remote AZ25 Probe Connections

4.7 Remote Transmitter – Remote AZ25 AutoCal Unit Connections

Terminal Number	Tag ID	Connection Type	Cable Color Code
1	Not used	Not used	Not used
2			
3	SCN	Screen	Screens
4	T / C –	Thermocouple (–ve)	White
5	T / C+	Thermocouple (+ve)	Green
6	ACJC	PT1000 Cold Junction Compensation	Grey
7	ACJC	PT1000 Cold Junction Compensation	Violet
8	CELL –	Oxygen Input (–ve)	Black
9	CELL +	Oxygen Input (+ve)	Red
10	PS2	Pressure Switch – Gas 2	White / Yellow
11	P COM	Pressure Switch – Common	White / Black
12	PS1	Pressure Switch – Gas 1	White / Orange
13	SV2	Solenoid Valve – Gas 2	White / Blue
14	SV COM	Solenoid Valve – Common	White / Red
15	SV1	Solenoid Valve – Gas 1	White / Green

Table 4.5 Remote Transmitter to Remote AZ25 AutoCal Unit Connections

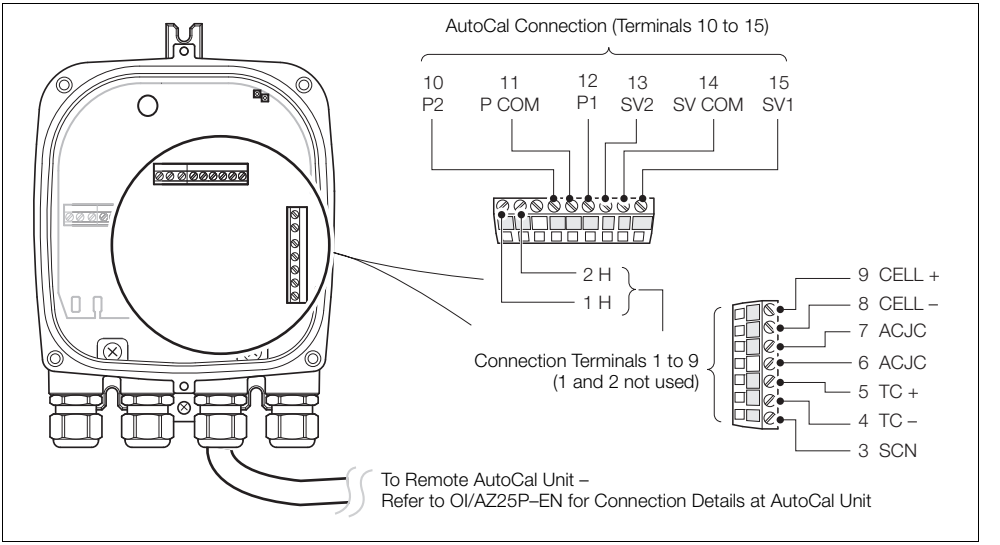


Fig. 4.8 Remote Transmitter to Remote AZ25 AutoCal Unit Connections

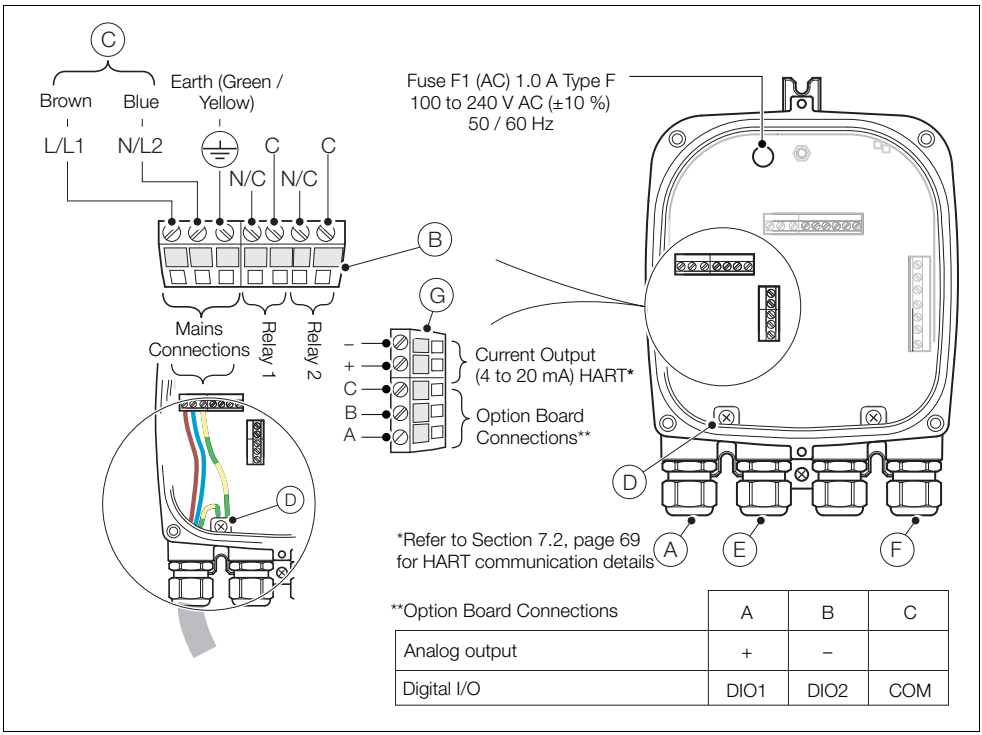
4.8 Remote Transmitter – Power Supply and Output Connections

Warning.

- The transmitter must be earthed.
- Isolate the incoming mains power supply cable before making connections at the transmitter or the probe.

To make power supply and output connections:

1. Feed the incoming AC power supply cable through cable gland (A).
2. At terminal block (B), make connections to the AC power supply live (brown) and neutral (blue) terminals (C).
3. Connect the incoming AC power supply earth wire to internal earth connection (D).
4. Feed the signal cable(s) through cable gland(s) (E) and (F) and make connections to the relay outputs (terminal block (B)) and current output and option board terminals (terminal block (G)) as required.
5. Refit the transmitter front cover – see Section 4.2, page 13.



**Option Board Connections	A	B	C
Analog output	+	–	
Digital I/O	DIO1	DIO2	COM

Fig. 4.9 Remote Transmitter – Power Supply and Output Connections

4.8.1 Remote Transmitter – Internal Heater Fuse Replacement

Note. The internal fuse is a protection device for the probe heater – it is not a transmitter mains power isolation device.

To replace the remote transmitter internal heater fuse:

1. Isolate the transmitter from mains power – see Section 4.1, page 11.
2. Referring to Section 4.2, page 13, remove the transmitter front cover and cartridge.
3. Referring to Fig. 4.10, remove the plug-in fuse (A) from the fuse socket.

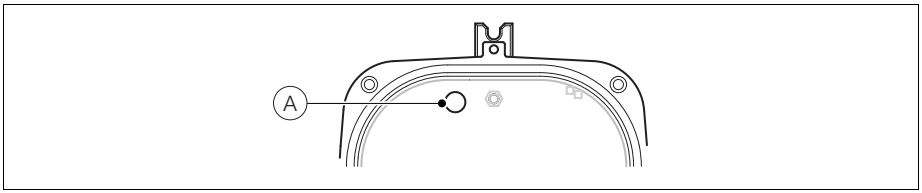


Fig. 4.10 Remote Transmitter – Replacing the Internal Fuse

4. Plug a new fuse (1 Amp Type F) into the fuse socket.
5. Referring to Section 4.2, page 13, refit the transmitter front cover and cartridge.

4.9 Integral Transmitter – Access to Connections

Warning. Isolate the power supply cable to the transmitter before removing the cover.

Referring to Fig. 4.11:

1. Unscrew and remove the transmitter rear cover (A).
2. Access power supply terminals, by unclipping latch (B) and lifting hinged power supply cover (C).

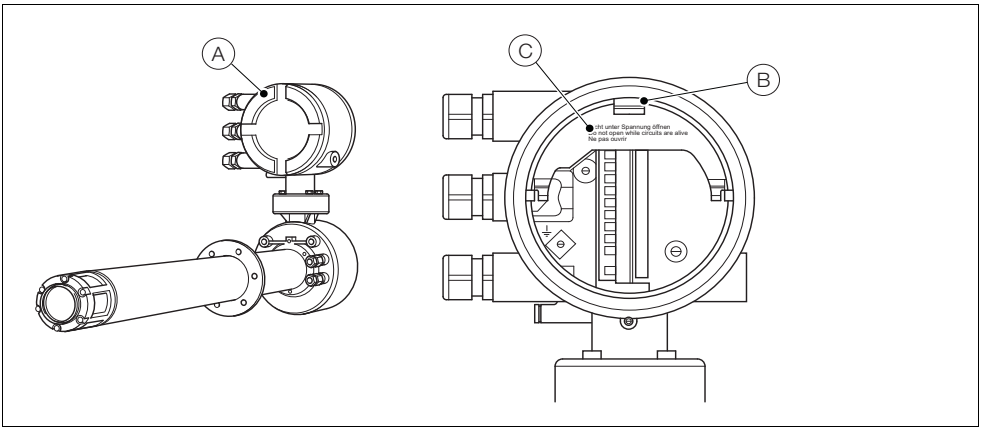


Fig. 4.11 Integral Transmitter – Access to Connections

4.10 Integral Transmitter – Probe Cable Connections

Terminal / Cable Color	Tag ID	Connection Type
Blue	H	Heater
Brown	H	Heater
Screen	SCN	Screen
White	TC –	Thermocouple (–ve)
Green	TC+	Thermocouple (+ve)
Black	CELL –	Oxygen Input (–ve)
Red	CELL +	Oxygen Input (+ve)
Grey	ACJC	PT1000 Cold Junction Compensation
Violet	ACJC	PT1000 Cold Junction Compensation
White / Blue	SV2	Solenoid Valve – Gas 2
White / Red	SV COM	Solenoid Valve – Common
White / Green	SV1	Solenoid Valve – Gas 1
White / Orange	PS1	Pressure Switch – Gas 1
White / Black	P COM	Pressure Switch – Common
White / Yellow	PS2	Pressure Switch – Gas 2

Table 4.6 Probe Cable Connections at Integral Transmitter

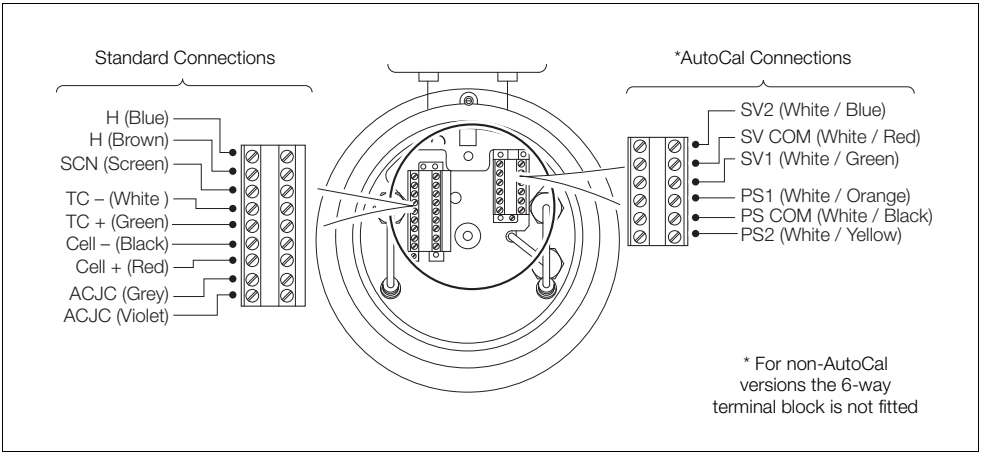


Fig. 4.12 Probe Cable Connections at Integral Transmitter

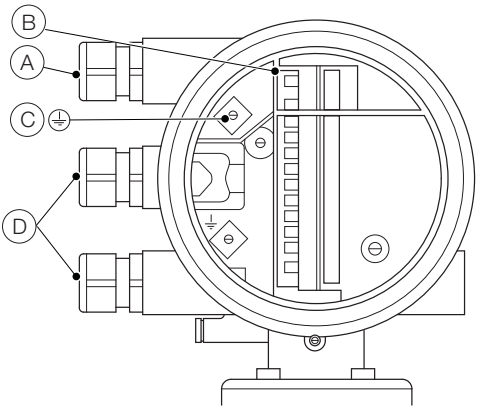
4.11 Integral Transmitter – Power Supply and Output Connections

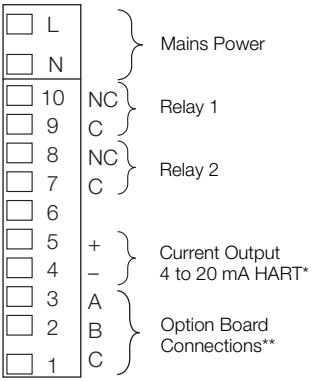
Warning.

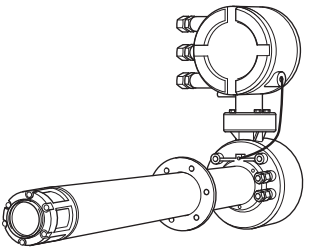
- The transmitter must be earthed.
- Isolate the incoming mains power supply cable before making connections at the transmitter.

Referring to Fig. 4.13:

1. Feed the incoming AC power supply cable through cable gland (A).
2. At terminal block (B) make connections to the AC power supply live (brown) and neutral (blue) terminals.
3. Connect the incoming AC power supply earth wire to internal earth connection (C).
4. Close the hinged power supply cover (see Fig. 4.11).
5. Feed the signal cable(s) through cable gland(s) (D) and make connections to the relay output(s), current output and option terminals as required.
6. Refit the rear cover (see Fig. 4.11) and tighten it hand-tight.







*Refer to Section 7.2, page 69 for HART communication details

**Option Board Connections	A	B	C
Analog output	+	–	
Digital I/O	DIO1	DIO2	COM

Fig. 4.13 Integral Transmitter – Power Supply and Output Connections

4.11.1 Integral Transmitter – Internal Heater Fuse Replacement

Note. The internal fuse is a protection device for the probe heater – it is not an integral transmitter mains power isolation device.

To replace the integral transmitter internal heater fuse:

1. Isolate the integral probe from mains power – see Section 4.1, page 11.
2. Referring to Fig. 4.14, screw in security screw (A).
3. Unscrew and remove lid (B).
4. Slacken the three cartridge screws (C) and lift the cartridge D away from the housing.

   Note. If screws (C) are not visible, refer to Fig. 4.2, page 13 to rotate the cartridge.

5. Remove the plug-in fuse (E) from the fuse socket and plug a new fuse (1 A type F) into the fuse socket.
6. Refit the cartridge and lid by reversing steps 4 to 1.

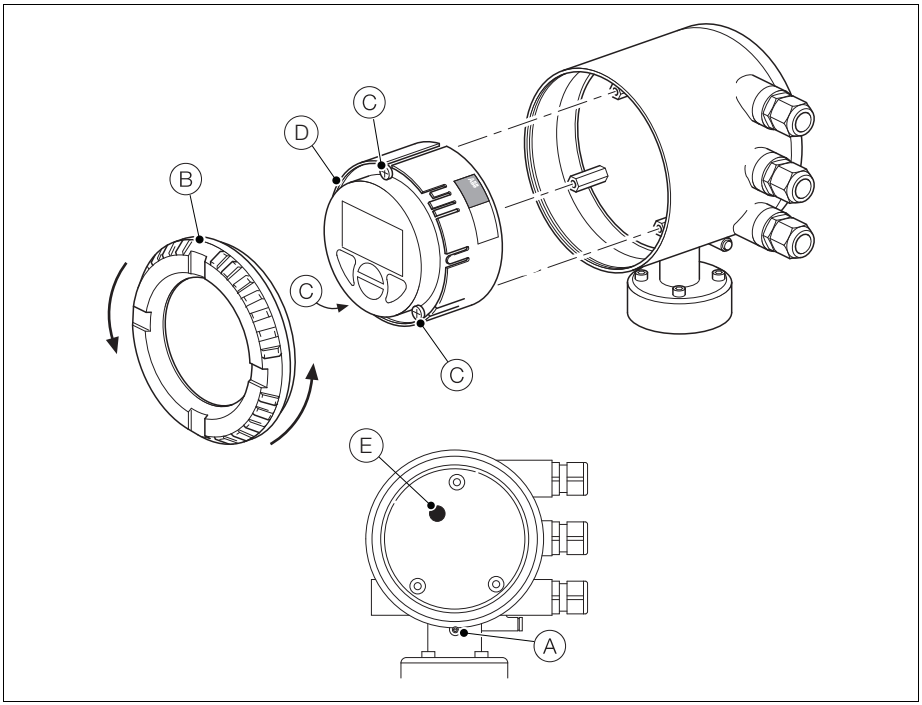


Fig. 4.14 Integral Transmitter – Replacing the Internal Fuse

5 Programming

5.1 Navigating Menus and Parameters

The four keys below the display are used to navigate the menus and execute all system commands and selections.

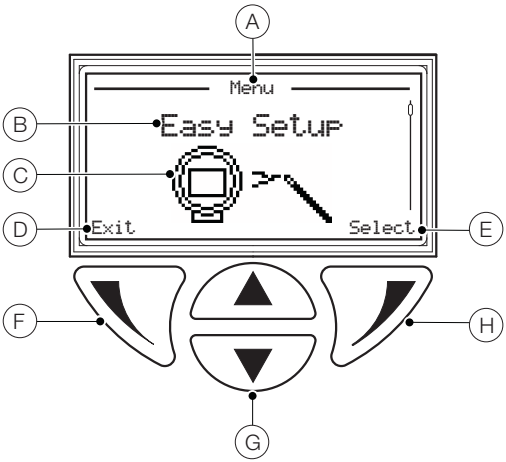


Fig. 5.1 Display and Keys

Item	Description
A	Screen title at the current level / parameter
B	Menu level title
C	Menu level icon
D	Prompt executed by pressing the key
E	Prompt executed by pressing the key
F	Left key – used for parameter navigation (back to previous screen)
G	Up / Down keys – used to scroll through menu options and to increase / decrease values in editable parameters
H	Right key – used to navigate to sub-levels and to accept / select parameter values / selections

Table 5.1 Display Features and Key Functions

5.2 Overview of Operator Pages and Menus

At power-up, *Operator Page 1* is displayed – this is the normal operating state of the transmitter.

The *Operator Menu* is accessed by pressing – see Section 5.2.2, page 28 for *Operator Menu* details.

The *Access Level* is accessed by pressing – see Section 5.3, page 30 for *Access Menu* details.

User / Configuration menus are accessed via the *Access Level*.

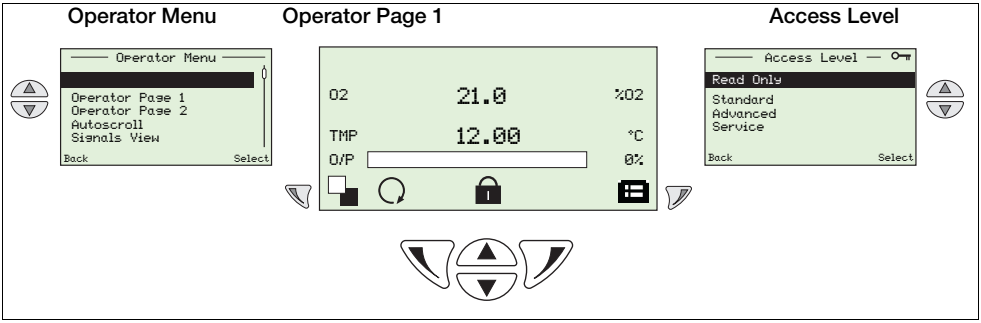


Table 5.2 Overview of an Operator Page and the Operator Menu / Access Level

5.2.1 Operator Pages

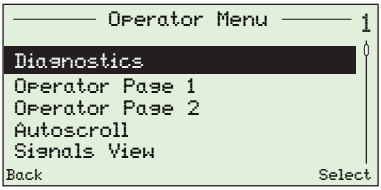
Two operator pages are available, *Operator Page 1* and *Operator Page 2*. *Operator Page 1* is always enabled, *Operator Page 2* can be enabled or disabled via the *Display* menu and an *Autoscroll* option can be enabled to toggle the page display at 10 second intervals. Information on each page can be configured to suit local requirements – see Section 5.4.5, page 48.

In addition to any status icons displayed (see Section 8.1, page 78), the following icons are displayed on at the bottom of each page:

- *Operator Menu* icon ( ) – always displayed.
- *Access Level* icon ( ) – always displayed.
- *Autoscroll* icon ( ) – displayed when *Autoscroll* is enabled (at the *Display* / *Autoscroll* parameter – see page 51.
- *Locked* icon ( ) – displayed when access to menus is denied due to a time-out or attempting to enter an incorrect password.
- *Measurement Quality* icons ( ) – the measurement quality icon can have between 0 and 3 bars, and these indicate confidence in the measurement quality as follows:
  - 3 bars ( ) = perfect
  - 2 bars ( ) = good
  - 1 bars ( ) = average
  - 0 bars = poor

Note. If an operational error (status message) is displayed, the *Autoscroll*, *Locked* and *Measurement Quality* icons are obscured.

5.2.2 Operator Menu



The *Operator Menu* is used to view:

- a list of current alarms (from the *Diagnostics* option)
- *Operator Page 1* only, *Operator Page 2* only or, if *Autoscroll* is enabled, the two page views are toggled at 10-second intervals.
- active signals and their values (from the *Signals View* option)

Note. It is not possible to configure the system or to modify data from the *Operator Menu*.

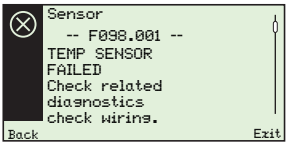
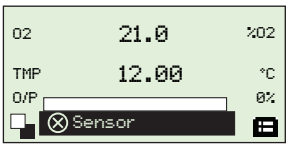
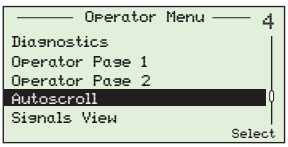
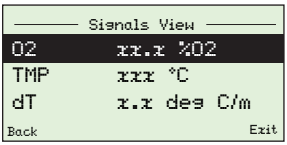
Display Overview	Section and Function
	**Diagnostics** ■ From the *Operator Menu*, press to select the *Diagnostic* menu that displays active diagnostic system data. ■ Use the and keys to scroll through active diagnostics. ■ Refer to Section 8.2.1, page 79 for diagnostic messages.
	**Operator Page 1 (2)** ■ Two *Operator* pages are available – *Operator Page 1* is always enabled, *Operator Page 2* can be set to *OFF* or enabled. When *Operator Page 2* is enabled, it is listed in the *Operator Menu*. ■ Setup of the two *Operator* pages is performed at the *Display* menu by selecting pre-configured display options – see Section 5.4.5, page 48.
	**Autoscroll** ■ When enabled the 2 *Operator* pages (1 and 2) are toggled at 10-second intervals, providing on-screen monitoring of up to 6 parameters. ■ Once selected, the transmitter remains in *Autoscroll* mode until *Operator Page 1* or *Operator Page 2* is selected. If *Operator Page 2* is set to *Off*, or *AutoScroll* is set to *Disabled*, *Operator Page 1* is displayed.

Table 5.3 Operator Menu Screens

Display Overview	Section and Function
	**Signals View** The *Signals View* displays active signals and their values as a list. ■ Values for signals that have not been configured are not displayed. ■ Use the ▲ and ▼ keys to scroll through active signals.

Signals Units

Mnemonic	Displayed	Description	Typical Values
O2	%O2	% Oxygen	0.01 to 100.00 % O_2
TMP	°C or °F	Cell Temperature	>700 °C (1292 °F) After stabilization phase
dT	°C / Min or °F / Min	Rate of Rise of Cell Temperature	0 to 60 °C / min (0 to 108 °F / min)
mV	mV	Cell Millivolts	–50 to 190 mV
O/P	%	Heater Output	0 to 100 %
CJ	°C or °F	Cold Junction Temp	–20 to 70 °C (–4 to 158 °F)
Off	mV	Calibration Offset	–20 mV to 20 mV
Fct		Calibration Factor	0.900 to 1.100
zOf	mV	Cell Zero Offset	<20 mV
Dev	%O2	O_2 Deviation	<0.5 % O_2
Ω	KΩ	Cell Impedance	0.1 to 10.0 kΩ
dΩ	KΩ / Year	Cell Impedance Drift	<1 kΩ
RT	s	Test Gas Response Time	8 to 30 s
RR	%O2 / s	Recovery Rate	0.05 to 0.30 % O_2
Vac	V	Mains Voltage	90 to 265 V
Frq	Hz	Mains Frequency	50 to 60 Hz
Int	°C or °F	Internal Temperature	–20 to 70 °C (–4 to 158 °F)

Table 5.3 Operator Menu Screens (Continued)

5.3 Passwords and Security Options

Passwords can be set to enable secure end-user access at two levels: *Standard* and *Advanced*. The *Service* level is reserved for factory use only. The *Read Only* level does not require password access.

Passwords are changed or restored to their default settings at the *Device Setup* / *Security Setup* parameter – see page 47.

Note.

- During manufacture, *Standard* and *Advanced* level passwords are left unset and must be user-allocated as required (when the transmitter is powered-up for the first time, *Standard* and *Advanced* levels can be accessed without password protection).
- The *Service* level password is factory-set.

5.3.1 Accessing Secure Levels and Entering Passwords

Notes.

- There is no limit to the number of times a user can attempt to enter a password.
- When allocating passwords, keep a copy and store in a safe location. It is not possible for end-users to interrogate the transmitter to identify 'lost' passwords.

All levels are selected from the *Access Level* screen and passwords for secure levels are entered at the *Enter Password* screen.

Advanced users have full end-user configuration privileges to set and change passwords for *Standard* and *Advanced* level users. Each password can comprise up to 6 alphanumeric characters (selectable from the *Enter Password* screen – see page 31) and any mix of letters or digits.

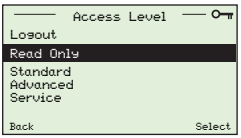
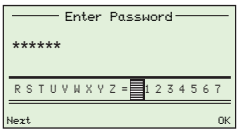
	**Access Level** The *Access Level* is used to access menus at *Read Only* , *Standard*, *Advanced* and *Service* levels. The *Access Level* screen is displayed by pressing from *Operator Page* (1 or 2). To enter a password-protected level (*Standard* or *Advanced*), scroll to the required level, and press . Enter the password as described in *Enter Password* below. To enter at *Read Only* level, press at the *Access Level* screen. The *Enter Password* screen is bypassed and the (*Read Only*) *Calibrate* menu is displayed – see Section 5.4.2, page 36. **Note**. The *Logout* option is displayed when returning to *Access Level* from password-protected levels.
	**Enter Password** At the *Enter Password* screen, use the and keys to navigate to individual password character(s). Press to select a password character. When all password characters have been selected, press . If the password is correct, the requested level is accessed. If the password is incorrect the last viewed *Operator Page* is displayed with the *Locked* ( ) icon in the status bar. **Note**. A default time-out period (within 5-minutes of exit) enables a user to return to the *Operator* level and then re-enter the configuration menus without re-entering the password. The configuration menu displayed at exit is also remembered. For periods in excess of 5 minutes, the password must be re-entered to access the password-protected menus.

Table 5.4 Access Level and Enter Password Screens

5.4 Menus

To access menus from an *Operator Page*, press (beneath the icon), select an access level and enter a user password for *Standard* and *Advanced* levels. To enter *Read Only* level press .

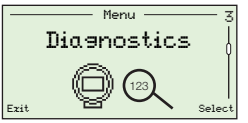
To scroll between top level menus, press or keys.

Overview of Top Level Menus

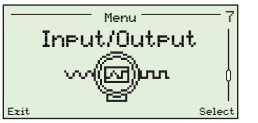
Refer to Section 5.4.1, page 33

Refer to Section 5.4.2, page 36

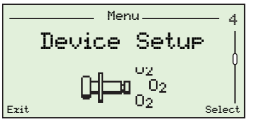
Refer to Section 5.4.6, page 53



Refer to Section 5.4.3, page 44

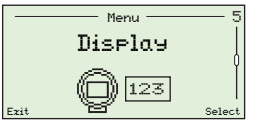


Refer to Section 5.4.7, page 54

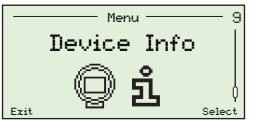


Refer to Section 5.4.4, page 45

Refer to Section 5.4.8, page 61



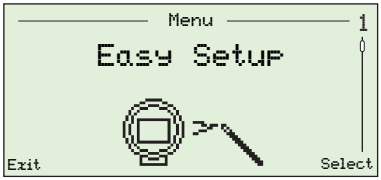
Refer to Section 5.4.5, page 48



Refer to Section 5.4.9, page 63

Table 5.5 Overview of Operating Menus

5.4.1 Easy Setup



The *Easy Setup* menu contains a series of easy setup options for users with *Advanced* level access.

Standard and *Read Only* level users cannot access the *Easy Setup* menu.

Parameter	Comment / [Range]	Default
Language	Selects the language displayed on the transmitter's local display – see Section 5.4.5, page 48 for language options.	English
Instrument Tag	Used to enter an instrument tag (up to 20 characters) displayed on the *Operator Page(s)* – see Section 5.4.5, page 48. Characters are selected from an alphanumeric list – see Section 5.1, page 26 for navigation details. The tag is not displayed on the *Operator Page(s)* if a *Display Mode* of *3 x 9* is selected – see Section 5.4.5, page 48.	N / A
Date Format DD-MM-YYYY MM-DD-YYYY YYYY-MM-DD	Selects the format of the displayed date.	YYYY-MM-DD
Time & Date Hr:Min:Sec Year:Month:Day	Sets the current local time and date.	N / A
Probe Type AZ20 & Integral Tx AZ20 & Remote Tx AZ25 & Remote Tx AZ30 & Integral Tx AZ30 & Remote Tx AZ35 & Remote Tx AZ10 With Filter AZ10 No Filter	Selects the probe type to be used with the transmitter.	AZ20 & Remote Tx*

*For marine application Exhaust Gas Recirculation (EGR) transmitters, the probe type is set to *AZ10 No Filter* and cannot be changed.

Table 5.6 Easy Setup Menu

Parameter	Comment / [Range]	Default
…Easy Setup		
Cable Length	The length in metres of the cable between the probe and the remote transmitter. This length is used in the cold junction measurement to compensate for the impedance of the cable. [0 to 100 m] **Note**. Applicable only to remote transmitters.	0 m
Autocal Hardware	Selects the type of automatic calibration hardware to be used.	None
None	All auto-calibration functions disabled.	
Internal	Select this option if the probe's (optional) built-in automatic calibration is fitted.	
Remote	Select this option if an external automatic calibration system is to be used. **Note**. The solenoid valve outputs or relays can be used to activate a remote automatic calibration system.	
%O2 Range Hi	Sets the maximum oxygen concentration. [0.01 to 100 % O_2]	25.00 %O_2
%O2 Range Lo	Sets the minimum oxygen concentration. [0.01 to 100 % O_2]	0.01 %O_2
Thermocouple Type	Selects the thermocouple type used for cell temperature measurement. For heated probes (AZ20 and AZ30) this is fixed as Type K. For unheated probes (AZ25 and AZ35), select the thermocouple type used in the probe being used with the transmitter.	
K	[–100 to 1300 °C (–148 to 2372 °F)]	K
B	[–18 to 1800 °C (–0.4 to 3272 °F)]	
N	[–200 to 1300 °C (–328 to 2372 °F)]	
R	[–18 to 1700 °C (–0.4 to 3092 °F)]	
S	[–18 to 1700 °C (–0.4 to 3092 °F)]	

Table 5.6 Easy Setup Menu (Continued)

Parameter	Comment / [Range]	Default
…Easy Setup		
Temperature Units °C °F	Selects the units to be used for all temperature values in the transmitter.	°C
Factory Cal. Offset	Used to enter the calibration offset value supplied with the new probe / cell. When changing the *Probe Type* to / from *AZ10*, the following defaults are used:. ■ AZ10 = –10 mV ■ non-AZ10 = 0 mV **Note**. Refer to the label supplied with cell.	
Factory Cal. Factor	Used to enter the calibration factor value supplied with the new probe / cell. **Note**. Refer to the label supplied with cell.	1.00
New Probe/Cell Fitted	Used to confirm and setup a new probe or cell. Select *OK* to confirm a new probe or cell has been fitted; this resets the diagnostic measurements and states. A new entry is created in the *Performance Log* to record that a new cell or probe has been fitted and that factory values have been entered.	N / A

Table 5.6 Easy Setup Menu (Continued)

5.4.2 Calibrate

Used to calibrate the sensor, select test gas types, set oxygen hold action, enable automatic calibration hardware (if fitted) and set calibration diagnostics options.

Note. Ensure reference air and test gas supplies are set up before running a calibration – see IM/AZ20P–EN.

Parameter	Comment / [Range]	Default
Sensor Cal.	See Section *6.1*, page *64* for calibration routines. **Note**. Calibration options *1-Pt AutoCal* to *Manual Cal - 2-Pt* are displayed only when the probe reaches 690 °C (1274 °F) and all error messages are cleared. *Restore Defaults* is displayed only when the probe temperature is < 690 °C (1274 °F).	N / A
1-Pt AutoCal	Performs a single-point automatic calibration. Enabled only if calibration is currently inactive, Autocal is fitted and temperature has stabilized.	
2-Pt AutoCal	Performs a two-point automatic calibration. Enabled only if calibration is currently inactive, Autocal is fitted and temperature has stabilized.	
Manual Cal - Offset	Performs a manual single-point offset calibration. Enabled only if calibration is currently inactive and when temperature has stabilized.	
Manual Cal - Factor	Performs a manual single-point factor calibration. Enabled only if calibration is currently inactive and when temperature has stabilized.	
Manual Cal - 2-Pt	Performs a manual two-point calibration. Enabled only if calibration is currently inactive and when temperature has stabilized.	
Restore Defaults	Restores the factory calibration offset and factor values entered in *Easy Setup* – see page 35.	

Table 5.7 Calibrate Menu

Parameter	Comment / [Range]	Default
…Calibrate		
Test Gases	Configures the test gas types and values used in calibration.	
Test Gas 1 Type		
Gas	Enables the *Test Gas 1 Value* option.	
Air	Test gas or instrument air @ 20.95 % O_2 applied as a test gas.	Air
Process Air	The atmospheric air within the flue surrounding the probe used to calibrate the system.	
Test Gas 1 Value	Enabled when *Test Gas 1 Type* is set to *Gas* [0.01 to 100.00 % O_2]	1.00 % O_2
Test Gas 2 Type	Select *Gas* to enable *Test Gas 2 Value* option.	
Gas	Enables the *Test Gas 2 Value* option.	Gas
Air	Test gas or instrument air @ 20.95 % O_2 applied as a test gas.	
Process Air	The atmospheric air within the flue surrounding the probe used to calibrate the system.	
Test Gas 2 Value	Enabled when *Test Gas 2 Type* is set to *Gas*. [0.01 to 100.00 % O_2]	1.00 %O_2
Oxygen Hold	During O_2 calibrations, the % O_2 value displayed on the local HMI (human-machine interface) is set according to the *Action* selected below. This value is also retransmitted as current outputs and transmitted via HART.	
Action		
Off	The displayed and transmitted % O_2 value follows the value measured during the calibration.	Off
Hold	The displayed and transmitted % O_2 value is held at its value immediately prior to the start of the calibration.	
Preset Value	Sets the displayed and transmitted % O_2 value to the user-defined *Preset Value*.	
Preset Value	Displayed when *Action* is set to *Preset Value*. [0.01 to 100.00 % O_2]	1.00 %O_2

Table 5.7 Calibrate Menu (Continued)

Parameter	Comment / [Range]	Default
…Calibrate		
AutoCal Hardware	Selects the type of automatic calibration hardware to be used.	
Hardware Type		
None	Disables automatic calibration functions.	None
Internal	Enabled if the (optional) built-in automatic calibration is fitted.	
Remote	Enabled if an external automatic calibration system is used. **Note**. The solenoid valve outputs or relays can be used to activate a remote automatic calibration system.	
Test Gas Delay Time	The estimated delay in seconds it takes the test gas to pass from a remote automatic calibration unit to the probe. **Note**. For use with remote automatic calibration units only. [0 to 9999 s]	0
Test Gas Detection	The probe's internal automatic calibration system has pressure switches to detect the presence of the test gases automatically (when enabled). This option can also be used with remote automatic calibration units with suitable pressure switches.	
Test Gas 1 Detection	Disabled if *AutoCal Hardware* / *Hardware Type* is set to *None*.	
Disabled		Disabled
Enabled	If test gas is not present when a calibration is activated an error message is created and calibration stops.	
Test Gas 2 Detection	Disabled if *AutoCal Hardware* / *Hardware Type* is set to *None*.	
Disabled		Disabled
Enabled	If test gas is not present when a calibration is activated an error message is created and calibration stops.	

Table 5.7 Calibrate Menu (Continued)

Parameter	Comment / [Range]	Default
…Calibrate		
…AutoCal Hardware	Selects the type of automatic calibration hardware to be used.	
Valve Manual Control	The automatic calibration solenoid valves can be energised manually. The current % O_2 value is shown for reference. When this frame is exited the valves return to the closed state. **Note**. Pressing ▲ opens the valve; pressing ▼ closes the valve. A valve open / closed icon is displayed to indicate valve status: Valve Open Valve Closed	
Test Gas 1 Valve	Disabled if *AutoCal Hardware* / *Hardware Type* is set to *None*.	Closed
Test Gas 2 Valve	Disabled if *AutoCal Hardware* / *Hardware Type* is set to *None*.	Closed
Scheduled Cal.	If AutoCal is fitted, automatic calibrations can be set to run at scheduled time intervals. **Note**. This option is not available if the *AutoCal Hardware* / *Hardware Type* is set to *None*.	
Type	Selects the scheduled calibration type.	
One point	Offset only calibration.	
Two point	Offset and cal factor calibration.	Two point
Frequency	Selects the frequency of automatic calibrations.	
Off	Disables scheduled calibrations.	Off
Daily	Enables the *Daily Interval* parameter.	
Weekly	Enables the *Weekly Interval* parameter.	
Monthly	Enables the *Monthly Interval* parameter.	

Table 5.7 Calibrate Menu (Continued)

Parameter	Comment / [Range]	Default
…Calibrate		
…Scheduled Cal.	If AutoCal is fitted, calibrations can be set to run automatically at scheduled time intervals. **Note**. This option is not available if the *AutoCal Hardware* / *Hardware Type* is set to *None*.	
Daily Interval	Sets the required daily interval for scheduled automatic calibrations of the probe. Enabled when *Frequency* is set to *Daily*	
Daily 2, 3, 4, 5, 6, 7 Days		Daily
Weekly Interval	Sets the required weekly interval for scheduled automatic calibrations of the probe. Enabled when *Frequency* is set to *Weekly*	
Weekly 2, 3, 4, 6, 13, 26, 52 Weeks		Weekly
Monthly Interval	Sets the required monthly interval for scheduled automatic calibrations of the probe. Enabled when *Frequency* is set to *Monthly*	
Monthly 2, 3, 4, 6, 12 Months		Monthly

Table 5.7 Calibrate Menu (Continued)

Parameter	Comment / [Range]	Default
…Calibrate		
…Scheduled Cal.	If AutoCal is fitted, calibrations can be set to run automatically at scheduled time intervals. **Note**. This option is not available if the *AutoCal Hardware / Hardware Type* is set to *None*.	
Time of Next Cal.	Selects the time and date of the next and subsequent scheduled calibrations. No scheduled calibrations are performed until the date / time set is reached. The date of the next scheduled calibration is updated automatically according to the frequency set. For example, if *Frequency* is 5 days and *Time of Next Cal.* is 12:00:00 2009-01-05, it is updated automatically to 12:00:00 2009-01-10. **Note**. If the scheduled calibration cannot be run, or is unsuccessful, the next scheduled calibration date is updated according to the frequency set and an *Out of Specification / Missed Scheduled AutoCal* diagnostic message is created – see Section 8.2.2, page 82.	N / A
Sequence	Selects the type of calibration / check to be performed.	
Calibration	Performs a calibration that automatically updates the calibration offset and factor if successful.	Calibration
Accuracy check	Performs an accuracy check – this follows the normal calibration sequence, but does not update the calibration offset and factor in use by the transmitter.	
Cal. On Error limit	Performs an accuracy check but if the error is greater than the set *Cal. Error Limit* (see below), the calibration offset and factor are updated automatically.	
Warn On Error Limit	Performs an accuracy check, but if the error is greater than the *Cal. Error Limit* value, a calibration required warning is generated.	
Cal. Error Limit	Sets the limit for use with *Warn On Error Limit* field. [0.01 to 10.00 % O_2]	1.00 % O_2

Table 5.7 Calibrate Menu (Continued)

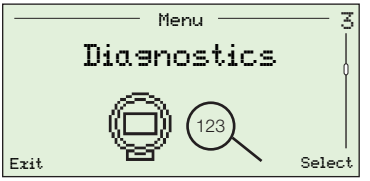
Parameter	Comment / [Range]	Default
…Calibrate		
Cal. Diagnostics		
Cal. Overdue Diag.	A diagnostic warning can be generated to advise when a calibration is due.	
Off		Off
Weeks	[1, 2, 3 or 4]	
Months	[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12]	
Cal. Limits Diag.	Sets the limits for the calibration coefficients. If calculated coefficients are outside limits, calibration fails, the coefficients are not updated and an *Out of Specification* diagnostic message is generated – see Section 8.2.2, page 82. It is recommended that limits are left at the factory default settings.	
Offset Limit	An ideal probe has an offset of 0 mV. The limit is a deviation from the ideal – for example, if 10 mV is set, the calibration offset has an acceptable range of –10 to 10 mV. [0.00 to 20.00 mV]	20.00 mV
Factor Limit	An ideal probe has a factor of 1.000. The limit is a deviation from the ideal – for example, if 0.100 is set, the calibration factor has an acceptable range of 0.900 to 1.100. [0.000 to 0.100]	0.100
Cell Diagnostics		
Slow Response Diag.	A diagnostic function to warn if the probe's response to the injection of a test gas is slower than expected.	
Disabled		Disabled
Enabled		
Response Time Limit	Sets the maximum time allowed for a response to the test gas. The *Test Gas Delay Time* (see page 38) is added to this value for remote automatic calibration systems. [0 to 99 s]	60 s

Table 5.7 Calibrate Menu (Continued)

Parameter	Comment / [Range]	Default
…Calibrate		
…Cal. Diagnostics		
…Cell Diagnostics		
Slow Recovery Diag.	Warns if the probe's recovery rate is slower than expected after a calibration or accuracy check is measured. **Note**. The recovery rate is measured only if the difference between the test gas and process gas values is > 10 % of the oxygen range.	
Disabled		Disabled
Enabled		
Recovery Rate Limit	Sets the limit to be used with the slow recovery rate diagnostic function. [0.1 to 10.0 % O_2 / s]	10.0 % O2 / s
High Impedance Diag.	Warns if the cell's impedance goes above a preset limit (a high impedance can indicate a faulty or ageing cell).	
Disabled		Disabled
Enabled	Performs an impedance check when a *Two point* calibration is selected – see page 39.	
Measure Impedance	With a stable output from the cell, a cell impedance check can be performed: **Note**. The cell impedance cannot be calculated if the cell output is less than 20 mV (test gas value greater than approximately 8 % O_2 @ 700 ºC [1292 °F])	100 KΩ

Table 5.7 Calibrate Menu (Continued)

5.4.3 Diagnostics



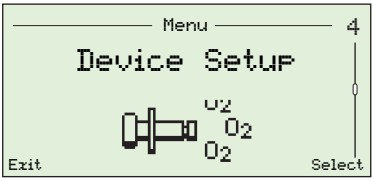
Used to view diagnostic and performance (historical) data and review cell diagnostics – see Section 8.1, page 78.

Note. Diagnostics messages listed at this level do not include troubleshooting tips. Diagnostics messages that include troubleshooting tips are listed at the *Operator Menu / Diagnostics* level – see Section 5.2.2, page 28.

Parameter	Comment / [Range]	Default
Diagnostics Log	Lists / clears available diagnostics codes / messages.	N / A
Diagnostics History	Displays a list of alarms (since last clear alarms command). Includes a count of occurrences, total duration and time since the last occurrence. Data is displayed in the following format: Configuration -- C002.042 -- CONFIGURATION MODE n:2 Σt:00h 04m 07s tn:01h 03m 15s Back n = number of instances of the diagnostic state Σt = total time spent in this diagnostic condition tn = time since last instance of this diagnostic condition. **Note**. Use the ▲ and ▼ keys to scroll through the list of alarms.	
Clear History	Clears the saved diagnostic history log.	
Performance Log	A time and date stamped (historical) log of all entries. See Section 8.3, page 88 for details of *Performance Log* entry types and codes.	N / A
Performance History	A log of calibrations, accuracy checks and new probe / cell events. The most recent 100 events are kept in the log.	
Clear History	Clears all saved performance log data.	

Table 5.8 Diagnostics Menu

5.4.4 Device Setup



Used by *Advanced* users to set the instrument tag, specify the type of probe, select cable length, set oxygen and temperature ranges and to setup passwords for access at all levels.

Standard users have read-only privileges (except at the *Security Setup* level) and *Read Only* users have read-only privileges for a reduced set of menu options.

Parameter	Comment / [Range]	Default
Instrument Tag	Used to enter a tag (ID) of up to 20 characters in length for the transmitter. Characters are selected from an alphanumeric list. The 'Instrument Tag' is not displayed in the *Operator* page(s) when a *Display Mode* of *3 x 9* is selected – see Section 5.4.5, page 48.	N / A
Probe Type AZ20 & Remote Tx AZ20 & Integral Tx AZ25 & Remote Tx AZ30 & Integral Tx AZ30 & Remote Tx AZ35 & Remote Tx AZ10 With Filter AZ10 No Filter	Selects the probe type to be used with the transmitter.	AZ20 & Remote Tx*
Cable Length	The length in metres of the cable between the probe and the remote transmitter. This length is used in the cold junction measurement to compensate for the impedance of the cable. [0 to 100 m] **Note**. Applicable only to remote transmitters.	0 m

*For marine application Exhaust Gas Recirculation (EGR) transmitters, the probe type is set to *AZ10 No Filter* and cannot be changed.

Table 5.9 Device Setup Menu

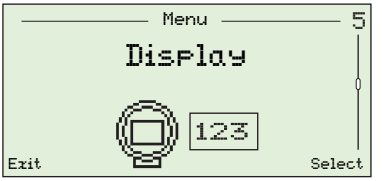
Parameter	Comment / [Range]	Default
…Device Setup		
Oxygen Setup		
%O2 Range Hi	Sets the maximum oxygen concentration [0.01 to 100 % O_2]	25.00 $\%O_2$
%O2 Range Lo	Sets the minimum oxygen concentration [0.01 to 100 % O_2]	0.01 $\%O_2$
Filter Time	Sets the amount of filtering time required on the oxygen input measurement. **Note**. This is a rolling-average filter. [1 to 60 s]	1 s
Pressure Comp.	Sets the pressure compensation value. **Note**. Set a value if, in normal operation, positive or negative pressure with respect to the pressure during a calibration is present. If calibrations are performed at the same pressure as normal operation, set this value to 0.00 psi. [– 5.00 to 5.00 psi]	0.00 psi
Temp. Setup	Selects thermocouple type and temperature units.	
Thermocouple Type	Selects the thermocouple type used for cell temperature measurement. For heated probes (AZ20 and AZ30) this is fixed as type K. For unheated probes (AZ25 and AZ35), select the thermocouple type used in the probe.	
K	[–100 to 1300 °C (–148 to 2372 °F)]	K
B	[–18 to 1800 °C (–0.4 to 3272 °F)]	
N	[–200 to 1300 °C (–328 to 2372 °F)]	
R	[–18 to 1700 °C (–0.4 to 3092 °F)]	
S	[–18 to 1700 °C (–0.4 to 3092 °F)]	
Temperature Units	Selects the temperature units to be used in the transmitter.	°C

Table 5.9 Device Setup Menu (Continued)

Parameter	Comment / [Range]	Default
…Device Setup		
Security Setup	Used to set *Standard* and *Advanced* level passwords of up to 6 alphanumeric characters. **Note**. *Standard* and *Advanced* passwords are not set at the factory and must be added by the end-user(s).	None
Standard	Set by *Standard* and *Advanced* users.	
Advanced	Set by *Advanced* users.	
Reset Fact. Settings	Resets all configuration parameters to their default values.	Factory-set
Reset Temp. Trip	For heated probes (AZ20 and AZ30), if the cell temperature exceeds a preset limit (approx. 850 °C [1562 °F]), a hardware over- temperature trip automatically activates and switches off power to the heater. If the cell temperature remains at this elevated temperature for less than 30 minutes, the trip is reset automatically. If the elevated temperature remains for more than 30 minutes, it is necessary to reset the trip (at this menu). Alternatively, the trip can be reset by switching power to the transmitter off and on again.	N / A

Table 5.9 Device Setup Menu (Continued)

5.4.5 Display



Used to set the *Display Mode* (lines of information displayed on the *Operator Pages*), enable or disable *Autoscroll*, set the time and date and time and date format, select a *Daylight Saving* region and adjust the screen contrast.

Parameter	Comment / [Range]	Default
Language	Selects the language displayed on the transmitter's local display.	
English		English
Deutsch		
Français		
Español		
Italiano		
Operator Page 1	Specifies the type of information to be displayed on each (text) line.	
Display Mode	Selects the number of lines of information and maximum number of characters per line displayed on the selected *Operator* page. **Note**. The instrument ID tag (if added) is displayed in the operator page except when the *3 x 9* format is selected.	
1 x 4	Displays 1 line with up to 4 characters.	1 x 4
1 x 6	Displays 1 line with up to 6 characters.	
1 x 6 + Bargraph	Displays 1 line with up to 6 characters, plus bargraph.	
2 x 9	Displays 2 lines, each with up to 9 characters.	
2 x 9 + Bargraph	Displays 2 lines, each with up to 9 characters plus bargraph.	
3 x 9	Displays 3 lines, each with up to 9 characters.	

Table 5.10 Display Menu

Parameter	Comment / [Range]	Default
…Display		
…Operator Page 1		
1st Line View		
% Oxygen		% Oxygen
2nd Line View		
Cell Temperature		Cell Temperature
Cell Millivolts		
Control Output		
3rd Line View		
Cell Temperature		
Cell Millivolts		Cell Millivolts
Control Output		
Bargraph	Specifies the parameter represented on the bargraph. **Note**. Available only when *Display Mode* is set to *1 x 6 + Bargraph* or *2 x 9 + Bargraph* (see page 48).	
Control Output		
% Oxygen (linear)		% Oxygen (linear)
% Oxygen (log)		

Table 5.10 Display Menu (Continued)

Parameter	Comment / [Range]	Default
…Display		
Operator Page 2	Specifies the type of information to be displayed on each (text) line.	
Display Mode	Selects the number of lines of information and maximum number of characters per line displayed on the selected *Operator* page. **Note**. The instrument ID tag (if added) is displayed in the operator page except when the *Display Mode / 3 x 9* format is selected (see page 48).	
Off	Disables *Operator Page 2*.	Off
1 x 4	Displays 1 line with up to 4 characters.	
1 x 6	Displays 1 line with up to 6 characters.	
1 x 6 + Bargraph	Displays 1 line with up to 6 characters, plus bargraph.	
2 x 9	Displays 2 lines, each with up to 9 characters.	
2 x 9 + Bargraph	Displays 2 lines, each with up to 9 characters plus bargraph.	
3 x 9	Displays 3 lines, each with up to 9 characters.	
1st Line View		
% Oxygen		% Oxygen
Cell Temperature		
Cell Millivolts		
Control Output		
2nd Line View		
% Oxygen		
Cell Temperature		Cell Temperature
Cell Millivolts		
Control Output		

Table 5.10 Display Menu (Continued)

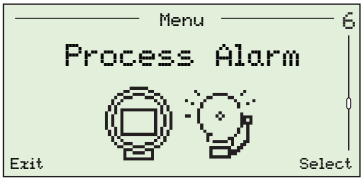
Parameter	Comment / [Range]	Default
…Display		
…Operator Page 2		
3rd Line View		
% Oxygen		
Cell Temperature		
Cell Millivolts		Cell Millivolts
Control Output		
Bargraph	Specifies the parameter represented on the bargraph. **Note**. Available only when *Display Mode* is set to *1 x 6 + Bargraph* or *2 x 9 + Bargraph* (see page *48*).	
Control Output		
% Oxygen (linear)		% Oxygen (linear)
% Oxygen (log)		
Autoscroll		
Disabled		
Enabled	When *Enabled*, the display toggles automatically between *Operator Page 1* and *Operator Page 2* at 10 second intervals. If enabled here it can be disabled in the *Operator* level.	Enabled
Time & Date	Sets the date format and the time / date.	
Format		
DD-MM-YYYY		
MM-DD-YYYY		
YYYY-MM-DD		YYYY-MM-DD
Time & Date	Sets the current local time and date.	N / A

Table 5.10 Display Menu (Continued)

Parameter	Comment / [Range]	Default
…Display		
Daylight Saving	Sets the geographical region and daylight saving start / end times, occurrences and dates.	
Region		
Off	Daylight saving is disabled.	Off
Europe	Standard daylight saving start- and end-times are selected automatically for Europe.	
USA	Standard daylight saving start- and end-times are selected automatically for USA.	
Custom	Used to create custom daylight saving start- and end-times for regions other than Europe or USA. **Note**. Enables *Daylight Start* and *Daylight End* parameters.	
Daylight Start Daylight End	Sets the *Daylight Saving* start- and end-criteria. **Note**. Displayed only when the *Region* sub-parameter is *Custom*.	N / A
Time	Start time selected in 1-hour increments [00.00 to 23.00]	
Occurrence	First / Second / Third / Fourth / Last	
Day	Sunday / Monday / Tuesday / Wednesday / Thursday / Friday / Saturday	
Month	January / February / March / April / May / June / July / August / September / October / November / December.	
Contrast	Increases or decreases the display contrast to suit local environmental conditions. [0 to 100 %]	50 %
Display Test	Performs a self-test to verify the integrity of the display.	N / A

Table 5.10 Display Menu (Continued)

5.4.6 Process Alarm



Used to setup process alarms (1 to 4) for alarm types (high / low oxygen or high / low temperature), set alarm trip temperatures and to set hysteresis values (as % for oxygen and ° C value for temperature).

Parameter	Comment / [Range]	Default
Alarm 1 (to 4)	Each of the four alarms can be activated on high or low values or switched off.	
Type	Sets the alarm type required – see Fig. 5.2.	
Off		Off
Low Oxygen		
High Oxygen		
Low Temperature		
High Temperature		
Trip	Sets the alarm trip value in engineering units – see Fig. 5.2. **Note**. One trip value can be set for each alarm.	
Oxygen	[0.01 to 100.00 % O_2]	1.00 % O2
Temperature	[–300 to 1800 °C (–508 to 3272 °F)]	720 °C
Hysteresis	Sets the hysteresis value in engineering units – see Fig. 5.2.	
Oxygen	[0.00 to 100.00 % O_2]	0 % O2
Temperature	[0 to 1000 °C (–32 to 1832 °F)]	0 °C

Table 5.11 Process Alarm Menu

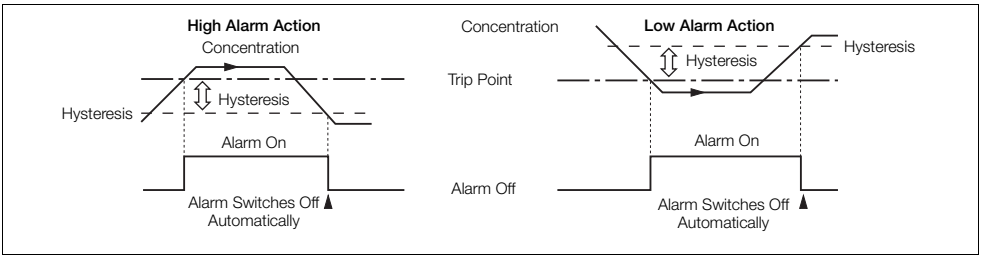
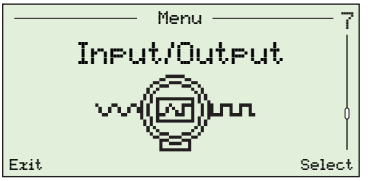


Fig. 5.2 Hysteresis High / Low Alarm Action

5.4.7 Input/Output



Used to assign relays (1 and 2), digital I/O (1 and 2) and current outputs (1 and 2).

Menus displayed at this level are dependent on the system configuration / options fitted.

Parameter	Comment / [Range]	Default
Relay 1 (2)		
Relay Assignment	Selects the alarm and diagnostic states required to activate the relay. Each *Relay Assignment* parameter can be *Assigned* or *Not Assigned*. **Note**. *Assigned* parameters are OR'd together.	Not Assigned (all parameters)
Alarm 1 (2, 3, 4)	See Section 5.4.6, page 53 for alarm types and triggers.	
Cal. In Progress	Relay is activated when a calibration is in progress.	
Cal. Failed	Relay is activated if a calibration fails.	
Gas 1 Not Present	Relay is activated if test gas 1 is not detected.	
Gas 2 Not Present	Relay is activated if test gas 2 is not detected.	
Test Gas 1 Valve	Relay is activated if test gas 1 valve is open.	
Test Gas 2 Valve	Relay is activated if test gas 2 valve is open.	
Diag. - Failure	Activates the relay if a *Failure* diagnostic status is generated – see Section 8.1, page 78.	
Diag. - Off Spec.	Activates the relay if an *Out of Specification* diagnostic status is generated – see Section 8.1, page 78.	
Diag. - Maint. Reqd.	Activates the relay if a *Maintenance Required* diagnostic status is generated – see Section 8.1, page 78.	
Diag. - Chk. Function	Activates the relay if a *Check Function* diagnostic status is generated – see Section 8.1, page 78.	

Table 5.12 Input/Output Menu

Parameter	Comment / [Range]	Default
…Input/Output		
Relay 1 (2)		
Polarity	Selects whether the relay contacts are closed or open if any of the *Relay Assignment* options are active (*Assigned*).	
Active Open		
Active Closed		Active Closed
Digital I/O 1 (2)	Digital I/O (1 and 2) parameters are available only if an option board is fitted.	
Mode	Selects if the Digital I/O functions as an input or an output.	
Input		Input
Output		
Output Assignment	If the *Digital I/O/Mode* is *Output*, selects which alarm and diagnostic states are required to energize the output. Each *Output Assignment* parameter can be *Assigned* or *Not Assigned*. **Note**. *Assigned* parameters are OR'd together.	Not Assigned (all parameters)
Alarm 1 (2, 3, 4)	See Section 5.4.6, page 53 for alarm details.	
Cal. In Progress	Output is triggered when a calibration is in progress.	
Cal. Failed	Output is triggered if a calibration fails.	
Gas 1 Not Present	Output is triggered if test gas 1 is not detected.	
Gas 2 Not Present	Output is triggered if test gas 2 is not detected.	

Table 5.12 Input/Output Menu (Continued)

Parameter	Comment / [Range]	Default
…Input/Output		
…Digital I/O 1 (2)		
…Output Assignment		
Diag. - Failure	Activates the output if a *Failure* diagnostic status is generated – see Section 8.1, page 78.	
Diag. - Off Spec.	Activates the output if an *Out of Specification* diagnostic status is generated – see Section 8.1, page 78.	
Diag. - Maint. Reqd.	Activates the output if a *Maintenance Required* diagnostic status is generated – see Section 8.1, page 78.	
Diag. - Chk. Function	Activates the output if a *Check Function* diagnostic status is generated – see Section 8.1, page 78.	
Test Gas 1 Valve	Activates the output if test gas 1 valve is open.	
Test Gas 2 Valve	Activates the output if test gas 1 valve is open.	
Polarity	Selects whether the digital output is high or low when any of the assigned states are active.	
Active High		Active High
Active Low		
Input Function	If the *Digital I/O/Mode* is *Input*, selects the function to be performed by the digital input.	
Off		Off
Start Autocal ↓	Starts automatic calibration on falling edge (when a voltage-free switch is closed).	
Stop Autocal ↓	Stops automatic calibration on falling edge (when a voltage-free switch is closed).	
Start/Stop Autocal	Starts automatic calibration on falling edge (voltage-free switch is closed) and stops automatic calibration on rising edge (voltage-free switch is open).	
Start Autocal ↑	Starts automatic calibration on rising edge (when a voltage-free switch is opened).	
Stop Autocal ↑	Stops automatic calibration on rising edge (when a voltage-free switch is opened).	
Calibration Type	Calibration type (for the other I/O's *Input Function 'Start..'. [or 'Start/Stop...'])* is set by this I/O's digital input. ■ Low signal (voltage-free switch closed) = *One point* ■ High signal (voltage-free switch open) = *Two point*	

Table 5.12 Input/Output Menu (Continued)

Parameter	Comment / [Range]	Default
…Input/Output		
…Digital I/O 1 (2)		
Type	Selects the type of automatic calibrations started by a digital input – see Section 6.1, page 64. Available only if the *Input Function* is a '*Start Autocal*', *or* '*Start/Stop Autocal*' and the other I/O is not *Calibration Type*.	
One point		One point
Two point		Calibration
Sequence	Selects the type of calibration / check performed when activated by a digital input.	
Calibration	Performs a calibration that updates the calibration offset and factor automatically if successful.	
Accuracy Check	Performs an accuracy check (the normal calibration sequence) but does not update the calibration offset and factor in use by the transmitter.	
Cal. On Error Limit	Performs an accuracy check but, if the error is greater than the value set in the *Cal. Error Limit* field (see page 41), the calibration offset and factor are updated automatically.	
Warn On Error Limit	Performs an accuracy check, but if the error is greater than the value set in the *Cal. Error Limit* field (see page 41) a calibration warning is generated.	

Table 5.12 Input/Output Menu (Continued)

Parameter	Comment / [Range]	Default
…Input/Output		
Current Output 1		
Source	Selects the parameter to be retransmitted by the current output.	
% Oxygen		% Oxygen
Temperature		
Cell mV		
Type	Selects a linear or logarithmic output. **Note**. Displayed only when *Source* is set to *% Oxygen*.	
Linear		Linear
Log. Two Decades		
Log. Three Decades		
Eng. Range Hi	Selects an engineering range high value, depending on the option selected in *Source*.	
Oxygen	[0.00 to 100.00 % O_2]	25.00 %O2
Temperature	[–200 to 1800 °C (–328 to 3272 °F)]	
mV	[–100.0 to 400.0 mV]	
Eng. Range Lo	Selects an engineering range low value depending on the option selected in *Source*. **Note**. Not enabled if *Type* = *Log Two Decades* or *Log Three Decades*.	
Oxygen	[0.00 to 100.00 % O_2]	0.25 %O2
Temperature	[–200 to 1800 °C (–328 to 3272 °F)]	
mV	[–100.0 to 400.0 mV]	

Table 5.12 Input/Output Menu (Continued)

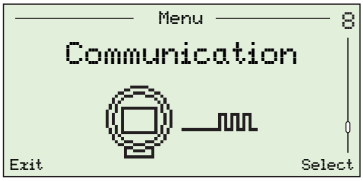
Parameter	Comment / [Range]	Default
…Input/Output		
…Current Output 1		
Elec. Range Hi	Selects the electrical range high current output value. [3.80 to 22.00 mA]	
mA		20.00 mA
Elec. Range Lo	Selects the electrical range low current output value. [3.80 to 22.00 mA]	
mA		4.00 mA
Output Failure	When *Enabled*, the current output can be driven to a preset value if a *Failure* category diagnostic state occurs – see page 78.	
Disabled Enabled		Disabled
Failure Current	Sets a preset value that the current output is driven to when a *Failure* category diagnostic state is present – see page 78. Available only if *Output Failure* is *Enabled*. [3.80 to 22.0 mA]	22.00 mA
Output #1 Test	Selects % output levels for *Current Output 1*. When this parameter is exited, the current output returns to its normal operating value. [0, 25, 50, 75 or 100 %]	0

Table 5.12 Input/Output Menu (Continued)

Parameter	Comment / [Range]	Default
…Input/Output		
Current Output 2	Displayed only if an option board is fitted.	
Elec. Range Hi	Selects the electrical range high current output value. [0.00 to 22.00 mA]	
mA		20.00 mA
Elec. Range Lo	Selects the electrical range low current output value. [0.00 to 22.00 mA]	
mA		4.00 mA
Output Failure	When 'Enabled', the current output can be driven to a preset value if a *Failure* category diagnostic state occurs – see Section 8.1, page 78.	
Disabled Enabled		Disabled
Failure Current	Sets a preset value that the current output is driven to when a *Failure* category diagnostic state is present – see page 78. Only available if *Output Failure* is *Enabled*. [0.00 to 22.0 mA]	22.00 mA
Output #2 Test	Selects % output levels for *Current Output 2*. When this parameter is exited, the current output returns to its normal operating value. [0, 25, 50, 75 or 100 %]	0

Table 5.12 Input/Output Menu (Continued)

5.4.8 Communication



Used to configure HART communication parameters and cyclic output communication via the IrDA interface on the front of the transmitter.

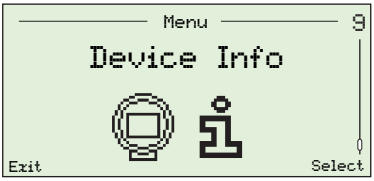
Parameter	Comment / [Range]	Default
HART		
HART Poll Address	Used to enter a unique device address. When set to 0, *Current Output 1* is active and provides an analog output proportional to its source. HART operates in point-to-point mode. If set between 1 and 15, *Current Output 1* is fixed at 4 mA and HART operates in multi-drop mode. **Note**. See Section 7.2, page 69 for multi-drop configuration details. [0 to 15]	0
HART Device ID	The unique ID for the HART device.	Factory-set read-only ID
HART Tag	Used to enter a user-defined tag for the HART device (transmitter), selected from the alphanumeric character set displayed when the *Edit* button is selected at this sub-parameter. [0 to 8 characters]	N / A
HART Device Message	Used to specify a a user-defined message for the HART device (transmitter), selected from the character set displayed when the *Edit* button is selected at this sub-parameter. [0 to 16 characters]	N / A
HART Descriptor	Used to specify a unique HART descriptor, selected from the character set displayed when the *Edit* button is selected at this sub-parameter. Maximum of 32 characters.	N / A
Device Install Date	The time and date of installation.	User-set
Final Assembly No.	The device's (transmitter's) final assembly (ID) number.	Factory-set

Table 5.13 Communication Menu

Parameter	Comment / [Range]	Default
…Communication		
Cyclic Output	For diagnostic purposes, it is possible to configure the device (transmitter) to send out data values via the IrDA interface on the front of the transmitter – these can be viewed via hyperterminal.	
Interval	Selects the time interval between each set of data to be sent out via IrDA.	
Off		Off
1, 10, 30 s		
1, 10, 30, 60 m		
Assignment	Selects which signals are to be transmitted. [Assigned / Not Assigned]	Not Assigned (all parameters)
Oxygen		
Cell Temperature		
Cell Temp. Rate		
Cell mV		
Output		
CJ Temperature		
Cal. Details		
Performance Details		
Mains Supply Details		
Internal Temperature		

Table 5.13 Communication Menu (Continued)

5.4.9 Device Info



Identifies the transmitter's serial number, transmitter's date of manufacture, the last oxygen calibration date, the probe type, the transmitter options card (if fitted), AutoCal hardware (if fitted) and main board and software version numbers.

Note. Parameters in this menu are read-only.

Parameter	Comment / [Range]	Default
Serial Number	The serial number of the transmitter.	Factory-set
Date of Manufacture	The time and date the transmitter was manufactured.	Factory-set
Date of Last Cal.	The date of the last oxygen calibration. **Note**. The date is updated automatically against the date set in the transmitter.	N / A
Probe Type AZ20 & Integral Tx AZ20 & Remote Tx AZ25 & Remote Tx AZ30 & Integral Tx AZ30 & Remote Tx AZ35 & Remote Tx AZ10 With Filter AZ10 No Filter	The probe type used with the transmitter.	AZ20 & Remote Tx*
Autocal Hardware	The automatic calibration system configured for use with the transmitter.	
None	Disables automatic calibration functions.	None
Internal	Enabled if the (optional) built-in automatic calibration is fitted.	
Remote	Enabled if an external automatic calibration system is used.	
Transmitter Options None Fitted Digital I/O Analog Output	The transmitter option card fitted.	Factory-set
Main Board Version	The main PCB hardware version.	Factory-set
Software Version	Displays the version of software installed on the transmitter.	Factory-set

*For marine application Exhaust Gas Recirculation (EGR) transmitters, the probe type is set to *AZ10 No Filter* and cannot be changed.

Table 5.14 Device Info

6 Calibration

Caution. Set up the test gas and reference air supplies before running a calibration – see IM/AZ20P-EN.

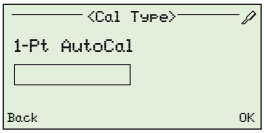
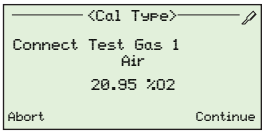
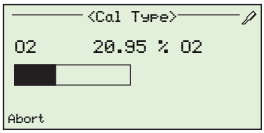
6.1 Overview of Calibration Procedures

Procedure	Calibration Type and Description
1-Pt AutoCal	Single-point automatic calibration of Calibration Offset ■ The values of the two test gases are compared and an offset calibration is performed using whichever test gas is closest to air (20.95 %). ■ If the values of the two test gases are equal, test gas 1 is used.
2-Pt AutoCal	Two-point automatic calibration of Calibration Offset and Calibration Factor ■ Performs slope and offset calibration using both test gases.
Manual Cal – Offset	Single-point manual calibration of Calibration Offset ■ The values of the two test gases are compared and an offset calibration is performed using whichever test gas is closest to air (20.95 %). ■ If the values of the two test gases are equal, test gas 1 is used.
Manual Cal – Factor	Single-point manual calibration of Calibration Factor ■ The values of the two test gases are compared and a factor calibration is performed using whichever test gas is furthest from air. ■ If the values of the two test gases are equal, test gas 2 is used.
Manual Cal – 2-Pt	Two-point manual calibration of Calibration Offset & Calibration Factor ■ Performs slope and offset calibration using both test gases.

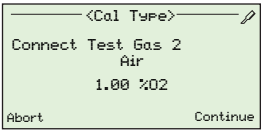
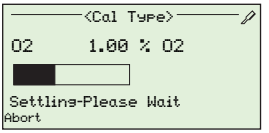
Table 6.1 Overview of Calibration Procedures

6.2 Calibrating the System

The calibration routines applicable to calibration types are identified in the right column of the following table:

 **Back** • Return to *Sensor Cal.* **OK** • Start *AutoCal*	**Start automatic calibration**	1-Pt AutoCal	2-Pt AutoCal		
 **Abort** • Close test gas valve • Return to *Sensor Cal.* **Continue** • Continue calibration procedure	**Waiting For Application Of Test Gas (1st Point)** **Note**. The test gas used for this stage of the calibration is dependent on the type of calibration and the values of the test gases.			Manual Cal – Offset	Manual Cal – 2-Pt Manual Cal – Factor
 **Abort** • Close test gas valve • Return to *Sensor Cal.*	**Calibration In Progress (1st Point)** **Note**. The test gas used for this stage of the calibration is dependent upon the type of calibration and the values of the test gases. Test gas detection is monitored and, if no test gas is detected, the calibration fails. Otherwise the test gas valve is opened and the procedure continues (not applicable if the *Test Gas Type* is *Process Air* – see page 37). Test Gas Response Time monitored – if no response to the application of the test gas is detected the test gas valve is closed and the calibration fails. At this point the calibration procedure remains idle while the test gas delay timer runs (AutoCal only). Oxygen value is monitored for stability – if the stability criteria are not met, the test gas valve is closed and the calibration fails. Once the stability criteria have been met, a cell impedance check is performed and the test gas valve is closed If a *1-Pt calibration* is being performed, the new calibration coefficient (*Offset* or *Factor*) is calculated. If the new coefficient is outside its permitted limits (defined by *Offset Limit or Factor Limit* – see page 42), the calibration fails and a ✕ calibration entry is added to the *Performance Log*. If a *2-Pt calibration* is being performed, the process values are retained for the *Calibration Offset & Factor* calculations that are performed after the 2nd-point calibration stage.	1-Pt AutoCal	2-Pt AutoCal	Manual Cal – Offset	Manual Cal – Factor	Manual Cal – 2-Pt

…Calibration Procedures

 **Abort** • Close test gas valve • Return to *Sensor Cal.* **Continue** • Continue calibration procedure	**Waiting for Application of Test Gas (2nd Point)** **Note**. The test gas used for this stage of the calibration is always Test Gas 2.				Manual Cal – 2-Pt
 **Abort** • Close test gas valve • Return to *Sensor / Cal.*	**Calibration In Progress (2nd Point)** **Note**. The test gas used for this stage of the procedure is always test gas 2. Test gas detection is monitored and, if no test gas is detected, the calibration fails. Otherwise the test gas valve is opened and the procedure continues (not applicable if the *Test Gas Type* is *Process Air* – see page 37). Test Gas Response Time monitored – if no response to the application of the test gas is detected, the test gas valve is closed and the calibration fails. At this point the calibration procedure remains idle while the test gas delay timer runs (AutoCal only). Oxygen value is monitored for stability, if the stability criteria are not met, the test gas valve is closed and the calibration fails. Once the stability criteria have been met a cell impedance check is performed and the test gas valve is closed. Once the stability criteria have been met, a cell impedance check is performed, the test gas valve is closed and, finally, the process values are collated with those retained following the 1st-point calibration stage and the calibration coefficients (*Offset* and *Factor*) are re-calculated. If either or both of the new coefficients are outside the permitted limits (defined by *Offset Limit* and *Factor Limit* – see page 42), the calibration fails and a ✗ calibration entry is added to the Performance Log.		2-Pt AutoCal		Manual Cal – 2-Pt

…Calibration Procedures

<Cal Type> O2 1.00 %O2 Cal Offset 0.00 mV Cal Factor 1.000 Reject Accept **Reject** • New calibration coefficients discarded • Accuracy check entry added to Performance Log • Return to *Sensor Cal.* **Accept** • New calibration coefficients saved **Save successful** • Calibration entry added to Performance Log • Return to *Sensor Cal.* **Save unsuccessful** • Accuracy check entry added to Performance Log • Display Failure	**Calibration completed successfully**	Manual Cal – 2-Pt Manual Cal – Factor Manual Cal – Offset 2-Pt AutoCal 1-Pt AutoCal
<Cal Type> O2 20.95 %O2 Calibration Failed Signal Not Stable Exit **Exit** • Return to *Sensor Cal.*	**Calibration failed to complete** The reason for failure is displayed: Signal Not Stable – stability criteria not met No Response – no response to the application of a test gas detected NV Error – calibration successful but *Save* of new calibration factor unsuccessful Result Out of Bounds – newly calculated calibration factor is outside the limits defined by *Factor Limit* and / or the newly calculated calibration offset is outside the *Offset Limit* parameter – see page 42.	Manual Cal – 2-Pt Manual Cal – Factor Manual Cal – Offset 2-Pt AutoCal 1-Pt AutoCal

7 HART®-Protocol

Endura AZ20 transmitters are HART-compatible, factory-calibrated devices. HART-Protocol enables simultaneous indication of process variables and digital communication. The 4 to 20 mA current output signal transmits process information and the digital signal is used for bi-directional communication. The analog process value output enables analog indicators, recorders and controllers to be used, while the simultaneous digital communication uses HART-Protocol.

7.1 Hardware and Software Requirements

Item	Description
Device Manager (Hardware)	■ Install a HART modem (FSK Frequency Shift Keyed-Modem) for HART-Communication when connecting to a PC. ■ The HART-Modem converts the analog 4 to 20 mA signal into a digital output signal (Bell Standard 202) and connects to the PC using a USB (or RS232C) connector. ■ Alternatively, a hand-held terminal can be used (see below).
Compatible Management Software	■ Management software required to communicate with HART-compatible devices using 'Universal' and 'Common Practice' commands.
Hand-held Terminal	■ The transmitter can be accessed and configured using a compatible hand-held terminal (such as the ABB Mobility DHH801-MFC or equivalent – see Fig. 7.1, page 69). ■ Transmitter connection is made in parallel with the 4 to 20 mA current output – see Section 4.8, page 21, *Current Output* (4 to 20 mA) for terminal connection details.
Device Type Manager (Software) DTM	■ Provides offline and online configuration of the transmitter. ■ Provides online monitoring and simulation of inputs and diagnostics. ■ Compatible with FDT frameworks, for example: ABB Asset Vision Basic (DAT200).
Electronic Device Description (Software) EDD	■ Provides offline and online configuration of the transmitter. ■ Provides online monitoring and simulation of inputs and diagnostics. ■ Compatible with Emerson AMS and Siemens PDM tools.

Table 7.1 HART-Protocol – Hardware / Software Requirements

7.2 HART-Protocol Connection

Fig. 7.1 shows HART-Protocol connection details for transmitter installations.

Note.

- Current output connection details are common for both remote and integral transmitters.
- The HART-Protocol is also available optically via the IrDA interface on the front of the transmitter.

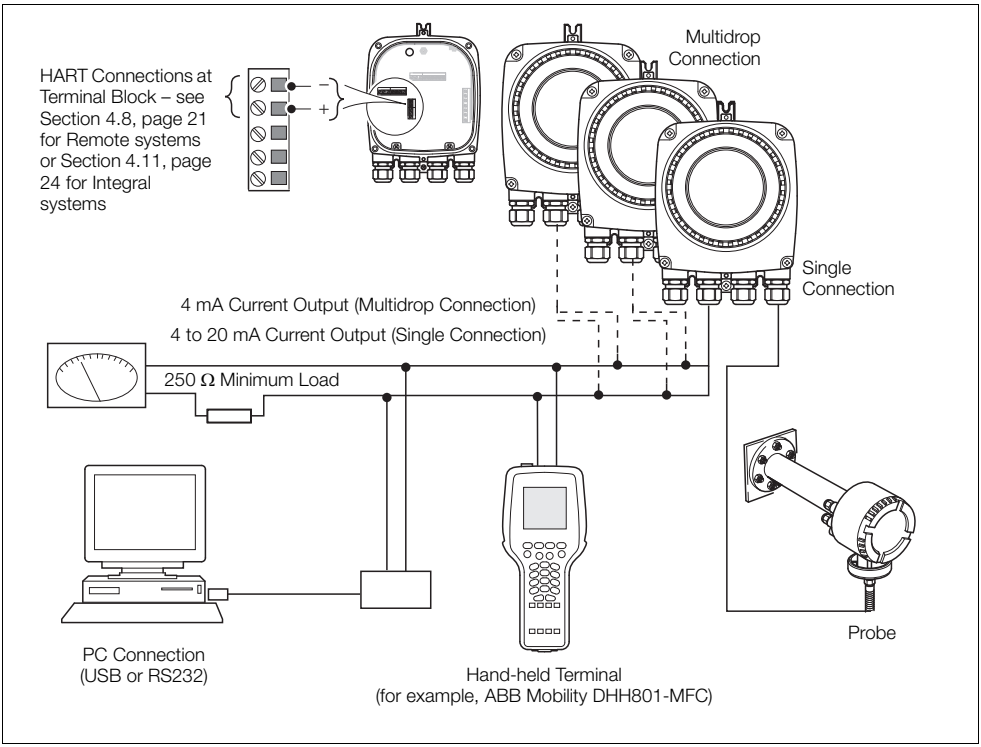


Fig. 7.1 HART-Protocol Connection (Remote Installation Shown)

7.3 HART Universal Commands Set

Command No.	Description	Details
0	Read Transmitter Unique Identifier	Expanded device type code. Manufacturer identification code. Manufacturer device type code. Number of preambles. Revision level of HART Universal Command set implemented. Revision level of device specific command set implemented. Transmitter software revision level. Transmitter hardware revision level. Device identification number.
1	Read Primary Variable	% Oxygen value.
2	Read Current and Percent of Range	PV (% Oxygen) as current output (mA). PV (% Oxygen) as percentage of range.
3	Read Dynamic Variables and Current	Current output value (mA). % Oxygen value. Cell Temperature (°C or °F). Cell Millivolts.
6	Write Polling Address	When set to 0 *Current Output 1* is active and provides an analog output proportional to its source. HART operates in point-to-point mode. When set between 1 to 15, *Current Output 1* is fixed at 4 mA and HART operates in multi-drop mode.
11	Read Unique Identifier Associated With Tag	Returns the expanded device type code, revision levels and device identification number of the transmitter that contains the HART identification tag sent with this command.

Table 7.2 HART Universal Commands Set

Command No.	Description	Details
12	Read Message	Returns the user-defined HART message. Message can also be viewed via *Communications* menu on the transmitter's local HMI.
13	Read Tag, Descriptor and Date	Returns the user-defined HART information: HART Tag HART Descriptor device installation date
14	Read Primary Variable Sensor Information	Returns the range limits and minimum permissible span for the probe.
15	Read Primary Variable Output Information	PV Alarm selection code: 0 = Low, 1 = High, 239 = Hold Last Output Value. PV upper and lower range values. Filter (damping) time. HART write protection code. Any private label distributor code associated with the transmitter.
16	Read Final Assembly Number	Returns the user-defined final assembly number. Number can also be viewed via *Communications* menu on the device's local HMI.
17	Write Message	Enables a user-defined message of up to 32 characters to be entered. Message can also be entered via the *Communications* menu on the device's local HMI.
18	Write Tag, Descriptor and Date	Enables the user to assign a user-defined 8-character tag to the transmitter. Enables a user-defined 16-character descriptor to be entered. Allows an installation date to be entered.
19	Write Final Assembly Number	Enables a user-defined final assembly number to be entered. This can be used for inventory or maintenance purposes.

Table 7.2 HART Universal Commands Set (Continued)

7.4 HART Common Practice Command Set

Command No.	Description	Details
33	Read Transmitter Variables	Up to 4 slots. Each slot can be programmed to return the following parameters based on the Transmitter Variable Code: 0 = % Oxygen 1 = Cell temperature 2 = Cell mV 3 = Cold junction 4 = Heater power (%) 5 = Rate of rise of cell temperature 6 = Cell impedance 7 = Cell impedance drift 8 = Recovery rate 9 = Test gas response time 10 = O_2 deviation 11 = Cell calibration offset 12 = Cell calibration factor 13 = Cell zero offset 14 = Mains frequency 15 = Mains voltage
34	Write Primary Variable Damping Value	Sets the filter value for the % Oxygen reading.
35	Write Primary Variable Range Values	Sets the % Oxygen range hi and lo values.
38	Reset Configuration Changed Flag	Bit 6 (Configuration Changed) of the Transmitter Status Byte is reset by this command. When a parameter has been changed via HART or the local HMI the configuration changed bit is set.
40	Enter / Exit Primary Variable Current Mode	For system troubleshooting purposes, current output 1 can be set to a constant mA value. Entering a value of 0 mA cancels the fixed output mode.

Table 7.3 Common Practice Command Set

Command No.	Description	Details
45	Trim Primary Variable Current DAC Zero	The transmitter re-calibrates the current output *Zero Offset* based on the externally measured primary value received.
46	Trim Primary Variable Current DAC Gain	The transmitter re-calibrates the current output *Span Scale Factor* based on the externally measured primary value received.
48	Read Additional Transmitter Status	The status of the transmitter, determined from results of the continuous self-diagnostics, is reported every time communications with the transmitter are established. If the transmitter indicates there is additional status information, it can be obtained via this command.
49	Write Primary Variable Sensor Serial Number	Enables a transducer serial number to be entered.
60	Read Analog Channel and Percent of Range	Returns the current mA value on *Current Output 2* and that value as a percentage of its range.
66	Enter / Exit Fixed Analog Channel Mode	*Current Output 2* can be set to a constant mA value. Sending a value of '0x7F, 0xA0, 0x00, 0x00' cancels the fixed output mode.
67	Trim Analog Channel Zero	The transmitter re-calibrates the *Current Output 2 / Zero Offset* based on the externally-measured primary value received.
68	Trim Analog Channel Gain	The transmitter re-calibrates the *Current Output 2 / Span Scale Factor* based on the externally-measured primary value received.

Table 7.3 Common Practice Command Set (Continued)

7.5 Device Status Information

7.5.1 Field Device Status First Byte

First Bit is set to 1	Description
Bit #7	Set to 1 = communications error
Bit #6	Vertical parity error
Bit #5	Overrun error
Bit #4	Framing error
Bit #3	Longitudinal parity error
Bit #2	Reserved
Bit #1	Buffer overflow
Bit #0	Reserved

First Bit is set to 0	Description
Bit #7	Set to 0
0x00 hex = 0 dec	No command-specific error
0x02 hex = 2 dec	Invalid selection
0x03 hex = 3 dec	Passed parameter too large
0x04 hex = 4 dec	Passed parameter too small
0x05 hex = 5 dec	Too few data bytes received (incorrect byte count)
0x06 hex = 6 dec	Device-specific command error
0x07 hex = 7 dec	In write protect mode
0x09 hex = 9 dec	Lower range value too high
0x0A hex = 10 dec	Lower range value too low
0x0B hex = 11 dec	Upper range value too high
0x0C hex = 12 dec	Upper range value too low
0x0D hex = 13 dec	Upper und lower range values out of limits
0x0E hex = 14 dec	Span too small
0x10 hex = 16 dec	Access restricted
0x12 hex = 18 dec	Invalid units code
0x20 hex = 32 dec	Busy
0x40 hex = 64 dec	Command not implemented

Table 7.4 Field Device Status First Byte

7.5.2 Field Device Status Second Byte

Second Byte	Description
Bit #7	Field Device Malfunction ■ A hardware error or failure has been detected by the device. ■ Further information may be available through the *Read Additional Transmitter Status* command.
Bit #6	Configuration Changed ■ A write command has been executed. ■ A set command has been executed.
Bit #5	Cold Start
Bit #4	More Status Available ■ More Status information is available than can be returned in the *Field Device Status*. Command #48 *Read Additional Status Information* provides this additional status information. ■ Set if any of the device-specific status bits in command #48 are set.
Bit #3	Primary Variable Analog Output Fixed ■ The analog and digital analog outputs for the *Primary Variable* are held at the requested value. They do not respond to the applied process. ■ Primary analog output set to a fixed value via HART (or via the HMI) putting the current output into test mode.
Bit #2	Primary Variable Analog Output Saturated ■ The analog and digital outputs for the 'Primary Variable' are beyond their limits and no longer represent the true applied process. ■ Calculated *Current Output 1* value is beyond the physical limits of the output.
Bit #1	Non Primary Variable Out of Limits ■ The temperature or cold junction cell voltage are beyond the operating limits of the probe. The *Read Additional Transmitter Status* command, #48, is required to identify the variable. ■ Set if SV, TV or QV sensor limit failure diagnostic bits are set.
Bit #0	Primary Variable Out of Limits ■ The measured oxygen value is beyond the operating limits of the probe. ■ PV sensor out-of-limits diagnostic set.

Table 7.5 Field Device Status Second Byte

7.5.3 Additional Transmitter Status Information – Command 48

Byte 0	Description
Bit #7	Probe O_2 sensor broken
Bit #6	ADC failure
Bit #5	SV (Temperature) out of range
Bit #4	PV (% 0_2) probe out of range
Bit #3	SV (Temperature) probe out of limits
Bit #2	PV (% 0_2) probe out of limits
Bit #1	SV (Temperature) probe failure
Bit #0	PV (% 0_2) probe failure

Byte 1	Description
Bit #7	Heater fuse blown
Bit #6	Heater failed
Bit #5	Heater tripped
Bit #4	Cell stabilizing
Bit #3	Cell warming up
Bit #2	Cold Junction failure
Bit #1	Thermocouple reversed
Bit #0	Thermocouple failure

Byte 2	Description
Bit #7	Solenoid valves in test mode
Bit #6	Test gas 2 not present
Bit #5	Test gas 1 not present
Bit #4	Scheduled accuracy check missed
Bit #3	Scheduled automatic calibration missed
Bit #2	Sensor calibration required
Bit #1	Sensor calibration overdue
Bit #0	Mains frequency error

Table 7.6 Additional Transmitter Status Information – Command 48

Byte 3	Description
Bit #7	Cell offset approaching limit
Bit #6	Cell factor approaching limit
Bit #5	Accuracy check stability failure
Bit #4	Calibration stability failure
Bit #3	Test gas 2 accuracy check in progress
Bit #2	Test gas 1 accuracy check in progress
Bit #1	Test gas 2 calibration in progress
Bit #0	Test gas 1 calibration in progress

Byte 4	Description
Bit #7	Option NV memory failure
Bit #6	Main NV memory failure
Bit #5	Diffuser response time slow
Bit #4	No response from sensor
Bit #3	Sensor impedance warning
Bit #2	Slow cell response
Bit #1	Calibration offset failure
Bit #0	Span calibration factor failure

Byte 5	Description
Bit #7	Internal communications error
Bit #6	Current output 2 in test mode
Bit #5	Current output 1 in test mode
Bit #4	In factory test mode
Bit #3	In demo mode
Bit #2	In configuration mode
Bit #1	In simulation mode
Bit #0	Ambient temperature too high / low

Table 7.6 Additional Transmitter Status Information – Command 48 (Continued)

8 Troubleshooting

8.1 Diagnostics Classification Codes

Diagnostic messages and icons conforming to the NAMUR NE107 classification code are used to define information during operation and data entry – a typical diagnostic message is shown in Fig. 8.1:

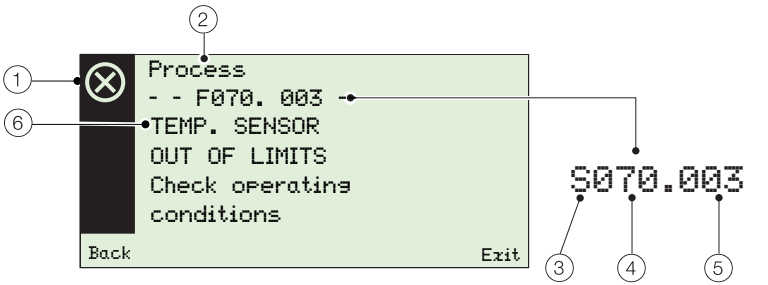


Fig. 8.1 Example Diagnostic Message and Components

Item	Description	Item	Description
1	NAMUR status Icon (see 3): ■ Failure ■ Out of Specification ■ Maintenance ■ Check Function	4	Diagnostic Priority: ■ Failure 070 to 100 ■ Out of Specification 048 to 068 ■ Maintenance 022 to 042 ■ Check Function 002 to 020
2	Group Name: ■ Electronics ■ Process ■ Configuration ■ Operation	5	Diagnostic Number (Internal Use Only): ■ Minimum 000 ■ Maximum 047
3	NAMUR Classification Code: ■ C Check Function ■ F Failure ■ M Maintenance ■ S Out of Specification	6	Diagnostic Text: ■ a unique message associated with a diagnostic message ■ see Section 8.2.1, page 79

Table 8.1 Diagnostic Message Components

8.2 Diagnostics Messages

Note. Diagnostics messages are listed in order of highest priority.

8.2.1 Failure Messages

Message range: F100.000 to F070.003.

Status Icon	Diagnostic Message	Possible Cause(s)	Corrective Measure(s)
⊗	--F100.000-- O2 SENSOR FAILED Check related diagnostics check wiring.	Broken sensor connection, faulty cell or electronics.	Check for related diagnostics. Check wiring. If problem persists contact local ABB service.
⊗	--F098.001-- TEMP. SENSOR FAILED Check related diagnostics check wiring	Broken sensor connection, faulty thermocouple or cold junction sensor.	Check for related diagnostics. Check wiring. If problem persists contact local ABB service.
⊗	--F096.006-- ADC FAILURE Cycle power. If problem persists change cartridge	Temporary or permanent hardware failure.	Cycle power to transmitter. Replace cartridge. If problem persists contact local ABB service.
⊗	--F094.007-- SENSOR BROKEN Check wiring	Cell connection is open circuit.	Check wiring. Replace cell. If problem persists contact local ABB service.
⊗	--F092.036-- NO RESPONSE FROM SENSOR Check gas pipes. Check wiring Replace cell.	Test gas pipes blocked or broken, faulty cell or cell connections.	Check gas pipes. Check cell wiring. Replace cell.
⊗	--F090.008-- THERMOCOUPLE FAILED Check wiring	Thermocouple open circuit or faulty.	Check wiring. Replace thermocouple. If problem persists contact local ABB service.

Table 8.2 Diagnostics – Failure Messages

Status Icon	Diagnostic Message	Possible Cause(s)	Corrective Measure(s)
⊗	--F088.009-- THERMOCOUPLE REVERSED Correct wiring	Thermocouple wired incorrectly.	Correct wiring.
⊗	--F086.010-- COLD JUNCTION FAILED Check wiring. Replace cold junction sensor	Cold junction sensor in head open circuit or faulty.	Check wiring. Replace cold junction sensor. If problem persists contact local ABB service.
⊗	--F084.014-- HEATER FAILED Check power level at heater connections.	Faulty heater or electronics.	Check power level at heater connections in probe head. If problem persists contact local ABB service.
⊗	--F082.015-- HEATER FUSE BLOWN Replace fuse. If problem persists replace heater	Faulty heater or temporary surge.	Replace fuse – see Section 4.8.1, page 22 (remote transmitter) or 4.11.1, page 25 (integral transmitter). Replace heater in probe. If problem persists contact local ABB service.
⊗	--F080.013-- HEATER TRIPPED Wait for cell temperature to cool down	Maximum cell temperature exceeded.	Wait for temperature to cool down. If problem persists contact local ABB service.
⊗	--F078.038-- MAIN NV MEMORY FAILED Cycle power. Check & re-enter configuration	Failure during reading of NV memory or permanent corruption of data.	Switch power to transmitter off and then on again. Check and re-enter configuration parameters. Replace cartridge. If problem persists contact local ABB service.

Table 8.2 Diagnostics – Failure Messages (Continued)

Status Icon	Diagnostic Message	Possible Cause(s)	Corrective Measure(s)
⊗	--F076.047-- INTERNAL COMMS ERROR Cycle power. If problem persist change cartridge	Temporary or permanent hardware failure.	Switch power to transmitter off and then on again. If problem persists replace cartridge. Contact local ABB service.
⊗	--F074.039-- OPTION NV MEMORY FAILE Cycle power. Check & re-enter configuration	Failure during reading of NV memory or permanent corruption of data.	Switch power to transmitter off and then on again. Check and re-enter configuration parameters. Replace cartridge. If problem persists contact local ABB service.
⊗	--F072.002-- O2 SENSOR OUT OF LIMITS Address process issue & check wiring.	Process oxygen concentration beyond sensor range.	Address process issue. Check wiring. If problem persists contact local ABB service.
⊗	--F070.003-- TEMP SENSOR OUT OF LIMITS Check operating conditions	Maximum temperature range for thermocouple exceeded.	Check operating conditions.

Table 8.2 Diagnostics – Failure Messages (Continued)

8.2.2 Out of Specification Messages

Message range: S068.040 to S048.005

Status Icon	Diagnostic Message Displayed	Possible Cause(s)	Corrective Measure(s)
⚠	--S068.040-- INTERNAL TEMP. OUT OF RANGE Check internal temperature	Ambient temperature too high / low or fault in electronics.	Modify ambient temperature. Replace cartridge. If problem persists contact local ABB service.
⚠	--S064.032-- CAL. FACTOR FAILED Cell is faulty. Replace cell.	Cell is faulty.	Replace cell.
⚠	--S062.033-- CAL. OFFSET FAILED Cell is faulty. Replace cell.	Cell is faulty.	Replace cell.
⚠	--S060.028-- CALIBRATION STABILITY FAILED Check test gas connections. Re-calibrate	Cell input measurement is too noisy.	Check gas connections. Repeat calibration. If problem persists contact local ABB service.
⚠	--S058.019-- MISSED SCHEDULED AUTOCAL Check reason for missed cal. Re-calibrate	Device not in operating mode when calibration was scheduled.	Check reason why automatic calibration was not performed. Perform calibration.
⚠	--S056.016-- MAINS FREQUENCY ERROR Check mains power source.	Power frequency not within 45 Hz to 65 Hz range.	Check power source.

Table 8.3 Diagnostics – Out of Specification Messages

Status Icon	Diagnostic Message Displayed	Possible Cause(s)	Corrective Measure(s)
⚠	--S054.011-- CELL WARMING UP Wait for cell temp. to reach 690°C/1274°F	Cell temperature is below 690 °C (1274 °F).	Wait for cell temperature to reach 690 °C (1274 °F) .
⚠	--S052.012-- CELL STABILIZING Wait for cell temperature to stabilize (5min)	Cell temperature above 690 °C (1274 °F) but not stable.	Wait for cell temperature to stabilize (5 minutes).
⚠	--S050.004-- O2 SENSOR OUT OF RANGE Address process issue or extend operating range	Process oxygen concentration beyond set operating range.	Address process issue or extend oxygen operating range.
⚠	--S048.005-- TEMP. SENSOR OUT OF RANGE Check operating conditions	Maximum temperature range for thermocouple exceeded.	Check operating conditions.

Table 8.3 Diagnostics – Out of Specification Messages (Continued)

8.2.3 Maintenance Messages

Message range: M042.029 to M022.020

Status Icon	Diagnostic Message Displayed	Possible Cause(s)	Corrective Measure(s)
	--M042.029-- ACCURACY CHECK STABILITY FAILED Check test gas connections. Re-calibrate	Cell input measurement is too noisy.	Check gas connections. Repeat accuracy check. If problem persists contact local ABB service.
	--M040.035-- SENSOR IMPEDANCE WARNING Cell is reaching end of its life. Replace cell	Cell is reaching end of its life.	Replace cell.
	--M038.034-- SLOW CELL RESPONSE Check gas pipes. Replace cell.	Blocked or broken test gas pipes or faulty cell.	Check gas pipes. Replace cell.
	--M036.037-- SLOW RECOVERY RATE Diffuser blocked Clean diffuser?	Diffuser is blocked.	Clean or, if necessary, replace diffuser.
	--M034.031-- CAL. OFFSET NEAR LIMIT Cell is reaching end of its life. Replace cell.	Cell is reaching end of its life.	Replace cell.
	--M032.030-- CAL. FACTOR NEAR LIMIT Cell is reaching end of its life. Replace cell.	Cell is reaching end of its life.	Replace cell.

Table 8.4 Diagnostics – Maintenance Messages

Status Icon	Diagnostic Message Displayed	Possible Cause(s)	Corrective Measure(s)
	--M030.021-- TEST GAS 1 NOT PRESENT Check test gas	Test gas cylinder empty.	Check test gas lines. Replace test gas cylinder.
	--M028.022-- TEST GAS 2 NOT PRESENT Check test gas	Test gas cylinder empty.	Check test gas lines. Replace test gas cylinder
	--M026.018-- SENSOR CAL. REQUIRED Re-calibrate	Accuracy check indicates re-calibration is required.	Perform calibration.
	--M024.017-- SENSOR CAL. OVERDUE Re-calibrate	Customer entered calibration interval exceeded.	Perform calibration.
	--M022.020-- MISSED SCHEDULED ACCURACY CHECK Check reason for missed check. Re-calibrate	Device not in operating mode when accuracy check was scheduled.	Check reason why accuracy check was not performed. Perform calibration.

Table 8.4 Diagnostics – Maintenance Messages (Continued)

8.2.4 Check Function Messages

Message range: C020.041 to M002.0XX

Status Icon	Diagnostic Message Displayed	Possible Cause(s)	Corrective Measure(s)
	--C020.041-- SIMULATION MODE Signals and/or diagnostics being simulated	Transmitter is in simulation mode.	Exit simulation mode before using in the field.
	--C019.044-- FACTORY TEST MODE Set to run mode before using in the field	Transmitter in special factory test mode.	Set to normal run mode before using in the field.
	--C018.043-- DEMONSTRATION MODE Set to run mode before using in the field	Transmitter in demonstration mode.	Set to normal run mode before using in the field.
	--C016.045-- CURRENT OUTPUT 1 IN TEST MODE Output under manual control. No action req'd	Current Output 1 under manual control.	No action required.
	--C014.046-- CURRENT OUTPUT 2 IN TEST MODE Output under manual control. No action req'd	Current Output 2 under manual control.	No action required.

Table 8.5 Diagnostics – Check Function Messages

Status Icon	Diagnostic Message Displayed	Possible Cause(s)	Corrective Measure(s)
	--C012.023-- TEST GAS VALVES IN TEST MODE Valves under manual control. No action req'd	Calibration in progress.	No action required.
	--C010.024-- TEST GAS 1 CALIBRATION Cal. in progress No action req'd	Calibration in progress.	No action required.
	--C008.025-- TEST GAS 2 CALIBRATION Cal. in progress No action req'd	Calibration in progress.	No action required.
	--C006.026-- TEST GAS 1 ACCURACY CHECK Cal. in progress No action req'd	Calibration in progress.	No action required.
	--C004.027-- TEST GAS 2 ACCURACY CHECK Cal. in progress No action req'd	Calibration in progress.	No action required.
	--C002.042-- CONFIGURATION MODE Device is being configured. No action req'd	Calibration in progress.	No action required.

Table 8.5 Diagnostics – Check Function Messages (Continued)

8.3 Performance Log

8.3.1 Log Entries

Information displayed in the *Performance Log* is derived from the values obtained during calibration routines.

When the *Performance Log* is selected, an icon (1 in Fig. 8.2) at the left side of the display indicates a successful or failed calibration or accuracy check; or if a new probe / cell has been fitted. Icon types are shown in Table 8.6 below:

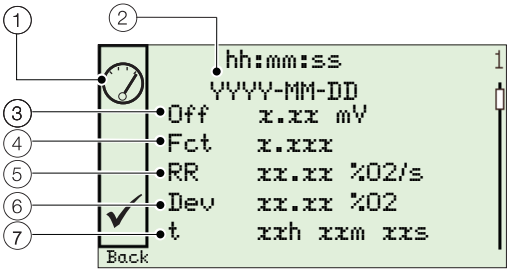


Fig. 8.2 Typical Performance Log and Performance Code Structure

Item	Icon				
1	Calibration check successful	Calibration check failed	Accuracy check successful	Accuracy check failed	New probe / cell

Table 8.6 Performance Log Icons

Item	Description	Item	Description
2	hh:mm:ss YYYY-MM-DD Time and date of entry	5	RR Recovery rate
3	Off Calibration offset	6	Dev Deviation
4	Fct Calibration factor	7	t Time duration

Table 8.7 Performance Log Codes

8.3.2 Performance Log Codes

Parameter	Comment / Range
Type	The calibration type, represented as an icon – see Table 8.6, page 88: ■ Calibration ■ Failed Cal ■ Accuracy Check ■ Failed Accuracy Check ■ New Probe
Time and Date of Entry	The time and date the calibration / accuracy check was performed or the new probe / cell was fitted.
Calibration Offset	The calculated calibration offset value displayed as a mV value.
Calibration Factor	The calculated calibration factor value.
Deviation	
Calibration	The difference between the oxygen value as it is being calculated with the newly-updated coefficients *and* the oxygen value as it would have been calculated with the coefficients used before the calibration was performed.
Accuracy Check	The difference between the oxygen value as it would be calculated using the coefficients calculated by the accuracy check *and* the oxygen value as it is being calculated with the existing coefficients.
New probe / cell	Not applicable – ---- is displayed

Table 8.8 Performance Log Fields

Parameter	Comment / Range
Recovery Rate	
Calibration / Accuracy Check	The maximum recorded rate of change of the calculated oxygen value when the test gas is removed and the measurement returns to the process value. **Notes**: A valid recovery rate cannot be calculated if: ■ a manual calibration / accuracy check is performed ■ either of the test valves are set to manual mode before the test is complete ■ a subsequent calibration or accuracy check is started before the test is complete ■ the difference between the test gas value and process value is less than 10 % of the oxygen range ■ the maximum rate of recovery is not achieved within 3 minutes of removal of the test gas
New probe / cell	Not applicable – ----- is displayed
Time Since Last Cal	The elapsed time between the last successful calibration and this entry.

Table 8.8 Performance Log Fields

9 Remote Computer Connection

9.1 Utility Software for PC

When communication between the device and a remote PC is made (using the IrDA adaptor and ABB Service Port Switch software) ABB Utility Software enables:

- cyclic data and parameter data to be downloaded and saved to a compatible spreadsheet application such as Excel – see page 93.
- the device to be operated via a PC using the Remote HMI application
- any HART command to be read or written using the HART application

9.2 Installing the Utility Software

Note. The Utility Software is compatible only with 32 bit operating systems.

To install the Utility Software onto a PC:

1. Insert the Utility Software CD into the PC's CD drive.
   The installation screen is displayed automatically.
2. Install the virtual port.
3. Install the Service Port Switch.
4. Install the Remote HMI.

9.3 Connecting the IrDA Port

Note.

- The IrDa port is functional only when the Cyclic Output Interval parameter (see Section 5.4.8, page 62) is not set to 'Off'.
- The Cyclic Output Interval parameter setting resets to 'Off' when the transmitter is powered up.

The IrDA adaptor enables communication between the device and a PC via a port selected at the Service Port Swtch.

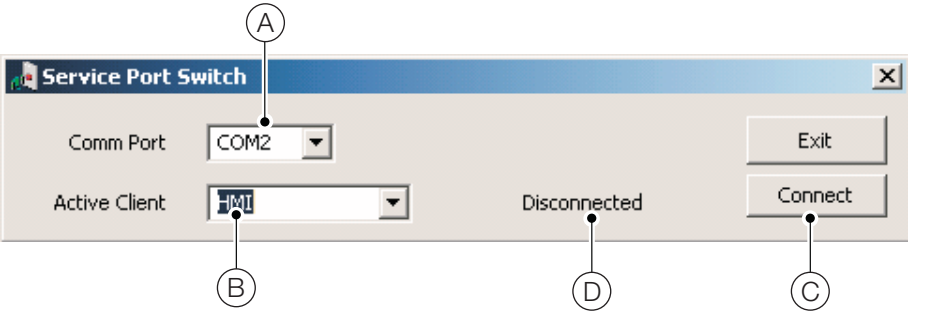
To prepare the IrDA interface for use:

1. Install the Utility Software CD onto the PC – see Section 9.2, page 91.
2. Plug the IrDA adaptor into a USB / RS232 adaptor cable and plug the USB connection into the PC.
3. Align the IrDA adaptor to within 0.5 m (1.5 ft) of the transmitter.

9.4 Configuring the Service Port Switch

To configure the Service Port switch:

1. Ensure the IrDA adaptor is connected – see Section 9.3 (above).
2. Launch the Service Port Switch utility.



3. From the drop-down list, select the COM port (A) to be used.
4. From the drop-down list, select the client application (B) to be used:
   - Cyclic O / P – see Section 9.5, page 93
   - Parameter Dump – see Section 9.6, page 93
   - HMI – see Section 9.7, page 94
   - HART – see Section 9.8, page 94
5. Click 'Connect' (C)? The 'Disconnected' status (D) changes to 'Active' to confirm connection is made.

Note. It is necessary to keep the Service Port Switch open the whole time the service port is used.

9.5 Cyclic Data

Cyclic data can be saved and output to a spreadsheet or as text. The update rate and data groups enabled for output are selected at the *Communication / Cyclic Output* menu.

To output cyclic data:

1. Launch a terminal application.
2. Configure the terminal application to communicate with the COM port specified previously in the Service Port Switch.
3. To start the output routine, press 'P' on the PC keyboard (press 'S' to stop).

   A header row is created and enabled data is output at the interval set.
4. To output the data to a spreadsheet:
   a. use the capture capability to save a text (.txt) file
   b. open the .txt file into Excel
   c. at the Excel *Text Import Wizard*, select the file type as *Delimited*

   Data is labelled and formatted automatically for display and analysis.

9.6 Parameter Dump

The parameter dump option enables two types of information to be downloaded:

- Configuration settings
- Diagnostic Log and Signals View values

To run a **Configuration** settings dump:

1. Launch a terminal application.
2. Configure the terminal application to communicate with the COM port specified previously in the Service Port Switch – see Section 9.4, page 92.
3. Press 'C' on the PC keyboard to start the output routine.
4. To output the data to a spreadsheet:
   a. use the capture capability to save a text (.txt) file
   b. open the .txt file into Excel
   c. at the Excel *Text Import Wizard*, select the file type as *Delimited*

   Data is labelled and formatted automatically for display and analysis.

To run a **Signals and Alarm** parameter dump:

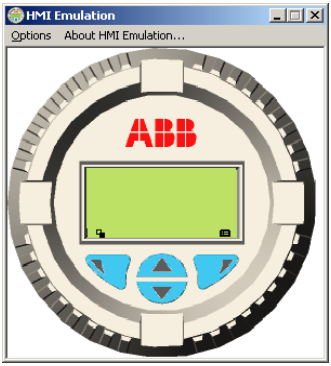
1. Launch a terminal application.
2. Configure the terminal application to communicate with the COM port specified previously in the Service Port Switch – see Section 9.4, page 92.
3. Press 'I' on the PC keyboard to start the output routine.
4. To output the data to a spreadsheet:
   a. use the capture capability to save a text (.txt) file
   b. open the .txt file into Excel
   c. at the Excel *Text Import Wizard*, select the file type as *Delimited*

   Data is labelled and formatted automatically for display and analysis.

9.7 Remote HMI (Human Machine Interface)

To run the Remote HMI application:

1. Launch the Remote HMI application:



2. From the *Options / Comms Ports* menu, select the COM number assigned in the Service Port Switch.
3. Click *Save Settings*.
4. Operate the Remote HMI using the mouse and cursor to select the , , and keys in the same way as operating the physical HMI.

9.8 HART Client

Note. Any standard HART application can be used via the infrared interface and the ABB Service Port Switch. All communications are handled automatically with no need for a HART modem.

To run the HART client:

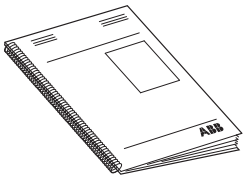
1. Configure the HART application to communicate with the COM port specified previously in the Service Port Switch – see Section 9, page 91.
2. Launch any preferred PC HART application.
3. Configure the COM port on the running HART application to be the COM port specified previously in the Service Port Switch.

   The HART application operates as normal allowing any HART command to be read or written.

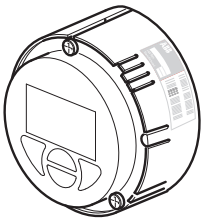
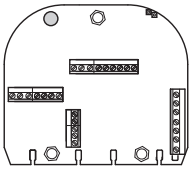
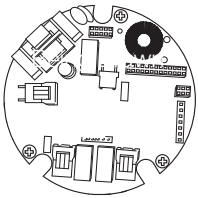
Note. An increase in operating speed may be noticed as HART communication transmits faster through the service port than through a normal HART modem.

10 Spares and Accessories

10.1 Documentation & Software

Part No.	Description
IM/AZ20M–EN	Maintenance Guide Download* the guide from: www.ABB.com/analytical-instruments 
AZ20 DTM Software	Device Type Manager – please contact ABB for details

10.2 Transmitter Spares

Part No.	Description
AZ200 750 AZ200 751 AZ200 752	AZ20 Transmitter Cartridge Standard Standard + Analog O/P Standard + Digital O/P 
AZ200 758	Type 4 (Remote) Transmitter Backplane 
AZ200 757	Type 3 (Integral) Transmitter Backplane 

11 System Specification

Measurement Performance

Range – AZ20
0.01 to 100 % O_2

Range – AZ25
0 to 25 % O_2

Test gas response time
Initial dead time 3 seconds

T90 < 10 seconds

System accuracy – AZ20
< ±0.75 % of reading or 0.05 % O_2, whichever is the greater, based on a nominal range of 0.01 to 25 % O_2 or 20 to 100 % O_2

System accuracy – AZ25
< ±2.0 % of reading or 0.2 % O_2, whichever is the greater (reference conditions)

Drift
< ± 1 % maximum % O_2 range value per month (without calibration)

< ± 0.2 % typical

Environmental Data

Ambient operating temperature

Transmitter	–20 to 55 °C (–4 to 131 °F)
AZ20 Probe	–20 to 70 °C (–4 to 158 °F)
AZ25 Probe standard cable	–20 to 100 °C (–4 to 212 °F)
AZ25 Probe high temperature cable requirement	–20 to 200 °C (–4 to 424 °F) 6-core, 200AWG, overall screen (tin / copper wire braid), 20AWG drain wire, sheathed

Storage temperature
–40 to 85 °C (–40 to 185 °F)

Operating humidity
Up to 95 % RH, non-condensing

Sunlight
Store and operate out of direct sunlight

Ingress protection

Probe (excludes remote / integral transmitter)	IP66 (NEMA 4X)
Electronics enclosures – remote and integral	IP66 (NEMA 4X)

Power Supply

AC power supply
100 to 240 V AC ±10 % (90 V min. to 264 V max.) 50 / 60 Hz

Electronics
< 10 W

Probe heater
< 100 W

EMC

Emissions and immunity
Conforms to EN61326-1:2006

Safety

General safety
Conforms to EN61010-1: 2001

Approvals and safety certification
CE mark

12 Transmitter Specification

Transmitter enclosures

Remote

Wall-, pipe- or stand-mounted

4 gland entries

Optional 1/2 in NPT, M20

Integral

Head-mounted

3 gland entries

Optional 1/2 in NPT, M20

Automatic calibration

AutoCal hardware

Isolated solenoid valve control as standard, 24 V @ 2 W per valve*

Dedicated isolated digital inputs to monitor pressure switch contacts as standard – voltage-free, normally closed with gas present

Display and switches

Display type

Graphical 128 x 64 pixel LCD

Display backlight

Green LED

Operator switches

4 capacitive switches
(operated through the front glass)

Relay outputs

Number

2 standard

Type

Normally closed
5 A @ 230 V AC or 30 V DC (non-inductive)

Functions

User-configurable – can be activated by one or more of the following signals:

Process alarm 1, 2, 3, 4
Calibration in progress
Calibration failed
Out of test gas 1, 2
Test gas 1 valve control
Test gas 2 valve control
Failure diagnostic
Out-of-specification diagnostic
Maintenance required diagnostic
Function check diagnostic

*For driving internal automatic calibration (AutoCal) probes or can be used to drive external calibration units on remote transmitters only.

Analog outputs

Standard

1 isolated current output

Programmable to retransmit oxygen (linear or logarithmic) or temperature

Programmable over 4 to 20 mA

Over-range capability to indicate system failure programmable from 4 to 22 mA

Optional

1 isolated current output

Programmable to retransmit oxygen (linear or logarithmic) or temperature

Programmable over 0 to 20 mA

Over-range capability to indicate system failure programmable from 0 to 22 mA

Digital inputs/outputs

Number
2 (optional)

Type
User-configurable as either input or output

Input
Volt-free contact

Output
Transistor switch capable of sinking 220 mA

Low output, < 2 V DC

Switch voltage 30 V DC maximum

Isolation
Not isolated from each other or from other circuitry

Input functions
User-configurable for:

Automatic calibration start
Automatic calibration stop
Automatic calibration start/stop

Functions
User-configurable – can be activated by one or more of the following signals:

Process alarm 1, 2, 3, 4
Calibration in progress
Calibration failed
Out of test gas 1
Out of test gas 2
Test gas 1 valve control
Test gas 2 valve control
Failure diagnostic
Out-of-specification diagnostic
Maintenance required diagnostic
Function check diagnostic

Hart communications

Version
5.7 as standard

Integration
Device Type Manager (DTM) and Electronic Device Description (EDD)

Provide online/offline device configuration, online monitoring of measurement values and diagnostic states

DTM
FDT v1.2.1 compliant

Works with FDT framework packages
(for example, ABB Asset Vision Basic)

EDD
Compliant with suitable framework tools
(for example, SDC 625 and Simatic PDM tools)

Infrared service port

Accessibility
Through front face

Type
IrDA standard

Baud rate
Up to 115K baud

Functions
Firmware update

Remote HMI

Diagnostic log download

Datalog output

HART via IrDA

Languages

English

Calibration

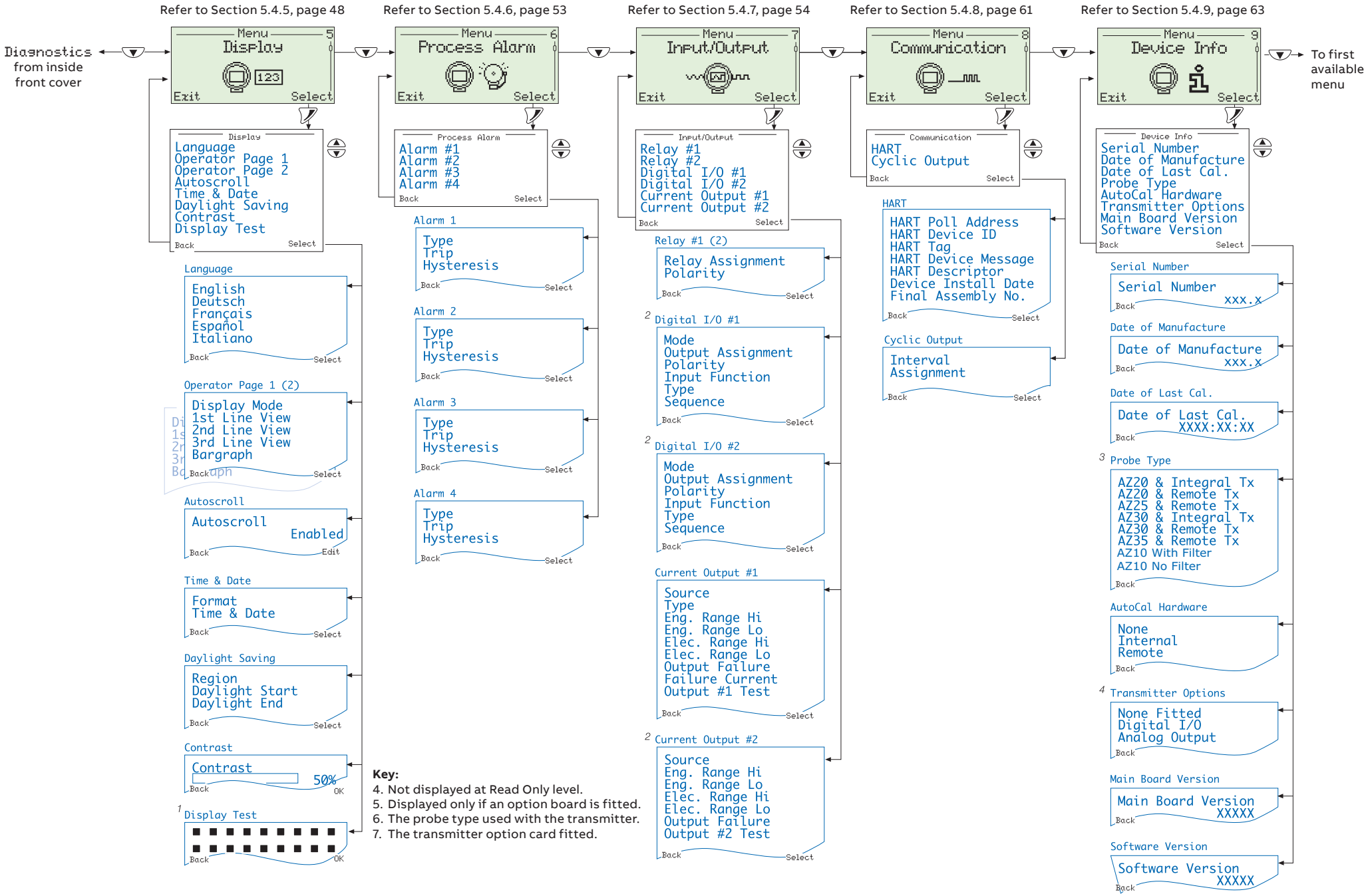
Manual calibration
1 point (offset)
1 point (factor)
2 point (offset + factor)

Automatic calibration
1 point (offset)
2 point (offset + factor)

Calibration control
Front panel controls
Digital inputs
HART commands
User-defined schedule

Calibration scheduler
User-defined schedule enables automatic calibration frequency to be set from 1 day to 12 months

DS/AZ20–EN Rev. H,
DS/AZ25–EN Rev. A


Refer to Section 5.4.5, page 48
Refer to Section 5.4.6, page 53
Refer to Section 5.4.7, page 54
Refer to Section 5.4.8, page 61
Refer to Section 5.4.9, page 63
Diagnostics from inside front cover
Menu 5 Display Exit Select
Menu 6 Process Alarm Exit Select
Menu 7 Input/Output Exit Select
Menu 8 Communication Exit Select
Menu 9 Device Info Exit Select
To first available menu
Display
Language
Operator Page 1
Operator Page 2
Autoscroll
Time & Date
Daylight Saving
Contrast
Display Test
Back Select
Process Alarm
Alarm #1
Alarm #2
Alarm #3
Alarm #4
Input/Output
Relay #1
Relay #2
Digital I/O #1
Digital I/O #2
Current Output #1
Current Output #2
Communication
HART
Cyclic Output
Device Info
Serial Number
Date of Manufacture
Date of Last Cal.
Probe Type
AutoCal Hardware
Transmitter Options
Main Board Version
Software Version
Language
English
Deutsch
Français
Español
Italiano
Operator Page 1 (2)
Display Mode
1st Line View
2nd Line View
3rd Line View
Bargraph
Autoscroll
Autoscroll Enabled
Edit
Time & Date
Format
Time & Date
Daylight Saving
Region
Daylight Start
Daylight End
Contrast
Contrast 50%
OK
1 Display Test
Alarm 1
Type
Trip
Hysteresis
Alarm 2
Alarm 3
Alarm 4
Relay #1 (2)
Relay Assignment
Polarity
2 Digital I/O #1
Mode
Output Assignment
Polarity
Input Function
Type
Sequence
2 Digital I/O #2
Current Output #1
Source
Type
Eng. Range Hi
Eng. Range Lo
Elec. Range Hi
Elec. Range Lo
Output Failure
Failure Current
Output #1 Test
2 Current Output #2
Output #2 Test
HART
HART Poll Address
HART Device ID
HART Tag
HART Device Message
HART Descriptor
Device Install Date
Final Assembly No.
Cyclic Output
Interval
Assignment
Serial Number
Serial Number xxx.x
Date of Manufacture
Date of Manufacture xxx.x
Date of Last Cal.
Date of Last Cal. XXXX:XX:XX
3 Probe Type
AZ20 & Integral Tx
AZ20 & Remote Tx
AZ25 & Remote Tx
AZ30 & Integral Tx
AZ30 & Remote Tx
AZ35 & Remote Tx
AZ10 With Filter
AZ10 No Filter
AutoCal Hardware
None
Internal
Remote
4 Transmitter Options
None Fitted
Digital I/O
Analog Output
Main Board Version
Main Board Version XXXXX
Software Version
Software Version XXXXX
Key:
4. Not displayed at Read Only level.
5. Displayed only if an option board is fitted.
6. The probe type used with the transmitter.
7. The transmitter option card fitted.

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