
User's Manual

Model DO202G (S)
Dissolved Oxygen
Transmitter

EXA



TABLE OF CONTENTS

PREFACE

1. INTRODUCTION AND GENERAL DESCRIPTION	1-1
1-1. Instrument check	1-1
1-2. Application	1-2
2. GENERAL SPECIFICATIONS	2-1
2-1. Specifications	2-1
2-2. Operating specifications	2-2
2-3. Model and suffix codes	2-2
3. INSTALLATION AND WIRING	3-1
3-1. Installation and dimensions	3-1
3-1-1. Installation site	3-1
3-1-2. Mounting methods	3-1
3-2. Wiring of power	3-3
3-2-1. General precautions	3-3
3-2-2. Connection of the power supply	3-3
3-2-3. Switching the instrument	3-3
3-2-4. mA Preperation	3-3
3-2-5. Cables, terminals and glands	3-3
3-3. Wiring of sensors	3-3
3-3-1. Wiring the standard galvanic sensor	3-3
3-3-2. Wiring other galvanic sensors	3-4
3-3-3. Wiring polarographic sensors	3-4
3-3-4. Wiring sensors with Vp connector	3-4
3-3-5. Sensor cable connections using junction box (BA10) and extension cable (WF10)	3-4
4. OPERATION; DISPLAY FUNCTIONS AND SETTING	4-1
4-1. Operator interface	4-1
4-2. Explanation of operating keys	4-2
4-3. Passcode protection	4-2
4-4. Display examples	4-3
4-5. Display functions	4-3
5. PARAMETER SETTING	5-1
5-1. Maintenance mode	5-1
5-1-1. Manual activation of hold	5-1
5-1-2. Manual temperature adjustment	5-2
5-1-3. Manual pressure adjustment	5-2
5-2. Commissioning mode	5-3
5-2-1. Output range	5-3
5-2-2. Hold	5-4
5-2-3. Service	5-5
5-3. Notes for guidance in the use of service coded settings	5-6
5-3-1. Parameter specific functions	5-6
5-3-2. Temperature functions	5-6
5-3-3. Calibration functions	5-6
5-3-4. mA Output functions	5-8
5-3-5. User interface	5-8
5-3-6. Communication setup	5-10
5-3-7. General	5-10
5-3-8. Test and setup mode	5-10

TABLE OF CONTENTS

6. CALIBRATION	6-1
6-1. General	6-1
6-1-1. Calibration methods	6-1
6-1-2. Diagnostic functions performed during calibration	6-1
6-2. Calibration procedure using air calibration method	6-2
6-2-1. Preperation	6-2
6-2-2. Procedure for air calibration	6-2
6-3. Calibration procedure using water calibration method	6-3
6-3-1. Preperation	6-3
6-3-2. Calibration operation (water calibration method)	6-3
6-3-3. Procedure for water calibration	6-4
6-4. Calibration procedure using manual calibration method	6-5
6-4-1. Preperation	6-5
6-4-2. Procedure for manual slope (sensitivity) calibration	6-6
6-4-3. Procedure for manual zero (offset) calibration	6-7
7. MAINTENANCE	7-1
7-1. Overall dissolved-oxygen metering system	7-1
7-1-1. Inspection and maintenance to be implemented periodically	7-1
7-1-2. Inspection and maintenance to be implemented occasion	7-1
7-2. Periodic maintenance for the EXA DO202 converter	7-2
8. TROUBLESHOOTING	8-1
8-1. Measures in the case of transmitter operation failure	8-1
8-2. Measures in the case of failure (error) detection	8-1
9. SPARE PARTS	9-1
9-1. Itemized parts list	9-1
APPENDIX 1. USER SETTINGS	A1-1
A-1-1. User setting table	A1-1
A-1-2. Configuration checklist for DO202	A1-2
A-1-3. Hart process variables	A1-2
A-1-4. Device description (DD) menu structure	A1-3
APPENDIX 2. Quality Inspection Standard (QIS)	A2-1
A-2-1. Introduction	A2-1
A-2-2. General inspection	A2-1
A-2-3. Safety test	A2-1
A-2-4. Accuracy test	A2-1
A-2-5. Accuracy test of all supported temperature elements	A2-1
A-2-6. Overall accuracy test	A2-2
A-2-7. Accuracy test mA output circuit	A2-2
A-2-8. Quality Inspection Certificate	A2-3
A-2-9. Software revision history	A2-4

WARNING

Electric discharge

The EXA analyzer contains devices that can be damaged by electrostatic discharge. When servicing this equipment, please observe proper procedures to prevent such damage. Replacement components should be shipped in conductive packaging. Repair work should be done at grounded workstations using grounded soldering irons and wrist straps to avoid electrostatic discharge.

Installation and wiring

The EXA analyzer should only be used with equipment that meets the relevant international and regional standards. Yokogawa accepts no responsibility for the misuse of this unit.

CAUTION

The instrument is packed carefully with shock absorbing materials, nevertheless, the instrument may be damaged or broken if subjected to strong shock, such as if the instrument is dropped. Handle with care.

Although the instrument has a weatherproof construction, the transmitter can be harmed if it becomes submerged in water or becomes excessively wet.

Do not use an abrasive material or solvent when cleaning the instrument.

Notice

The contents of this manual are subject to change without notice. Yokogawa is not responsible for damage to the instrument, poor performance of the instrument or losses resulting from such, if the problems are caused by:

- Improper operation by the user
- Use of the instrument in improper applications
- Use of the instrument in an improper environment or improper utility program
- Repair or modification of the related instrument by an engineer not authorized by Yokogawa

Warranty and service

Yokogawa products and parts are guaranteed free from defects in workmanship and material under normal use and service for a period of (typically) 12 months from the date of shipment from the manufacturer. Individual sales organizations can deviate from the typical warranty period, and the conditions of sale relating to the original purchase order should be consulted. Damage caused by wear and tear, inadequate maintenance, corrosion, or by the effects of chemical processes are excluded from this warranty coverage.

In the event of warranty claim, the defective goods should be sent (freight paid) to the service department of the relevant sales organization for repair or replacement (at Yokogawa discretion). The following information must be included in the letter accompanying the returned goods:

- Part number, model code and serial number
- Original purchase order and date
- Length of time in service and a description of the process
- Description of the fault, and the circumstances of failure
- Process/environmental conditions that may be related to the installation failure of the device
- A statement whether warranty or non-warranty service is requested
- Complete shipping and billing instructions for return of material, plus the name and phone number of a contact person who can be reached for further information

Returned goods that have been in contact with process fluids must be decontaminated/disinfected before shipment. Goods should carry a certificate to this effect, for the health and safety of our employees. Material safety data sheets should also be included for all components of the processes to which the equipment has been exposed.

In this manual a **mA** sign appears if it concerns the DO202 G (S)-A.

1. Introduction And General Description

The Yokogawa EXA 202 is a 2-wire transmitter designed for industrial process monitoring, measurement and control applications. This user's manual contains the information needed to install, set up, operate and maintain the unit correctly. This manual also includes a basic troubleshooting guide to answer typical user questions.

Yokogawa can not be responsible for the performance of the EXA analyzer if these instructions are not followed.

1-1. Instrument check

Upon delivery, unpack the instrument carefully and inspect it to ensure that it was not damaged during shipment. If damage is found, retain the original packing materials (including the outer box) and then immediately notify the carrier and the relevant Yokogawa sales office.

Make sure the model number on the nameplate affixed to the side of the instrument agrees with your order. Example of nameplate is shown below.



Figure 1-1. Nameplates

Note: The nameplate will also contain the serial number and any relevant certification marks. Be sure to apply correct power to the unit. The first two characters of the serial number refers to the year and month of manufacturing. Check that all the parts are present, including mounting hardware, as specified in the option codes at the end of the model number. For a description of the model codes, refer to Chapter 2 of this manual under General Specifications.

Basic Parts List: Transmitter DO202

User's Manual

Optional mounting hardware when specified (See model code)

Y= year		M= month	
2000	M	January	1
2001	N	February	2
2002	P	March	3
2003	R	April	4
.....	..		..
2008	W	September	9
2009	X	October	O
2010	A	November	N
2011	B	December	D

1-2. Application

The EXA converter is intended to be used for continuous on-line measurement in industrial installations. The unit combines simple operation and microprocessor-based performance with advanced self-diagnostics and enhanced communications capability to meet the most advanced requirements. The measurement can be used as part of an automated process control system. It can also be used to indicate dangerous limits of a process, to monitor product quality, or to function as a simple controller for a BOD/COD system.

Yokogawa designed the EXA analyzer to withstand harsh environments. The converter may be installed either indoors or outside because the IP65 (NEMA4X) housing and cabling glands ensure the unit is adequately protected. The flexible polycarbonate window on the front door of the EXA allows pushbutton access to the keypad, thus preserving the water and dust protection of the unit even during routine maintenance operations.

A variety of EXA hardware is optionally available to allow wall, pipe, or panel mounting. Selecting a proper installation site will permit ease of operation. Sensors should normally be mounted close to the converter in order to ensure easy calibration and peak performance. If the unit must be mounted remotely from the sensors, WF10 extension cable can be used up to a maximum of 30 metres (100 feet) with a BA10 junction box.

The EXA is delivered with a general purpose default setting for programmable items. (Default settings are listed in Chapter 5). While this initial configuration allows easy start-up, the configuration should be adjusted to suit each particular application. An example of an adjustable item is the type of sensor used. The EXA can be adjusted for galvanic and polarographics sensors.

To record such configuration adjustments, write changes in the space provided in Chapter 11 of this manual. Because the EXA is suitable for use as a monitor, a controller or an alarm instrument, program configuration possibilities are numerous.

Details provided in this user's manual are sufficient to operate the EXA with all Yokogawa sensor systems and a wide range of third-party commercially available probes. For best results, read this manual in conjunction with the corresponding sensor user's manual.

Yokogawa designed and built the EXA to meet the CE regulatory standards. The unit meets or exceeds stringent requirements of EMC Directive 89/336/EEC, to assure the user of continued accurate performance in even the most demanding industrial installations.

2. GENERAL SPECIFICATIONS

2-1. Specifications

A. Input specifications

The DO202 Dissolved Oxygen converter measures the current, that is generated by the Dissolved Oxygen sensor. The flexibility of the input circuit allows the use of many commercially available sensors, whether they are of the Galvanic type (driving voltage generated internally) or Polarographic type (driving voltage supplied by converter).

The input range varies from 0.0 nA up to 1200 nA for polarographic sensors and 0.0 μ A up to 50 μ A for galvanic sensors.

Temperature measurement for automatic temperature compensation utilizes the PT1000 RTD element as used by DO30G sensors, as well as the 22k NTC as used by the Hamilton Oxygold and Oxyferm Sensors.

B. Input ranges

- DO : 0 to 50 ppm
- : 0 to 1999 ppb
- : 0 to 600 % saturation
- Temperature: -20 to 150 °C (-4 to 302 °F)

mA C. Output span

- DO : min 1 - max 50 ppm
- : min 25 - max 1999 ppb
- : min 10 - max 600 % saturation

mA D. Transmission Signal

Isolated output of 4 - 20mA DC
Maximum load 425 Ω
Burn up (21mA) or Burn down (3.6mA)
Or/puls of 21mA to signal failure see Fig 2-1 and 2-2.

E. Temperature compensation

0 to 100 °C (32 to 212 °F)
Sensor types: Pt1000 RTD
22k NTC and P636
Automatic or Manual temperature compensation.

F. Calibration

Semi-automatic calibration with manual compensation for influence of barometric pressure and altitude on partial pressure of oxygen in air (or solubility of oxygen in water).
Automatic compensation for influence of salinity of water on solubility of oxygen in water is programmable.
The correction for pressure, salinity and temperature meets ISO 5814.

Possible calibration routines are:

- Sensitivity (span) calibration in ambient air
- Sensitivity (span) calibration in water, saturated with air: according to ISO 5814
- Zero calibration (normally inactive)

mA G. Serial communication

Bi-directional HART® digital communication super imposed on the 4 - 20mA signal.

H. Logbook

Software record of important events and diagnostic data. Available through FF interface.

I. Display

Custom liquid crystal display, with a main display of 31/2 digits 12.5 mm high. Message display of 6 alphanumeric characters, 7 mm high.

- J. Power supply** : Nominal 24 volt DC loop powered system
- | | |
|------------|------------------------|
| DO202G-A | : up to 40 volts |
| DO202G-F/P | : 9-32 VDC / 24.5mA |
| DO202S | : See control drawings |

mA Note: The transmitter contains a switched power supply. The transmitter requires a minimum Power voltage in order to work correctly, which is dependant on the load. Please refer to figures 2-1 and 2-2 for the correct power supply.

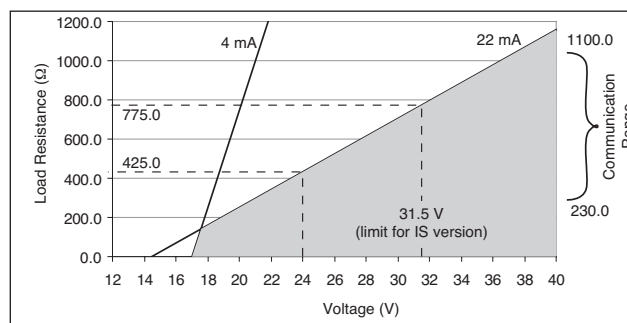


Figure 2-1. Supply voltage/ load diagram

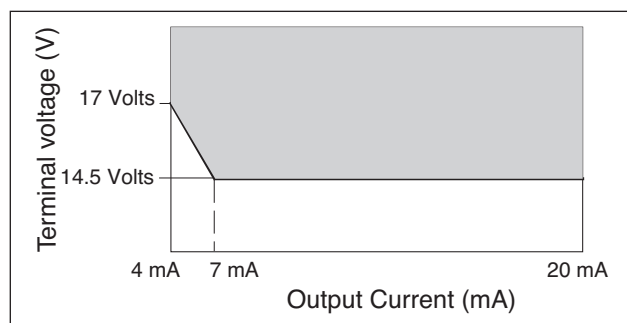


Figure 2-2. Minimum terminal voltage at the DO202

2-2. Operating specifications

A. Performance: DO ppm (at T process = 25 °C)

- Linearity: $\leq 0.05 \text{ ppm} \pm 0.02 \text{ mA}$
- Repeatability: $\leq 0.05 \text{ ppm} \pm 0.02 \text{ mA}$
- Accuracy: $\leq 0.05 \text{ ppm} \pm 0.02 \text{ mA}$

B. Performance: DO ppb (at T process = 25 °C)

- Linearity: $\leq 1 \text{ ppb} \pm 0.02 \text{ mA}$
- Repeatability: $\leq 1 \text{ ppb} \pm 0.02 \text{ mA}$
- Accuracy: $\leq 1 \text{ ppb} \pm 0.02 \text{ mA}$

C. Performance: Temperature

- Linearity: $\leq 0.3 \text{ °C} \pm 0.02 \text{ mA}$
- Repeatability: $\leq 0.1 \text{ °C} \pm 0.02 \text{ mA}$
- Accuracy: $\leq 0.3 \text{ °C} \pm 0.02 \text{ mA}$
- Response time 90% in $\leq 10 \text{ seconds}$

Note: The specifications are expressed with simulated inputs, because the DO202 can be used with many different sensors with their unique characteristics.

D. Ambient operating temperature

- 10 to +55 °C (10 to 130 °F).
- Excursions to -30 to +70 °C (-20 to 160 °F) will not damage the instrument, specification may be adversely affected.
- Drift < 500 ppm/°C. Storage temperature -30 to +70 °C (-20 to 160 °F)

E. Humidity

10 to 90% RH non-condensing

mA F. HART specification

- Min. cable diameter: 0.51mm, 24 AWG
- Max. cable length: 1500m
- Detailed information can be found at: www.hartcomm.org

G. FF specification

Twisted 2-wire with shield.

H. Housing

Cast aluminium case with chemically resistant coating, cover with flexible polycarbonate window. Case color is off-white and cover is moss green. Cable entry is via two 1/2" polyamide glands. Cable terminals are provided for up to 2.5 mm² finished wires. Weather resistant to IP65 and NEMA 4X standards. Pipe, wall or panel mounting, using optional hardware.

I. Data protection

EEPROM for configuration and logbook and lithium battery for clock.

J. Watchdog timer

Checks microprocessor.

K. Automatic safeguard

Return to measuring mode when no keystroke is made for 10 min.

L. Operation protection

3-digit programmable password.

M) Intrinsic safety

- ATEX : EEx ib [ia] IIC T4 for Ta -10 to 55 °C
EEx ib [ia] IIC T6 for Ta -10 to 40 °C
 II 2 (1) G KEMA 05ATEX1125

- CSA : Ex ia CL I, DIV 1, GP ABCD,
T4 for Ta -10 to 55 °C
T6 for Ta -10 to 40 °C
 Refer to Installation Drawing
ISC202S CSA

- FM : IS CL I, DIV 1, GP ABCD
T4 for Ta -10 to 55 °C
T6 for Ta -10 to 40 °C
 HAZ LOC per Control Drawing
FF1-ISC202S-00

N) Non-Incendive

- FM : NI CL I, DIV 2, GP ABCD
T4 for Ta -10 to 55 °C
T6 for Ta -10 to 40 °C
 HAZ LOC per Control Drawing
FF1-ISC202S-00

- CSA : NI CL I, DIV 2, GP ABCD
T4 for Ta -10 to 55 °C
T6 for Ta -10 to 40 °C
 Refer to Installation Drawing
ISC202S CSA

- ATEX : EEx nA [L] IIC T4 for Ta -10 to 55 °C
EEx nA [L] IIC T6 for Ta -10 to 40 °C
 II 3 G KEMA 05ATEX1127

O. Regulatory compliance

- EMC: meets council directive 89/336/EEC
- Emission: meets EN 55022 Class A
- Immunity: meets IEC 61326

Note: Due to the very sensitive input circuitry the measurement accuracy can be affected by strong EM fields. Therefore extra attention should be paid to the installation of the instrument.

P. DD specification

The DO202 Device Description is available enabling communications.

2-3. MODEL AND SUFFIX CODES

Model	Suffix code	Option code	Description
DO202G (S)			Dissolved Oxygen Transmitter, General Purpose version
Type	-A -F -N -B -D -P		Milli-amp (+HART®) version FOUNDATION® Fieldbus version Non-incendive Milli-amp (+HART®) version Non-incendive FOUNDATION® Fieldbus version Non-incendive Profibus PA Version Profibus PA Version
	-E		Always E
Options		/H /U /SCT /Q	Hood for Sun Protection Pipe & Wall mounting hardware Stainless steel tagplate Calibration certificate

3. Installation And Wiring

3-1. Installation and dimensions

3-1-1. Installation site

The EXA converter is weatherproof and can be installed inside or outside. It should, however, be installed as close as possible to the sensor to avoid long cable runs between sensor and converter. In any case, the cable length should not exceed 30 mtr (100 feet).

Select an installation site where:

- Mechanical vibrations and shocks are negligible
- No relay/power switches or RF transmitters are in the direct environment
- Access is possible to the cable glands (figure 3-1)
- The transmitter is not mounted in direct sunlight or severe weather conditions
- Maintenance procedures are possible (avoiding corrosive environments)

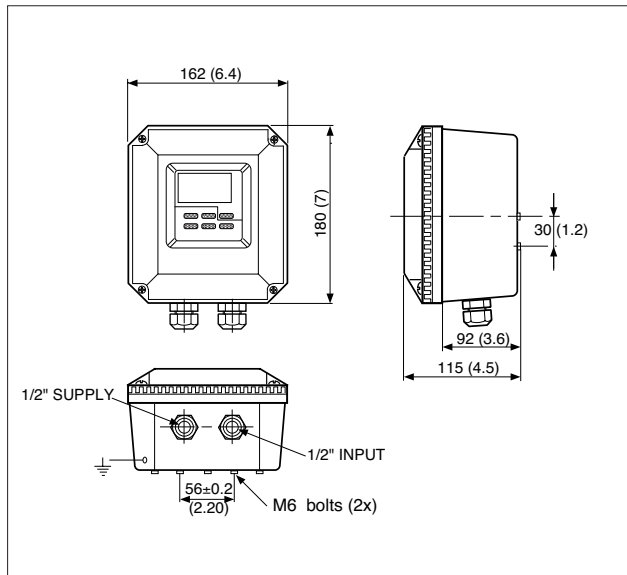


Figure 3-1. Housing dimensions and layout of glands

The ambient temperature and humidity of the installation environment must be within the limits of the instrument specifications. (See chapter 2).

3-1-2. Mounting methods

Refer to figures 3-2 and 3-3. Note that the EXA converter has universal mounting capabilities:

- Panel mounting using two (2) self-tapping screws
- Surface mounting on a plate (using bolts from the back)
- Wall mounting on a bracket (for example, on a solid wall)
- Pipe mounting using a bracket on a horizontal or vertical pipe (maximum pipe diameter 50 mm)

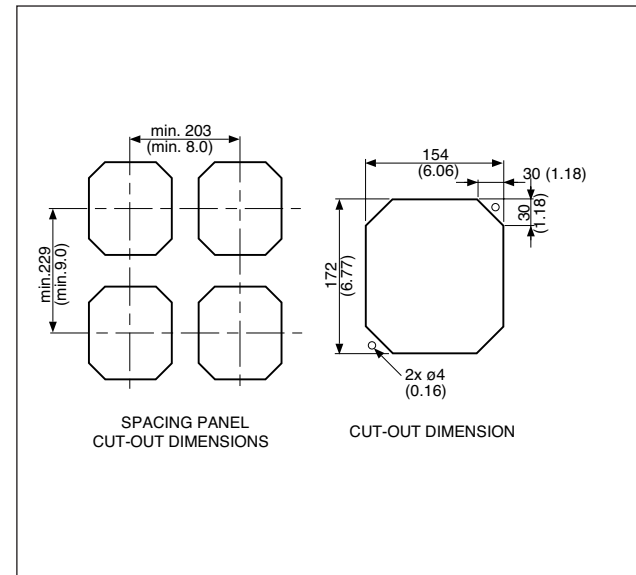


Figure 3-2. Panel mounting diagram

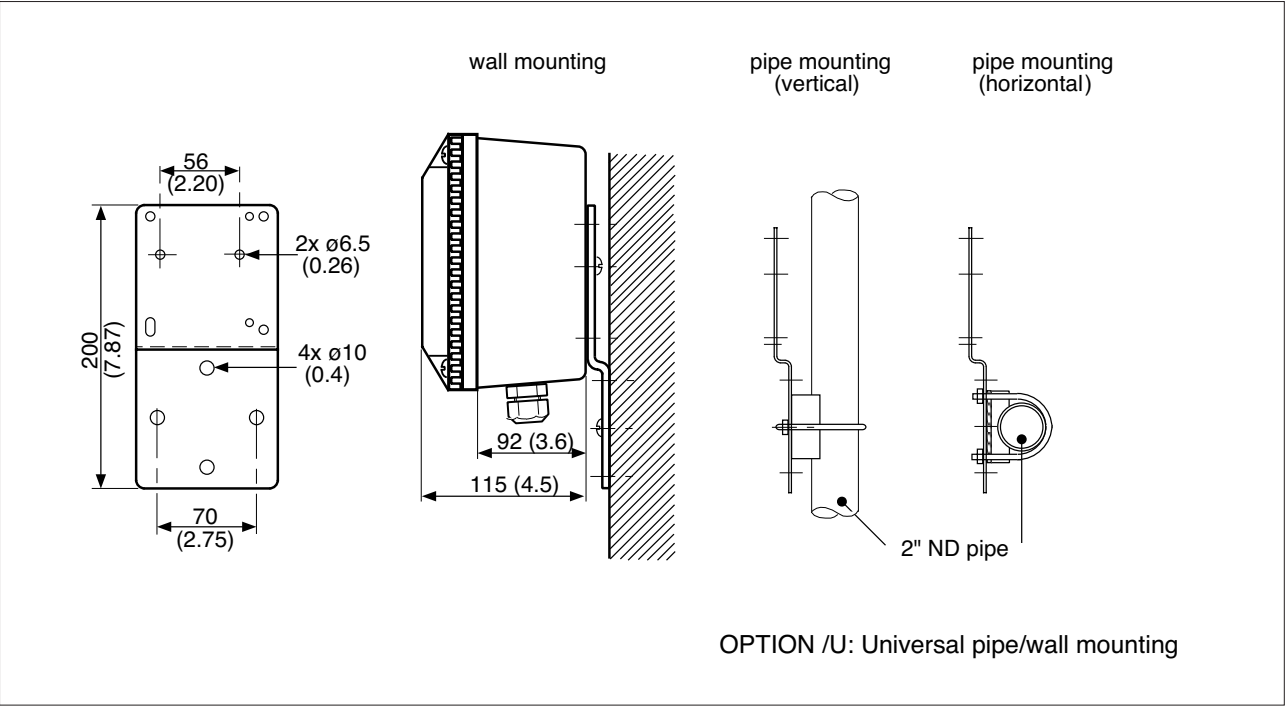


Figure 3-3. Wall and pipe mounting diagram

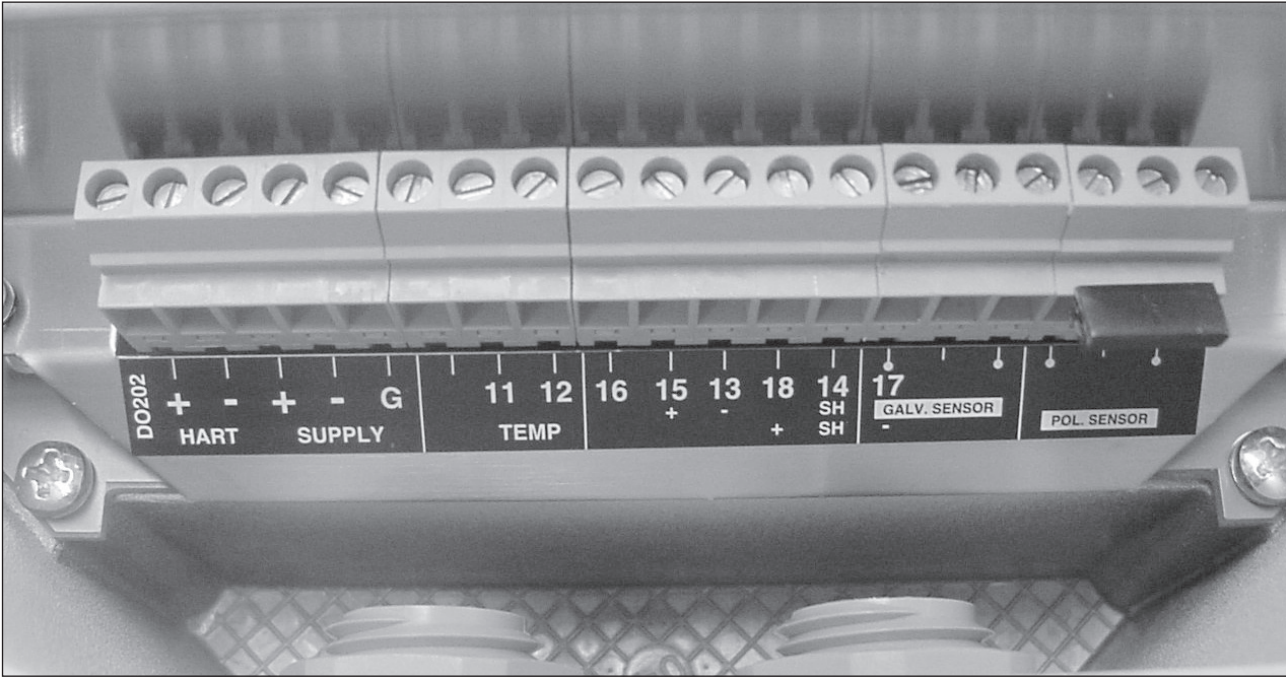


Figure 3-4. Internal view of EXA wiring compartment

3-2. Wiring of power supply

mA 3-2-1. General precautions

Do not activate the power supply yet. First make sure that the DC-power supply is according to the specifications given.

WARNING

DO NOT USE ALTERNATING CURRENT OR MAINS POWER SUPPLY! !

The cable leading to the distributor (power supply) or safety barrier transports power to and output signal from the transmitter. Use a two conductor shielded cable with a size of at least 1.25 mm² and an outside diameter of 7 to 12 mm. The cable gland supplied with the instrument accepts these diameters. The maximum length of the cable is 2000 metre, or 1500 metres when using the communications. This ensures the minimum operating voltage for the instrument.

Grounding:

- If the transmitter is mounted on a grounded surface (e.g. a metal frame fixed in the soil) the shield of the 2-wire cable may NOT be connected to ground at the distributor.
- If the transmitter is mounted on a non-conducting surface (e.g. a brick wall) it is recommended to ground the shield of the 2-wire cable at the distributor end.

mA 3-2-2. Connection of the power supply

The terminal strip is accessed as was described in section 3-2-1. Use the left-hand gland to insert the supply/output cable to the transmitter. Connect the supply to the terminals marked +, - and G as is indicated in figures 3-8.

3-2-3. Switching the instrument on

After all connections are made and checked, the power can be switched on from the distributor. Observe the correct activation of the instrument at the display. If for any reason the display does not indicate a value, consult the trouble shooting section.

mA 3-2-4. Preparation

Refer to figure 3-4. The power/output connections and the sensor connections should be made in accordance with the diagram on page 15. The terminals are of a plug in style for ease of mounting.

To open the EXA 202 for wiring:

1. Loosen the four frontplate screws and remove the cover.
2. The terminal strip is now visible.
3. Connect the power supply. Use the gland on the left for this cable.
4. Connect the sensor input, using the gland on the right (see fig. 3-5). Switch on the power.

Commission the instrument as required or use the default settings.

5. Replace the cover and secure frontplate with the four screws.
6. Connect the grounding terminals to protective earth.
7. The optional hose connection is used to guide the cables coming from an immersion fitting through a protective plastic tubing to the transmitter.

3-2-5. Cables, terminals and glands

The DO202 is equipped with terminals suitable for the connection of finished cables in the size range: 0.13 to 2.5 mm (26 to 14 AWG). The glands will form a tight seal on cables with an outside diameter in the range of 7 to 12 mm (9/32 to 15/32 inches).

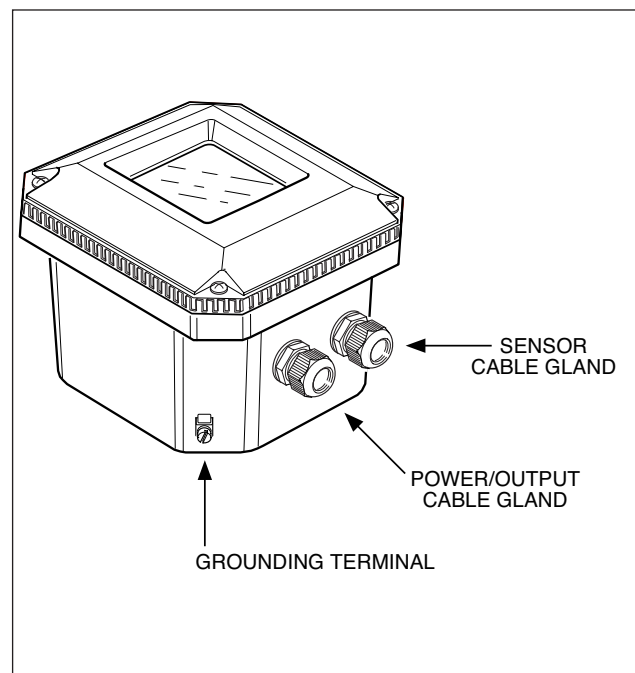


Figure 3-5. Glands to be used for cabling

3-3. Wiring of sensors

3-3-1. Wiring the standard galvanic sensor

The sensor cable has markers on the individual wires. These markings refer to the markers on the terminals.

The temperature sensor has two wires with the markings T1, T2 and/or 11, 12 and must be connected to terminal 11 and 12.

The measuring electrode: the cathode is marked with IE and/or 13 and must be connected to terminal 13. The reference electrode: the anode is marked with RE and/or 15 and must be connected to terminal 15. The liquid earth (solution ground) is marked with 16 and must be connected to terminal 16. The overall shield of the cable is marked with 14 and must be connected to terminal 14. Place the jumper in the GALVANIC position.

3-3-2. Wiring other galvanic sensors

Consult the users manual for the color identification of the sensor cable.

- The temperature sensor has two wires and must be connected to the terminal 11 and 12.
- The measuring electrode: the cathode must be connected to terminal 13.
- The reference electrode: the anode must be connected to terminal 15.
- The overall shield of the cable must be connected to terminal 14 if there is one available.
- Place the jumper in the GALVANIC position.

3-3-3. Wiring polarographic sensors

Consult the owners manual for the color identification of the sensor cable.

- The temperature sensor has two wires and must be connected to the terminal 11 and 12.
- The measuring electrode: the cathode must be connected to terminal 17.
- The reference electrode: the anode must be connected to terminal 18.
- The overall shield of the cable must be connected to terminal 14 if there is one available.
- Place the jumper in the POLAROGRAPHIC position.

3-3-4. Wiring sensors with Vp connector

Consult the owners manual for the color identification of the sensor cable.

- The temperature sensor has two wires and must be connected to terminal 11 and 12
- Polarographic : the measuring electrode (cathode) must be connected to terminal 17
- Polarographic : the reference electrode (anode) must be connected to terminal 18
- Galvanic : the measuring electrode (cathode) must be connected to terminal 13
- Galvanic : the reference electrode (anode) must be connected to terminal 15
- The overall shield of the cable must be connected to 14
- Place the jumper in the Polarographic or Galvanic position

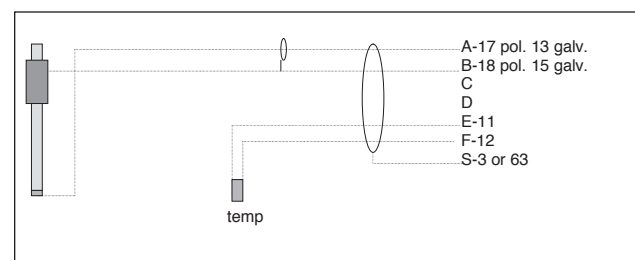


Figure 3-6. Connections DO

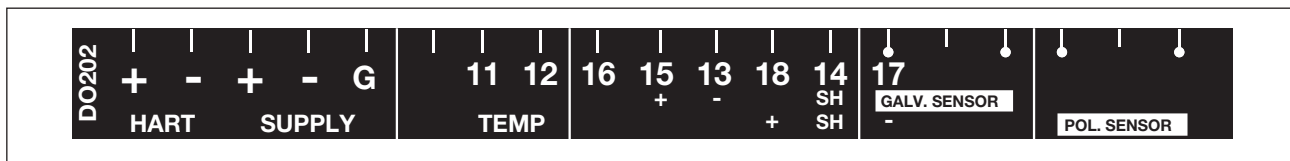


Figure 3-7. Terminal identification labels

3-3-5. Sensor cable connections using junction box (BA10) and extension cable (WF10)

Where a convenient installation is not possible using the standard cables between sensors and transmitter, a junction box and extension cable may be used. The Yokogawa BA10 junction box and the WF10 extension cable should be used. These items are manufactured to a very high standard and are necessary to ensure that the specifications of the

system are not compromised. The total cable length should not exceed 60 metres (e.g. 5 m fixed cable and 55 m extension cable).

Note: 17 of both WF10 and BA10 do not need to be used.

Note: See page 3-10 for termination for WF10 cable in combination with EXA SC

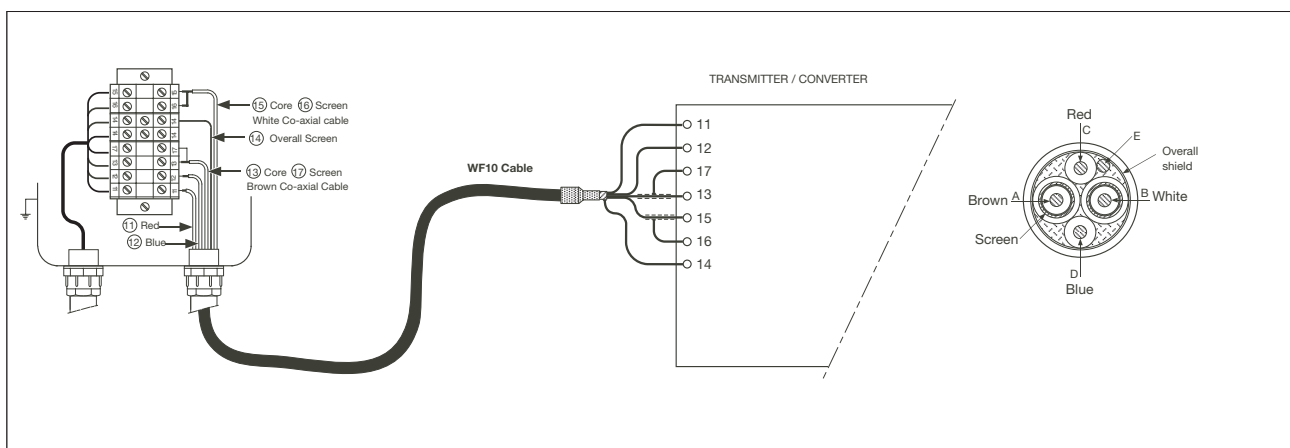


Fig. 3-8. Connection of WF10 extension cable and BA10/BP10 junction box

Extension cable may be purchased in bulk quantities, cut to length. Then it is necessary to terminate the cable as shown below.

Termination procedure for WF10 cable.

1. Slide 3 cm of heat shrink tube (9 x 1.5) over the cable end to be terminated.
2. Strip 9 cm of the outer (black) insulating material, taking care not to cut or damage internal cores.

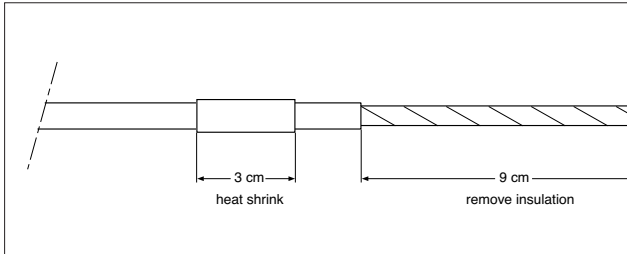


Figure 3-9a.

3. Remove loose copper screening, and cut off the cotton packing threads as short as possible.
4. Strip insulation from the last 3 cm of the brown, and the white coaxial cores.

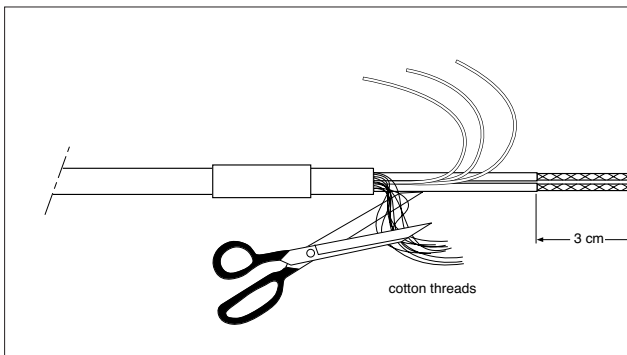


Figure 3-9b.

5. Extract the coaxial cores from the braid, and trim off the black (low-noise) screening material as short as possible.
6. Insulate the overall screen and drain wire (14) and the 2 coaxial screens with suitable plastic tubing.
7. Strip and terminate all ends with suitable (crimp) terminals and identify with numbers as shown.

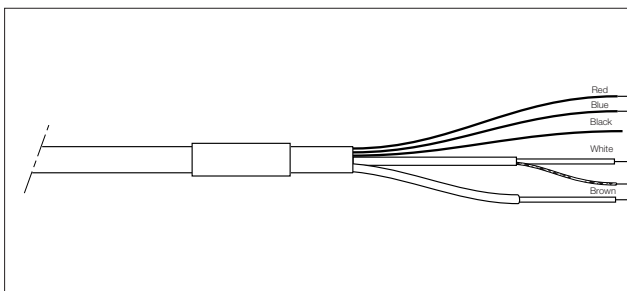


Figure 3-9c.

8. Finally shrink the overall heat shrink tube into position.

3-3-6. Additional precautions for installations in hazardous areas

Make sure that the total of capacitances and inductances connected to the input terminals of the EXA DO202S do not exceed the limits given in the certificate.

This sets a limit to the cable and extensions used.

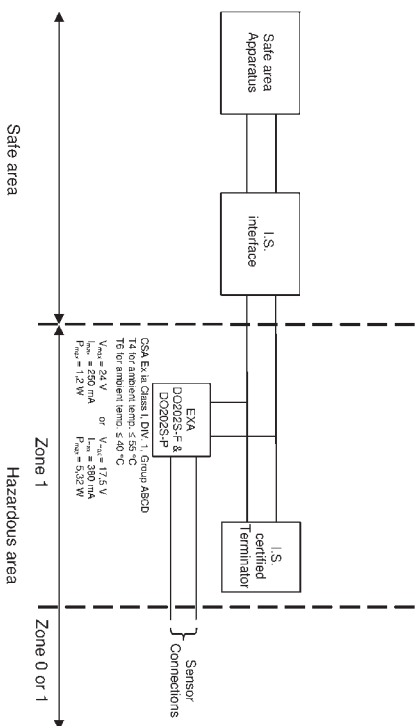
- The intrinsic safe version of the DO202S instrument can be mounted in Zone 1.
- The sensors can be installed in Zone 0 or Zone 1 if a safety barrier according to the limits given in the system certificate is used.
- Ensure that the total of capacitances and inductances connected to the terminals of the EXA DO202S do not exceed the limits given in the certificate of the safety barrier or distributor.
- The cable used should preferably have a BLUE colour or marking on the outside.
- Installation for (sensors in Zone 0 or 1):
Generally, the distributor with input/output isolation has no external earth connection. If there is an earth connection on the distributor and the external connection of the transmitter is connected to “protective” earth, the shield of the 2-wire cable may NOT be connected to “protective” earth at the distributor too.

3-3-7. Installation in: Hazardous Area-Non-Incendive

The EXA DO202S-N may be installed in a Category 3/ Zone 2/ Div.2 area without the use of safety barriers. Maximum permissible supply voltage 31.5V

2J6C3-E-E

Intrinsically safe design CSA: Ex ia Class I, Div.1, Group A,B,C,D. T4 for ambient temp. $\leq 55^{\circ}\text{C}$ T6 for ambient temp. $\leq 40^{\circ}\text{C}$ (HAFT compatible) EXA DO202S analyzer Sensor terminals 11-18 CSA certified power supply (HAFT compatible) 24 VDC Nominal Supply Voltage Excess current protection Excess voltage protection Excess power protection Excess temperature protection Excess pressure protection Excess flow protection Excess level protection Excess density protection Excess viscosity protection Excess conductivity protection Excess resistivity protection Excess pH protection Excess ORP protection Excess DO protection Excess CO₂ protection Excess O₂ protection Excess H₂ protection Excess CH₄ protection Excess C₂H₆ protection Excess C₃H₈ protection Excess C₄H₁₀ protection Excess C₅H₁₂ protection Excess C₆H₁₄ protection Excess C₇H₁₆ protection Excess C₈H₁₈ protection Excess C₉H₂₀ protection Excess C₁₀H₂₂ protection Excess C₁₁H₂₄ protection Excess C₁₂H₂₆ protection Excess C₁₃H₂₈ protection Excess C₁₄H₃₀ protection Excess C₁₅H₃₂ protection Excess C₁₆H₃₄ protection Excess C₁₇H₃₆ protection Excess C₁₈H₃₈ protection Excess C₁₉H₄₀ protection Excess C₂₀H₄₂ protection Excess C₂₁H₄₄ protection Excess C₂₂H₄₆ protection Excess C₂₃H₄₈ protection Excess C₂₄H₅₀ protection Excess C₂₅H₅₂ protection Excess C₂₆H₅₄ protection Excess C₂₇H₅₆ protection Excess C₂₈H₅₈ protection Excess C₂₉H₆₀ protection Excess C₃₀H₆₂ protection Excess C₃₁H₆₄ protection Excess C₃₂H₆₆ protection Excess C₃₃H₆₈ protection Excess C₃₄H₇₀ protection Excess C₃₅H₇₂ protection Excess C₃₆H₇₄ protection Excess C₃₇H₇₆ protection Excess C₃₈H₇₈ protection Excess C₃₉H₈₀ protection Excess C₄₀H₈₂ protection Excess C₄₁H₈₄ protection Excess C₄₂H₈₆ protection Excess C₄₃H₈₈ protection Excess C₄₄H₉₀ protection Excess C₄₅H₉₂ protection Excess C₄₆H₉₄ protection Excess C₄₇H₉₆ protection Excess C₄₈H₉₈ protection Excess C₄₉H₁₀₀ protection Excess C₅₀H₁₀₂ protection Excess C₅₁H₁₀₄ protection Excess C₅₂H₁₀₆ protection Excess C₅₃H₁₀₈ protection Excess C₅₄H₁₁₀ protection Excess C₅₅H₁₁₂ protection Excess C₅₆H₁₁₄ protection Excess C₅₇H₁₁₆ protection Excess C₅₈H₁₁₈ protection Excess C₅₉H₁₂₀ protection Excess C₆₀H₁₂₂ protection Excess C₆₁H₁₂₄ protection Excess C₆₂H₁₂₆ protection Excess C₆₃H₁₂₈ protection Excess C₆₄H₁₃₀ protection Excess C₆₅H₁₃₂ protection Excess C₆₆H₁₃₄ protection Excess C₆₇H₁₃₆ protection Excess C₆₈H₁₃₈ protection Excess C₆₉H₁₄₀ protection Excess C₇₀H₁₄₂ protection Excess C₇₁H₁₄₄ protection Excess C₇₂H₁₄₆ protection Excess C₇₃H₁₄₈ protection Excess C₇₄H₁₅₀ protection Excess C₇₅H₁₅₂ protection Excess C₇₆H₁₅₄ protection Excess C₇₇H₁₅₆ protection Excess C₇₈H₁₅₈ protection Excess C₇₉H₁₆₀ protection Excess C₈₀H₁₆₂ protection Excess C₈₁H₁₆₄ protection Excess C₈₂H₁₆₆ protection Excess C₈₃H₁₆₈ protection Excess C₈₄H₁₇₀ protection Excess C₈₅H₁₇₂ protection Excess C₈₆H₁₇₄ protection Excess C₈₇H₁₇₆ protection Excess C₈₈H₁₇₈ protection Excess C₈₉H₁₈₀ protection Excess C₉₀H₁₈₂ protection Excess C₉₁H₁₈₄ protection Excess C₉₂H₁₈₆ protection Excess C₉₃H₁₈₈ protection Excess C₉₄H₁₉₀ protection Excess C₉₅H₁₉₂ protection Excess C₉₆H₁₉₄ protection Excess C₉₇H₁₉₆ protection Excess C₉₈H₁₉₈ protection Excess C₉₉H₂₀₀ protection Excess C₁₀₀H₂₀₂ protection Excess C₁₀₁H₂₀₄ protection Excess C₁₀₂H₂₀₆ protection Excess C₁₀₃H₂₀₈ protection Excess C₁₀₄H₂₁₀ protection Excess C₁₀₅H₂₁₂ protection Excess C₁₀₆H₂₁₄ protection Excess C₁₀₇H₂₁₆ protection Excess C₁₀₈H₂₁₈ protection Excess C₁₀₉H₂₂₀ protection Excess C₁₁₀H₂₂₂ protection Excess C₁₁₁H₂₂₄ protection Excess C₁₁₂H₂₂₆ protection Excess C₁₁₃H₂₂₈ protection Excess C₁₁₄H₂₃₀ protection Excess C₁₁₅H₂₃₂ protection Excess C₁₁₆H₂₃₄ protection Excess C₁₁₇H₂₃₆ protection Excess C₁₁₈H₂₃₈ protection Excess C₁₁₉H₂₄₀ protection Excess C₁₂₀H₂₄₂ protection Excess C₁₂₁H₂₄₄ protection Excess C₁₂₂H₂₄₆ protection Excess C₁₂₃H₂₄₈ protection Excess C₁₂₄H₂₅₀ protection Excess C₁₂₅H₂₅₂ protection Excess C₁₂₆H₂₅₄ protection Excess C₁₂₇H₂₅₆ protection Excess C₁₂₈H₂₅₈ protection Excess C₁₂₉H₂₆₀ protection Excess C₁₃₀H₂₆₂ protection Excess C₁₃₁H₂₆₄ protection Excess C₁₃₂H₂₆₆ protection Excess C₁₃₃H₂₆₈ protection Excess C₁₃₄H₂₇₀ protection Excess C₁₃₅H₂₇₂ protection Excess C₁₃₆H₂₇₄ protection Excess C₁₃₇H₂₇₆ protection Excess C₁₃₈H₂₇₈ protection Excess C₁₃₉H₂₈₀ protection Excess C₁₄₀H₂₈₂ protection Excess C₁₄₁H₂₈₄ protection Excess C₁₄₂H₂₈₆ protection Excess C₁₄₃H₂₈₈ protection Excess C₁₄₄H₂



- Sensor(s) are a thermocouple, RTD(s), passive resistive switch devices, or is CSA entity approved and meet connection requirements.
- Electrical data of the EXA DOQ202S-F & DOQ202S-P :
 - Supply and output circuit:

Maximum input voltage $V_{max}=24\text{ V}$	or	Maximum input voltage $V_{max}=17.5\text{ V}$
Maximum input current $I_{max}=250\text{ mA}$		Maximum input current $I_{max}=380\text{ mA}$
Maximum input power $P_{max}=1.2\text{ W}$		Maximum input power $P_{max}=1.5\text{ W}$

Effective internal capacitance $C_i = 737$ pF; Effective internal inductance $L_i = 2.6$ μ H.

Sensor input circuit:

- Any CSA approved J.S. interface may be used that meets the following requirements:

Maximum output voltage $V_{oc} \leq 14.4$ V	Maximum output current $I_{sc} \leq 22$ mA
Maximum allowed external capacitance $C_e \leq 659$ nF	
Maximum allowed external inductance $L_e \leq 70$ mH	
$V_{max} \leq 24$ V	or
$V_{max} \leq 17.5$ V	
$I_{max} \leq 250$ mA	$I_{max} \leq 360$ mA
$P_{max} \leq 1.2$ W	$P_{max} \leq 5.32$ W

$$C_a \geq 737 \text{ pF} + C_{\text{cable}}; L_a \geq 2.6 \text{ }\mu\text{H} + L_{\text{cable}}$$

Installation should be in accordance with Canadian Electrical Code, Part I or CEC, Part I. Maximum safe area voltage should not exceed 250 Vrms.

For Class I, Div. 2, Group ABCD the CSA approved I.S. interface is not required, and the sensor input circuit is non-incendive having the parameters:

Maximum output voltage $V_{oc}=14\text{ V}$; Maximum output current $I_{sc}=22\text{ mA}$
Maximum allowed external capacitance $C_a=1.4\text{ }\mu\text{F}$
Maximum allowed external inductance $L_a=180\text{ mH}$

Stamp Company :	Stamp Certification Institute :
Safe area Hazardous area Zone 1 Zone 0 or 1 Safe area Apparatus I.S. interface I.S. certified Terminator EXA DO202S-F 8 DO202S-P Sensor Connections CSA E-14, Class I Div. 1, Group ABCD T4 for ambient temp. ≤ 55 °C T5 for ambient temp. ≤ 40 °C V_{max} = 24 V or V_{max} = 17,5 V I_{max} = 380 mA I_{max} = 380 mA P_{max} = 5,32 W P_{max} = 5,32 W	Signature : Remarks : Model EXA DO202S-F Model EXA DO202S-B Model EXA DO202S-P Model EXA DO202S-D
- Sensor(s) are a thermocouple, RTD's, passive resistive switch devices, or is CSA entity approved and meet connection requirements. - Electrical data of the EXA DO202S-F & DO202S-P : - Supply and output circuit: - Maximum input voltage V_{max}=24 V or Maximum input voltage V_{max}=17,5 V - Maximum input current I_{max}=250 mA Maximum input current I_{max}=380 mA - Maximum input power P_{max}=1,2 W Maximum input power P_{max}=5,32 W - Effective internal capacitance C_i=737 pF; Effective internal inductance L_i=2,6 μH. - Sensor input circuit: - Maximum output voltage Voc=14,4 V; Maximum output current I_{sc}=22 mA - Maximum allowed external capacitance Ca=659 nF - Maximum allowed external inductance La=70 mH - Any CSA approved I.S. interface may be used that meets the following requirements: - V_{max} ≤ 24 V or V_{max} ≤ 17,5 V - I_{max} ≤ 250 mA I_{max} ≤ 380 mA - P_{max} ≤ 1,2 W P_{max} ≤ 5,32 W - Ca ≥ 737 pF + C_{cable}; La ≥ 2,6 μH + L_{cable} Installation should be in accordance with Canadian Electrical Code, Part I or CEC, Part I. Maximum safe area voltage should not exceed 250 Vrms. For Class I, Div. 2, Group ABCD the CSA approved I.S. interface is not required, and the sensor input circuit is non-incendive having the parameters: Maximum output voltage Voc=14,4 V; Maximum output current I_{sc}=22 mA Maximum allowed external capacitance Ca=1,4 μF Maximum allowed external inductance La=180 mH	Title : Installation Drawing DO202S CSA Number : FF1-DO202S-00 Page : 4 of 10 Revision : 1.0 Date : 31/01/2005 YOKOGAWA EUROPE B.V.

Stamp Company :	Stamp Certification Institute :
Signature :	Remarks : Model EXA DO202S-A No revision to drawing without prior FM Approval
Title : FM Control Drawing DO202S-A (Intrinsic Safety)	
Number : FF1-DO202S-00	Page : 5 of 10
YOKOGAWA EUROPE B.V.	Revision : 1.0
	Date : 17/08/2005

Intentionally safe design FM Class I, Div.2, Group ABCD. EXA DO202S analyzer T4 for ambient temp. < 55°C T16 for ambient temp. < 60°C FM Approved power supply $V_{AC} \leq 51.5 \text{ VAC}$	Stamp Company : Stamp Certification Institute :
Intentionally safe design FM Class I, Div.2, Group ABCD. EXA DO202S analyzer T4 for ambient temp. < 55°C T16 for ambient temp. < 60°C FM Approved power supply $V_{AC} \leq 51.5 \text{ VAC}$	Signature : Remarks : Model EXA DO202S-N No revision to drawing without prior FM Approval
Electrical data of the EXA DO202S : - Supply circuit (terminals + and -): Maximum input voltage $V_{max} = 31.5 \text{ V}$. Maximum input power $P_i = 1.2 \text{ W}$ Effective internal capacitance $C_i = 220 \text{ pF}$ Effective internal inductance $L_i = 0 \text{ } \mu\text{H}$ - Sensor input circuit (terminals 11 through 18): Maximum output voltage $V_o = 14.4 \text{ V}$. Maximum output current $I_o = 22 \text{ mA}$. Maximum allowed external capacitance $C_a = 3.5 \text{ } \mu\text{F}$. Maximum allowed external inductance $L_a = 170 \text{ mH}$. The Hand Held Terminal must be FM Approved in case it is used in the classified location. When installing this equipment, follow the manufacturers installation drawing. Installation shall be in accordance with Article 501.4(B) of the National Electrical Code (ANSI/NFPA 79). Nonincendive field wiring may be installed in accordance with Article 501.4(B)(3). Grounding shall be in accordance with Article 250 of the National Electrical code WARNING - Substitution of components may impair suitability for Division 2 - Do not remove or replace while circuit is live unless area is know to be non-hazardous - Explosion Hazard – Do not disconnect equipment unless area is know to be non-hazardous - Do not reset circuit breaker unless power has been removed from the equipment or the area is know to be non-hazardous	Title : FM Control Drawing DO202S-N (Non-incendive) Number : FF1-DO202S-00 Page : 6 of 10 Revision : 1.0 YOKOGAWA EUROPE B.V. Date : 17/08/2005

Stamp Company :	Stamp Certification Institute :
Signature :	Remarks : Model EXA DO202S-F Model EXA DO202S-P No revision to drawing without prior FM Approval
Title : FM Control Drawing DO202S-F & DO202S-P (Intrinsic safe Fisco concept)	
Number : FF1-DO202S-00	Page : 7 of 10
Revision : 1.0	
Date : 17/08/2005	
YOKOGAWA EUROPE B.V.	

Stamp Company :	Stamp Certification Institute :
The diagram illustrates the installation of the EXA DO2025-F & DO2025-P system. It is divided into two sections by a vertical dashed line labeled 'Division 1'. Unclassified Location: Contains the 'FM Approved barrier' with specifications: $V_{oc} (V) \leq 24$ V, $I_{oc} (A) \leq 250$ mA, $P_{oc} (W) \leq 1,2$ W, $C_a \geq 737$ pF + C_{cable}, and $L_a \geq 2,6$ μH + L_{cable}. Classified Location: Contains the 'EXA DO2025-F & DO2025-P' sensor and an 'I.S. certified terminator'. The sensor has specifications: $V_{oc} (V) \leq 24$ V, $I_{oc} (A) \leq 250$ mA, $P_{oc} (W) \leq 1,2$ W, $C_a \geq 737$ pF + C_{cable}, and $L_a \geq 2,6$ μH + L_{cable}. The terminator has specifications: $V_{oc} (V) \leq 24$ V, $I_{oc} (A) \leq 250$ mA, $P_{oc} (W) \leq 1,2$ W, $C_a \geq 737$ pF + C_{cable}, and $L_a \geq 2,6$ μH + L_{cable}. Additional specifications for the EXA DO2025-F & DO2025-P sensor include: Maximum input voltage $V_{max}=24$ V, Maximum input current $I_{max}=250$ mA, Maximum input power $P_i=1,2$ W, Effective internal capacitance $C_i=737$ pF, Effective internal inductance $L_i=2,6$ μH, Maximum output voltage $V_o=14,4$ V, Maximum output current $I_o=22$ mA, Maximum output power $P_o=187$ mW, Maximum allowed external capacitance $C_a=659$ nF, Maximum allowed external inductance $L_a=70$ mH, and Any FM Approved barrier may be used that meets the following requirements: - Any FM Approved barrier may be used that meets the following requirements: - Resistance between Intrinsically Safe Ground and earth ground must be less than 1.0 Ohm. WARNING - Substitution of components may impair Intrinsic Safety - To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing or read, understand and adhere to the manufacturer's live maintenance procedures.	Signature : Remarks : Model EXA DO2025-F Model EXA DO2025-P No revision to drawing without prior FM Approval
YOKOGAWA EUROPE B.V.	Title : FM Control Drawing DO2025-F & DO2025-P (Intrinsic safe Entity concept) Number : FF1-DO2025-00 Page : 8 of 10 Revision : 1.0 Date : 17/08/2005

FM Approved Power Supply Voc ≤ 32 VDC FM Approved Terminator R = 50.1kΩ C = 0.2/2 μF EXA DO202S-B & DO202S-D Sensor Connections Max. cablelength: 50 mtr, Cable dia.: 3...12 mm. FM Class I, Div. 2, Group ABCD Ta for ambient temp. < 55 °C Tb for ambient temp. ≤ 40 °C Unclassified Location Division 2 Classified Location • Sensor(s) are of a passive type to be regarded as 'simple apparatus', devices which neither store nor generate voltages over 1.5 V, currents over 0.1 A, power over 25 mW or energy over 20 μJ, or are FM Approvals entity approved and meet connection requirements. • Electrical data of the EXA DO202S-B & DO202S-D : - Supply circuit: Vmax=32 V; Pi=5.32 W; Ci= 737 pF; Li= 2.6 μH - Sensor input circuit: Vi=14.4 V; Ii=22 mA; Ca=3.5 μF; La= 170 mH When installing this equipment, follow the manufacturers installation drawing. Installation shall be in accordance with Article 501.4(B) of the National Electrical Code (ANSI/NFPA 79). Nonincendive field wiring may be installed in accordance with Article 501.4(B)(3). • Grounding shall be in accordance with Article 250 of the National Electrical code. WARNING - Substitution of components may impair suitability for Division 2. - Do not remove or replace while circuit is live unless area is know to be non-hazardous - Explosion Hazard – Do not disconnect equipment unless area is know to be non-hazardous - Do not reset circuit breaker unless power has been removed from the equipment or the area is know to be non-hazardous		Stamp Company : Stamp Certification Institute :
Signature :	Remarks : Model EXA DO202S-B Model EXA DO202S-D No revision to drawing without prior FM Approval	
Title : FM Control Drawing DO202S-B & DO202S-D (Non-incendive FNICO concept)		
Number : FF1-DO202S-00	Page : 9 of 10	
YOKOGAWA EUROPE B.V.		
	Revision : 1.0	
	Date : 17/08/2005	

FM Approved Power Supply Voc ≤ 32 VDC FM Approved Terminator R = 50.100Ω C = 0.2/2 μF EXA DO202S-B & DO202S-D Sensor Connections Max. cablelength: 50 mtr, Cable dia.: 3...12 mm. FM Class I, Div. 2, Group ABCD T4 for ambient temp. < 55 °C T5 for ambient temp. ≤ 60 °C Unclassified Location Division 2 Classified Location • Sensor(s) are of a passive type to be regarded as 'simple apparatus', devices which neither store nor generate voltages over 1.5 V, currents over 0.1 A, power over 25 mW or energy over 20 μJ, or are FM Approvals entity approved and meet connection requirements. • Electrical data of the EXA DO202S-B & DO202S-D : - Supply circuit: Vmax=32 V; P=1.2 W; Ci= 737 pF; Li= 2.6 μH - Sensor input circuit: Vi=14.4 V; Ii=22 mA; Ca=3.5 μF; La= 170 mH When installing this equipment, follow the manufacturer's installation drawing. Installation shall be in accordance with Article 501.4(B) of the National Electrical Code (ANSI/NFPA 79). Nonincendive field wiring may be installed in accordance with Article 501.4(B)(3). Grounding shall be in accordance with Article 250 of the National Electrical code. WARNING - Substitution of components may impair suitability for Division 2. - Do not remove or replace while circuit is live unless area is know to be non-hazardous - Explosion Hazard – Do not disconnect equipment unless area is know to be non-hazardous - Do not reset circuit breaker unless power has been removed from the equipment or the area is know to be non-hazardous	
Stamp Company :	Stamp Certification Institute :
Signature :	Remarks : Model EXA DO202S-B Model EXA DO202S-D No revision to drawing without prior FM Approval
Title : FM Control Drawing DO202S-B & DO202S-D (Non-incendive Entity concept)	
Number : FF1-DO202S-00	Page : 10 of 10
YOKOGAWA EUROPE B.V.	
	Revision : 1.0
	Date : 31/01/2005

4. Operation; Display Functions And Setting

4-1. Operator interface

This section provides a survey of the operation of the EXA operator interface. The basic procedures for obtaining access to the three levels of operation are described briefly. For a step-by-step guide to data entry, refer to the relevant section of this user’s manual. Figure 4-1 shows the EXA operator interface.

LEVEL 1: Maintenance

These functions are accessible by pushbutton through a flexible front cover window. The functions make up the normal day-to-day operations that an operator may be required to complete. Adjustment of the display and routine calibration are among the features accessible in this way. (See table 4-1).

LEVEL 2: Commissioning

A second menu is exposed when the EXA front cover is removed and the display board is revealed. Users gain access to this menu by pressing the button marked * in the lower right of the display board. This menu gives access to the service menu. (See table 4-1).

LEVEL 3: Service

For more advanced configuration selections, press the button marked *. Now push the “Yes” button. Selecting and entering “Service Code” numbers in the commissioning menu provide access to the more advanced functions. An explanation of the Service Codes is listed in chapter 5 and an overview table is shown in chapter 11.

Table 4-1. Operations overview

mA

	Routine		Function	Chapter
Maintenance	CALIB	AIR.CAL	Calibration in air (preferred method)	6
		H2O.CAL	Calibration in aeratid water	6
		SENS	Manual sensitivity calibration	6
		ZERO	Manual zero calibration	6
Commissioning	DISP		Read auxiliary data or set message display	4
	M.TEMP		Adjust manual temperature	5
	M.PRESS		Adjust manual pressure	5
	OUTPUT		Adjust the output range	5
Service (acces to coded entries from the commissioning level)	SET HOLD		Activate the hold function	5
	SERVICE		Fine tune the specialized functions of the transmitter	5

Note: All three levels may be separately protected by a password. See Service Code 52 in chapter 5 Service Code table for details on setting passwords.

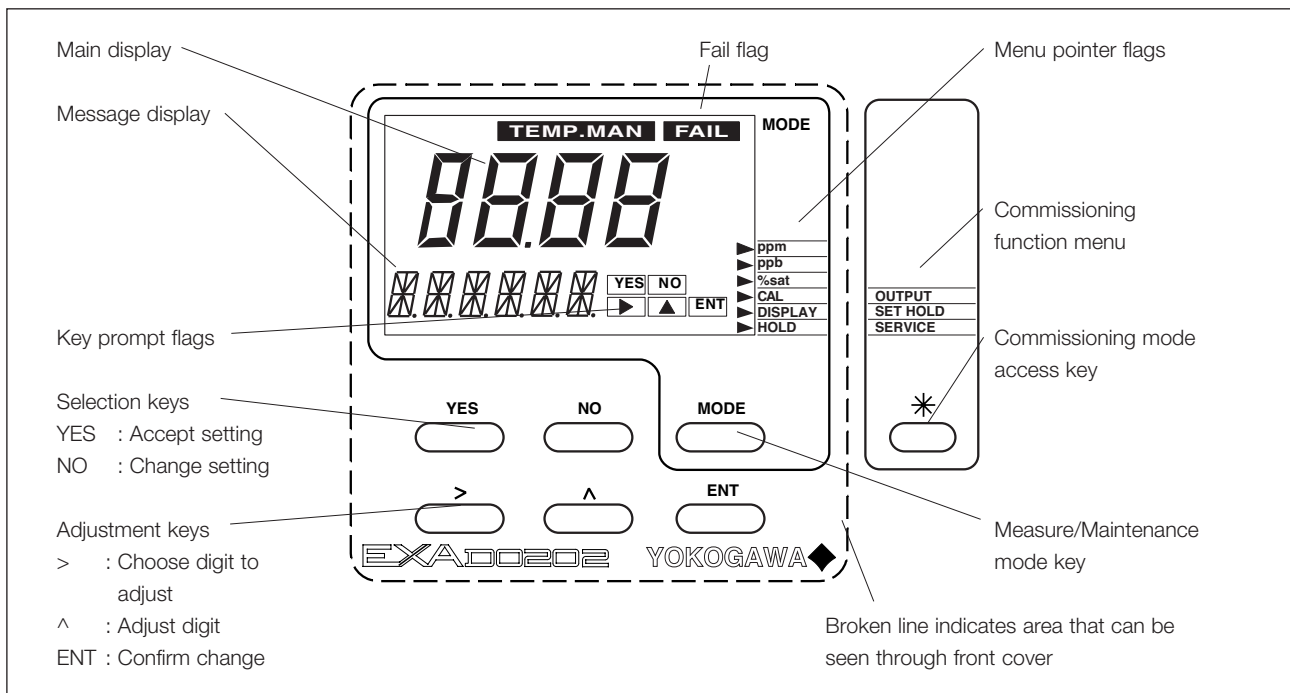


Figure 4-1. DO202 operator interface

4-2. Explanation of operating keys

MODE key

This key toggles between the measuring and maintenance modes. Press once to obtain access to the maintenance function menu.

CALIB

DISP

Press again to return to the measuring mode.

YES/NO keys

These are used to select choices from the menu.

YES is used to accept a menu selection.

NO is used to reject a selection, or to move ahead to the next option.

DATA ENTRY keys (▶ ▲ ENT)

▶ Is used as a "cursor" key. Each press on this key moves the cursor or flashing digit one place to the right. This is used to select the digit to be changed when entering numerical data.

▲ Is used to change the value of a selected digit. Each press on this key increases the value by one unit. The value can not be decreased, so in order to obtain a lower value, increase past nine to zero, then increase to the required number.

ENT When the required value has been set using the ▶ and ▲ keys, press ENT to confirm the data entry. Please note that the EXA does not register any change of data until the ENT key is pressed.

*key This is the commissioning mode key. It is used to obtain access to the commissioning menu.

ning menu. This can only be done with the cover removed or opened. Once this button has been used to initiate the commissioning menu, follow the prompts and use the other keys as described above.

4-3. Passcode protection

In Service Code 52, passcode protection can be set for each one of the three operating levels, individually. This procedure should be completed after the initial commissioning (setup) of the instrument. The passcodes should then be recorded safely for future reference.

When passcodes have been set, the following additional steps are introduced to the configuration and programming operations:

Maintenance

Press MODE key. The display shows 000 and *PASS* Enter a 3-digit passcode as set in Service Code 52 to obtain access to the Maintenance Mode.

Commissioning

Press *key. The display shows 000 and *PASS* Enter a 3-digit passcode as set in Service Code 52 to obtain access to the Commissioning Mode.

Service

From the commissioning menu, select *Service by pressing YES key. The display shows 000 and *PASS* Enter a 3-digit passcode as set in Service Code 52 to obtain access to the Service Mode.

Note: See Service Code 52 for the setting of passcodes.

4-4. Display examples

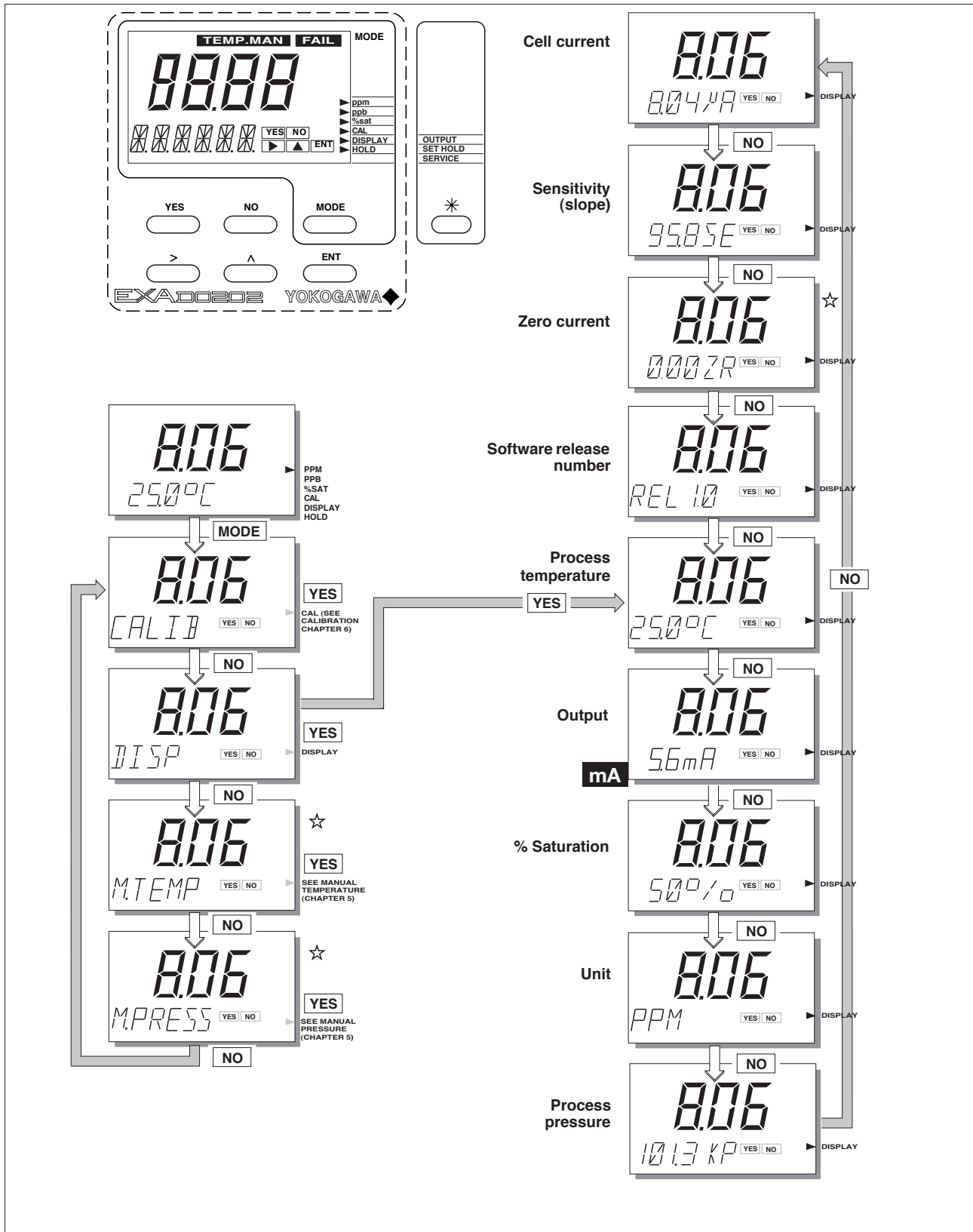
The following pages show the sequence of button presses and screens displayed when working in some standard configurations. More or less options will be made available by the configuration of

some service codes, or by choices made in the commissioning menu.

The following deviations are possible:

- * Item marked is omitted when switched off in commissioning mode.

4-5. Display function (default)



5. PARAMETER SETTING

5-1. Maintenance mode

Standard operation of the EXA instrument involves use of the maintenance (or operating) mode to set up some of the parameters.

Access to the maintenance mode is available via the six keys that can be pressed through the flexible window in the instrument cover. Press the MODE-key once to enter this dialog mode.

Note: At this stage the user will be prompted for pass code where this has been previously set up in service code 52 in chapter 5.

Calibration Air

See “calibration” section 6.

H₂O

See “calibration” section 6.

Sensitivity

See “calibration” section 6.

Zero

See “calibration” section 6.

mA Hold

Manually switch on/off “hold” (when enabled in commissioning menu). See adjustment procedure 5-2-2.

Display

See “operation” section 4.

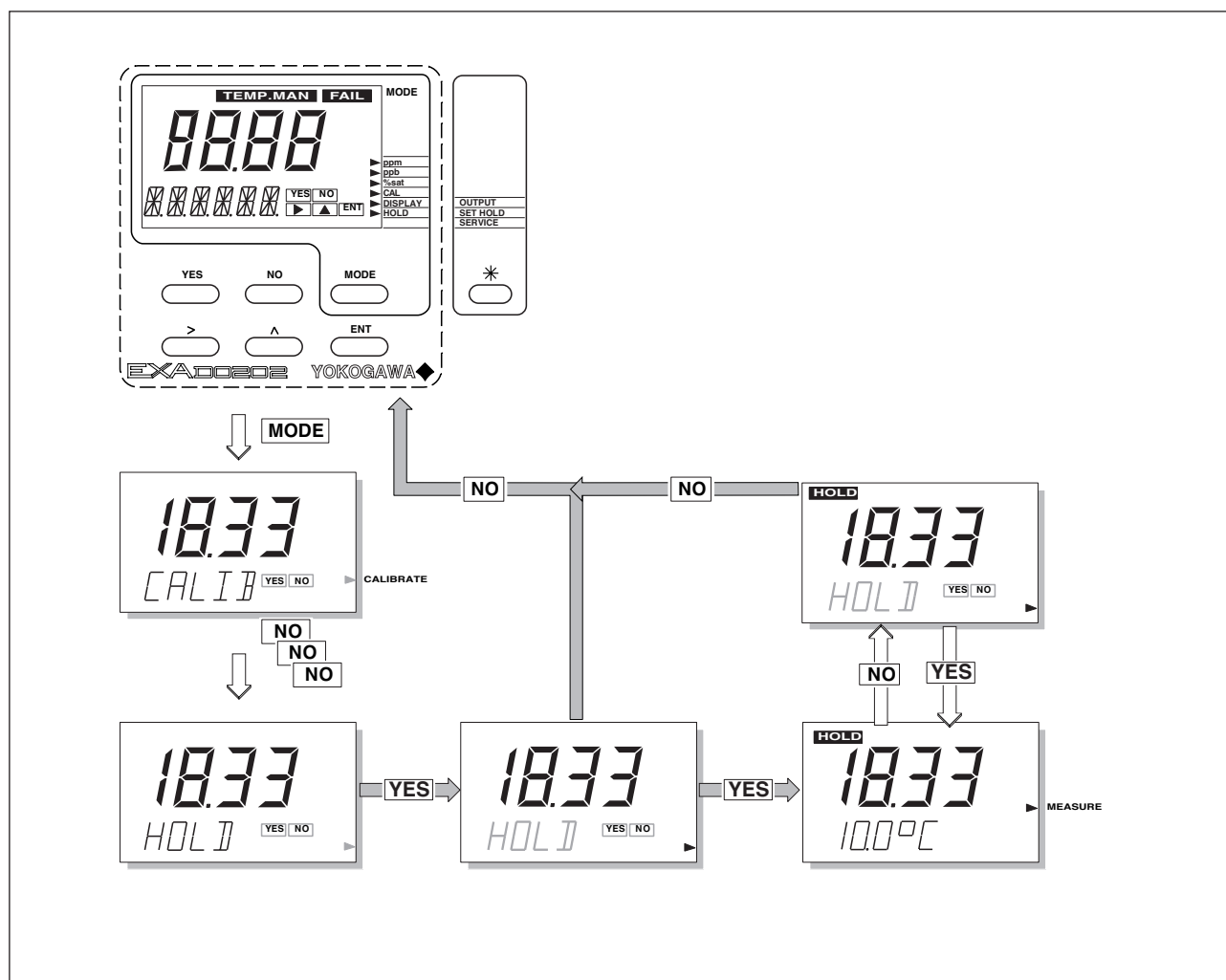
Manual temperature

See “manual temperature adjustment” section 5.1.1.

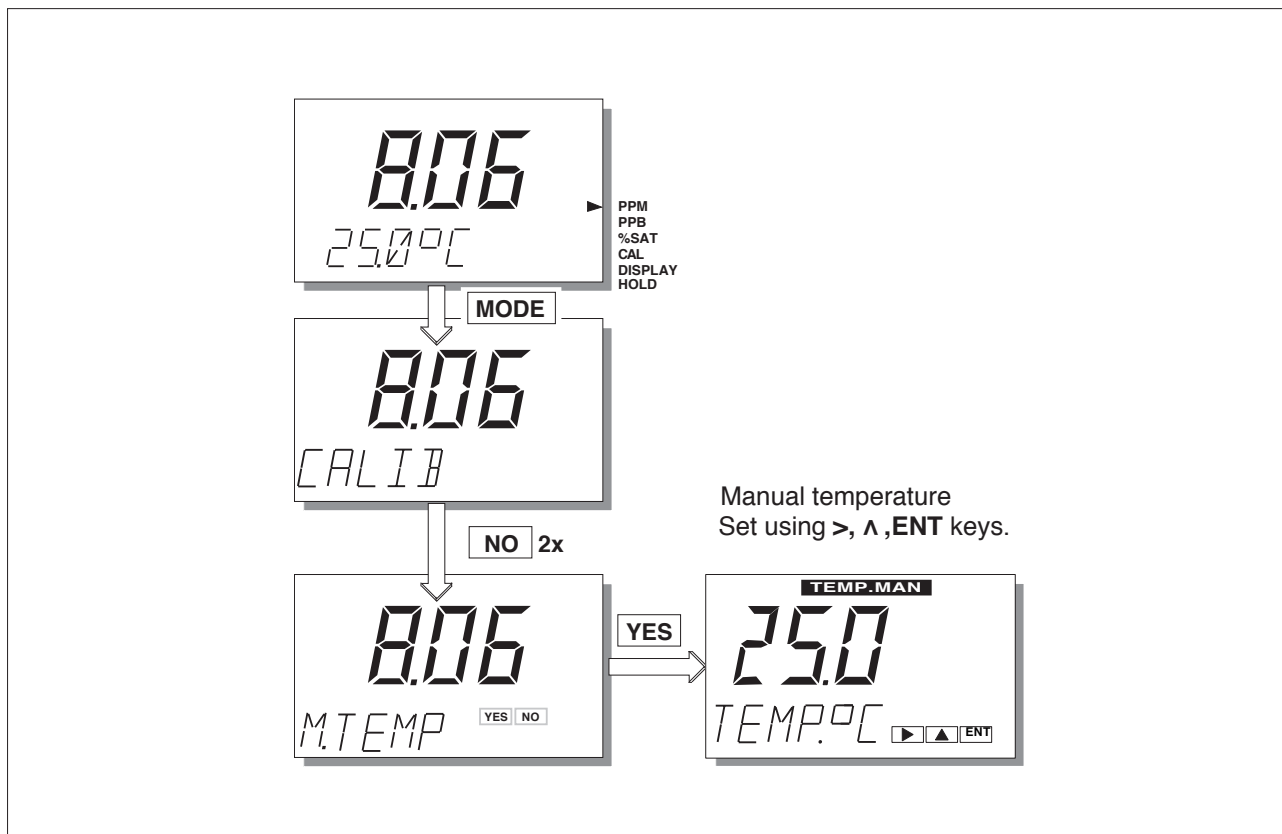
Manual pressure

See “manual pressure adjustment” section 5.1.2.

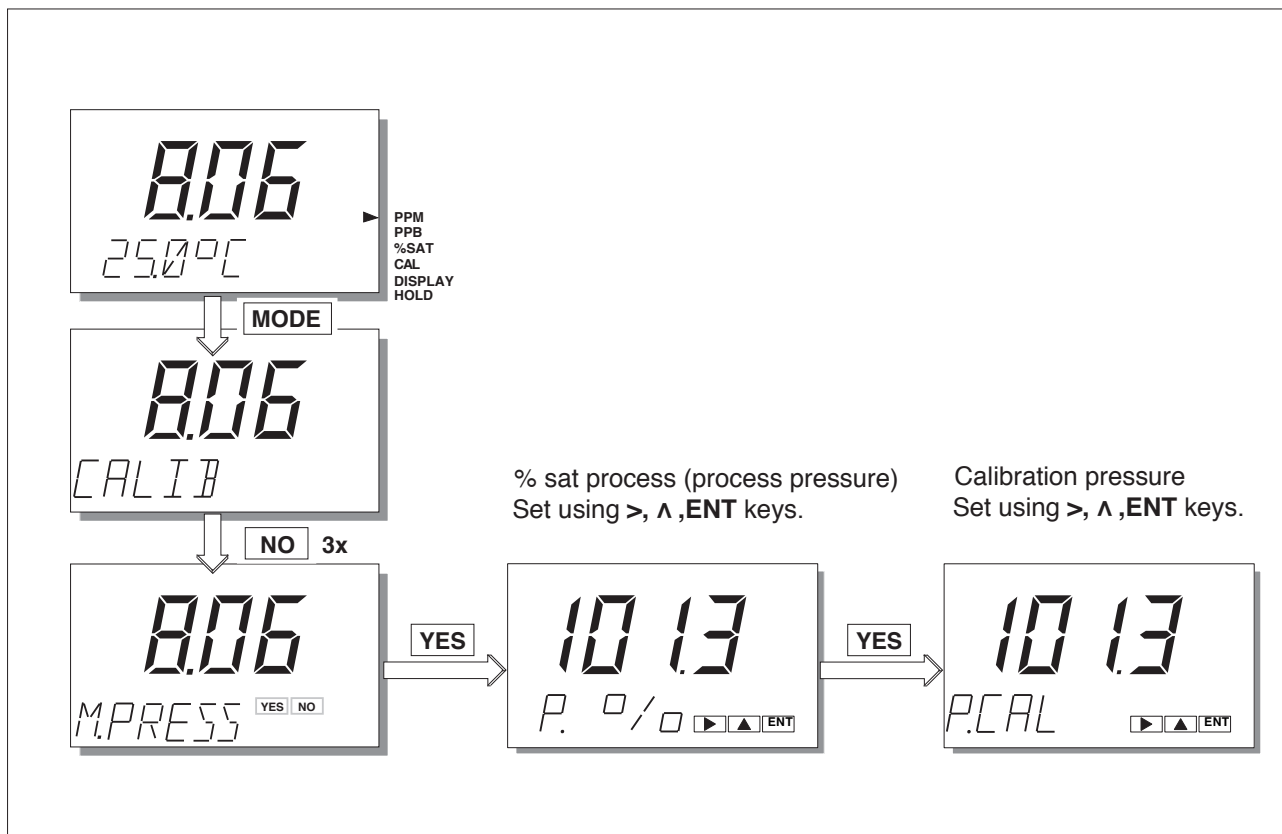
mA 5-1-1. Manual activation of hold



5-1-2. Manual temperature adjustment



5-1-3. Manual pressure adjustment



5-2. Commissioning mode

In order to obtain peak performance from the EXA converter, you must set it up for each custom application. Refer to section 1-4 for standard configurations and options.

Service

maintenance periods. This parameter should be set up to hold the last measured value, or a fixed value to suit the process.

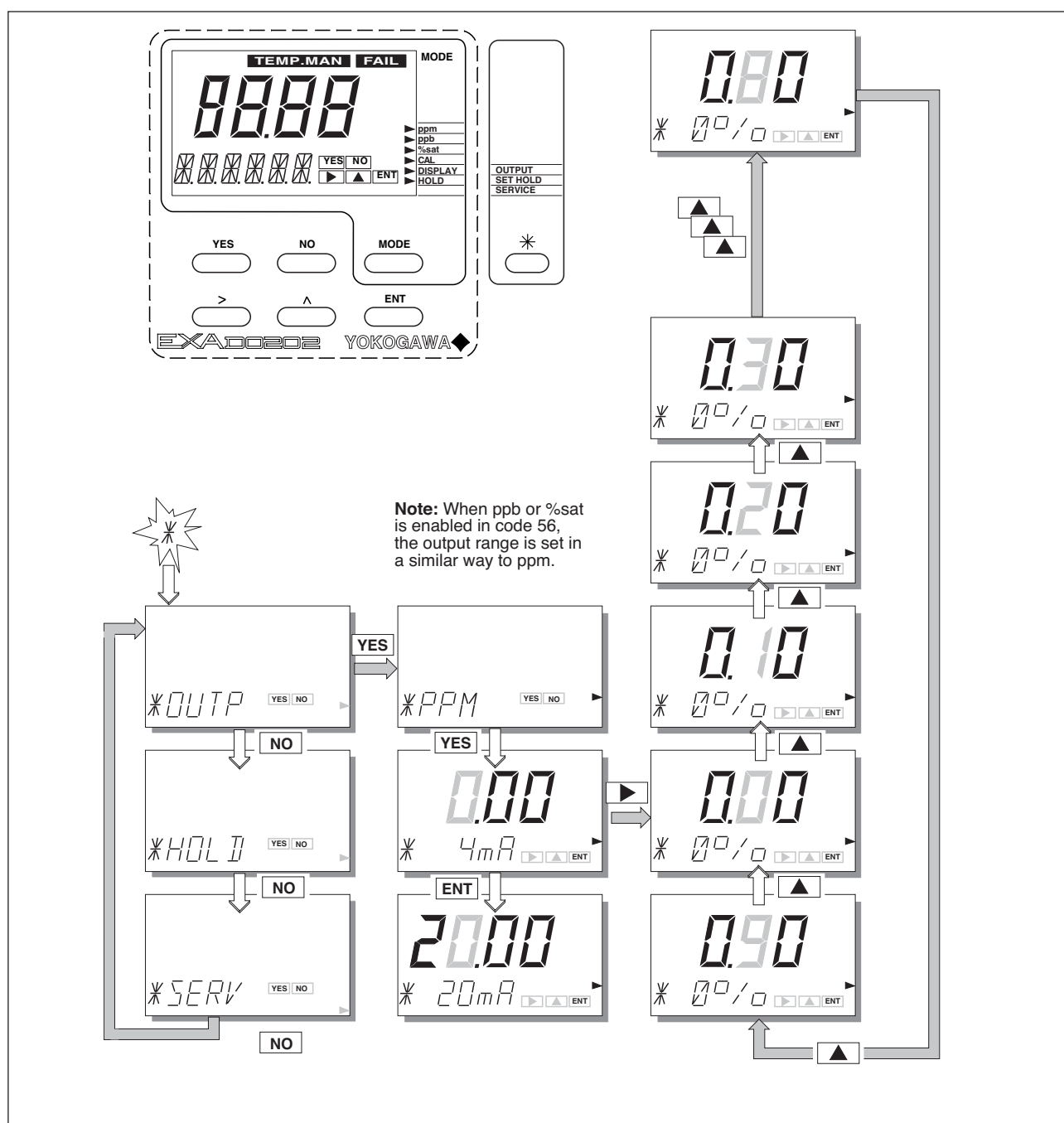
This selection provides access to the service menu.

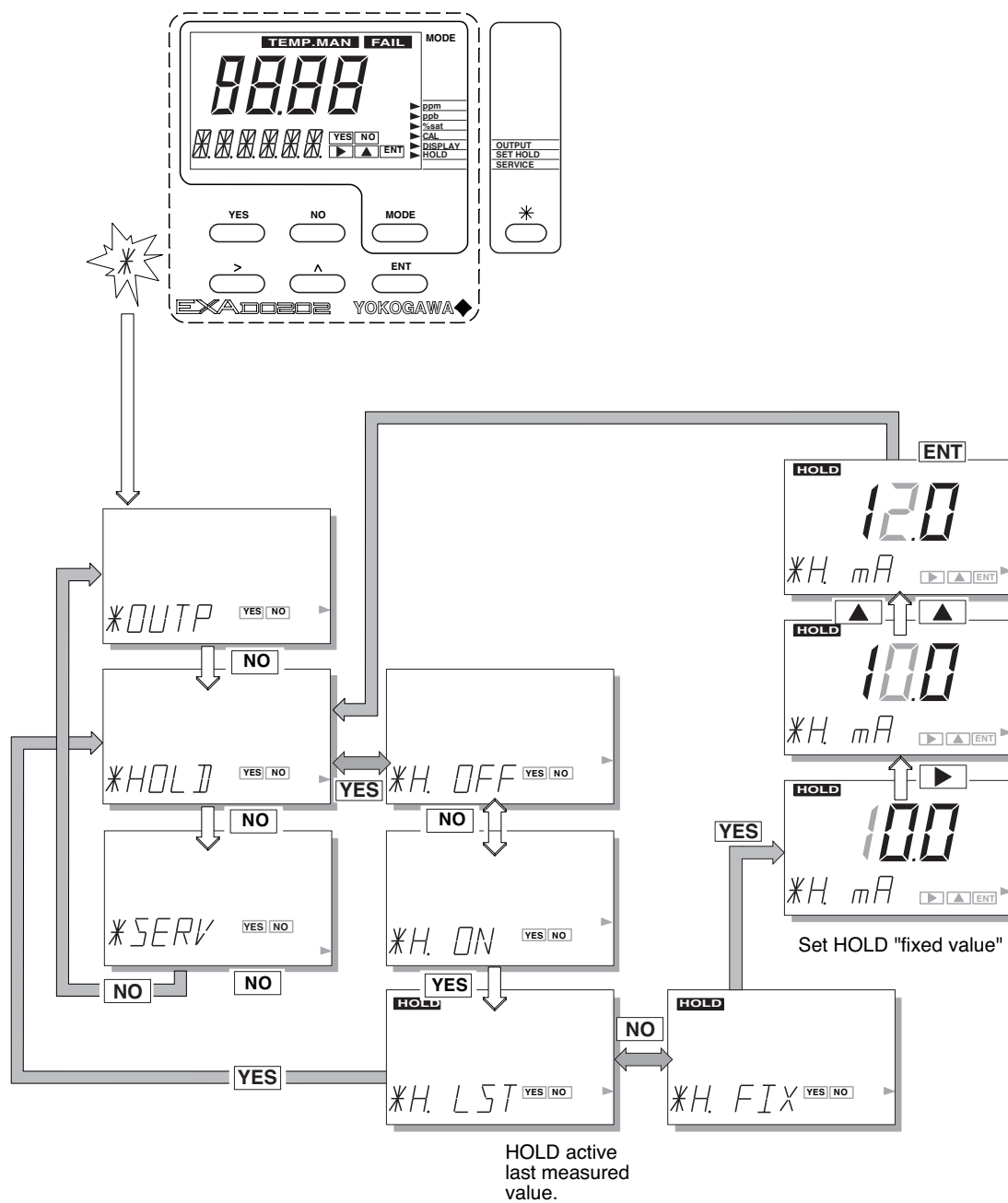
What follows are pictorial descriptions of typical frontplate pushbutton sequences for each parameter setting function. By following the simple YES/NO prompts and arrow keys, users can navigate through the process of setting range, setpoints, hold, wash and service functions.

mA Output range: mA output is set as default to 0 - 20ppm.
For enhanced resolution in more stable measuring processes, it may be desirable to select for example 5-10 ppm range.

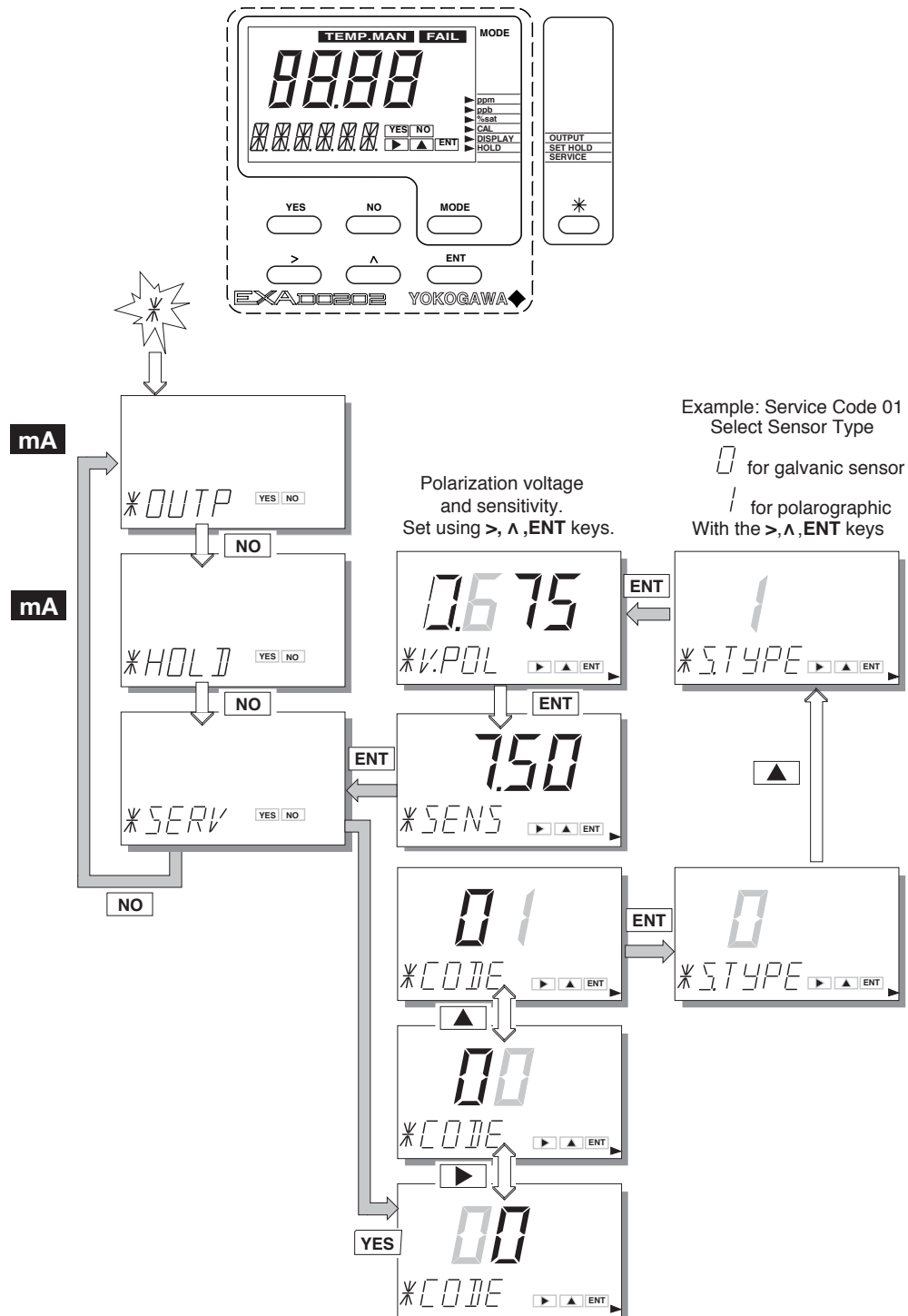
mA Hold The EXA DO202 transmitter has the ability to "HOLD" the output during

mA 5-2-1 Output range



mA 5-2-2. HOLD

5-2-3. SERVICE



5-3. Notes for guidance in the use of service coded settings

5-3-1. Parameter specific functions

Code 1	*S. TYPE	Select 0 for DO30G sensor or any other galvanic sensor. Select 1 for Oxyferm, Oxygold and other polarographic sensors.
	*V POL *SENS	Set the polarization voltage of the connected sensor (only for polarographic sensors). Set the sensitivity of the connected sensor.
Code 4	*SAL.TY	Enable or disable compensation. This function is particularly useful when measuring in estuarine or brackish waters.
	*[Cl-]	Set level for salinity compensation.

5-3-2. Temperature functions

Code 10	*T.SENS	Select temperature sensor to suit the measuring probe. The default selection is the 22k NTC sensor. Refer to the instructions delivered with the DO sensor to check which temperature sensor is used.
Code 11	*T.UNIT	Select °C or °F for temperature display.
Code 12	*T.ADJ.	Adjust offset in temperature measurement when the sensor is at a stable known value.
Code 13	*T.MAN.	Enable and set manual temperature compensation.

5-3-3. Calibration functions

Code 20	*ΔT.SEC *ΔZ.PPM *ΔZ.PPB *ΔZ.SAT *ΔS.PPM	Set stability parameters for calibration. A greater time, and/or a smaller step gives greater stability before a calibration can be accepted. Use caution, however, to avoid very long calibration times.								
Code 21	*Z.CAL *Z.LIM	Normally not necessary, zero calibration can be enabled when required. Zero check limit.								
Code 22	*ZERO *SENS	Calibration values can be entered from independent (laboratory) data. The sensitivity is the increase of the cell current per ppm and is specified in nA/ppm at 25°C (77°F).								
		<table><tr><td>Sensor</td><td>nominal sensitivity (nA/ppm at 25°C)</td></tr><tr><td>DO30(G)</td><td>450</td></tr><tr><td>OXYFERM</td><td>7.5</td></tr><tr><td>OXYGOLD</td><td>35</td></tr></table>	Sensor	nominal sensitivity (nA/ppm at 25°C)	DO30(G)	450	OXYFERM	7.5	OXYGOLD	35
Sensor	nominal sensitivity (nA/ppm at 25°C)									
DO30(G)	450									
OXYFERM	7.5									
OXYGOLD	35									

Code	Display	Function	Function detail	X	Y	Z	Default values
Parameter Specific functions							
01	*S. TYPE	Sensor type	Galvanic	0			1
			Polarographic	1			
	*V.POL	(Polarographic) Polarization Voltage					0.675 V
	*SENS	Sensor sensitivity					7.5 nA/ppm
04	*SAL.TY	Salinity comp.	Compensation disabled Compensation enabled	0 1			0
	*[Cl-]	NaCl conc.	Concentration in g/kg water: range 1 to 99.9 g/kg				0.0
05-09			Not used				

Code	Display	Function	Function detail	X	Y	Z	Default values
Temperature Measuring Functions							
10	*T.SENS	Temp. Comp.	Pt1000 RTD (DO30G)	0			1
			22k NTC (Oxyferm)	1			
			Pb36 = 2k2 NTC (DO30)	2			
11	*T.UNIT	Temp units	Celsius	0			0
			Fahrenheit	1			
12	*T.ADJ	Temp adjust	Adjustment +/- 7.5 °C or +/- 13.5 °F				
13	*T.MAN	Manual TC	Automatic temperature comp	0			0
			Manual temp compensation	1			25 °C/ 77 °F
14-19			Not used				

Code	Display	Function	Function detail	X	Y	Z	Default values
Calibration Settings							
20	*ΔT.SEC ΔZ.PPM (PPB or SAT) ΔS.PPM (always PPM)	Stabilization Step	Stabilisation time range 5- 600 s				60 s
			DO step change range 0-50 ppm				0.1 ppm (ΔZ.ppm)
			0-1999 ppb				1 ppb (ΔZ.ppb)
			0-600 %SAT				1.0 % SAT (ΔZ.SAT) 0.1 ppm (ΔS.ppm)
21	*Z.CAL	Zero calibration	Zero calibration disabled	0			0
			Zero Calibration enabled	1			
	*Z.LIM	Zero check limit	Zero check limit (galv.) 0-19.99 μA				19.99 μA
			Zero check limit (polar.) 0-199.9 nA				199.9 nA
22	*ZERO	Zero current	Offset range, ±Zero Check Limit				0 nA
	*SENS	Sensitivity entry	Sensitivity range 1-1999 nA/ppm				7.5 nA/ppm
23-29			Not used				

mA 5-3-4. mA output functions

Code 31	OUTP.F	For the DO202 the output may be chosen as linear to input, or configured in a 21 point table to a particular linearization. Enable the table setup in code 31, and configure the table in code 35.
Code 32	BURN	Diagnostic error messages can signal a problem by sending the output signals upscale or downscale (21 mA or 3.6 mA)*. This is called upscale or downscale burnout, from the analogy with thermocouple failure signaling of a burned-out or open circuit sensor. The pulse burnout setting gives a 21 mA signal for the first 30 seconds of an alarm condition. After the “pulse” the signal returns to normal. This allows a latching alarm unit to record the error. In the case of the EXA the diagnostics are extensive and cover the whole range of possible sensor faults. * Only when the HART communication is disabled the downscale output signal is 3.6 mA. When HART communication is enabled the output signal is 3.9 mA.
Code 35	TABLE	The table function allows the configuration of an output curve by 21 steps (intervals of 5%). The following example shows how the table may be configured to linearize the output with a mA curve.

5-3-5. User interface

Code 50	*RET.	When Auto return is enabled, the converter reverts to the measuring mode from anywhere in the configuration menus, when no button is pressed during the set time interval of 10 minutes.
Code 51	*P.MAN *P.% *P.CAL	In maintenance mode the pressure can be entered (M. PRESS).
Code 52	*PASS	Passcodes can be set on any or all of the access levels, to restrict access to the instrument configuration.
Code 53	*Err. xx	Error message configuration. Two different types of failure mode can be set. Hard fail gives a steady FAIL flag in the display. Soft fail gives a flashing FAIL flag in the display. The call for maintenance is a good example of where a SOFT fail is useful. A warning that the regular maintenance is due, should not be used to shut down the whole measurement.
Code 55	*CALL.M	Call for maintenance is a contact trigger to signal that the system has been in service for longer than the set time without calibration. The user can set up to 250 days as a routine service interval.
Code 56	*UNIT	Select ppm, ppb or % saturation as the main unit, to suit the application.

mA	Code	Display	Function	Function detail	X	Y	Z	Default values
Output Functions								
	30			Not used				
	31	*OUTP.F	mA output functions	Linear Table	0 1			0 Linear
	32	*BURN	Burn function	No burnout Burnout downscale Burnout upscale Pulse burnout	0 1 2 3			0 No Burn.
	33, 34			Not used				
	35	*TABLE *0% *5% *10% *95% *100%	Output table for mA	Linearization table for mA in 5% steps. The measured value is set in the main display using the >, ^, ENT keys, for each of the 5% interval steps. Where a value is not known, that value may be skipped, and a linear interpolation will take place.				
	36-39			Not used				

Code	Display	Function	Function detail	X	Y	Z	Default values
User Interface							
50	*RET	Auto return	No return to meas. from HOLD Return to meas after 10 min	0 1			1
51	*P.MAN *P.% *P.CAL	Manual pressure	No manual pressure in maint.mode Manual pressure in maint.mode Enter Manual process pressure 0-999.9 kPa Enter Cal. pressure in maint.mode 0-999.9 kPa	0 1			0 101.3 kPa 101.3 kPa
52	*PASS	Password Pass: 111 for #=1, 333 for #=2, 777 for #=3, 888 for #=4, 123 for #=5, 957 for #=6, 331 for #=7, 546 for #=8 and 847 for #=9	Direct access to MAINT MAINT protected by password Direct access to COMM COMM protected by password Direct access to SERV SERV protected by password	0 #			0.0.0
53	*Err.01 *Err.02 *Err.07 *Err.08 *Err.09 *Err.16	Error setting	Calibration not stable Soft fail Calibration not stable Hard fail Zero out of limits Soft fail Zero out of limits Hard fail Temperature sensor open Soft fail Temperature sensor open Hard fail Temp. sensor shorted Soft fail Temp. sensor shorted Hard fail Cell current abnormal Soft fail Cell current abnormal Hard fail Call for maintenance Soft fail Interval time exceeded Call for maintenance Hard fail Interval time exceeded	0 1 0 1 0 1 0 1 0 1 0 1			1 Hard 1 Hard 1 Hard 1 Hard 1 Hard 1 Hard 0 Soft
55	*CALL.M *CALL .M	E16 setting	No call for maintenance Call for maint. enabled E16 message after 1- 250 days	0 1			0 250
56	*UNIT	PV unit	Unit of measurement ppm Unit of measurement ppb Unit of measurement % sat.	0 1 2			0
57-59			Not used				

5-3-6. Communication setup

mA	Code 60	*COMM.	The settings should be adjusted to suit the communicating device connected to the output. The communication can be set to HART.
		*ADDR.	Select address 00 for point to point communication with 4-20mA transmission. Addresses 01 to 15 are used in multi-drop configuration (fixed 4mA output).
mA	Code 61	*HOUR	The clock/calendar for the logbook is set for current date and time as reference.
		*MINUT	
		*SECND	
		*YEAR	
		*MONTH	
		*DAY	
	Code 62	*ERASE	Erase logbook function to clear the recorded data for a fresh start. This may be desirable when re-commissioning an instrument that has been out of service for a while.

5-3-7. General

Code 70	*LOAD	The load defaults code allows the instrument to be returned to the default set up with a single operation. This can be useful when wanting to change from one application to another.
---------	-------	---

5-3-8. Test and setup mode

Code 80	*TEST	The test mode is used to confirm the instrument setup. It is based on the factory setup procedure and can be used to check the QIC (factory generated test certificate). To use this test feature it is necessary to have the detail provided only in the QIS, (Quality Inspection Standard) or the Service manual.
---------	-------	---

Note: attempting to change data in service code 80 and above without the proper instructions and equipment, can result in corruption of the instrument setup, and will impair the performance of the unit.

	Code	Display	Function	Function detail	X	Y	Z	Default values
mA	Communication							
	60	*COMM.	Communication	Set communication Set communication Communication write enable Communication write protect	Off On	0 1	0 1	1.0 On Write enable
		*ADDR.	Network address	Set address 00 to 15				00
	61	*HOUR *MINUT *SECND *YEAR *MONTH *DAY	Clock setup	Adjust to current date and time using >, ^ and ENT keys				
mA	62	*ERASE	Erase logbook	Press YES to clear logbook data				
	63-69			Not used				

	Code	Display	Function	Function detail	X	Y	Z	Default values
General								
	70	*LOAD	Load defaults	Reset configuration to default values				
	71-79			Not used				

	Code	Display	Function	Function detail	X	Y	Z	Default values
Test and setup mode								
	80	*TEST	Test and setup	Built in test functions as detailed in QIS and Service Manual				

6. CALIBRATION PROCEDURE

Calibration of the dissolved oxygen analyzer is performed in the following situations:

- When a new dissolved oxygen sensor is installed.
- When the membrane is replaced and/or the electrolyte solution is replaced
- When the sensor has been disassembled and reassembled for maintenance
- When the measuring error after cleaning exceeds the acceptable deviation from reference method
- When error message E16 indicates the need for maintenance

6-1. General

6-1-1. Calibration methods

There are four methods for calibration of the EXA dissolved-oxygen analyzer: air calibration, water calibration, sensitivity and zero (offset) calibration.

Air calibration

This is the most common and easiest way to calibrate the analyzing system. The calibration is done in **AIR.CAL** mode in maintenance level.

Water calibration

This is the traditional way to calibrate dissolved oxygen analyzers in laboratory environment. . Accurate results can be obtained if the calibration is performed carefully. The water calibration may include a zero calibration if so selected in service code 21. Normally only a zero check is performed without calibration, since a good sensor has no zero signal. Water calibration is not possible in salt water unless salinity compensation is activated in service code 04. The calibration is done in **H2O.CAL** mode in maintenance level

Note: In normal industrial environments better results are obtained with air calibration, which is therefore the recommended method.

Manual calibration

This is a calibration method whereby the sensor is not exposed to a calibration fluid, but is calibrated by comparison with a reference method. This reference method is normally a laboratory analysis of the water sample: either by Iodometric titration according ISO 5813 or an electrochemical method according ISO 5814.

The calibration is done in **SENS/ZERO** mode in maintenance level.

6-1-2. Diagnostic functions performed during calibration

The calibration is a semi-automatic calibration, which means that the sensor output is used for calculation of sensor parameters after the readings have stabilized. The criteria for stabilization are set in service code 20. If stable readings are not achieved within one hour error E1 message will appear on the display and the procedure is aborted.

The calculated sensor parameters are compared with preset tolerances and if these conditions are not met, Error E2 (Zero Error) or E3 (Sensitivity Error) will be signalled.

Notes:

1. Error messages that appear initially indicate inadequate settings of the diagnostic variables in service codes 01, 20 and/or 22.
2. Patience improves the accuracy of calibration. When the EXA prompts the user that the preset criteria are met by showing **CAL.END** message it only means that the minimum criteria are met. When the signal still changes after this initial acceptance, EXA will automatically update the sensor characteristics with the new information.

6-2. Calibration procedure using air calibration method

(a convenient way to accomplish this environment is to place the sensor in an empty bucket).

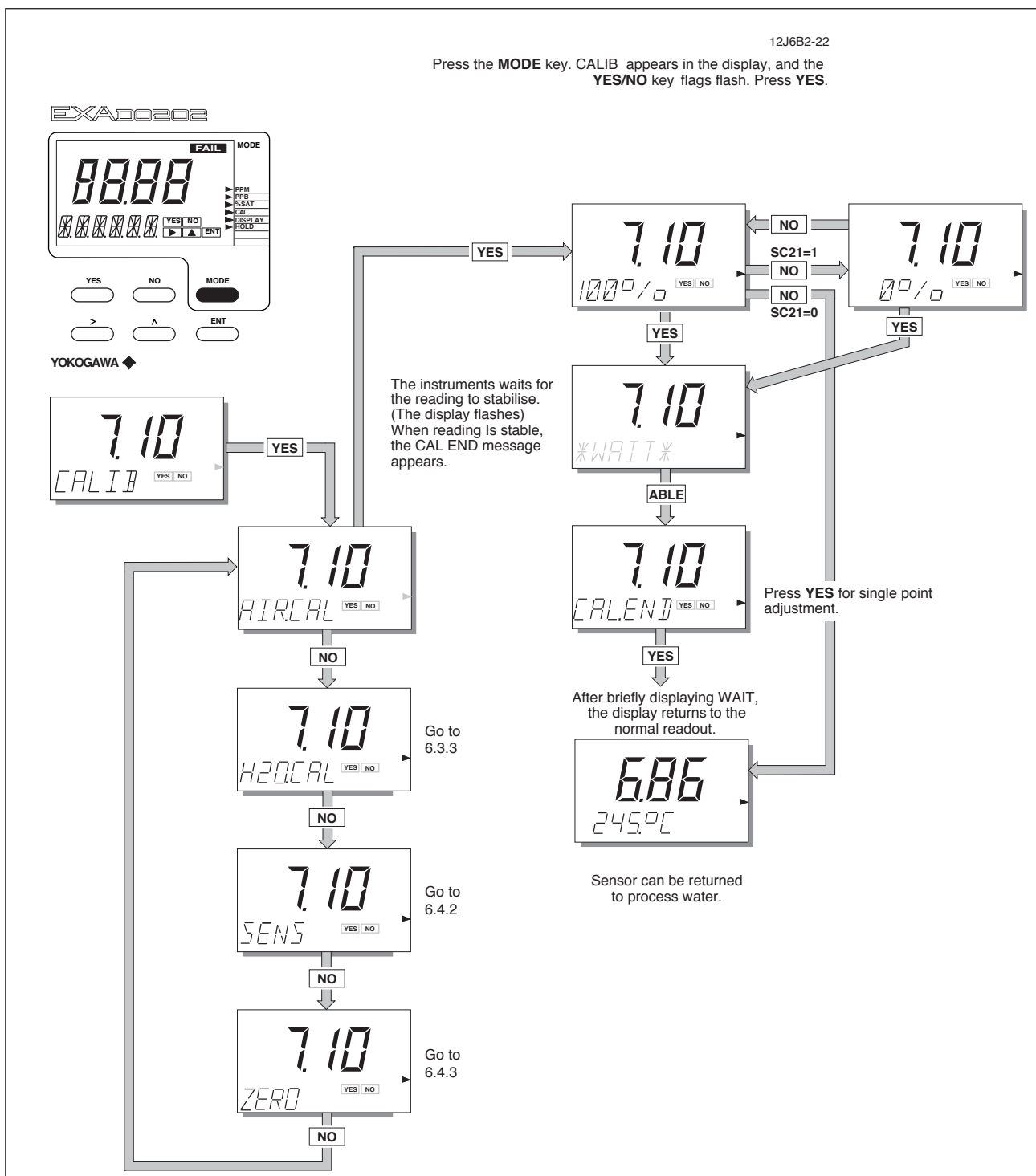
6-2-1. Preparation

Move the sensor to a maintenance site and wash off any dirt on the membrane. Lightly wipe off any remaining water from the membrane with a soft tissue.

Expose the sensor to the air in an environment where there is no temperature change and no wind

Note: If sensors are used without temperature compensating element, the temperature must be adjusted to ambient temperature in service code 13.

6-2-2. Procedure for air calibration



6-3. Calibration procedure using water calibration method

6-3-1. Preparation

Move the sensor to a maintenance site and wash off any dirt on the membrane. Lightly wipe off any remaining water from the membrane with a soft tissue.

Prepare the necessary equipment and reagents to be used for the span and (if required) zero calibration.

Equipment for span calibration includes:

- Beaker or bucket
- Magnetic stirrer or other means of agitating the water
- Demineralized water or salty process water if salinity compensation is activated
- Air supply pump (aquarium pump)
- Glass diffuser to generate small air bubbles

Note: It takes 15 to 30 minutes of aeration before it can be assumed that the water is fully saturated with air.

Reagent for zero calibration:

- Sodium sulfite
- demineralized water

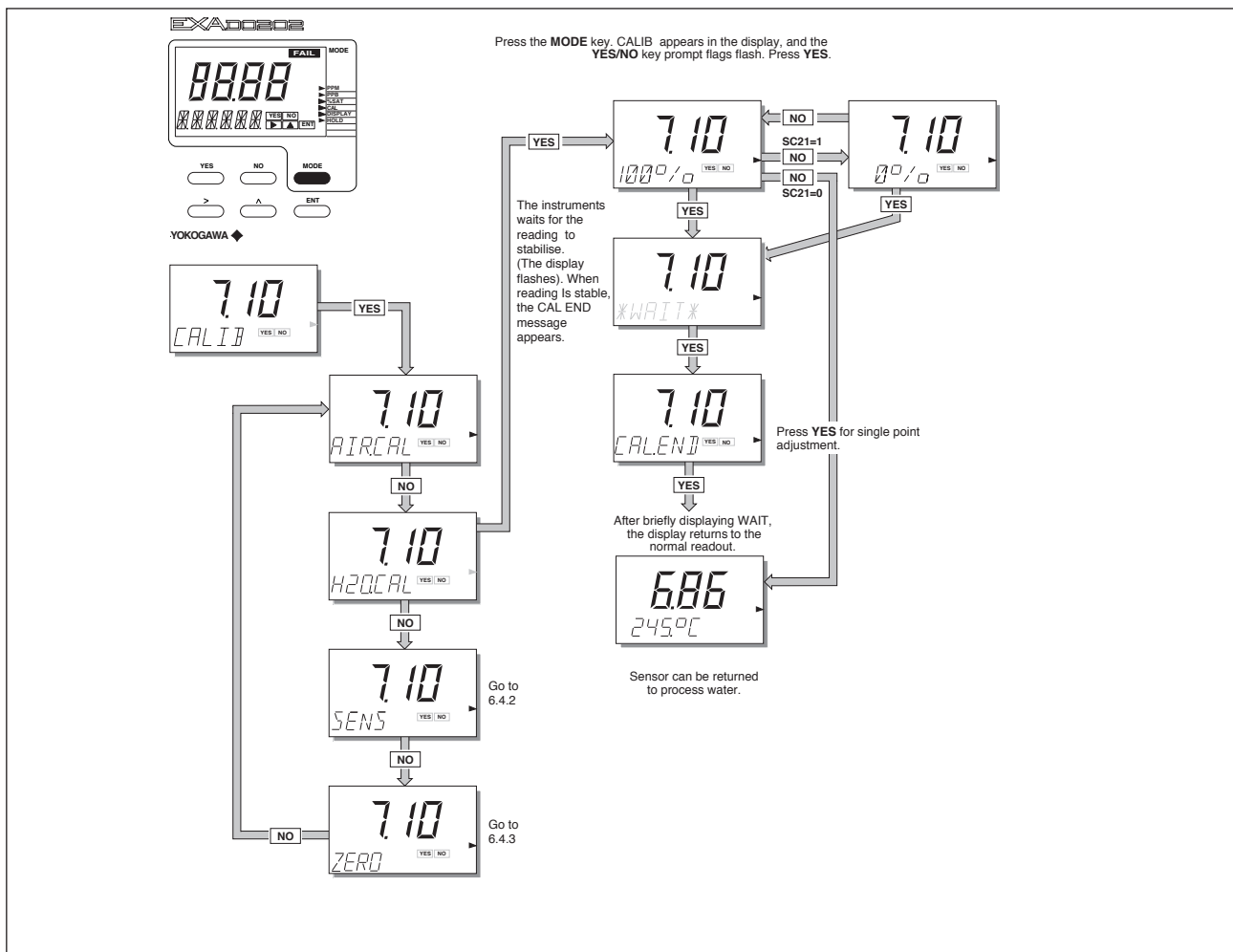
The zero oxygen solution contains 20- 30 grams of sodium sulfite per liter.

6-3-2. Calibration operation (water calibration method)

If both zero and span calibration are used, it is better to start with span calibration in spite of normal calibration sequence with analog instrumentation. Otherwise the sensor must be rinsed off carefully to prevent ingress of oxygen absorbing sulfite in the aerated water.

Note: Zero calibration in the sodium sulfite solution takes a long time. Even after CAL.END prompt it is necessary to wait 40-50 minutes before zero adjustment can be made. Otherwise calibration errors are introduced in the measurement. It is recommended not to do a zero calibration, but a zero check only. A good clean sensor does not have a zero current and does not require zero calibration. If the sensor has a substantial zero current, the sensor has to be disassembled, cleaned and filled with fresh electrolyte solution and a new membrane has to be fitted.

6-3-3. Procedure for water calibration



6-4. Calibration procedure using manual calibration method

6-4-1. Preparation

A. Cleaning

Confirm that the readings of the analyzer are stable and measured with a clean sensor.

Otherwise move the sensor to a maintenance site and wash off any dirt on the sensor membrane. Move the sensor back to the process water and wait for the readings to stabilize.

B. Sampling

The manual calibration procedure involves adjustment of the readings to a reference standard. Normally this reference is a laboratory measurement that analyses a sample that must be identical to the sample measured with the on-line analyzer.

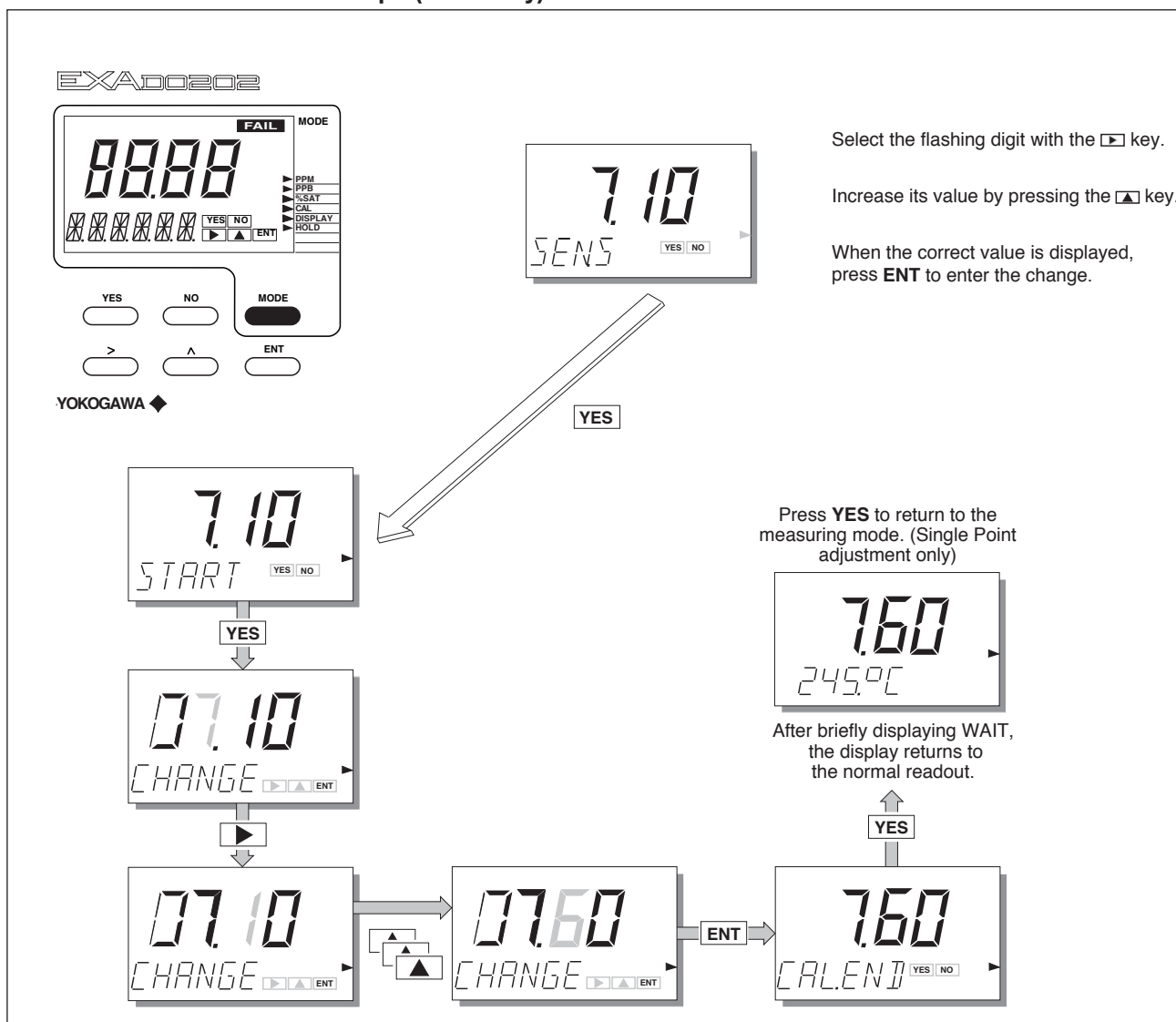
The following precautions must be taken into account:

- The sample must be analyzed directly after sampling to avoid change of dissolved oxygen concentration or temperature after sampling
- The reference standard must be analyzed with a laboratory meter that is calibrated prior to sample analysis
- The reference method must be calibrated with the same calibration data as specified in ISO 5814 to avoid indiscrepancies

Most important calibration data are:
Dissolved oxygen concentration at saturation conditions as function of temperature, barometric pressure, altitude and salinity.

These data are included in this manual for reference and verification of correct calibration of reference analyzers. DO202 has taken all these variables into account during the semi-automatic calibration methods.

6-4-2. Procedure for manual slope (sensitivity) calibration



6-4-3. Procedure for manual zero (offset) calibration

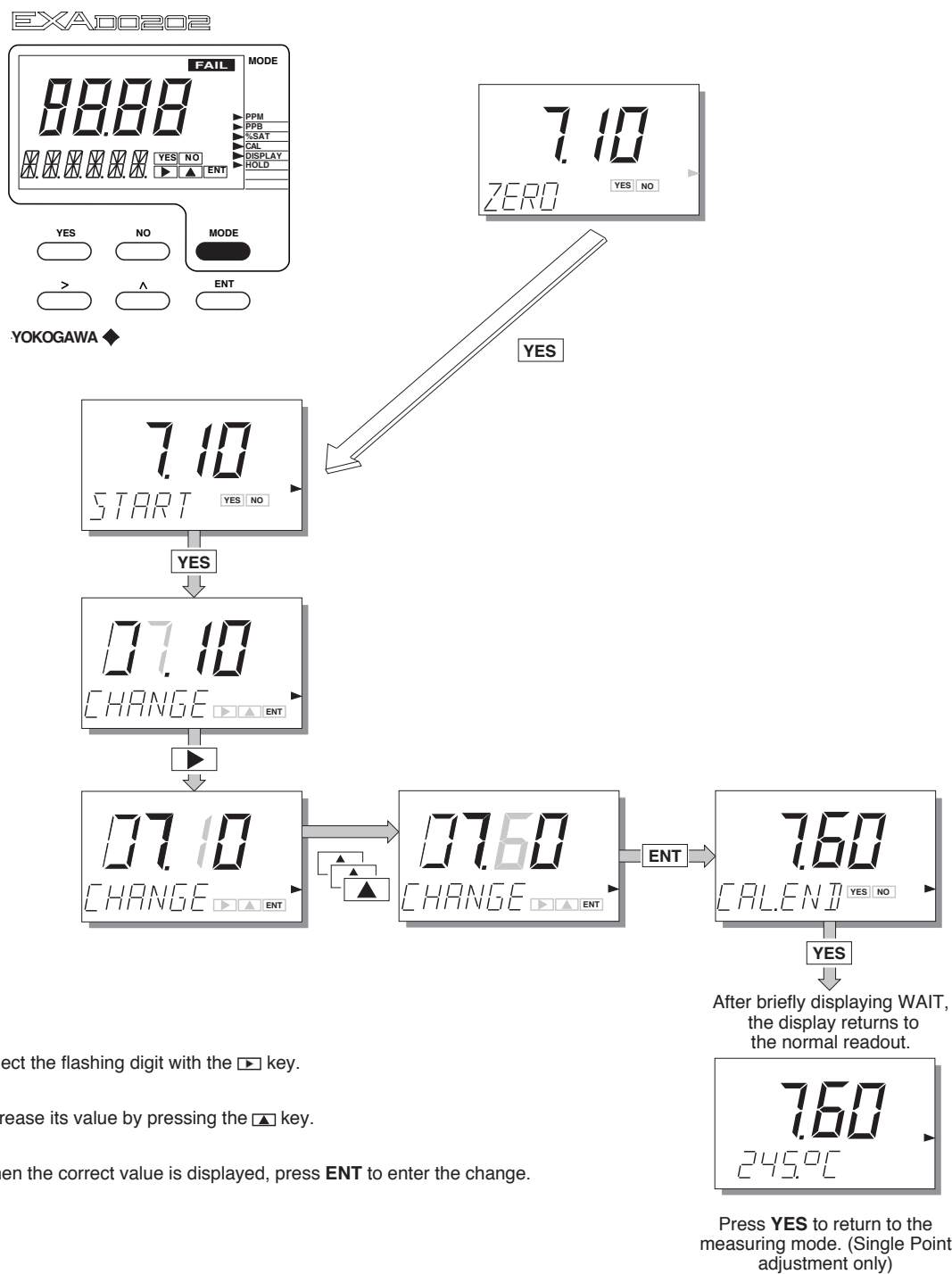


Table 6-1. Solubility of oxygen (mg/l) in water as a function of temperature & salinity (ISO 5814)

Temp	Solubility of oxygen in water in equilibrium with air @101.325kPa[pO ₂]	Correction to be subtracted for each degree of salinity expressed in grams per kilogram of total salts in water [ΔpO ₂]
°C	mg/l (ppm)	mg/l (ppm)
0	14.62	0.0875
1	14.22	0.0843
2	13.83	0.0818
3	13.46	0.0789
4	13.11	0.0760
5	12.77	0.0739
6	12.45	0.0714
7	12.14	0.0693
8	11.84	0.0671
9	11.56	0.0650
10	11.29	0.0632
11	11.03	0.0614
12	10.78	0.0593
13	10.54	0.0582
14	10.31	0.0561
15	10.08	0.0545
16	9.87	0.0532
17	9.66	0.0514
18	9.47	0.0500
19	9.28	0.0489
20	9.09	0.0475
21	8.91	0.0464
22	8.74	0.0453
23	8.58	0.0443
24	8.42	0.0432
25	8.26	0.0421
26	8.11	0.0407
27	7.97	0.0400
28	7.83	0.0389
29	7.69	0.0382
30	7.56	0.0371

Table 6-2. Solubility of oxygen (mg/l) at various temperatures and elevations (based on sea level barometric pressure of 760 mm Hg)

Temp °C	Elevation (metres above sea level)						
	0	300	600	900	1200	1500	1800
0	14.6	14.1	13.6	13.2	12.7	12.3	11.8
2	13.8	13.3	12.9	12.4	12.0	11.6	11.2
4	13.1	12.7	12.2	11.9	11.4	11.0	10.6
6	12.4	12.0	11.6	11.2	10.8	10.4	10.1
8	11.8	11.4	11.0	10.6	10.3	9.9	9.6
10	11.3	10.9	10.5	10.2	9.8	9.5	9.2
12	10.8	10.4	10.1	9.7	9.4	9.1	8.8
14	10.3	9.9	9.6	9.3	9.0	8.7	8.3
16	9.9	9.5	9.2	8.9	8.6	8.3	8.0
18	9.5	9.2	8.9	8.6	8.3	8.0	7.7
20	9.1	8.8	8.5	8.2	7.9	7.7	7.4
22	8.7	8.4	8.1	7.8	7.6	7.3	7.1
24	8.4	8.1	7.8	7.6	7.3	7.1	6.8
26	8.1	7.8	7.6	7.3	7.0	6.8	6.6
28	7.8	7.5	7.3	7.0	6.8	6.6	6.3
30	7.5	7.2	7.0	6.8	6.5	6.3	6.1
32	7.3	7.1	6.8	6.6	6.4	6.1	5.9
34	7.1	6.9	6.6	6.4	6.2	6.0	5.8
36	6.8	6.6	6.3	6.1	5.9	5.7	5.5
38	6.6	6.4	6.2	5.9	5.7	5.6	5.4
40	6.4	6.2	6.0	5.8	5.6	5.4	5.2

Table 6-3. Solubility of oxygen (mg/l) of sea water & fresh water (based on sea level barometric pressure of 760 mm Hg)

Temp °C	Solubility	
	Seawater mg/l (ppm)	Fresh water mg/l (ppm)
0	11.97	14.62
2	11.36	13.84
4	10.82	13.13
6	10.29	12.48
8	9.84	11.87
10	9.43	11.33
12	9.05	10.83
14	8.69	10.37
16	8.37	9.95
18	8.06	9.54
20	7.77	9.17
22	7.48	8.83
24	7.21	8.53
26	6.93	8.22
28	6.67	7.92
30	6.41	7.63

7. Maintenance

It is important for maintaining the measurement accuracy of the EXA DO series of wire dissolved-oxygen metering system to perform inspection and maintenance at fixed intervals. It also serves to prevent problems from arising.

This chapter describes daily inspection and maintenance for the purpose of maintaining system performance.

7-1. Overall dissolved-oxygen metering system

Tables 7-1 and 7-2 show the inspection and maintenance items for equipment composing dissolved-oxygen metering system. The procedure of inspection and maintenance for the dissolved-oxygen transmitter is described in Section 7-2. For inspection and maintenance of the sensors and holders, see each instruction manual respectively.

Table 7-1. Items for periodic inspection and maintenance of dissolved-oxygen metering system

Instrument or apparatus	Item	Recommended Interval
All equipment	a. Calibration	a. 1 to 2 months
Dissolved-oxygen sensor	a. Cleaning of membrane b. Polishing of silver electrode surface and replacement of electrolyte c. Replacement of membrane assembly	a. 1 to 2 months b. 6 to 8 months c. 6 to 8 months
Dissolved-oxygen transmitter	a. Inspection of temperature indication (error check)	a. 6 months
Float holder	a. Sweeping of winch mechanism	a. (depends on installation environment)
Immersion holder	a. Inspection of sensor holding O-ring b. Sweeping of cleaner nozzle c. Inspection for leakage from the solenoid valve for cleaning utility	a. 6 months b. 1 to 2 months c. 6 months

7-2. Periodic maintenance for the EXA DO202 converter

The DO202 transmitter requires very little periodic maintenance. The housing is sealed to IP65 (NEMA 4X) standards, and remains closed in normal operation. Users are required only to make sure the front window is kept clean in order to permit a clear view of the display and allow proper operation of the pushbuttons. If the window becomes soiled, clean it using a soft damp cloth or soft tissue. To deal with more stubborn stains, a neutral detergent may be used.

7-1-1. Inspection and maintenance to be implemented periodically

Table 7-1. shows the items which are recommended to be inspected and maintained periodically.

7-1-2. Inspection and maintenance to be implemented on occasion

Occasionally implement the maintenance that is not directly related to measurement functions and maintenance associated with errors.

Note: Never used harsh chemicals or solvents. In the event that the window becomes heavily stained or scratched, refer to the parts list (Chapter 9) for replacement part numbers.

When you must open the front cover and/or glands, make sure that the seals are clean and correctly fitted when the unit is reassembled in order to maintain the housing's weatherproof integrity against water and water vapor. The DO measurement uses small signal currents and may otherwise be prone to problems caused by exposure of the circuitry to condensation.

Table 7-2. Items for occasional inspection and maintenance of dissolved-oxygen metering

Faulty phenomenon	System content of inspection
Error E2 occurrence	Check whether the dissolved-oxygen sensor membrane is contaminated or not. Check whether the nozzle is clogged or not.
Error E3 occurrence	Polish the silver electrode surface of the dissolved-oxygen sensor and replace the electrolyte.
It is difficult to see the inside of the converter through the window	Wipe off the dirt on the transparent window using tissue paper or the like. (Use detergent for hard-to-clean dirt.)

8. Troubleshooting

This chapter describes the countermeasures for failures, classifying the cases into three categories: dissolved-oxygen transmitter failure, detection of failure with the self-diagnosis function, and abnormal measured values. The causes for abnormal measured values are not limited to equipment failures. If an abnormal phenomenon occurs, first check the following items:

- Is the property of the measuring solution different from normal?
- Is the dissolved-oxygen sensor properly installed?

8-1. Measures in the case of transmitter operation failure

If the operation keys do not operate smoothly or the display fails (e.g., a missing character segment), repair of the printed circuit board (digital board) or replacement with a new one is required.

After the printed circuit board is replaced, operation checks and parameter settings are necessary. Contact Yokogawa and request board-replacement work.

8-2. Measures in the case of failure (Error) detection

Table 8-1. Measures in the case of failure (Error) detection

Error No.	Generation Mode	Error Content and Causes	Measures
E 1	AIR.CAL mode H2O. CAL mode	Stability failure Even after an hour has elapsed, the measured value change does not decrease within the set value of Δ ppm • Sensor temperature changes. • Dissolved-oxygen of the calibration solution changes. • The value of Δppm is not suitable.	Eliminate the causes and press the (NO) key to perform re calibration.
E 2	H2O. CAL mode MAN.CAL mode (ZERO)	Zero error failure The zero error exceeds the set range • Dirt sticks to the sensor membrane. • Membrane abnormality. Electrolyte degradation.	Clean the sensor membrane and recalibrate. If the error is detected again, replace the electrolyte and the membrane.
E 3	AIR.CAL mode H2O. CAL mode MAN.CAL mode (SENS)	Sensitivity failure The sensitivity exceeds the range of 1 - 1999 nA/ppm. • Dirt sticks to the sensor membrane. • Membrane abnormality. Electrolyte degradation.	Clean the sensor membrane and recalibrate. If the error is detected again, replace the electrolyte and the membrane.
E 7	All modes	Measured temperature failure (too high) It exceeds 150.0 °C (302 °F). • Measuring solution temperature is high • CODE 10 setting is not correct • Sensor cable wiring failure • Temperature sensor has failed	Examine the temperatures of the measuring solution and sensor and the CODE 10 setting Examine the sensor cable connection status. If the temperature sensor fails (abnormal resistance), replace the sensor.
E 8	All modes	Measured temperature failure (too low) It falls below -20 °C (or -4 °F). • Measuring solution temperature is low • CODE 10 setting is not correct • Sensor cable wiring failure • Temperature sensor has failed.	Examine the temperatures of the measuring solution and sensor and the CODE 10 setting. Examine the sensor cable connection status. If the temperature sensor fails (abnormal resistance), replace the sensor.
E 9	All modes	Input current failure It does not satisfy the following equation: input current < 50 μ A for galvanic sensor < 1200 nA for polarographic sensor	Examine the setting for CODE 01, 022

Error No.	Generation Mode	Error content and Causes	Measures
E10	All modes	EEPROM writing failure Electronic circuit failure	Turn off the power and then turn it back on and check whether or not the system returns to normal. If the failure occurs again, contact Yokogawa to request repair.
E15	CODE 11	Temperature error correction failure The difference between the corrected value and the standard value exceeds the range corresponding to $\pm 7.5^{\circ}\text{C}$ ($\pm 13.5^{\circ}\text{F}$). • Temperature entry is not accurate. • Sensor cable failure	Accurately measure the temperature of the measuring solution (dissolved oxygen sensor). Examine whether the sensor cable fails (partial disconnection or degraded insulation) and then correct the temperature error again.
E16	All modes	Call for maintenance-interval time exceeded	Perform maintenance. Reset interval.
mA E17	*OUTP CODE 35	Output span too small. Min. span is 1ppm, 25ppb or 10%	Re-enter a value within the permissible range.
mA E18	CODE 35	Table values make no sense.	Reprogram.
E19	At data entry	Configuration failure A value not within the permissible range is entered.	Re-enter a value within the permissible range.
E20	All modes	Instrument initialization failure	Contact Yokogawa
E21	All modes	EPROM comparison failure	Contact Yokogawa

Note: It is possible that the error message does not disappear immediately after corrective measures. Then turn power off and the turn it back on and check whether the system returns to normal.

9. Spare Parts

Table 9-1. Itemized parts list

Item No.	Description	Part no.
1	Cover assembly including window, gasket and fixing screws	K1542JZ
2	Window	K1542JN
3	Internal works assembly (general purpose)	K1544VH
4	Digital (display) board	K1544EL
5	Analogue (input) board (general purpose)	K1544LK
6	Ribbon cable	K1544PH
7	EPROM + latest software	K1544BW
8	Lithium cell (battery)	K1543AJ
9	Terminals (block of 3)	K1544PF
	Terminals (block of 5)	K1544PG
	Terminal (F/B)	K1544FA
10	Housing	
	mA version	K1542JL
11	Gland set (one gland including seal and backing nut)	K1500AU
Options		
/U	Pipe and wall mounting hardware	K1542KW
/SCT	Stainless steel tag plate	K1544ST
/H	Hood for sun protection	K1542KG

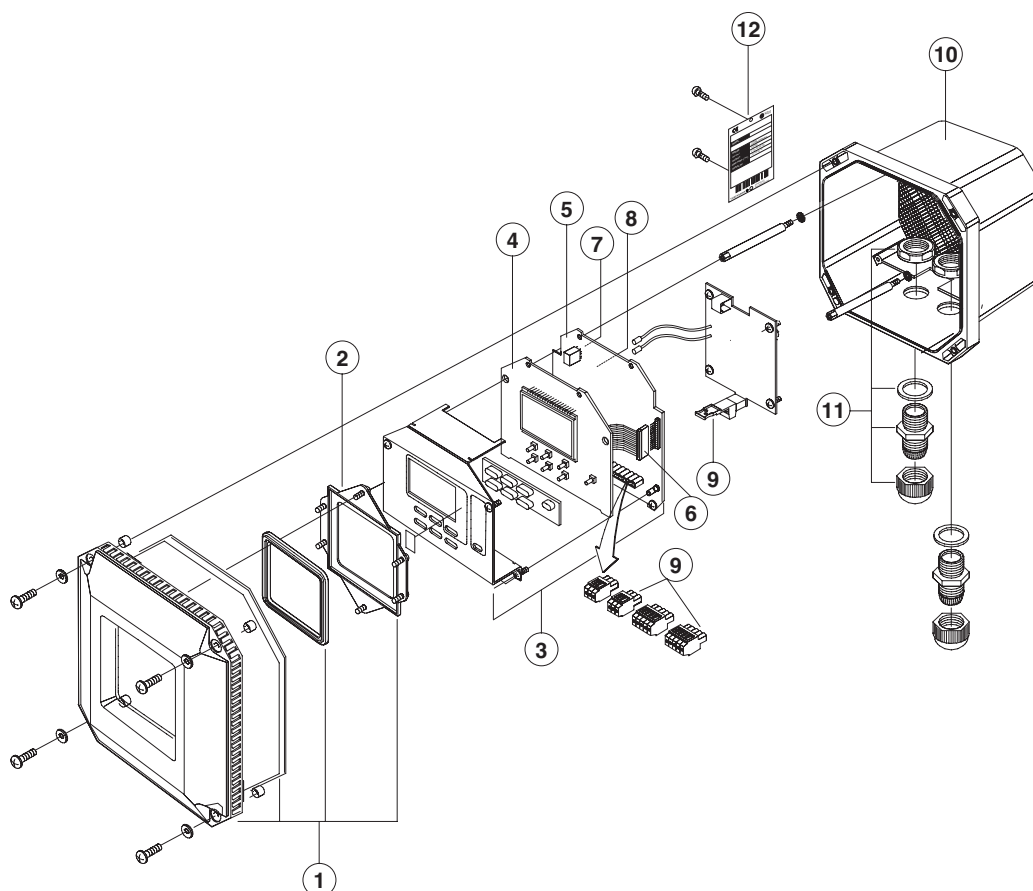


Figure 9-1. Exploded view

APPENDIX 1. User settings

A-1-1. User setting table

FUNCTION		SETTING DEFAULTS		USER SETTINGS		
Parameter specific functions						
01	*S.TYPE	1	Polarographic			
	*V.POL	0.675	V			
	*SENS	7.5	nA/ppm			
04	*SAL.TY	0	Off			
	[Cl-]	0	g/kg			
Temperature measuring functions						
10	*T.SENS	1	22k NTC			
11	*T.UNIT	0	°C			
12	*T.ADJ		None			
13	*T.MAN	0	Off			
Calibration parameter functions						
20	*ΔT.SEC	60	sec.			
	*ΔZ.PPM	0.1	ppm			
	*ΔZ.PPB	1	ppb			
	*ΔZ.SAT	1	%			
	*ΔS.PPM	0.1	ppm			
21	*ΔZ.CAL	0	Off			
	*ΔZ.LIM	199.9	nA			
22	*ZERO	0	μA (nA)			
	*SENS	7,5	nA/ppm			
mA outputs						
31	*OUTP.F	0	Linear ppm			
32	*BURN	0	No Burn			
35	*TABLE	0 to 20	ppm			
User Interface						
50	*RET	1	on			
51	*P.MAN	0	off			
	*P.%	101.3	kPa			
	*P.CAL	101.3	kPa			
52	*PASS	0.0.0	all off			
53	*Err.01	1	hard fail			
	*Err.02	1	hard fail			
	*Err.07	1	hard fail			
	*Err.08	1	hard fail			
	*Err.09	1	hard fail			
	*Err.16	0	soft fail			
55	*CALL.M	0	Off			
	*CALL.M	250	days			
56	*UNIT	0	ppm			
Communication						
60	*COMM	1.0	on/write enable			
	*ADDR	00				
61	*HOUR					
62	*ERASE					
General						
70	*LOAD					
Test and setup mode						
80	*TEST					

A-1-2 Configuration Checklist for DO202

	Standard configuration	Options	Reference for change
Measured variable(s)			
Primary inputs DO units Temperature unit	DO and Temp ppm Celsius	ppb. % saturation Fahrenheit	code 56 code 11
mA mA Outputs			
Analog output Output linearization Burn out	4-20mA for ppm disabled disabled	ppb or %sat ppm, ppb or %sat burn low (3.6) / high (21) on mA output	code 56, 31 code 35 code 32
mA Communication			
Digital interface Communication software	HART external	disabled HHC	code 60 contact factory
Interface			
Variables on display Password protection Autoreturn Add. functions in MAINT	ppm and temp disabled return to measure in 10 minutes disabled	%sat, °C, SE, ZR, REL for mains/ comm./ serv level enable or disable manual pressure	"display" code 52 code 50 code 51
Diagnostics			
Check on Slope Check on zero Check on stability	active disabled 0.1 ppm per 60 s	1-1999 na/ppm enable or disable 0-50 ppm in 5-600 s	code 22 code 02, 21, 22 code 20
Compatibility			
DO sensor Temperature sensor Sensor principle Manual temp. comp.	SM31 22k NTC polarographic disabled	DO30G Pt 1000 galvanic disable or enable	code 01, 10 code 10 code 01, "wiring" code 13
Special Features			
Salinity compensation Temperature calibration Zero calibration Atm. press. compensation Soft fail alarm Logbook	disabled none disabled manual disabled disabled	comp. for 1-99.9 ppt NaCl adjustment $\pm 7.5^{\circ}\text{C}$ or $\pm 13.5^{\circ}\text{F}$ disable or enable possible for E1..E2, E7..E9, E16 2 volumes of 50 events	code 04 code 12 code 21 code 53 code 61,62

mA A-1-3 HART process variables

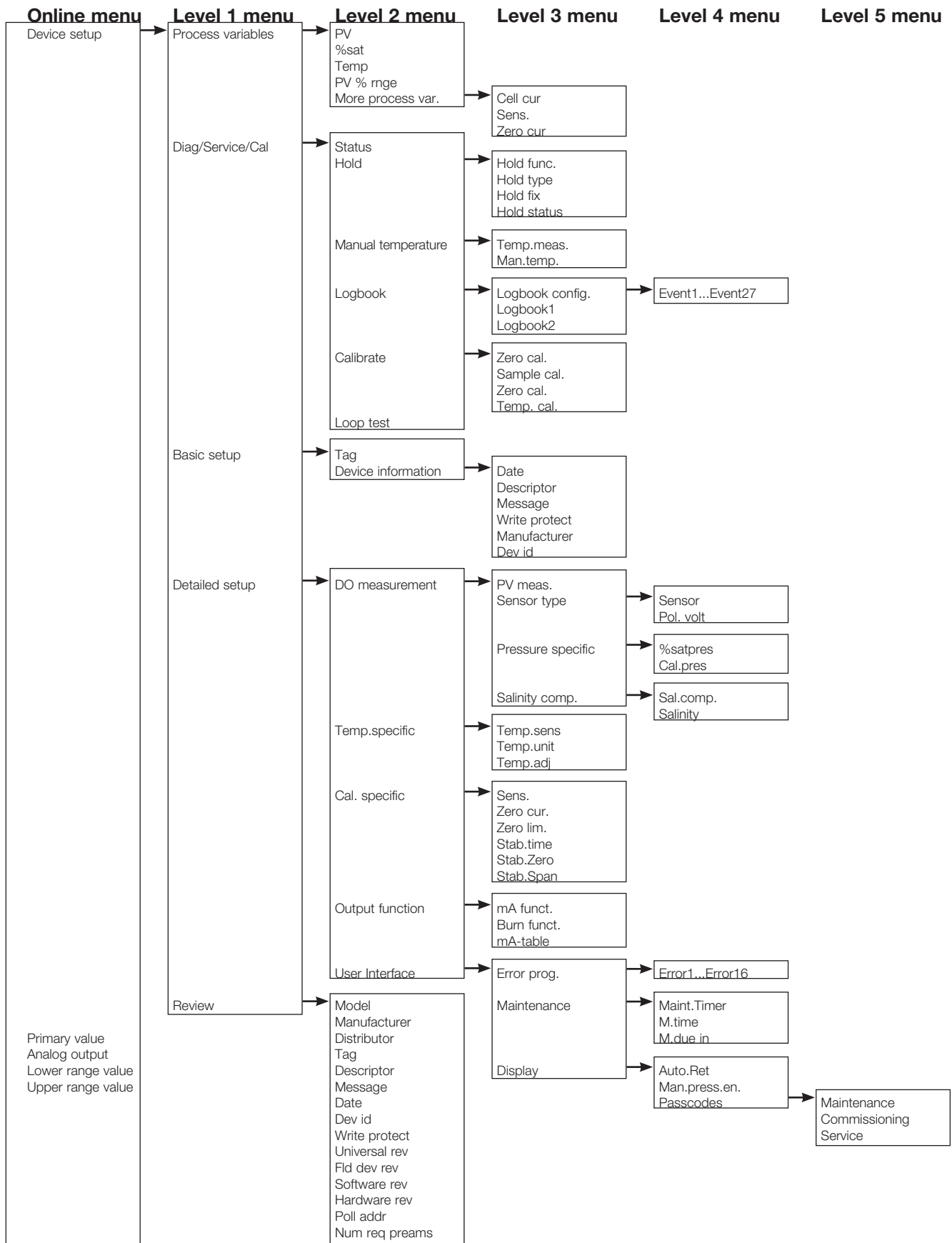
Through HART the user has access to the process variables:
 PV: User selected process value: ppm, ppb or % saturation
 SV: Temperature
 TV: % Saturation
 QV: sensor current

Each of these process variables can be decoded into current output or contact output through the HIM: Hart Interface Module.

Yokogawa offers standard a HIM with two 0- 20 or 4- 20 mA outputs and three contact outputs with 24 VDC power supply. Full communication with the DO202 can be done through various brands of HART Handheld terminals (HHT) or through Pactware. This program and the Yokogawa DTM library can be downloaded from YOKOGAWA WEB sites free of charge by Yokogawa customers. Yokogawa recommends the use of MH-02 modem for HART-RS232 conversion.

mA A-1-5 Device description (DD) menu structure

The Device Description (DD) is available from Yokogawa or the HART® foundation. An example is shown below of the ON LINE menu structure. This manual makes no attempt to explain the operation of the Hand Held Communicator (HHC). For detailed operating instructions, refer to the HHC instruction manual and the on-line help structure.



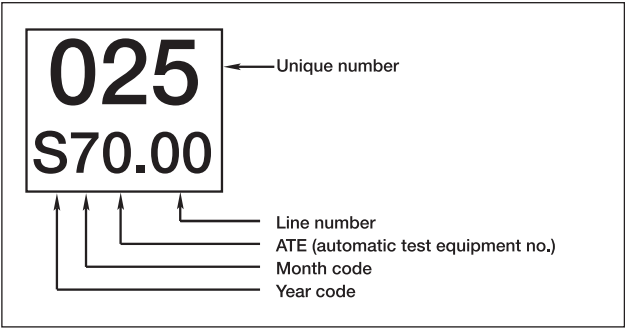
APPENDIX 2 Quality Inspection Standard (QIS)

Quality
Inspection
Standard

EXA Series
Model DO202
Dissolved Oxygen Transmitter

A-2-1. Introduction

This inspection procedure applies to the model DO202 dissolved oxygen transmitter. There is a serial number, unique to the instrument, which is stored in non-volatile memory. Each time the converter is powered up, the serial number is shown in the display. An example is shown below, for details see the Users manual:



A-2-2. General Inspection

Final testing begins with a visual inspection of the unit to ensure that all the relevant parts are present and correctly fitted.

A-2-3. Safety Test

Terminal 14 and the (-) minus are interconnected. This interconnection and the external ground terminal of the housing are connected to a Voltage generator (600 VAC RMS) for 1 second. The leakage current should remain below 4 mA.

The interconnection and the external ground terminal of the housing are connected to a Voltage generator (100 VDC). The measured impedance value should be over 100 Ω .

A-2-4. Accuracy Testing

Our automated testing facility checks the accuracy of the current input of the instrument using a calibrated current source to simulate the sensor current.

A-2-5. Accuracy Testing of all supported temperature elements

Our automated testing facility checks the input accuracy of the instrument using a calibrated variable resistor (decade resistor box) to simulate the resistance of all temperature elements.

A-2-6. Overall accuracy test

This test can be performed by the end-user to check the overall accuracy of the instrument. The data specified on the Quality Inspection Certificate are results of the overall accuracy test performed during production and can be reproduced by performing similar tests with the following test equipment:

1. A variable resistor box 1 (resistor decade box) to simulate the temperature element. All tests are performed simulating 25°C (77 °F).
2. A fixed resistor of 300 Ω to simulate the μ A-output load.
3. A current source ranging from 0 μ A to 50 μ A, resolution 0.01 μ A with an accuracy of 0.05% (galvanic).
4. A current source ranging from 0 nA to 1200nA, resolution 0.01 nA with an accuracy of 0.05% (polarographic).
5. A stabilised voltage supply unit: nominal 24 Volt DC
6. A current meter for DC currents up to 25 mA, resolution 1mA, accuracy 0.1%
7. A multimeter capable of measuring megohm ranges to check insulation impedance.
8. Screened cable to connect the input signals.

Connect the DO202 as shown in Figure 1. Set box 1 to simulate 25 °C (22 k Ω for 22k NTC)

Before starting the actual test, the DO202 and peripheral testing equipment has to be connected to the power supply for at least 5 minutes, to assure the instrument is warmed up properly.

The tolerances specified relate to the performance of the DO202 with calibrated test equipment under controlled test conditions (humidity, ambient temperature). Note that these accuracy's are only reproducible when performed with similar test equipment under similar test conditions. Under other conditions, the accuracy and linearity of the test equipment will be different. The display may show values, which differ as much as 1% from those measured under controlled conditions.

A-2-7. Accuracy test mA output circuit
Our automated testing facility checks the output accuracy of the instrument with simulated mA-output values.

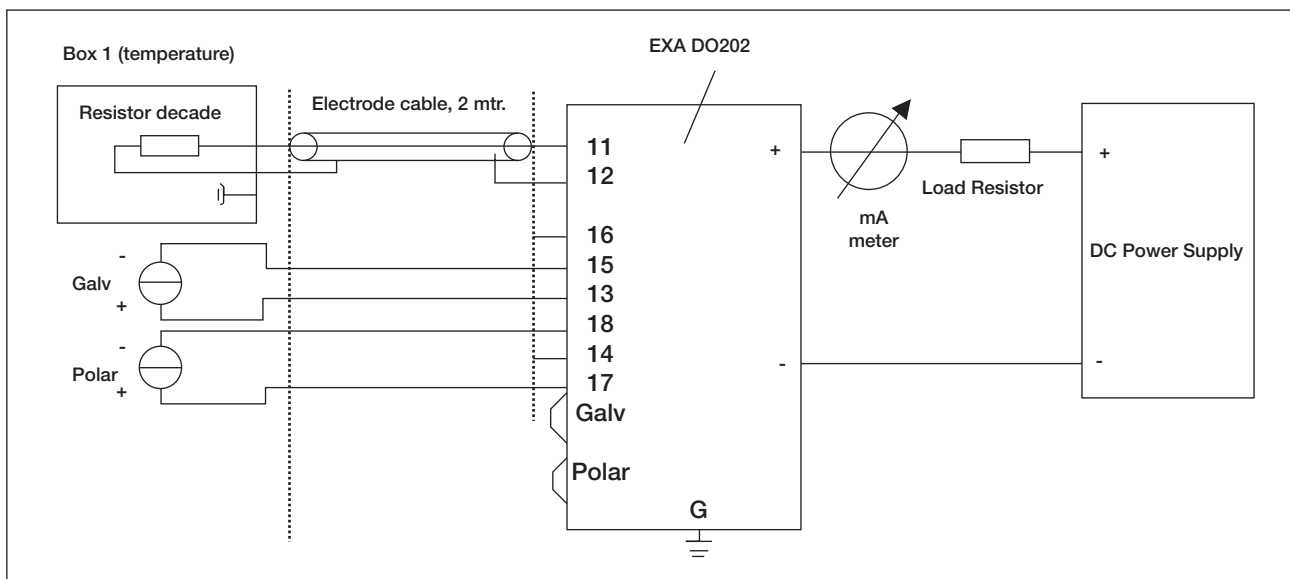


Figure 1. Connection diagram for the overall accuracy test

A-2-8. Quality Inspection Certificate

Quality Inspection Certificate

Model DO202
Dissolved Oxygen
Transmitter

EXA

1. Instrument Description							
Model :				Serial No :			
Order :				Release Version :			
2. General Inspection		OK					
3.1 Safety Test		OK		3.2 Communication Test		OK	
4.1.1 Accuracy Test (galvanic)				4.1.2 Accuracy Test (Polarographic)			
Input μA	Display μA	Tolerance μA	Reading μA	Input nA	Display nA	Tolerance nA	Reading nA
0	0.00	± 0.02		0.00	0.00	± 0.01	
10	10.00	± 0.06		4.00	4.00	± 0.03	
20	20.0	± 0.1		12.00	12.00	± 0.07	
30	30.0	± 0.1		40.0	40.0	± 0.2	
40	40.0	± 0.2		100.0	100.0	± 0.5	
50	50.0	± 0.2		400	400	± 2	
				1000	1000	± 5	
4.2.1 Accuracy Test (Temp. Display with Pt1000 RTD)				4.2.2 Accuracy Test (Temp. Display 22k NTC sensor)			
Resistance Ω	Temp. $^{\circ}\text{C}$	Tolerance $^{\circ}\text{C}$	Reading $^{\circ}\text{C}$	Resistance Ω	Temp. $^{\circ}\text{C}$	Tolerance $^{\circ}\text{C}$	Reading $^{\circ}\text{C}$
964.8	-9	± 0.3		99600	-9	± 0.3	
1097.3	25	± 0.3		22000	25	± 0.3	
1232.4	60	± 0.3		6072	60	± 0.3	
1385.0	100	± 0.3		1797	100	± 0.3	
1535.8	140	± 0.3		653.8	140	± 0.3	
4.2.3 Accuracy Test (Temp. Display with PB36)							
Resistance Ω	Temp. $^{\circ}\text{C}$	Tolerance $^{\circ}\text{C}$	Reading $^{\circ}\text{C}$				
9029	-9	± 0.3					
2179	25	± 0.3					
904.2	50	± 0.3					
4.3 Overall Accuracy Test (Sensitivity = 7.5 nA/ppm ; 22k NTC @ T = 25$\pm$ 0.3$^{\circ}\text{C}$)							
Input μA	Display μA	Tolerance μA	Reading μA	Nominal mA	Tolerance mA	Reading mA	
0.00	0.00	± 0.01		4.00	± 0.02		
7.55	1.00	± 0.02		4.80	± 0.04		
60.4	8.00	± 0.16		10.40	± 0.15		
150.9	20.0	± 0.4		20.00	± 0.34		
4.4 V polarization							
V polarization mV	Display V	Tolerance mV	Reading mV				
0	0.000	± 50					
250	0.250	± 50					
500	0.500	± 50					
750	0.750	± 50					
1000	1.000	± 50					
5. Accuracy Test mA output circuit				Date	Ambient Temp	Rel. Humidity	
Simulated Output mA	Tolerance mA	Actual Output mA			$^{\circ}\text{C}$	%RH	
4.0	± 0.02		Approved by:				
8.0	± 0.02						
12.0	± 0.02						
16.0	± 0.02						
20.0	± 0.02						

YOKOGAWA

Databankweg 20
3821AL Amersfoort
The Netherlands

QIC 12J6C3-E-E
1st Edition November 2004

A-2-9 Software Revision History

Software changes of the DO202

A-2-9-1. Changes made by software release 1.1

- Pb36 (DO30) temperature sensor added.

A-2-9-2. Changes made by software release 1.2

- Implementation of Burn low in combination with HART changed.
- Fixed hanging DO202 hangs during startup with low temperature resistor.
- Display real sensor current on LCD instead of a compensated current.
- Fixed unstable measurement in ppb range when sensor current is negative.

YOKOGAWA HEADQUARTERS 9-32, Nakacho 2-chome, Musashinoshi Tokyo 180 Japan Tel. (81)-422-52-5535 Fax (81)-422-55-1202 www.yokogawa.com	YOKOGAWA CORPORATION OF AMERICA 2 Dart Road Newnan GA 30265 United States Tel. (1)-770-253-7000 Fax (1)-770-251-2088 www.yokogawa.com/us	Yokogawa has an extensive sales and distribution network. Please refer to the European website (www.yokogawa.com/eu) to contact your nearest representative.  YOKOGAWA ◆
YOKOGAWA EUROPE B.V. Databankweg 20 3821 AL Amersfoort The Netherlands Tel. +31-33-4641 611 Fax +31-33-4641 610 www.yokogawa.com/eu	YOKOGAWA ELECTRIC ASIA Pte. Ltd. 5 Bedok South Road Singapore 469270 Singapore Tel. (65)-241-9933 Fax (65)-241-2606 www.yokogawa.com.sg	