Instruction Manual
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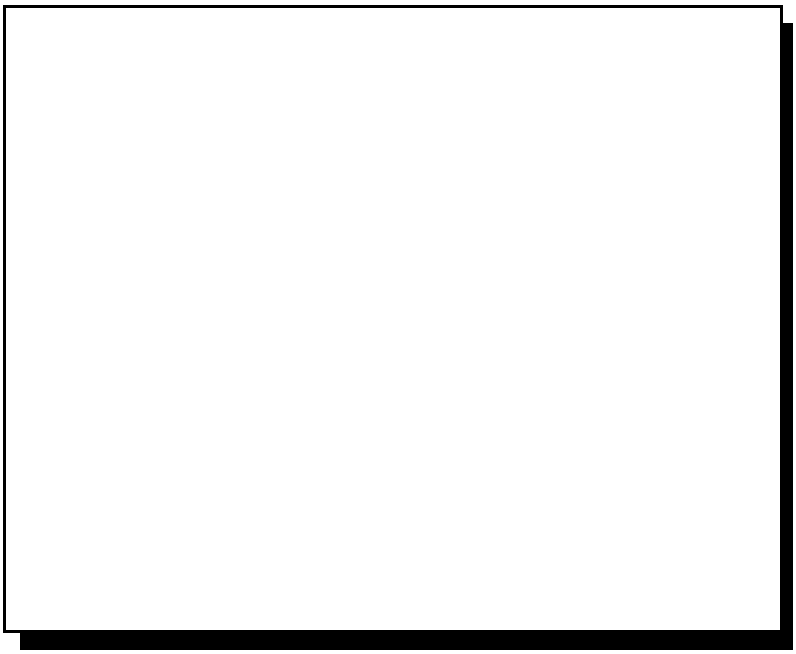
CCO 5500

Carbon Monoxide (CO) Analyzer



ROSEMOUNT® Analytical

http://www.raihome.com

EMERSON™ Process Management

CCO 5500 Carbon Monoxide (CO) Analyzer

ESSENTIAL INSTRUCTIONS

READ THIS PAGE BEFORE PROCEEDING!

Rosemount Analytical designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you **MUST properly install, use, and maintain them** to ensure they continue to operate within their normal specifications. The following instructions **MUST be adhered to** and integrated into your safety program when installing, using, and maintaining Rosemount Analytical products. Failure to follow the proper instructions may cause any one of the following situations to occur: Loss of life; personal injury; property damage; damage to this instrument; and warranty invalidation.

- **Read all instructions** prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, **contact your Rosemount Analytical representative** for clarification.
- **Follow all warnings, cautions, and instructions** marked on and supplied with the product.
- **Inform and educate your personnel in the proper installation, operation, and maintenance of the product**.
- **Install your equipment as specified in the Installation Instructions of the appropriate Instruction Manual and per applicable local and national codes.** Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, **use qualified personnel** to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, **and VOID YOUR WARRANTY**. Look-alike substitutions may result in fire, electrical hazards, or improper operation.
- **Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.**

The information contained in this document is subject to change without notice.

PREFACE

The purpose of this manual is to provide information concerning the components, functions, installation and maintenance of the CCO 5500.

Some sections may describe equipment not used in your configuration. The user should become thoroughly familiar with the operation of this module before operating it. Read this instruction manual completely.

DEFINITIONS

The following definitions apply to WARNINGS, CAUTIONS, and NOTES found throughout this publication.

⚠WARNING

Highlights an operation or maintenance procedure, practice, condition, statement, etc. If not strictly observed, could result in injury, death, or long-term health hazards of personnel.

⚠CAUTION

Highlights an operation or maintenance procedure, practice, condition, statement, etc. If not strictly observed, could result in damage to or destruction of equipment, or loss of effectiveness.

NOTE
Highlights an essential operating procedure, condition, or statement.

SYMBOLS

⏚ : EARTH (GROUND) TERMINAL

⏚ : PROTECTIVE CONDUCTOR TERMINAL

⚠ : RISK OF ELECTRICAL SHOCK

⚠ : WARNING: REFER TO INSTRUCTION BULLETIN

NOTE TO USERS

The number in the lower right corner of each illustration in this publication is a manual illustration number. It is not a part number, and is not related to the illustration in any technical manner.

Table of Contents

SECTION 3 Configuration and Startup

SECTION 4 Normal Operation

Section 1 Description and Specifications

OVERVIEW

Rapid advances in the design of 'across the duct' infrared gas analyzers have led to the general acceptance of this technique for the monitoring of gas levels in flue gases of power generation boilers and large industrial process steam boilers.

The CCO 5500 is designed to operate on duct widths of less than 26 ft (8 m) at flue gas temperatures up to 572°F (300°C). Their rugged construction makes installation extremely simple, and through the use of microprocessor technology they have many advanced features:

- Local normalizing inputs for compliance with legislation requirements
- Serial data facility to allow communication between analyzers and a central data logging station
- User-definable output in either mg/m^3, mg/Nm^3 or ppm
- Four rolling averages are held - selectable from 10 seconds to 30 days
- Integral, back lit 32 character LCD provides diagnostic and measurement information
- Plant status input to prevent emissions dilution during plant off periods

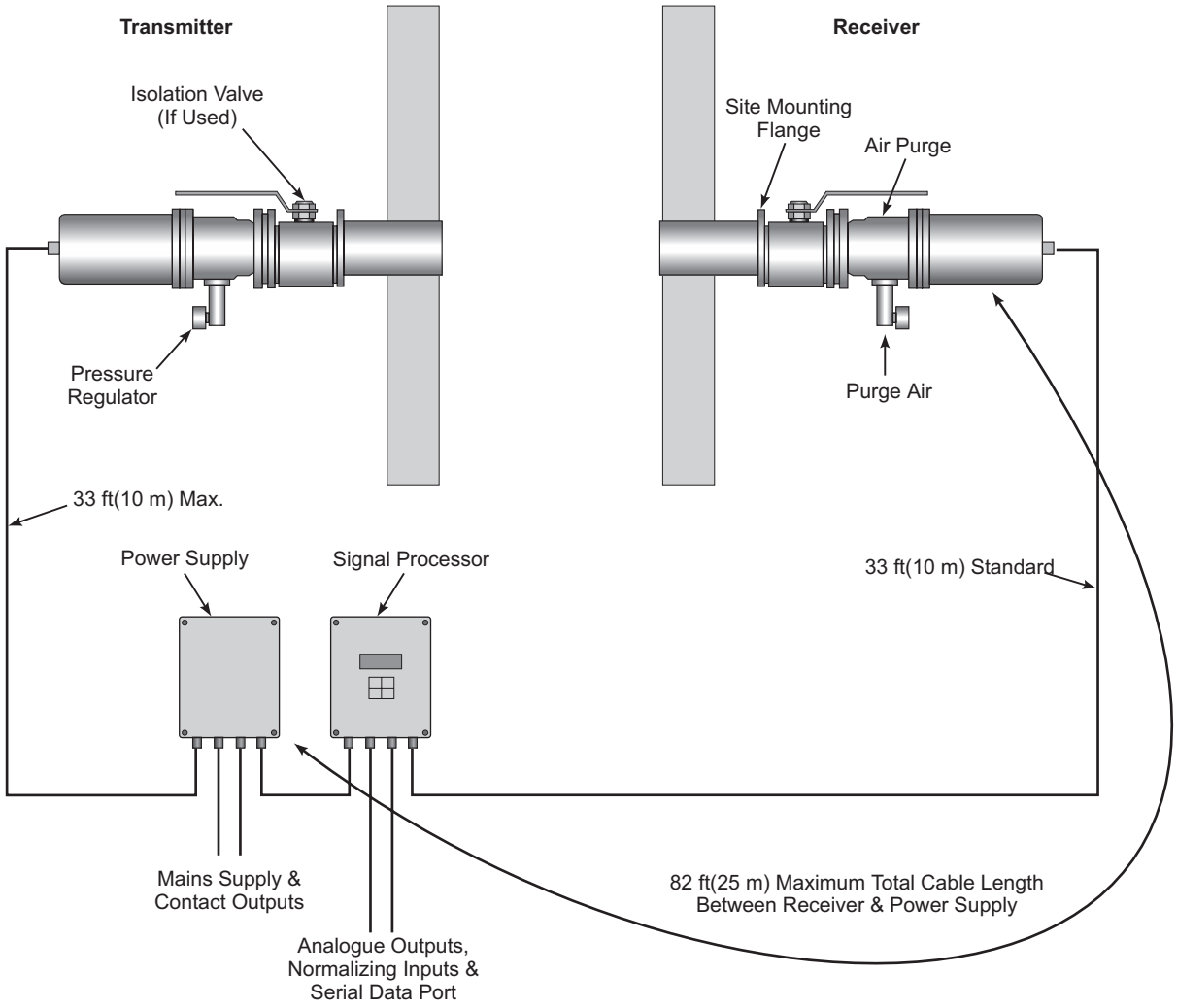
SYSTEM DESCRIPTION

The CCO 5500 Carbon Monoxide (CO) Analyzer Monitor consists of four items (Figure 1-1):

- An infrared **transmitter** unit to project a beam of infrared radiation across the duct
- A **receiver** to measure that radiation
- A **power supply unit** to provide the necessary power rails, and
- A **signal processor** to compute the gas concentration from the signals provided by the receiver unit.

Each of these units is designed to be rugged and durable. They are all fully sealed to IP65 standards and are suitable for outside mounting, without the need for further weatherproof enclosures.

Figure 1-1. Typical System Layout



Infrared Transmitter Unit

At the heart of this unit is a small heater assembly designed to give a high intensity uniform source of infrared energy over a long lifetime, in excess of two years continuous operation, with a power consumption of only 26 watts. The heater has a stainless steel cylindrical core, plasma coated with refractory, and around which is a 'Kanthal' heating element. This is then enclosed within refractory fibers and encapsulated in an aluminium cartridge. In the infrequent event of failure, the complete heater assembly can be replaced on site within ten minutes.

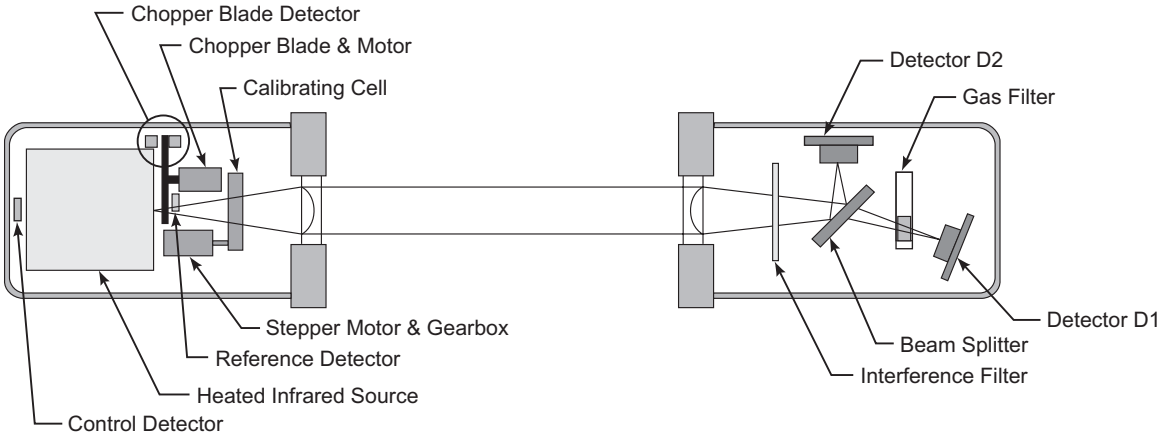
The radiation emitted by the heater is then 'chopped' by a motor-driven disc, and focused across the duct by a lens. The chopper disc is driven by a small DC motor. The phase and frequency of the chopper disc are monitored by a radiation detector to provide a reference signal that is utilized by the signal processor unit.

System calibration is achieved by a small calibration cell containing pure reference gas (CO) that can be swung into the sight path by means of a 'stepper' motor and gearbox assembly to enable continuous calibration updates to be maintained. The chopper motor and stepper motor represent the only moving components in the entire system.

A printed circuit board mounted at the front of the unit provides control circuitry for the heater, the motors, and the reference wave detector.

Figure 1-2 illustrates the transmitter and receiver units.

Figure 1-2. Transmitter and Receiver Schematic



Infrared Receiver Unit

The precision and reliability which CO concentration levels can be measured governs the performance of the complete instrument. For this reason design efforts have been concentrated in producing an extremely simple and robust receiver unit. It contains no moving parts, is fully sealed and designed to give many years of trouble-free and maintenance-free operation.

The unit comprises a lens to focus radiation received from across the duct, followed by a precision interference filter to limit the wave band of energy used. This filter tolerance is strictly controlled since it alone determines the instrument scale shape and calibration. The radiation then passes to an optical beam-splitter where approximately half the radiation is reflected at right angles directly onto a radiation detector. The other half of the radiation is transmitted, by the beam-splitter, through a gas cell containing pure reference gas (CO) and onto a second radiation detector.

The detectors used are lithium tantalate pyro-electric detectors, renowned for their sensitivity, stability and ability to operate at normal ambient temperatures, without the need for cooling. They respond only to changing levels of radiation and thus to the chopped radiation from the infrared source unit and not to background radiation from the flue or flue gas. The detector signals are amplified and fed to the signal processor unit.

Signal Processor Unit

The signal processor unit is housed in a fully-sealed cast-aluminum enclosure. It houses the microprocessor to monitor the data from the receiver and produces a 4-20 mA output signal for gas levels within the flue.

A non-volatile RAM section - requiring no battery back-up - enables all of its operation data to be retained during a power down condition. The instrument can resume operation immediately when power is restored without having to be recalibrated.

All operation data is entered via a surface-mounted keypad. A 32-character LCD provides the operator with measurement details and diagnostic information.

Inputs are available to receive the 4-20 mA outputs of normalizing measurement transducers - O_2, temperature and pressure, if required. This data can also be entered via the keypad or via the serial data port.

A serial communication facility within the processor allows the instrument to communicate with other Rosemount analyzers and a central data logging unit.

Power Supply Unit

The power supply unit is housed in a fully-sealed cast-aluminium enclosure and contains the power supplies for the instrument. A switched mode power supply is utilized to provide an extremely stable power source, able to cope with large fluctuations in the supply voltage. The contact outputs are also taken from this unit - data valid and high gas alarm.

Air Purge

The air purge unit has its own integral adjustable mount and provides the interface between the site mounting flange and the transmitter and receiver units. The purge is designed to provide a steady laminar flow of air away from the instrument lens, preventing optical contamination.

A supply of air to the purge is essential.

Isolating Valves

Isolating valves, if required, may be attached between the air purges and the duct. These will allow protection for personnel servicing instruments on high pressure ducts.

PRINCIPLES AND MODES OF OPERATION

Calculation of Gas Concentration

Gas levels are determined by measuring the absorption of infrared radiation, transmitted through the flue gas, in a wave band sensitive to absorption by the measurement gas. CCO 5500 monitors have two detectors; one measures the radiation directly to provide a live output, sensitive to the measurement gas, while a second detector measures the radiation after passing through a gas cell filled with pure reference gas (CO), to provide a reference measurement, completely unaffected by the measurement gas.

The basic expression from which the gas concentration in the gas is determined is:

$$Y = G - K.\ D2/D1$$

Where
- D1 = the reference output from the detector
- D2 = the live output from the detector
- G = a scaling factor (1600)
- K = a constant, known as the zero correction factor, set so that when there is zero measurement gas in the duct, Y = 0

thus, $$K = G.\ \frac{D1(0)}{D2(0)}$$

This parameter Y is then smoothed, linearized and compensated for effects of path length and flue gas temperature, to produce a measurement of gas concentration in the flue gas.

Error Compensation

The accurate determination of gas concentration depends on the measurement of the radiation levels received by the detectors. Any error in that measurement caused by detector drift will produce errors in the determination of the gas level. In order to maintain accuracy, it is necessary to be able to compensate for such drifts. In the CCO 5500 analyzer a technique of continuous calibration adjustment is used.

The operating cycle of the instrument is in two parts. First, measurements are obtained from the two detector outputs D1 and D2. The calibration cell, containing pure CO, is then positioned in the sight path and the two detector outputs are measured again to give readings E1 and E2.

From the basic scale shape equation:

$$Y = G - K.\ D2/D1$$

and from the calibration equation

$$Yo = G - K.\ E2/E1$$

or $$K = (G - Yo).\ E1/E2$$

thus substituting in the scale shape equation

$$Y = G - (G - Yo).\ E1/E2.\ D2/D1$$

The two ratios E1/D1 and E2/D2, being derived each from one detector, are independent of any detector drift, thus making the instrument output independent of any drift or change in detector gain characteristic.

This operating routine, giving measurements first of D1 and D2 and then, with the calibration cell in position, of E1 and E2, is repeated continuously and provides an effective continuous calibration update to enable accuracy to be maintained at all times.

Calculation Sequence

The calculations for one complete operating cycle of the instrument are given below:

- measure D1 & D2
- measure E1 & E2
- compute Y
- smooth Y
- linearize and correct for path length
- normalize measurement
- smooth to produce final gas outputs

Normalization Equations

Normalization of data collected by the analyses is essential to compare emission levels of pollutants into the atmosphere. Software in Rosemount Analyzers perform all calculations and provides results in various units, vpm, mg/m^3 and mg/Nm^3; derivation of these results is described in this section.

CCO 5500 CO analyzers are cross-duct type and thus measure the quantity (or number of molecules) of gas within their sight path. This measurement is converted into a concentration which is fully compensated for the expansion effects of temperature, while assuming constant atmospheric pressure. This basic measurement is referred to as 'ppm' (parts per million). However, to obtain a true concentration 'vpm' (ppm by volume) the 'ppm' value must be normalized for pressure using the following expression.

Correction to standard pressure -

$$vpm = ppm \times \frac{\text{standard pressure (abs)}}{\text{measured pressure (abs)}}$$

where standard pressure is taken as 101 kPascals.

The next stage in the process is to determine the mass concentration. The conversion at STP uses conversion factors determined as follows:

Conversion to mass concentration -

$$N = \frac{RMM}{V}$$

where
N = conversion factor
RMM = relative molecular mass of the gas
V = 22.4 (standard volume of an ideal gas)

The conversion factor given below:

Conversion factors (N) -

Molecular mass (RMM) = 12 + 16 = 28
1 vpm = 28/22.4 = 1.25 mg/m^3

The mass concentration present is calculated as below:

mg/m^3 (STP) = N. vpm

This value is the mass concentration of the gas at STP.

Correction for oxygen and water vapor.

Finally the effects of water vapor and oxygen need to be considered.

Since the vpm measurement is already normalized for temperature and pressure, the only further normalization required is for the dilution effects of water vapor and oxygen. These are straightforward calculations as shown below:

$$mg/Nm^3 = mg/m^3\ (STP) \times \frac{20.9 - 0\%_2\ standard}{20.9 - (0\%_2\ measured)\ DRY} \times \frac{100}{100 - H_2O\%}$$

20.9% is taken as the level of free oxygen in dry air.

NOTE

If the measured O_2% is a wet measurement the measured O_2 concentration must be corrected to a dry measurement. This is performed automatically by the software if the measured O_2 concentration is defined as a wet measurement; where:

$$(O_2\%\ measured)\ DRY = (O_2\%\ measured)\ WET \times \frac{100}{100 - H_2O\%}$$

If no correction is required for oxygen then standard O_2 = O_2 measured.

If no correction is required for water vapor then H_2O% = 0

After all these calculations have been performed the resulting measurement is the effective mass concentration of the pollutant normalized to standard conditions (in mg/Nm^3).

Measured conditions -

Where measured values are required (e.g. to calculate rates of emissions) they need to be recalculated for measured temperature and pressure as shown below:

$$mg/m^3 = N.vpm \times \frac{273}{T} \times \frac{measured\ pressure}{standard\ pressure}$$

substituting,

$$vpm = ppm \times \frac{standard\ pressure}{measured\ pressure}$$

the measured mass concentration of the gas is:

$$mg/m^3 = N.ppm \times \frac{273}{T}$$

Principles of Cross-Duct Gas Analyzers

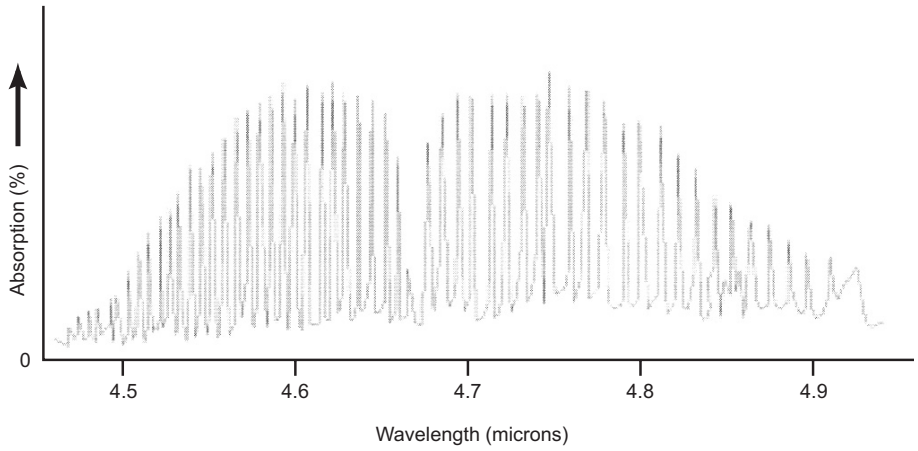
Cross-duct analyzers work on the basic principle that infrared (IR) energy is absorbed by particular gases in a manner very specific to the gas.

Although cross-duct analysis will differ from gas to gas, the basic principles are similar for all measured gases. This section examines the analysis of carbon monoxide in detail.

Carbon Monoxide IR Absorption Spectrum

Carbon monoxide absorbs IR energy in a band between wavelengths of approximately 4.5 and 4.9 μm. The absorption spectrum is complex and is illustrated in Figure 1-3 below.

Figure 1-3. CO IR Absorption Spectrum

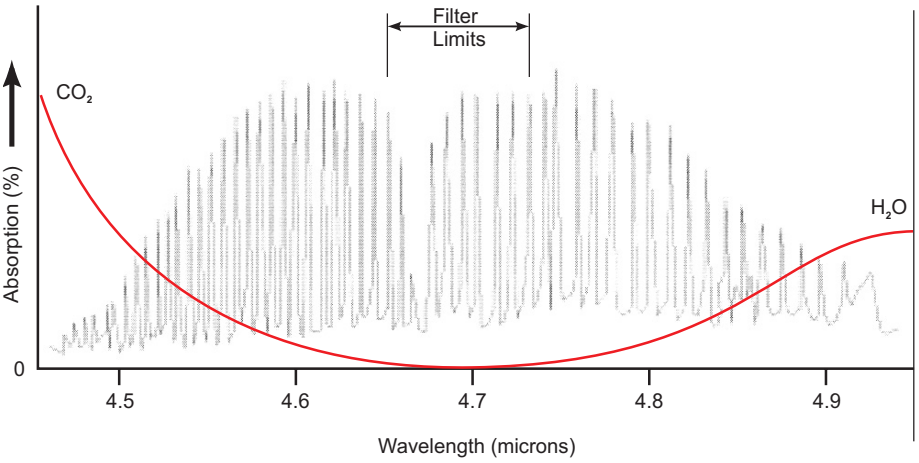


However, two other common flue gas constituents - carbon dioxide and water vapor - also absorb energy within this wave band. Fortunately, at 4.7μm, IR absorption by each of these gases is at a minimum. Figure 1-4 demonstrates how the absorption spectra of CO, CO_2 and water vapor affect wavelengths of between 4.5 and 4.9 μm.

Absorption Spectra of CO, CO_2 and Water Vapor

By using a narrow band pass filter which only passes IR energy at wavelengths of around 4.7μm, correctly designed CO analyzers are able to ignore the effects of water vapor and CO_2. (The filter characteristics are shown in Figure 1-4). No other flue gases absorb IR energy in this band.

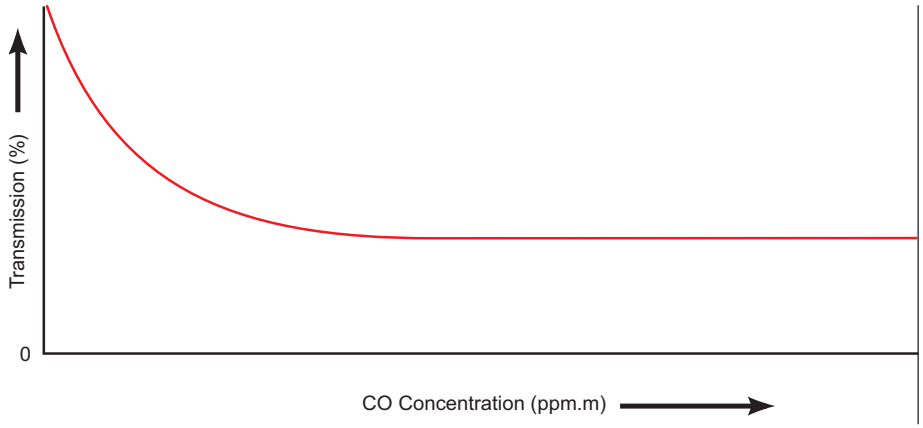
Figure 1-4. Comparison of Spectra



Transmissivity of CO Within the 4.7μm Band

The transmission through the gas of the IR energy at about 4.7μm is affected by the concentration of CO. Figure 1-5 illustrates how the energy within the selected band varies with CO concentration.

Figure 1-5. Transmissivity of CO



The shape of this curve is fixed by the characteristics of the 4.7μm filter - it cannot change, and the curve is practically flat at CO concentrations of above 10,000 ppm.meters. A cross-duct monitor effectively measures CO molecules in its optical path, so the same concentration of CO will have a greater effect across a large measurement path than a small measurement path. The term ppm.meters is the concentration of CO within the duct multiplied by the gas path length over which it has been measured.

Carbon Monoxide Calculation

CCO 5500 Analyzers make two measurements of IR energy in the narrow band around 4.7μm. Both measurements are made after the beam has passed through the gas to be measured. One, however, also passes through a cell containing pure CO (the gas cell shown in Figure 1-2). This absorbs all the energy capable of being absorbed by CO and provides a reference that is unaffected by any CO in the duct, but will be affected by any other material (e.g. dust) which reduces the energy received from the transmitter, in exactly the same way as the other beam.

The second beam does not have such a cell in front of it and, as such, is very sensitive to changes in CO within the duct.

The measurement of CO is calculated from a parameter Y, where:

$$Y = G\text{-}K.D2/D1$$

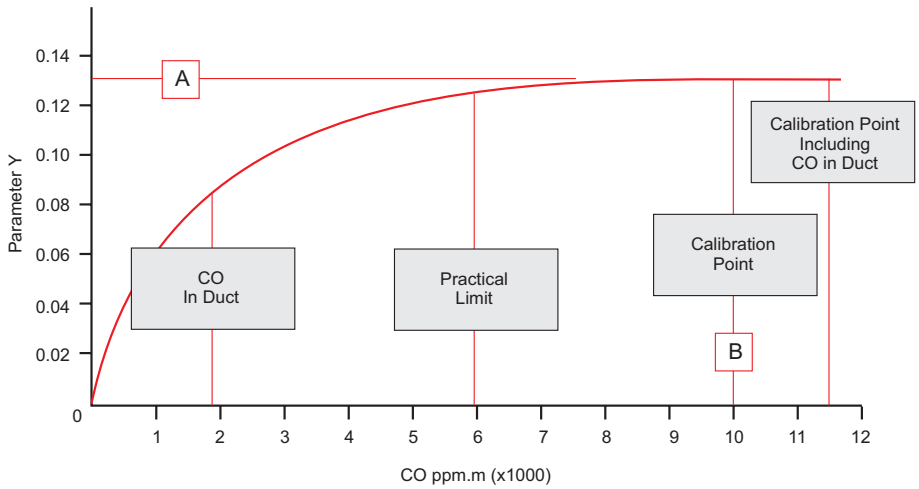
and

D2	=	the live detector output
D1	=	the reference detector output
K	=	a composite gain factor which takes account of all optical and electronic gains
G	=	scaling factor

Calibration

Figure 1-6 shows the parameter Y against the CO concentration.

Figure 1-6. Calibration Curve



This is the calibration curve for the instrument and is opposite in shape to the transmissivity curve shown in Figure 1-5. Each is fixed by the characteristics of the 4.7μm filter and cannot change. Rosemount Analytical analyzers make full use of this scale shape to provide an easily attainable calibration point.

It is not necessary to calculate K because we know that when the constant K is correct:

Y is 0 when the CO level is 0

If there is any drift in the measurement, it can only be due to a change in some optical or electronic gain and can always be corrected by setting Y to zero when the CO level is zero.

In practice, however, it is not always possible to produce a zero CO level, but if we consider the calibration curve, we can see that:

if Y = 0 when CO = 0
then Y = a when CO = b

We can also see from Figure 1-6 that at high CO levels, the parameter Y becomes completely insensitive to variable CO levels in the duct, such that:

Y = a when the CO $\geq$ b

By making Y = a when CO $\geq$ b, Y = 0 when CO = 0 and all these errors are eliminated.

A gas cell containing pure carbon monoxide can be introduced into the IR beam at the source. This cell represents a value of 10,000 ppm.meters and provides a reference point for the calibration of the instrument. Any further CO in the duct will have negligible effect on the reference point because the calibration curve is flat at these high concentrations of CO. Well-designed cross-duct analyzers introduce this gas cell regularly - every few seconds - to continuously check and (if necessary) modify their zero position.

SPECIFICATIONS

CCO 5500 Specifications	
Span*	Selectable from 0-100 ppm to 0-10,000 ppm, within the range 200 to 6,000 ppm.meters at STP
Display Units	ppm mg/m^3 (measured) mg/Nm^3 (normalized)
Averaging	Four averages selectable from 10 seconds to 30 days
Accuracy	±2% of measurements or ±5 ppm whichever is greater
Outputs Analog High Alarm Data Valid	4-20 mA isolated, 500Ω max. Volt-free contact, 10A @ 250V Volt-free contact, 10A @ 250V
Inputs Oxygen Temperature Pressure Plant Status Contact	 4-20 mA 4-20 mA 4-20 mA Volt-free Contact
Serial Port	For remote instrument operation, normalizing inputs and outputs
Path Length	1.6 to 26 ft (0.5 to 8 m)
Flue Gas Temperature	1202°F (0 to 650°C)
Construction	Cast aluminium, fully sealed to IP65
Transmitter	Electrically heated silicon nitride cylinder
Detector	Lithium tantalate pyro-electric detector
Ambient Temperature Limits	-4°F to 158°F (-20°C to 70°C)
Power Requirements	85-132/170-264V AC, 50/60 Hz, 50VA
Air Purge Consumption	2.2 cfm @ 14.9 psi (1 liter/sec @ 1 bar) (compressed air) 11 cfm (5 liter/sec) (blower air)

NOTE:
*The range of the output span is quoted in ppm.meters. To obtain the minimum and maximum span for your application, divide these figures by the path length in meters.

Section 2 Installation

⚠WARNING

Before installing this equipment, read the “Safety instructions for the wiring and installation of this apparatus” in Appendix A. Failure to follow safety instructions could result in serious injury or death.

⚠WARNING

Install all protective equipment covers and safety ground leads after installation. Failure to install covers and ground leads could result in serious injury or death.

⚠WARNING

Before making any electrical connections, make sure the AC power supply is first switched off. Failure to do so could cause personal injury or even death. Make sure that the voltage and frequency of the AC supply match the designations on the analyzer component tags.

SAFETY CONSIDERATIONS

The mains power is supplied to the whole system via the power supply. During installation, DO NOT connect the system to the mains until all units are in place and fully wired up. Keep the isolating valves, if used, CLOSED. The compressed air (to be supplied to the air purges) must be turned OFF until the full installation is complete. If any servicing or rewiring is to be performed ensure that the power supply is isolated. For configuration the system needs to have power, compressed air and the isolating valves open.

ELECTRICAL SUPPLY DATA

AC Supplies

The CCO 5500 may be powered from either 85-132V AC/170-264V AC at 47-440 Hz. A switch within the power supply unit selects the input voltage and an internal 2A/20 mm fuse protects the instrument.

Voltage fluctuations within the above ranges are tolerated without loss of performance and the total power requirement is less than 50VA.

Outputs

Three forms of output are provided:

1. A selectable, fully isolated, current output (either 4-20 mA or 0-20 mA), maximum load 500Ω - taken from the signal processor.
2. Single pole change-over relays (rating 250V at 10A), for:
   - Alarm triggering at a selectable gas threshold
   - Data valid indication, operating under power failure and any equipment fault condition - see the basic fault finding section for further details - contact outputs are taken from the power supply unit
3. 4-wire serial data link for 2-way communication with a central processor - taken from the signal processor unit.

Normalizing Inputs

Pressure, temperature, and oxygen values can be held to normalize the calculated gas value to standard conditions. These values may be read by the instrument using the following methods:

1. Fixed value from the key pad.
2. 4-20 mA outputs from measurement transducers - the ranges represented by these inputs are set from within the processor - inputs are taken to the signal processor.
3. If the analyzer is part of an integrated system, the serial data line can carry the normalizing values.

Plant Status Input

The plant status input facility is available to prevent the rolling average stacks being diluted by measurements made during periods where the plant is shut down. It is governed by one of three choices; a serial input (from an integrated system), the logic input (terminals PS1 and PS2 in the signal processor) and multiple. Multiple has five options; temperature, oxygen, water vapor thresholds, and logic input. It is set in Mode 5. All these are described in more detail later in this manual.

In normal operation (plant operating), the plant status will register as ON. However, if the plant status condition is broken, the status will change to OFF and the averaging stacks (minutes, hours, days) will not be updated.

NOTE
For normal operation terminals PS1 and PS2 must not be linked together.

CABLE REQUIREMENTS

1. Power supply to signal processor - 7-core, shielded, multi-stranded, 6/0.2 mm. 0.5 mm^2.

NOTE
Although screened cable is specified for the interconnecting cable, it is not necessary for the cable to be grounded.

2. Current loop output - any suitable 2-conductor cable - maximum length depends on keeping output load within the 500Ω maximum load requirement.
3. Contact outputs - any 2-conductor cable capable of supplying the power to the warning device/relay etc. 250V, 10A maximum.
4. A.C. power - any suitable 3-conductor power cable capable of transmitting 50VA.
5. Serial data link (if required) - twin twisted pair shielded cable - see IEM Communications Manual for further details (Doc. ID 0006/6).
6. Analog inputs - any suitable 2-conductor cable - Rosemount instruments have an internal impedance of 240Ω for these inputs.

UNPACKING THE EQUIPMENT

A typical Rosemount Analytical CCO 5500 Carbon Monoxide (CO) Analyzer should contain the following items. Record the part number, serial number, and order number for each component of your system.

1. Transmitter with 33 ft (10 m) of cable and air purge.
2. Receiver with 33 ft (10 m) of cable and air purge.
3. Signal processor.
4. Power supply.
5. Site mounting flange (2).
6. Gaskets (4), selected screws and washers.

SELECTING LOCATION

The equipment is designed for mounting on boiler ducting or stacks in positions open to the weather. It is fully sealed and requires no further enclosures or protection. The specific location of the instrument will depend on the application and user requirements, but the following considerations should be made when choosing a site.

1. The site must be accessible at both sides of the duct for servicing the transmitter and receiver.
2. The site should be as free from extremes of temperature and vibration as possible - permissible ambient temperature range -4°F to 158°F (-20°C to +70°C).
3. Flue gas temperatures should not exceed 572°F (300°C) at the point of measurement - at higher temperatures instrument accuracy will deteriorate.
4. There must be an uninterrupted sight path available between the transmitter and the receiver.
5. The maximum cable length allowed between the power supply and the transmitter is 33 ft (10 m).
6. The maximum total cable length between the power supply and the receiver is 82 ft (25 m).

See Figure 1-1 for an illustration of a typical system arrangement.

Points to Consider

Path Length

- Too long [>26 ft (8 m)] - low energy available.
- Too short [<1.6 ft (0.5 m)] - optical problems.

Flue Gas Temperature

- Too low (<dewpoint) - potential water droplets.
- Too high [>662°F (>300°C)] - reduced sensitivity.

Ambient Temperature

- Too low [< -4°F (< -20°C)] - condensation on lenses.
- Too high [>158°F (+70°C)] - potential instrument problems.

Measurement Range

- Minimum range depends on acceptable measurement uncertainty, which is 10 ppm.meters, e.g. for the level of uncertainty to be below 2% of range, the minimum range would be 500 ppm. meters.

  Note: 10 ppm CO = 12.5 mg/m^3
- For increased sensitivity (reduced uncertainty of measurement) the path length must be maximized.
- Maximum ranges - 6000 ppm.meters.

  Note: To correct ppm.meters to effective ppm, divide by the pathlength.

DUCT WORK

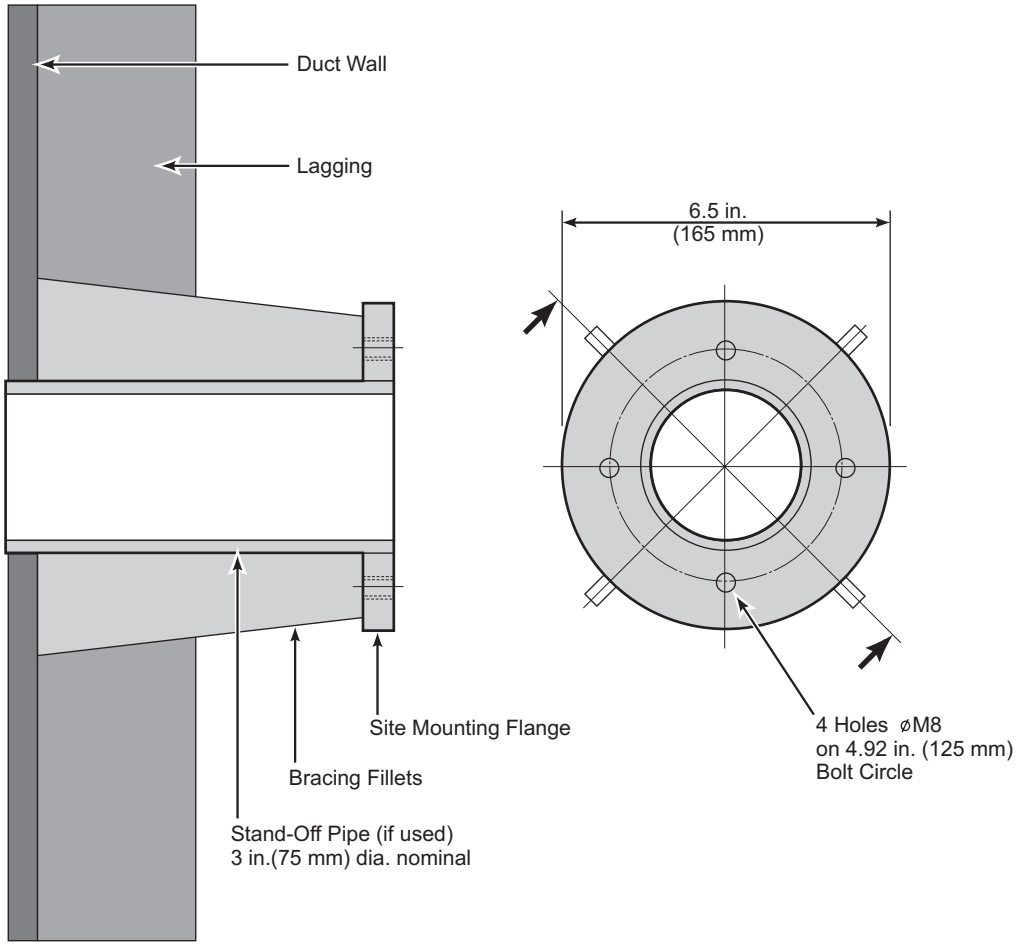
The transmitter and receiver units are mounted on a site mounting flange, Figure 2-1, on opposite sides of the duct. To protect operators, it is recommended that an isolating valve is used for ducts that operate at a higher than atmospheric pressure.

A stand-off pipe [nominal bore 3 in. (75 mm) - not supplied] should be used between the duct and the site mounting flange. The pipe should be long enough to clear the equipment from any duct lagging; it also helps to insulate the equipment from any high duct temperatures.

A hole should be cut on either side of the duct to be measured; these holes should accept a 'slip fit' with the stand-off pipe. The stand-off pipe should now be welded into each hole and a mounting flange welded to each pipe with the tapped holes positioned as shown in Figure 2-1 (it may be easier to weld the pipe and the flange together before they are fixed to the duct). To avoid vibration and movement, it may be necessary to fit spreader plates or bracing fillets.

Alignment is satisfactory if one orifice can be clearly seen when viewed through the stand-off pipe on the other side of the duct. It is suggested that the stand-off pipe is 'tacked' on to the duct and the alignment checked visually before a complete weld is made. The alignment of these holes is not critical, as the integral adjustable mount compensates for up to 4^{o} of misalignment.

Figure 2-1. Site Mounting Flange



ISOLATING VALVES

If isolating valves are used they mount directly onto the site mounting flanges.

AIR PURGE

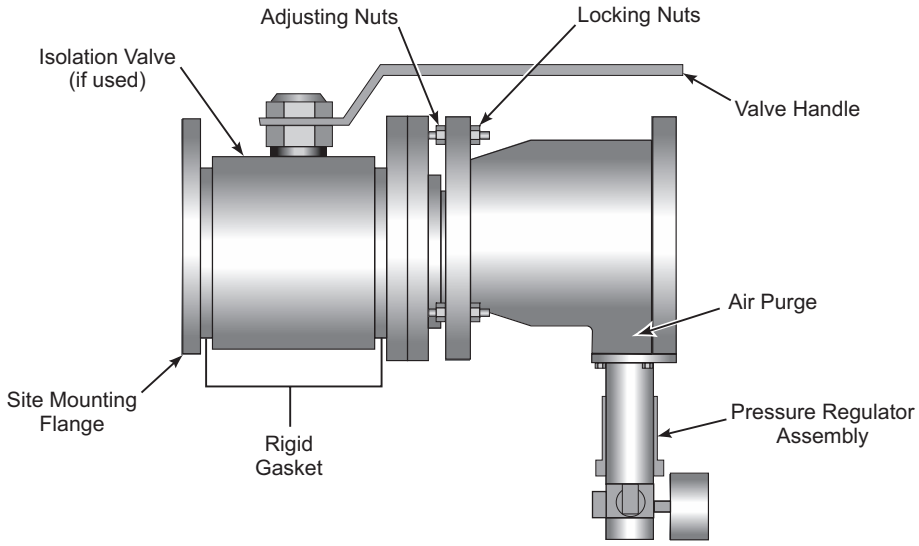
The air purge mounts on the isolating valve. They are mounted by separating the front flange from the air purge by unscrewing the four locking nuts. A 'snout' and o-ring arrangement locate into the front flange; work the two apart carefully. The front flange should now be bolted to the isolating valve if used or site flanges with a rigid gasket fitted between them, using the four countersunk screws provided.

NOTE

Before mounting the air purges, ensure that air is supplied to the air purge unit. If this precaution is not observed then the air purge and the optical surfaces may be severely contaminated.

The adjustable flange is then positioned on the front flange, taking care that the o-ring seal and 'snout' locate smoothly into the central aperture. This is then secured by the four locking nuts that screw down onto the adjustable flange. The arrangement should now appear as shown in Figure 2-2.

Figure 2-2. Valve and Purge Arrangement



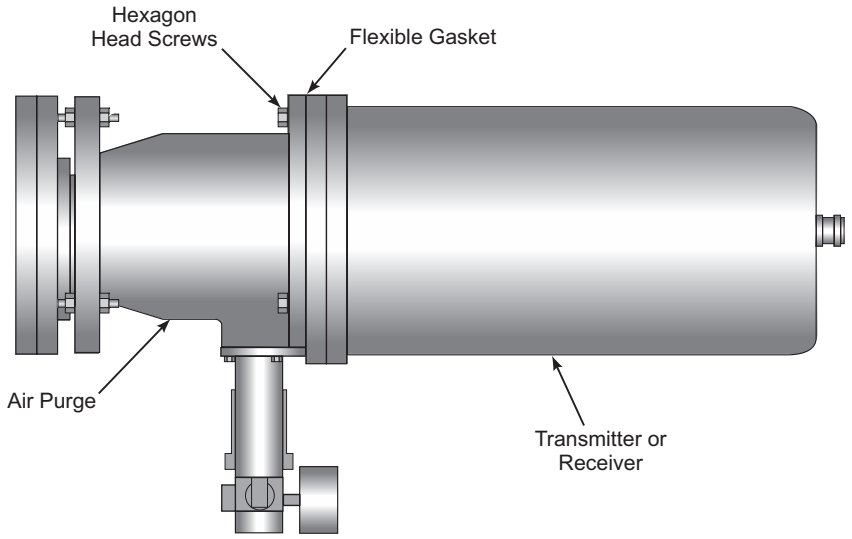
TRANSMITTER AND RECEIVER

The transmitter and receiver attach to the rear face of the air purge with a flexible gasket fitted between them, using the M6 x 20 hexagon head screws provided (see Figure 2-3). A locating dowel ensures that the units can only be attached to the air purge in one position - make sure this locates correctly.

NOTE

Before mounting the transmitter and receiver, ensure that air is supplied to the air purge unit. If this precaution is not observed then the air purge and the optical surfaces may be severely contaminated.

Figure 2-3. Analyzer Head Arrangement



AIR SUPPLY

The purpose of the air purge is to keep the windows of the transmitter and the receiver clean. Air may be supplied by one of three methods:

1. Negative pressure duct.

   If the duct across which the instrument is measuring operates at a negative pressure under all firing conditions, the air purge inlets may be simply left open and the negative draft in the duct allowed to draw in ambient air.

NOTE
For positive pressure ducts, they must be supplied with either compressed air, or air from a blower.

2. Compressed air.

   Using a fine flow regulator and filter, compressed air may be used to provide the low flow required - an air supply of 14.7 psi (1 bar) is required and the consumption is 2.2 cfm (1 liter/second) per purge.

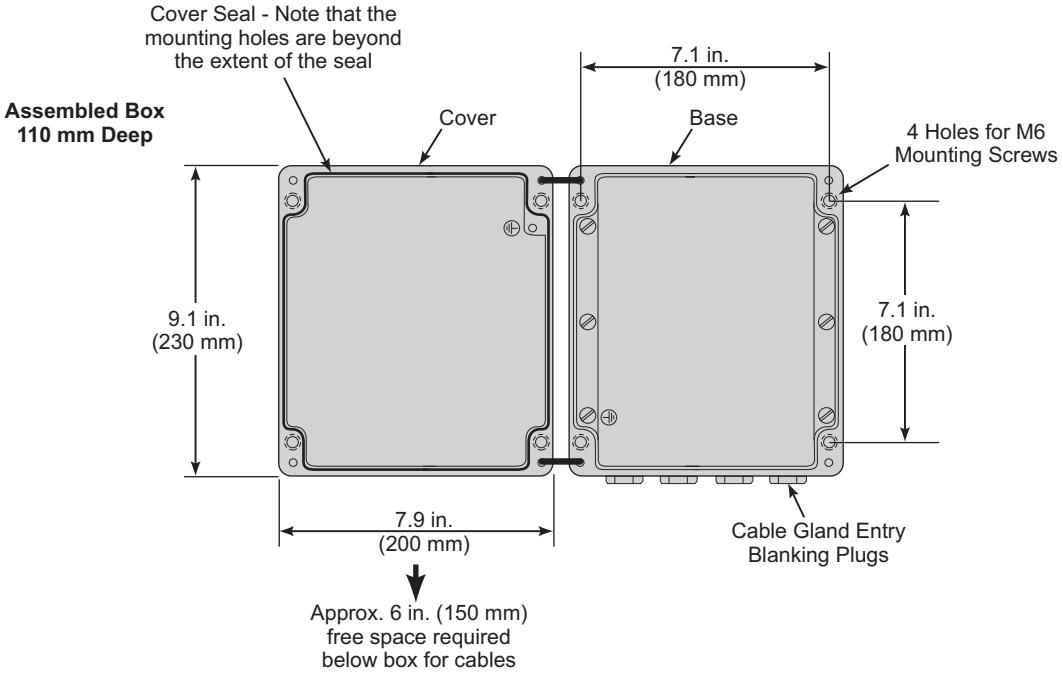
3. Blower air.

   A blower may be used to provide the air to the air purge - customers may specify their own blower - it should be able to deliver 11 cfm (5 liters/second) per purge against the working pressure of the duct - Rosemount Analytical can specify a blower if required.

SIGNAL PROCESSOR UNIT

Enough cable is supplied to mount the signal processor up to 33 ft (10 m) from the receiver. To mount the signal processor (Figure 2-4), first remove the cover by loosening the four captive screws, unplug the ribbon cable at the connector on the lid PCB. Note that the processor case has a hinged lid. The case is then secured to a firm support by use of the four mounting holes found in the four corners of the case, outside the sealing rim. Since the mounting holes are located outside the seal of the case, it is not necessary to seal the mounting holes after installation, nor is it necessary to remove the circuitry from the case for installation.

Figure 2-4. Signal Processor Unit/Power Supply Unit Mounting Detail



POWER SUPPLY UNIT

Enough cable is supplied to mount the power supply up to a maximum of 33 ft (10 m) from the transmitter. A maximum total cable length of 82 ft (25 m) may be used to link the power supply to the receiver. These are the maximum permitted lengths of cable and must not be exceeded.

Dimensions and mounting hole locations are identical to the signal processor and are illustrated in Figure 2-4.

ELECTRICAL CONNECTIONS

⚠WARNING

Wiring should only be undertaken by a qualified technician.

Ensure that the power supply is isolated.

DO NOT switch power on until all installation work is complete and the system is ready for configuring.

Installation of Cables

Decide routing for all **non-power cables** (both those supplied by Rosemount Analytical and those sourced locally). Use common routing wherever possible and install leaving sufficient free-end length to make final connections.

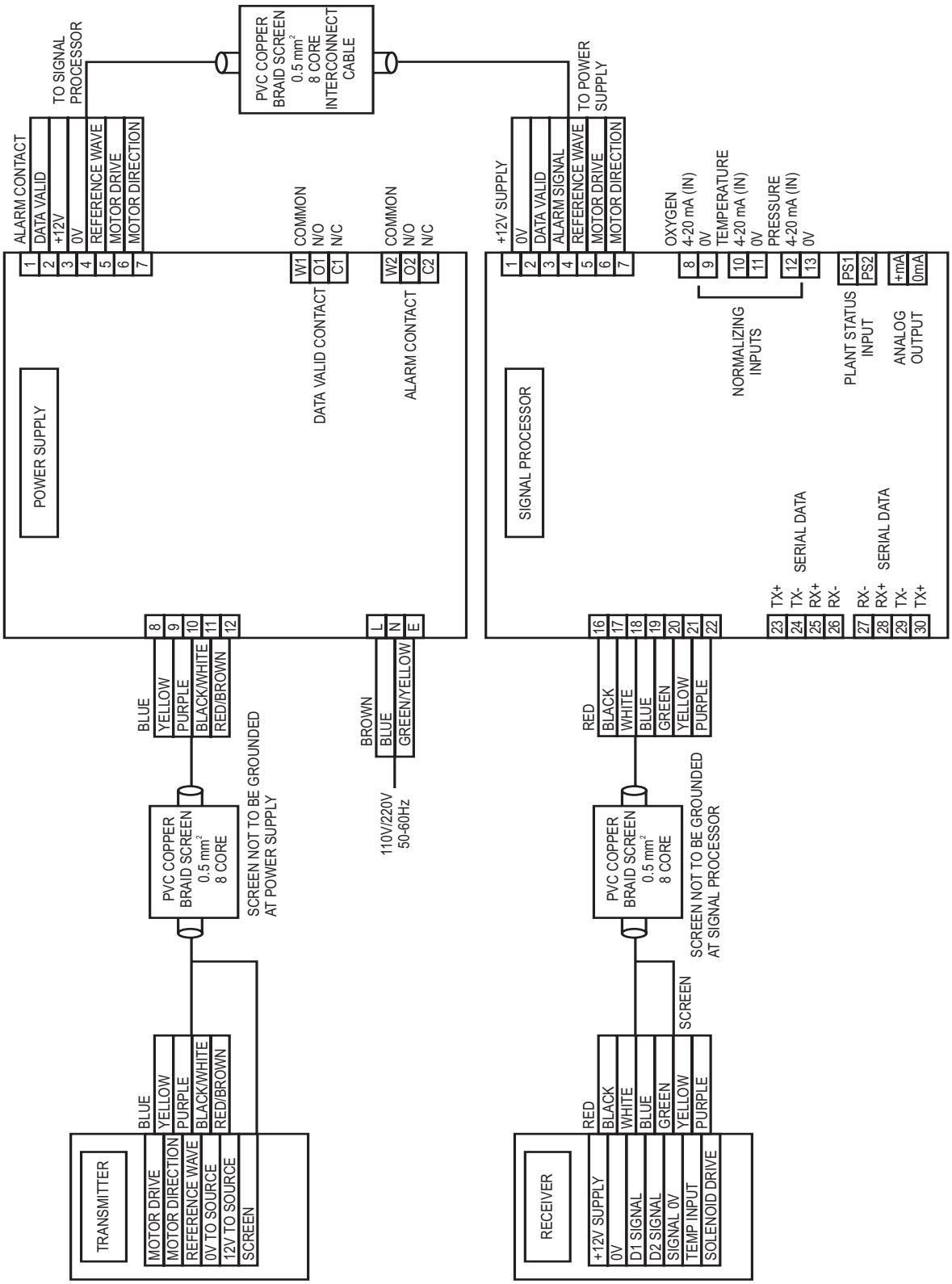
Power cables should be installed separately, using different routes if possible to reduce the risk of cross interference. Leave sufficient free-end length to make final connections.

Rosemount supplied cables are provided with ferrite beads fitted to all cores to protect against interference and should not be modified without consulting Rosemount.

Cable Connections

Overall system connections are illustrated in Figure 2-5.

Figure 2-5. System Cable Connections



Section 3 Configuration and Startup

INTRODUCTION

Configuring the instrument can take up to a couple of hours and consists of the following operations:

1. Power supply voltage selection - select from either 110 or 220V supply.
2. Apply power - switch the power ON and observe the power supply rail indications.
3. Alignment - optically align the transmitter and receiver units using the integral adjustable mounts*.
4. Gain adjustment - adjust the gain within the receiver head and the signal processor*.
5. Operating parameters - set the operating parameters within the micro-processor for correct instrument operation.
6. Calibration - calibrate to a zero or an estimated gas concentration*.
7. Current output calibration - calibrate the analog current loop output.
8. Record the set-up and calibration data - it is strongly recommended that the operating parameters are recorded in Table 3-1, and the calibration data in Table 3-2.

NOTE
*These operations are preferably conducted when a clean stack condition exists.

SAFETY CONSIDERATIONS

The mains power is supplied to the whole system via the power supply unit. If any servicing or rewiring is to be performed ensure that the power supply is isolated. For configuring the CCO 5500, the system needs power, compressed air to the air purges and the isolating valves (if used) to be open.

POWER SUPPLY VOLTAGE SELECTION

⚠WARNING

Disconnect and lock out power before removing the power supply cover.

With the mains supply switched OFF, unscrew the four captive screws on the cover of the power supply and remove the cover. Select the correct supply voltage using the sliding switch.

TURNING THE POWER ON

Once the supply voltage switch has been correctly set, switch the power ON. Check that the power supply rail indication LED illuminates and that the LCD display is functioning at the signal processor. Replace the lid of the power supply.

After the initial power on and while the heated source is reaching temperature, the display will show WAITING FOR REFERENCE. When the source has reached an adequate temperature for the reference to be detected, the message STABILIZING REF will be displayed, along with the frequency and mark/space ratio - see diagnostic mode for details.

The reference frequency will take some time to stabilize (about 5 minutes from cold startup). When it has been within tolerance for 10 consecutive measurement cycles, the instrument will automatically change to the operating mode - this is Mode 1 and is indicated by a number 1 appearing in the top left hand corner of the LCD. The display will show a reading in ppm - this is not accurate until configuration has been completed.

Allow 30 minutes before conducting the alignment procedure; this ensures that the source temperature has stabilized.

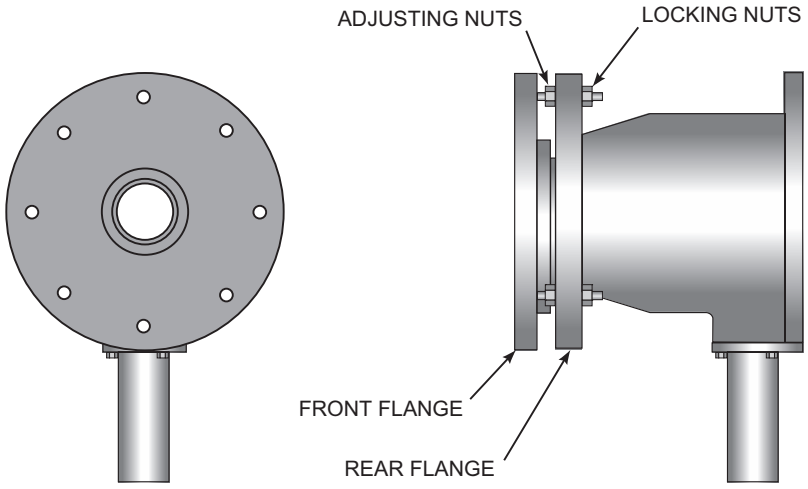
ALIGNMENT

In order for the instrument to operate satisfactorily, the transmitter and receiver units need to be aligned. A degree of optical redundancy is built-in and normal duct movements do not affect the operation of the instrument.

The transmitter and receiver need to be aligned. Remove the receiver from its air purge and align the transmitter so the red light it emits can be seen at the other side of the duct (through the receiver purge). Then replace the receiver and align, using as a guide, the detector levels displayed by the signal processor in Mode 5. Finally, the transmitter adjustment is 'fine tuned' once again using the detector levels in Mode 5. All these processes are described in the following steps.

1. Remove the receiver from its mounting flange. Adjust the alignment of the transmitter flange until the bright red disc of the transmitter is located centrally in the field of view, when viewed from the receiver air purge. Use the adjusting nuts to alter alignment. First adjust in one plane (using opposite nuts) then adjust in the other plane. Lock the transmitter flange with the locking nuts.
2. Adjustments to the alignment are made using the four adjusting nuts, and the flange is locked in position using the locking nuts - these are illustrated in Figure 3-1.

Figure 3-1. Adjusting Nuts for Alignment



3. Replace the receiver on its air purge. The next adjustment is done using the detector levels as viewed from the signal processor.
4. To change mode on the signal processor the MODE key needs to be pressed once to access each mode. Enter SET UP MODE (Mode 5) by pressing the MODE key 4 times. 5 SET UP will then be displayed on the LCD. Press ENTER to access the mode.
5. Because Mode 5 is used to configure the instrument, a security code is used to prevent any unauthorized alteration of settings. The default code set at the factory is 0000. The cursor will flash over the first digit that should be altered using the arrow keys until the desired number is displayed, press ENTER and the cursor will move onto the second digit. Similarly alter and press ENTER when the desired number is displayed. When the fourth digit has been correctly entered the processor will enter Mode 5.
6. Within Mode 5 select the CALIBRATE menu using the arrow keys. Press ENTER when calibrate is displayed.
7. Once again, use the arrow keys to select DISPLAY DETECTOR LEVELS option and press ENTER to access. The D1 and D2 detector levels will be displayed. **Important** - if not in this mode, the gas cell at the source will periodically interrupt the IR beam and make alignment difficult.
8. Adjust the alignment of the receiver by using the adjusting nuts. As for the transmitter, the alignment is best conducted by adjusting in one plane first, then in the other. As a 'rule of thumb', it will be observed that the D2 detector level will be affected to a greater extent by adjustment in one particular plane. Similarly, the D1 detector level will be affected more by adjustment in the other plane.
9. Use this guide to ensure that the MAXIMUM possible values of both D1 and D2 are reached. After alignment has been achieved, lock the flange into position using the locking nuts.
10. If the displayed detector level is below 5000, increase the gain from the signal processor to about 10,000; if above 15,000, reduce to 10,000. Refer to Detector Levels for details of this operation.

NOTE
The alignment of the receiver unit is important. Take time to ensure that maximum values of D1 and D2 are obtained.

11. To 'fine tune' the alignment, return once more and adjust the transmitter flange, again observing the values of D1 and D2 as appropriate; lock the flange in place when a MAXIMUM has been obtained.
12. After this procedure has been followed, the alignment is completed and there is rarely any need for further adjustments.

NOTE
The alignment of the receiver may be conducted by monitoring the output of the detector directly. This can be done using a voltmeter set to AC volts (10V max.) measuring across test points S0V and S2 for D3 and S0V and S1 for D1 on the RECEIVER CONTROL BOARD within the receiver (Figure 3-3). This is useful should the receiver be some distance from the signal processor.

DETECTOR LEVELS

The gain of the detector signals is set in two locations:

1. In the receiver: two potentiometers set the gain. Refer to Receiver Gain Adjustment.
2. In the signal processor: trim potentiometers adjust the level of the D1 and D2 signals before they enter the microprocessor. Refer to Receiver Gain Adjustment.

It is essential that the alignment procedure has been conducted and a maximum detector signal obtained before attempting to optimize the detector levels.

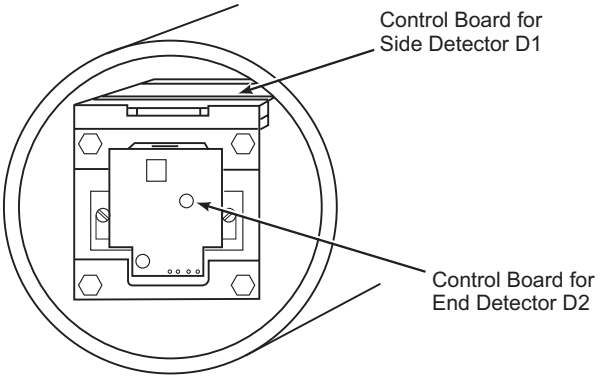
To give an optimum signal-to-noise ratio, the detector levels must be maximized.

Receiver Gain Adjustment

For the best signal-to-noise ratio, the gain of the detector signals within the receiver must be set to a maximum, without saturating. The gains will have been set by Rosemount Analytical at a pathlength of 6.5 ft (2 m). If the pathlength is above 13 ft (4 m) or below 5 ft (1.5 m), this adjustment may be necessary to optimize the detector levels. If the pathlength is within this range, this section may be ignored unless there is insufficient or too much gain.

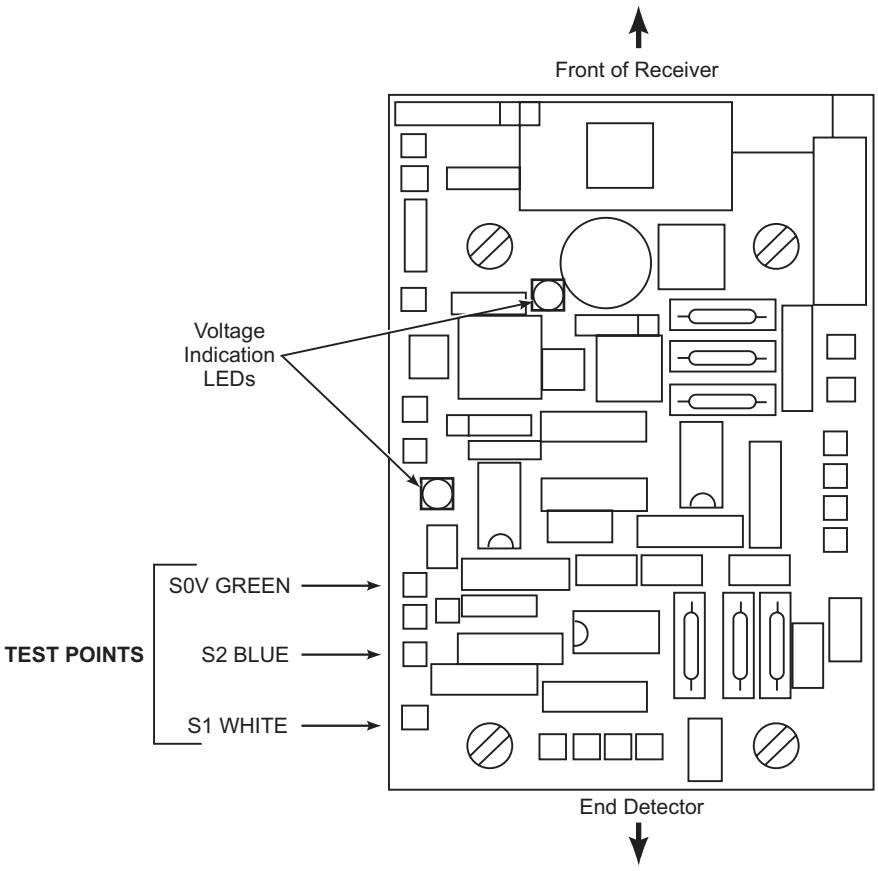
1. Enter the Setup mode, CALIBRATE OPTION-SET DETECTORS, and display the value of D2/D1.
2. Loosen the cable gland and remove the end cap from the receiver body, letting the cable slip through the gland.
3. The receiver can now be accessed as shown in Figure 3-2.

Figure 3-2. Receiver Trim Pots



4. Trim potentiometer(s) set the gain with the receiver. Levels should be measured with a voltmeter set to AC Volts.

Figure 3-3. Receiver Test Points



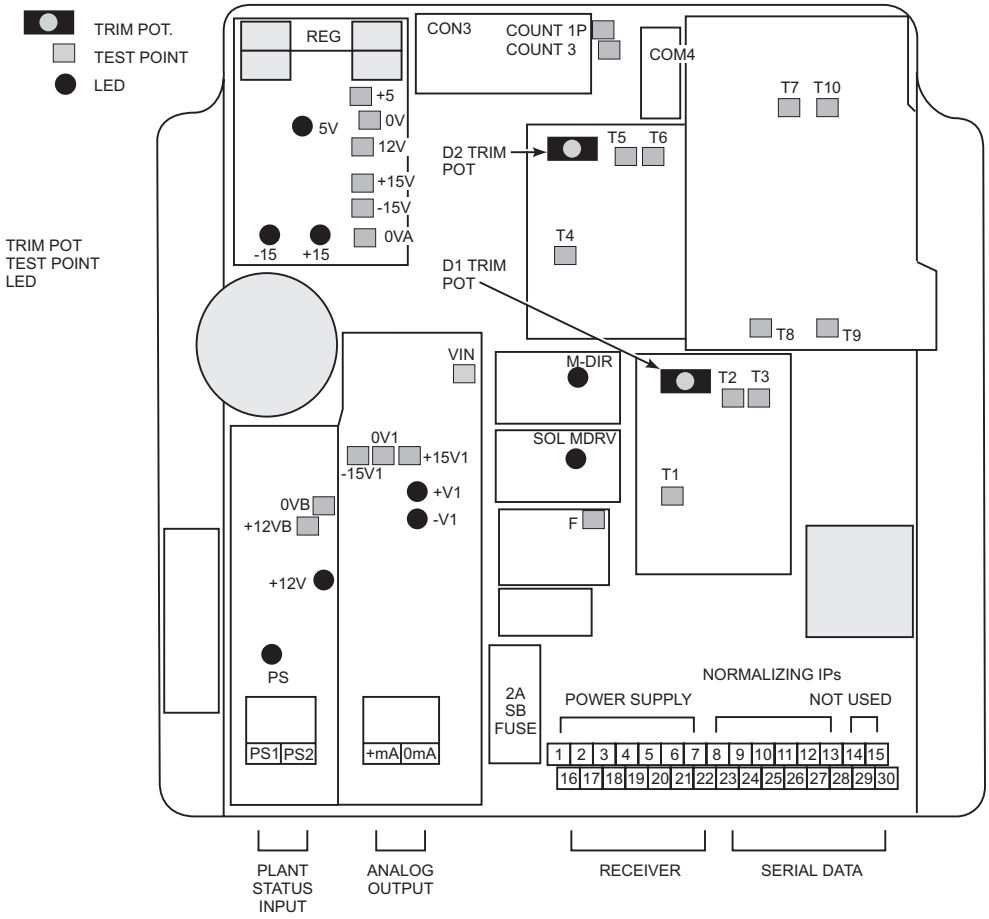
5. Connect the voltmeter to the S0V and S1 test points, as in Figure 3-3. Increase the gain using the trim pot at the END DETECTOR, until the voltage is a maximum of 4V rms.
6. Repeat the above procedure for the SIDE DETECTOR, measuring across S0V and S2 test point.
7. When the detector levels are satisfactory, replace the cover.

NOTE
If the duct is operating and a high opacity may be present, reduce the set voltages to 2V rms maximum. This is to prevent saturation should the opacity level drop.

Signal Processor Gain Adjustment

After the detector level(s) at the receiver have been optimized if necessary, the levels within the micro-processor should be adjusted. This adjustment is conducted by means of two trim potentiometers within the signal processor, Figure 3-4.

Figure 3-4. Gain Adjustment Potentiometers



1. *Set the gain to a minimum by turning the D2 - detector trim potentiometer within the signal processor fully CLOCKWISE - it is a 20-turn pot.
2. *Enter the DIAGNOSTIC MODE - DETECTOR LEVELS option, and display the values of D2 and D1. Turn the trim pot COUNTERCLOCKWISE until the D2 level is between 12,000 and 15,000. Allow time between adjustments for the readings to settle.

NOTE
If the duct is operating and the opacity levels are high, reduce the D2 level to about 8,500. This is to avoid saturation should the opacity level within the duct reduce.

3. *To ensure that the detector signal is not saturating, observe the saturation count signal displayed next to the detector levels. If a SAT # of more than 0 is displayed, turn the trim pot slightly to reduce the gain until a SAT # of 0 is displayed.
4. *Should saturation be indicated, with trim pot turned fully CLOCKWISE, reduce the gain in the receiver and repeat the procedure.
5. Repeat the steps above marked (*) for the D1 level, using the D1 trim potentiometer.

NOTE
The circuits are designed so that wherever saturation occurs (receiver or processor), it will always be detected by the micro-processor. If the displayed detector levels cannot be set to within this band or saturation cannot be avoided, the detector levels should be optimized at the receiver. Refer to Receiver Gain Adjustment.

TRANSMITTER ADJUSTMENTS

NOTE
It is recommended that Rosemount Analytical is consulted before making any adjustments within the transmitter.

Two trim potentiometers within the transmitter unit allow adjustments to be made to the intensity of the source and the frequency of the chopper motor. These are set up at the factory and rarely need adjustment.

NOTE
Increasing source intensity may severely reduce the source life.

Source Intensity

A trim pot, in the rear of the unit (furthest from the lens) is accessible after the end cover has been removed. This allows adjustments to be made to the intensity of the source.

Chopper Frequency

Remove the head from the duct to conduct this process. A trim pot. in the front of the unit (nearest to the lens) is accessible after the front flange has been removed (achieved by loosening and removing the four screws holding the flange in place). Once removed, the trim pot. is revealed. This allows adjustments to be made to the frequency of the chopper motor.

OPERATING PARAMETERS

Operating parameters must be set in the instrument for it to function correctly. All operating parameters are set within the signal processor during the setup mode, where they are held in non-volatile memory and so retained in the event of a power loss.

Even if the measured data is not going to be normalized the normalizing parameters must be set for the instrument to function properly.

NOTE
All operating parameters are entered in the setup mode.

Section 5, Normal Operation, lists all parameters in full. Basic details are given here for configuration purposes.

To aid configuration and to record any subsequent changes to the operating parameters, it is recommended that Table 3-1. Instrument Settings, at the end of this procedure be completed to provide a record of the instrument setup.

1. Press the MODE key until the number 5 is displayed in the top left-hand corner.
2. Enter 0000 for the security code - this is the default code set at the factory.
3. After the correct code has been entered the six sub-modes are accessed by using the ARROW keys and pressing ENTER when the required option is displayed.
4. First the instrument averages need setting.

   a. Press the ENTER key when this display is shown, the display will now show one of the averages. Use the ARROW keys to select the average time that requires setting, and press the ENTER key to access the value. Change the value by using the ARROW keys and input by pressing the ENTER key.

   5 SET AVERAGES

   b. Set the seconds averaging stack to the required value. This is limited to within 10 to 60 seconds in 10-second intervals.

   c. Set the minutes averaging stack to the required value. This is limited to within 1 to 60 minutes in 1-minute intervals.

   d. Set the hours averaging stack to the required value. This is limited to within 1 to 24 hours in 1-hour intervals.

   e. Set the days averaging stack to the required value. This is limited to within 1 to 30 days in 1-day intervals.

5. The analogue current loop output is set up in the next menu. Press the ENTER key while this display is shown to select it, then press the ARROW keys to step through the available options. Press the ENTER key to enter each option and change the displayed parameter.

   5 CONFIGURE O/P

   a. Base of Output

   An origin of 0 or 4mA can be set for the current loop output. The ARROW keys will 'toggle' between these two options. Press the ENTER key to enter the new value.

   5 CONFIGURE O/P
   OUTPUT = 4 to 20 mA

   b. Averaging Time of the Output

Any of the four averaging stacks (seconds, minutes, hours or days) may be used for the analog output. They are selected by the ARROW keys and entered using the ENTER key.

5 CONFIGURE O/P	
Average	**01m**

c. Output Units

The analog output can represent the gas concentration in units of either mg/m^3, mg/Nm^3 or ppm. The ARROW keys will 'toggle' between these three options. Press the ENTER key to enter the new value.

5 CONFIGURE O/P	
Units	**mg/m3**

d. Output Span

Select the required span using the ARROW keys for each digit. The ENTER key is pressed to enter the value of each digit. The units will be displayed as either ppm, mg/m^3 or mg/Nm^3, depending on what has been selected beforehand. The current value will be displayed for 1 second when this option is entered. The display then defaults to zero; thus the span value must be re-entered for the unit to function correctly.

5 CONFIGURE O/P	
Span	**0000mg/m3**

e. Fault Indication

Should a fault condition occur, the current output of the instrument may be set to any of the following options:

5 CONFIGURE O/P	
Fault cond	**ZERO**

- Set the output at 0 mA - ZERO.
- Adjust the output to the calculated gas concentration even though a fault condition exists - MEAS.
- Hold the last calculated gas concentration - HOLD.
- Set the output to full scale (20 mA) - F.S.

One of these options can be selected by pressing the ARROW keys; when the desired option is displayed press the ENTER key.

f. Set mA Output

NOTE
This is set at the factory and should not be altered without due consideration.

From this option the current levels of the analog output are set up. Press the ENTER key to select it, and the operator is prompted to set the current levels at 0 and 20 mA.

5 CONFIGURE O/P	
Set Zero	**(007)**

When this is displayed, the current output should be set to 0mA as measured with a calibrated current meter across the analog current loop terminals; nothing else should be connected to these terminals when the output is being set up.

The value is adjusted using the two arrow keys, the UP arrow will take the current output up, and the DOWN arrow will take it down. Press the ENTER key when the correct output current is displayed on the ammeter.

NOTE
Zero mA should be set up no matter what has been selected as the base of the current output. This is factory set by Rosemount Analytical.

g. In a similar manner to the above, the current output level should now be set to 20 mA.

5 CONFIGURE O/P	
Set span	**(247)**

6. The next menu to be configured is the Parameters menu - options are given below.

Select this option by pressing the ENTER key. The ARROW keys will now display the available options from within this sub-mode, when the option that requires changing is displayed, press the ENTER key. When all required changes have been made, select the EXIT option and press ENTER.

5 PARAMETERS

a. Security Number

To prevent any unauthorized tampering with the set up information, it is important that the security code is changed from the factory setting. Each digit is selected with the ENTER key and changed with the ARROW keys.

5 PARAMETERS	
Security #	**0000**

NOTE
It is important to make a note of this number, otherwise it will not be possible to change the instrument setup.

b. Identity Number

If the system is being used as part of an integral monitoring system and the serial input and outputs are being used, the central processor requires a 'Device Identity' to identify each instrument. This number must be unique for each equipment item and can be set from 1 to 30 as required. See the IEM Communication Equipment Manual (Doc. ID: 0006/6) for details.

5 PARAMETERS	
Identity #	**30**

c. Measurement Path Length.

NOTE
The current value entered for the path length will be displayed for 1 second then the display will default to zero. The path length must be re-entered for the unit to calculate gas concentrations correctly. (The display following shows the screen after 1 second, before the path length is reconfigured).

5 PARAMETERS	
Path length	**0000mm**

The transmissivity of a sample of any gas depends both on the concentration and on the path length through which the radiation is transmitted. Similarly, the output of the CCO 5500 monitor also depends on the path length of the flue gas through which the radiation is transmitted.

Refer to “Points to Consider” on page 2-4.

The Rosemount Analytical analyzers are sensitive to the product of concentration x path length, and in order to obtain a true value of concentration of gas, it is necessary to input the correct path length into the processor. This value is then used to produce a final value of gas concentration.

NOTE
The path length entered must represent the length of the actual gas pass, not the flange-to-flange dimension between the transmitter and receiver.

d. Alarm

5 PARAMETERS	
Alarm source	**15m**

A contact output is available to warn of a high gas concentration. This contact output may be triggered from any of the four averaging stacks. Select its source with the ARROW key and enter it with the ENTER key.

5 PARAMETERS	
Alarm	**mg/Nm3**

Select the units for the alarm - these may be different to the units selected for the analog output.

5 PARAMETERS	
Alarm	**0000mg/Nm3**

After the source has been selected, the instrument requires a level at which the output will be triggered. Set the desired level with the ARROW keys.

e. Cal Factor

NOTE
Do not enter this mode without recording the original cal factor as displayed in mode 4. The Cal factor will be lost when this menu option is entered.

5 PARAMETERS
Cal Factor

During the calibration routine, the instrument calculates a 'Cal Factor' which sets the basic calibration of the instrument. This value may be changed from this mode.

NOTE
As this value controls the calibration of the instrument do not change it without due consideration.

f. Plant Status Input

5 PARAMETERS
Plant Status I/P

Used to determine whether the plant is operating under correct conditions. There is a choice of three controls for plant status, only one can be used to control plant status at any one time; logic input, serial input and multiple input. The multiple input has five sub options; temperature threshold, oxygen threshold, water vapor threshold, detector level threshold and logic input. Any or all of these five options (in the multiple option) may be selected to determine plant status.

g. Logic Input

If the PS1 and PS2 terminals are linked in the signal processor the logic contact is made and the plant status is OFF. These terminals may be linked manually during a plant shut down, or they may be wired to a switch/contact outside the unit (e.g. a valve that opens and closes the duct). Press ENTER when the logic screen is displayed if this option is required.

h. Serial Input

If this option is selected the criteria controlling plant status are transmitted via the serial data link. Press ENTER on viewing the serial screen if this option is required to determine plant status.

i. Multiple

Press ENTER when the multiple display is seen and scroll through the following options. Select YES or NO for each option depending on whether it is to be used to determine plant status. If YES is chosen the configuration screen for that option will be shown. Enter the required value and press ENTER. The next option will then be shown, similarly select YES or NO and so on. After the final option (Logic Input) has been configured the display will revert to 'Multiple'. Scroll down using the arrow key and when EXIT is viewed press ENTER. The plant status is thus configured.

j. Temperature Threshold

5 Plant Status I/P	
T th'hold	**262°F**

A value is set here for the temperature threshold. While the temperature (taken from the normalizing temperature) is above the threshold value, plant status is ON. If the temperature drops below the threshold, plant status is OFF and only the seconds averaging stack will update.

k. Oxygen Threshold

Set and used in a similar manner to the temperature threshold. However, if the normalizing oxygen level rises above the threshold, plant status is OFF. For plant status ON, the oxygen level must be below the threshold set.

l. Water Vapor Threshold

Set and used in a similar manner to the temperature threshold. If the water vapor falls below the threshold plant, status is OFF. For plant status to be ON, the water vapor must be above the threshold set.

m. Detector Threshold

Set and used in a similar manner to the temperature threshold. However, if the detector level rises above the threshold, plant status is OFF. For plant status ON, the detector level must be below the threshold set. Only used for the NO_x analyzer.

n. Logic Input

Either selected as YES or NO - depending on whether the logic contracts (PS1 and PS2) will be used to indicate plant shut down.

7. Normalization

5 NORMALIZATION

All of the normalization inputs and parameters are set up from this mode. Press ENTER to access the mode and the ARROW keys will select which of the normalizing inputs are to be changed, they are :

- Temperature
- Oxygen
- Pressure
- Water Vapor

After selecting the normalizing parameter, the user may set the standard levels to which the measurement is to be normalized, and how the instrument reads the value, i.e., fixed keypad input, 4-20 mA input, or on the serial data line.

After selecting the parameter to be set up, the ARROW keys will select between entering the standard levels, and how the normalization data is to be brought into the instrument.

a. Set Standard Levels

5 TEMP DegF
std level = 000

Each normalizing parameter normalizes the measured gas concentration to standard conditions of temperature, oxygen, pressure and water vapor. These levels are set from within this option. Use the ARROW keys to change each displayed normalizing standard value.

b. Set Values

The normalizing data can be brought into the instrument in one of 3 ways:

1 By entering a fixed value via the keypad. This is suitable where the value is stable to about ±5%.

5 TEMP DegF
Keypad Input

2 If an INPUT UNIT is being used, all normalizing data can be transmitted via the serial data line.

5 TEMP DegF
Serial Input

3 Using the 4-20 mA inputs within the processor to receive a measurement transducer data. The values at 4 mA and at 20 mA will be requested should this option be selected.

5 TEMP DegF
Analog Input

With an integrated system the lead analyzer should have its normalizing parameters set to the 4-20 mA inputs. All the other analyzers must then be set to serial and the normalization parameters will be transmitted down the serial data highway.

c. Temperature

An analog input should always be used for temperature correction - this ensures that the flue gas temperature is being measured continuously and accurately. Connect the analog output of the temperature transducer into the Rosemount Analytical analyzer, and select the analog input option. This value is used to normalize the gas concentration measurement, and to correct for the effects of temperature on the IR absorption spectrum.

If a fixed value input is used, then at flue gas temperature higher than 572^{o}F (300^{o}C) the compensation algorithm will become less precise and instrument accuracy will deteriorate accordingly. This is not recommended.

NOTE
If normalization is not required, the instrument must hold the temperature of the gas in the duct - analog input.

d. Oxygen

To correct the data to standard levels of oxygen, an estimate of the oxygen at the point of measurement is required. If the oxygen level is being continuously measured, connect the analog output of the oxygen analyzer into the CCO 5500 analyzer, and select the analog input in the normalization menu. This input must be defined as either WET or DRY, depending on how the measurement is made. After the wet or dry has been defined the analog input values need defining, set the 4 mA and 20 mA values. If the oxygen level is relatively constant through all firing conditions, then a fixed (keypad) input may be used.

NOTE
If normalization is not required, the instrument must have the normalizing parameters for oxygen set.

With an integrated system the pressure data can be taken to the instrument via the serial data line.

e. Pressure

To correct the data to a standard pressure - normally 14.65 psi (101 kPa), the pressure at the point of measurement needs to be determined. If the flue pressure is relatively constant through all firing conditions, then a fixed input may be used. If the pressure is not constant, it should be measured and brought into the instrument via the 4-20 mA input within the processor.

NOTE
If normalization is not required, the instrument must have the normalizing parameters for pressure set to 14.65 psi (101 kPa)(standard level and keypad input).

With an integrated system the pressure data can be taken to the instrument via the serial data line.

f. Water Vapor

An 'across the duct' monitor measures the gas concentration under wet conditions, that is, unlike a sampling system, the gas has not been preconditioned in any way before the measurement is made.

To normalize it to dry conditions, when the water vapor present is of a known and relatively fixed level, set the standard level to DRY, and use a fixed value in the keypad option representing the expected water vapor produced for the fuel type. If the measurement is not to be normalized for water vapor, set the standard level to WET.

8. Reset Averages

5 RESET AVERAGES

The average values that are currently held in the averaging stacks will not be accurate as configuration has not yet been completed, these therefore need resetting using this option. This process will erase the current average that is held in all of the averaging stacks. Select this option by pressing the ENTER key and using the Arrow keys.

NOTE
Confirmation is requested before the averages are reset.

If this option is selected after the instruments' first configuration, all data in the averaging stacks is reset, and the data for as much as the last 30 days will be lost.

9. Calibration

From this option the two detector levels may be displayed and a basic calibration conducted. During Set Detectors the gas cells are not moved; this gives an immediate response for setting up the detector levels. The basic calibration of the instrument is set by a 'CAL FACTOR' which is calculated during a calibration routine. Press the ENTER key while this is displayed and the following options are available.

5 CALIBRATE

a. Set Detectors

Both the D1 and D2 levels from the receiver are displayed, and saturation counts are also displayed. To give an immediate response to any alterations that are required, the gas cells are not moved during this operation.

5 D2 = 10534 # = 00000
D1 = 15000 # = 00000

b. Span Adjust

NOTE
The Span Factor is set at the factory by Rosemount Analytical; Do not adjust it unless the instrument sensitivity is suspected. It is recommended that before adjustments are made, the original value is recorded.

Instrument sensitivity can be adjusted if a known concentration of measurement gas exists between the transmitter and receiver units, and instrument sensitivity is suspected. If a problem arises with this, please consult Rosemount Analytical.

5 Val = 250 –> 250ppm
Span Factor 1000

The Span Factor may need adjusting if new gas cells or filters have been fitted.

Refer to Span Factor Adjustment.

c. Calibrate

Re-enter Mode 5 Calibrate menu and proceed to the calibrate option. The basic calibration of the instrument can be calculated from this routine. It is preferable to conduct this operation with the plant shut down to ensure a zero gas concentration within the duct. If this is not possible, however, the instrument can calibrate to a known value of the gas concentration - the calibration target.

5 CALIBRATE
Calibrate

Set the calibration target either to a known value of the gas concentration or to zero, and set the desired number of cycles over which the calibration factor is determined (a minimum of 30 is recommended). The calibration should now be run and the display will show a count down during its execution. When the calibration is complete the new "Cal Factor" will be displayed for about 5 seconds and the instrument will exit the calibration routine.

5 CALIBRATE	
Target	**0000ppm**

5 CALIBRATE
Set # cycles = 30

5 cycle # 30
CAL IN PROGRESS

5 CAL COMPLETE	
Cal FACT	**K = 9054**

NOTE
The calibration routine must be run during commissioning, otherwise the instrument will not be able to calculate the true level of gas within the duct.

Do not run the calibration routine unless reasonable conditions exist in the duct. If it is not the initial calibration, it is recommended that the Cal Factor is recorded from the parameters option, before the calibration is run.

To aid configuration, and to record any subsequent changes to the operating parameters, Table 3-1 lists all of the options available, and can be used as a record of the operating parameters.

Table 3-1. Instrument Settings

Parameter		Config.	
Averages	Seconds		
	Minutes		
	Hours		
	Days		
Output	0 or 4 mA base		
	Units		
	Average		
	Fault condition		
Parameters	Path Length		
	Alarm source		
	Alarm units		
	Alarm levels		
Normalization	**Temperature**		
	Standard level ^{o}F (^{o}C)		
	I/P ^{o}F (^{o}C) @ 4 mA		
	I/P ^{o}F (^{o}C) @ 20 mA		
	Keypad input ^{o}C (not ideal)		
	Serial input		
	Oxygen		
	Standard level%		
	Wet or dry gas		
	I/P % @ 4 mA		
	I/P % @ 20 mA		
	Keypad input %		
	Serial input		
	Pressure		
	Standard level psi (kPa)		
	I/P psi (kPa) @ 4 mA		
	I/P psi (kPa) @ 20 mA		
	Keypad input		
	Serial input		
	Water vapor		
	Standard level (wet %/dry)		
	Keypad input %		
	Measured value		

After the calibration has been conducted, a CAL FACTOR will be calculated; this determines the calibration of the instrument. The cal factor will be displayed for a few seconds after a calibration has been conducted, and it can also be interrogated from Mode 4 (diagnostic mode). Enter the cal factor into the table below, as a record of instrument operation.

Table 3-2. Calibration Data

Calibration Data		
Detector Outputs	**Factory**	**Config**
D2		
D1		
E1		
E2		
Calibration Data		
Cal factor		
Span factor		
Output Calibration		
Set zero		
Set span		

NOTE

Factory settings were obtained under the following conditions:

- 6.5 ft (2 m) path length
- Clean conditions
- 240V, 50 Hz supply

CURRENT OUTPUT CALIBRATION

NOTE
This is set at the factory and should not be altered without due consideration.

The current output should now be set up using a calibrated milliammeter set to DC current, 20 mA max. Conduct this procedure as follows :

1. Connect the milliammeter to the output terminals within the signal processor - terminals +mA and -mA.
2. Enter the SET UP MODE - CONFIGURE OUTPUT - SET ZERO OPTION, and adjust the level using the ARROW keys until 0mA is recorded. Record the value in brackets on the display in Table 2 - Calibration Data.
3. Enter the SETSPAN option and adjust the level using the ARROW keys until 20 mA is recorded. Record the value in brackets on the display in Table 2 - Calibration Data.

Section 4 Normal Operation

INTRODUCTION

After the CCO 5500 has been configured, it will measure the gas levels between the transmitter and receiver and produce an output proportional to the gas levels. An integral 32-character display also shows the calculated levels.

The CCO 5500 allows the operator to interrogate the micro-processor to observe the system parameters and to change them if required.

A menu-based program is used and access is gained by four keys mounted on the lid of the signal processor.

Measurement

Once configuration has been completed, the absorption of IR radiation is measured and a parameter 'Y' is calculated - refer to “Principles and Modes of Operation” on page 1-4. This value is used to produce a final concentration of gas that can be normalized to standard conditions and averaged over a time ranging from 10 seconds to 30 days.

The instrument computes four averages, any of which can be used to drive the analog output, or displayed on the integral 32-character LCD.

Calibration

During the configuration procedure a calibration is conducted that sets the system gains to produce a zero or known gas level. Once the routine has been conducted the calibration of the instrument is fixed by precision filters, which do not change.

NORMAL STARTUP PROCEDURE

Power-up the system and wait for 30 minutes. This allows time for the infrared source to heat up. Once the receiver is detecting a signal a reading will be seen on the signal processor display. This should be in normal operating mode, Mode 1 (shown by a number 1 at the top left corner of the LCD); a reading in vpm, mg/m^3 or Nmg/m^3 will be shown. If this appears, the system is functioning properly.

MODES OF OPERATION

The instrument has six modes of operation identified by a number in the top left corner of the display:

Mode 1 - Operating Mode
Displays average gas concentration.

Mode 2 - Parameter Mode
Displays operating parameters.

Mode 3 - Normalization Mode
Displays normalization data.

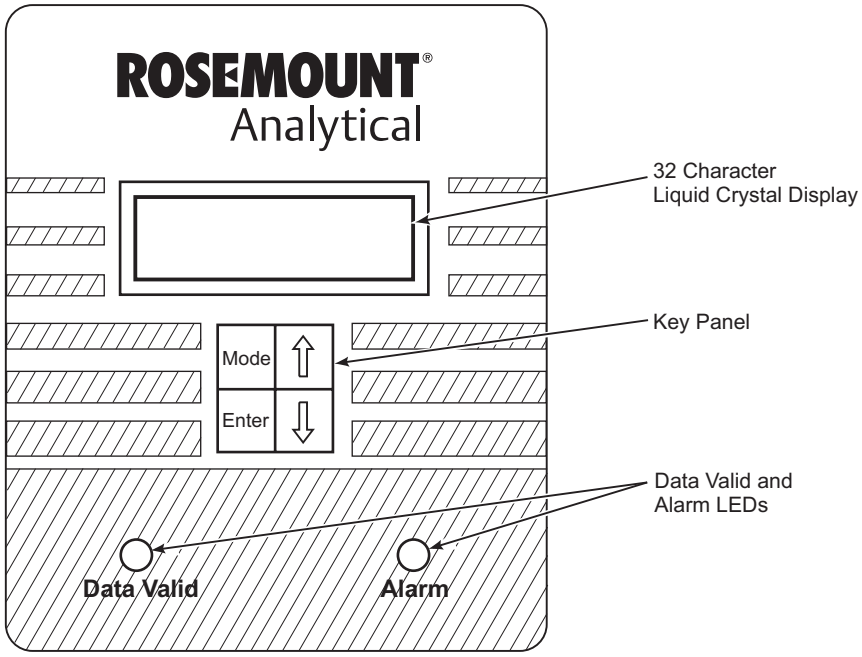
Mode 4 - Diagnostic Mode
Investigates instrument operation. Self checks are continually made by the instrument; should a complication exist, this mode will automatically be selected and the fault displayed on the display.

Mode 5 - Setup Mode
Sets operating parameters. The opening parameters must be entered for the instrument to function correctly. This mode can only be accessed using a security code.

Mode 6 - Check Cell Mode
Used to verify the instruments' operation and calibration.

NOTE
The outputs of the instrument are unaffected by key operation in all modes except the setup mode.

Figure 4-1. Keypad



KEY OPERATION

Each mode is accessed sequentially by each push of the MODE key. Figure 4-1 illustrates the display and keys of the signal processor. After a mode has been selected, the ARROW keys will select the various options within these modes. The ENTER key will input the displayed value, and may step the cursor to the next option, if this is applicable.

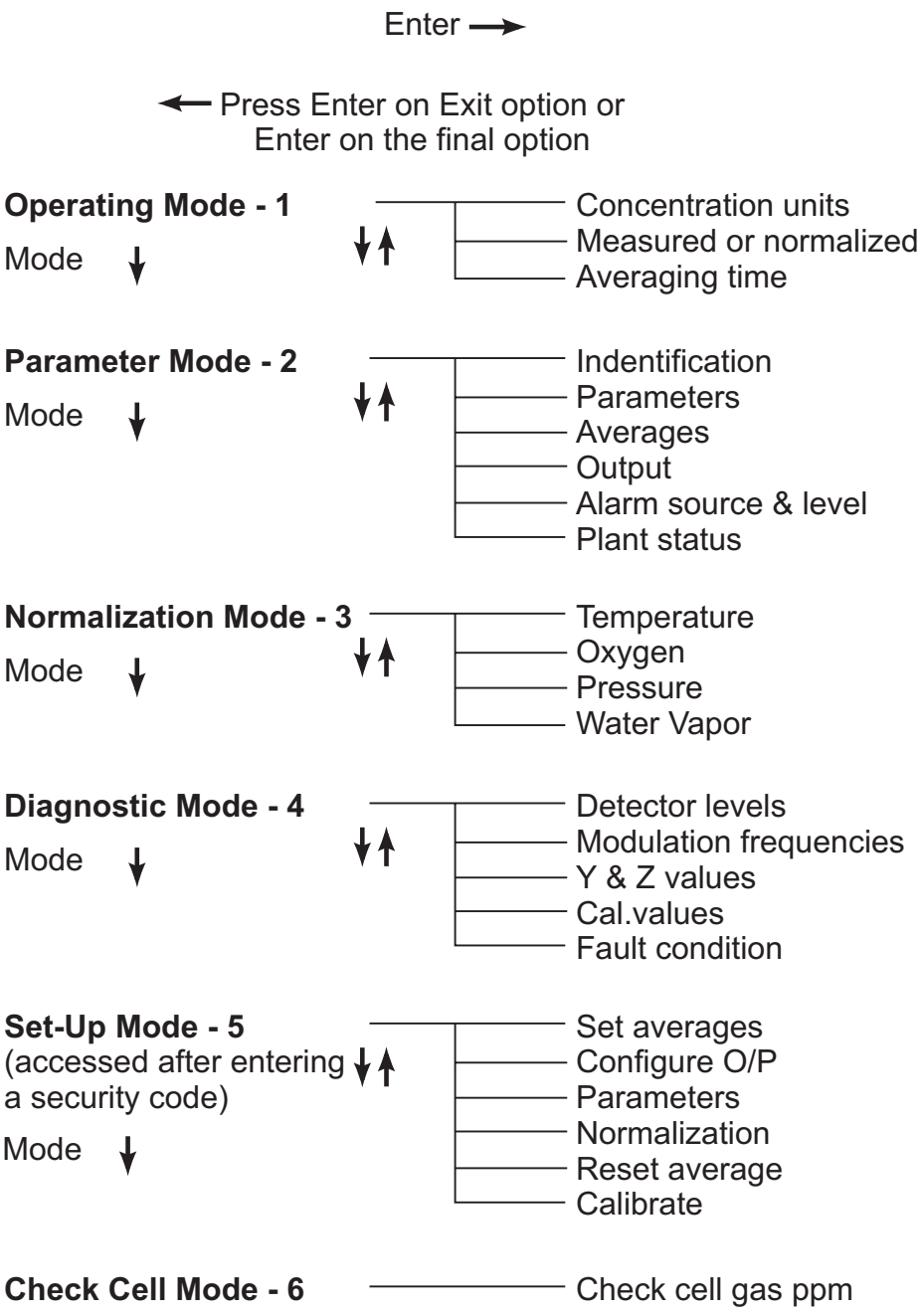
1. Mode Key. Pressing the MODE key will either take the instrument to the next mode of operation, or back to the operating mode if pressed from within a mode.
2. Arrow Keys. Pressing the ARROW keys will do one of two things depending on the position in the program:
   - It will increase › or decrease ﬂ the displayed value. If the key is held down it will scroll quickly to the desired value.
   - It will step through the available options within a mode or sub mode.
3. Enter Key. Pressing the ENTER key will do one of two things depending on the position in the program:
   - It will input the displayed parameter value, or
   - It will select the displayed mode or option from within a mode or sub mode.

NOTE
Allow time for the instrument to respond to a key instruction, otherwise a double key entry may be recorded.

PROGRAM TREE

Figure 4-2 illustrates the main program of the CCO 5500.

Figure 4-2. Program Operation Tree



OPERATING MODE

From this mode of operation the averaging time of the displayed gas concentration may be altered to one of the other averaging stacks, and the measured/normalized gas measurements observed. When in this mode, the display will appear similar to that shown below. If the display is not similar to this, press the MODE key until number 1 appears in the top left corner of the display.

1 CO 0015mg/Nm3
Normalized Av03h

To change the data displayed press the ENTER key and a flashing cursor will appear at the beginning of the concentration units, i.e. vpm or mg/Nm^3. The ARROW keys will now change the highlighted parameter. Each push of the ENTER key will select another of the parameters, in the following order:

- Concentration Units - vpm, mg/m^3 (or mg/Nm^3).
- Measured or Normalized display.
- Averaging Time - seconds, minutes, hours or days.

Press the ENTER key when the cursor is flashing on the averaging time and the cursor will disappear from the display. The ENTER key may be pressed again if required to bring the cursor back onto the display.

PARAMETER MODE

In this mode, the parameters set within the set-up mode may be examined, but not changed. Press the MODE key until the number 2 appears in the top left corner of the display, then press the ENTER key.

The ARROW keys will now scroll through the available options; press the ENTER key to display the selected option.

Press the ENTER key again to exit from each option.

Refer to Setup Mode, for further details of the display information and how to change the held parameters.

Identification

The analyzer type, identity number, and EPROM program ID are displayed from this option. Use the arrow keys to scroll between these options.

Parameters

The following parameters are examined from this option, selected using the ARROW keys:

1. Measurement Path Length - The path length currently used to calculate the gas concentration.
2. Span Factor - From the SET UP MODE - CALIBRATE option, the sensitivity of the instrument can be adjusted. The Span Factor was initially set at the factory using known gas concentrations.
3. Output Fault - Should a fault condition occur, the analog output can be set from one of four options.

Averages

Selecting this option will display the times set for each of the four averaging stacks.

Output

The base, span and averaging of the analog output are displayed from this option.

Alarm

A changeover relay contact output is available to indicate a high gas concentration. The level at which this output is operated, and the averaging stack from which the gas value is obtained, may be examined from this display.

Plant Status

When plant status is off, the minutes, hours and days averaging stacks do not update.

NOTE
When the plant is off, pollutant levels will be zero and it is not normally permitted to use plant off zero levels to reduce the recorded mean emitted pollutant levels.

This function may be used to ensure data is only collected when the plant is fully operational. There are three options that can be used to determine plant status ON or OFF; logic input, serial input and multiple input. The multiple input has four options: temperature threshold, or oxygen threshold, water vapor threshold and logic input. The plant status and its governing factor may be viewed from this display.

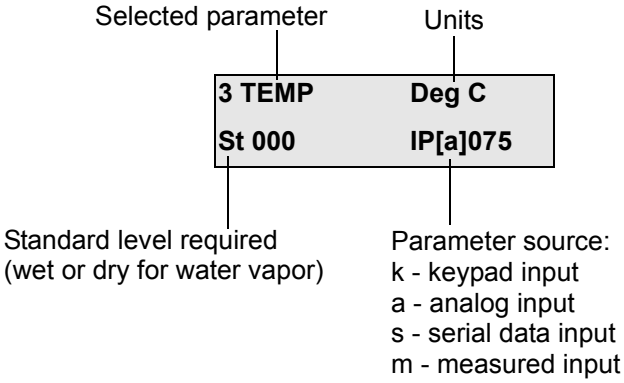
NORMALIZATION

Press the MODE key until the number 3 is seen in the top left corner of the display. From this mode, the normalization parameters currently being used can be displayed. Press the ENTER key to enter the routine and use the ARROW keys to select which of the normalizing parameters to display.

When the required normalizing parameter is displayed, press the ENTER key to display the normalization data. Press the ENTER key again to exit the parameter.

Display Format

For each of the normalizing parameters the display will appear similar to that shown below.

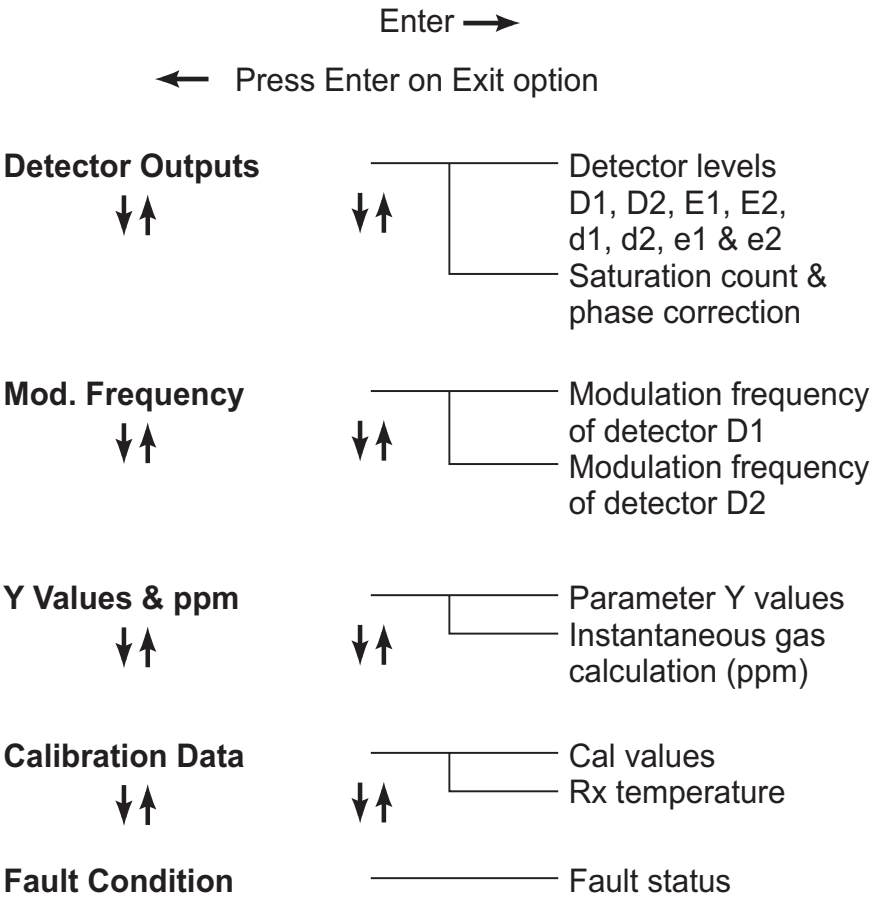


DIAGNOSTIC MODE

The detector levels, chopper blade frequency, 'Y' parameter and the fault condition may be examined from this mode. Press the MODE key until number 4 appears in the top left corner of the display and press ENTER to enter the mode.

The ARROW keys will now select from the following list; press the ENTER key to select the displayed option. Refer to Figure 4-3.

Figure 4-3. Diagnostic Mode Tree



Detector Levels

Detector levels from the detector are displayed here. D1 is the reference level and should always be less than D2. The level of D2 should be between 10,000 and 20,000.

E2 and E1 are the detector levels with the gas cell within the transmitter unit in the sight path, and will be of the order of 1/2 of the D2 and D1 levels. Smoothed detector values may also be displayed, these are noted as d1, d2, e1 and e2.

4 D2 = 18765E = 13453
D1 = 15464E = 10654

The first of these two parameters (Sat.#) indicates whether the detector signals are saturating within the micro-processor (this value should always be zero). If a number other than zero is displayed, it indicates saturation and the detector gain should be adjusted. Refer to Section 3, Detector Levels.

Phase a is the phase time correction applied for the calculation of the detector levels. This will be between 0.1 and 5.9 milliseconds. This value is calculated by the instrument and may not be adjusted.

4 Sat. # = 00000
Phase a = 3.5msec

Chopper Motor Frequency

The chopper blade should 'chop' the IR radiation at a frequency of about 37 Hz. This frequency is measured by the processor and can be displayed from this option.

```
4 ModFreq = 37.4 Hz
Mark/Space = 0.984
```

As the chopper blades interrupts the IR beam, the radiation is split into two - half the time the blade obscures the beam and half the time the beam radiates across the duct. The value of MARK/SPACE should be between 0.9 and 1.1 where:

MARK/SPACE = Time IR Beam Obscured/Time IR beam clear.

YVals and Gas ppm

A parameter 'Y' determines the calculation of the gas concentration - refer to Section 1, Principles of Cross-Duct Gas Analyzers.

As a check on the program operation, this parameter and the resulting raw gas calculation, may be interrogated here.

```
4 CO (0) = 3287ppm
  CO (60) = 3289ppm
```

The term Yx is the second averaging stack's held value, and the term Y(60) is the 60-second raw value from which all of the other averaging stacks are calculated. These gas values represent the raw gas data before averaging for the corresponding Y values. Also displayed by pressing the arrow keys are the Z values. These are adjusted Y values used to compensate for cross sensitivities in the measurement range.

```
4 Y = 6060      Yx = 6058
      Y (60) = 6058
```

Calibration Data

The calibration factors, determined during the calibration routine (Kcal), and the value currently being used (Kwkg) can be examined from this display. Should the two values be different, this indicates a change in instrument temperature between the time of calibration and the current temperature. Press one of the ARROW keys to examine the temperature information.

```
4 Kwkg    9877
  Kcal    9865
```

Temperature has a small effect on the filter/gas cell characteristics compensated for by the instrument; temperature measurement is made within the receiver.

```
4 Rx T°F = 30.3
  Kcal T°F = 30.1
```

Fault Condition

To display the current fault condition, press the ENTER key while this is displayed. This display mode is automatically selected by the instrument, should a fault condition occur. The following fault conditions are recognized by the instrument:

4 Diagnostic
Fault Condition

1. *ALL CLEAR* - No fault condition.
2. Det. Saturated - the detector level gain within either the receiver or the signal processor is too high for the current duct conditions.
3. Low Det. Level - detector levels are too low (<3,000).
4. Mod. Freq. O.R. - chopper motor frequency is out of range (<30 Hz or >45 Hz).
5. Reference Fail. - no reference signal from the transmitter unit.
6. Cal. Fact. O.R. - after the calibration routine, the calculated Set Cal factor is out of range. Refer to Section 6, Troubleshooting.

By pressing the arrow key the previous fault condition can be observed.

4 Previous fault
Det. Saturated

NOTE
If a fault condition exists, the minutes, hours and days averages will not be updated. Refer to Section 6, Data Valid LED Out.

Setup Mode

All operating parameters - averaging times, output settings, normalization parameters, path length, calibration, etc. - can be changed from this mode. To prevent any unauthorized changes, the user must enter a four number code before the mode can be entered.

NOTE
After this mode has been selected, the instrument will suspend its operation and the Data Valid LED will extinguish. If no key is pressed within 5 seconds after selection of this mode, the CCO 5500 will revert to the normal operating mode.

Press the MODE key until the number 5 is displayed in the top left-hand corner. After the security code has been correctly entered, there are 6 sub-modes of operation from which the set-up parameters may be changed (Figure 4-4); these are:

1. Set Averages - The four averaging stack times (seconds, minutes, hours and days) may be set as required.
2. Configure O/P - Analog output setup - origin, units, span, rolling average and fault condition.
3. Parameters - The following are set from this mode - security code, identity number, path length, alarm level, cal factor and plant status.
4. Normalization - All normalization parameters may be set up from this mode.
5. Reset Average - Selecting this sub-mode allows the four averaging stacks to be reset.
6. Calibrate - The outputs of the detectors and the basic calibration of the instrument can be set.

After the correct code has been entered, the user may access each of the six sub-modes (listed above) by using the ARROW keys and pressing ENTER when the required option is displayed.

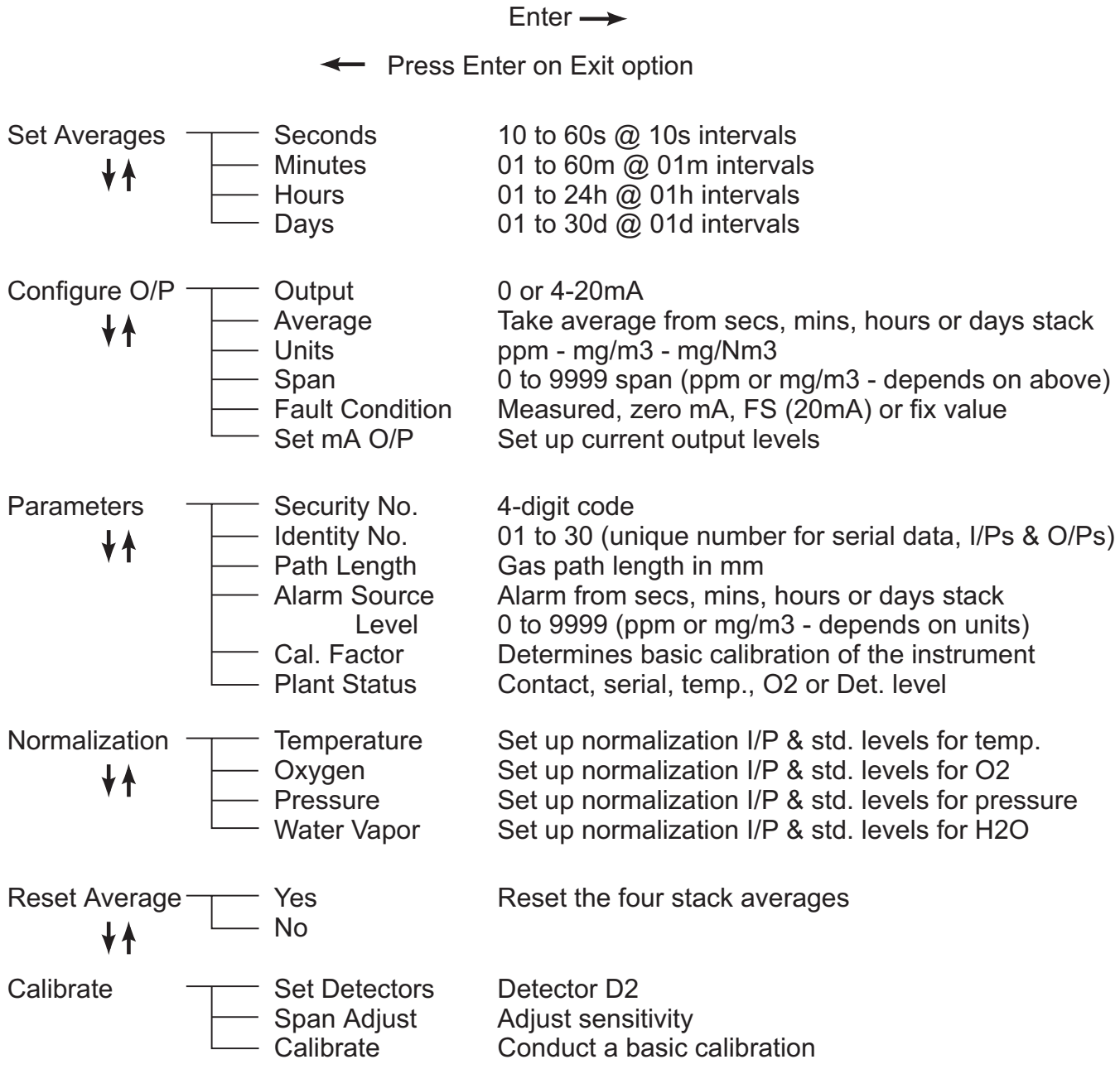
Security Code Entry

Once the display is as shown here, press the ENTER key to gain access to the set-up mode. The cursor will now flash over the first digit of the presented code number; select the required first digit with the arrow keys and press ENTER. Repeat this procedure for the four numbers. If the code is correct after the ENTER key is pressed on the last digit, then the sequence will be continued. If it is not correct, the instrument will return to the operating mode - refer to Parameters for further details.

5 SET UP MODE
Security # 0000

NOTE
The code number will be set to 0000 at the factory and should be changed by the user from within the set-up mode.

Figure 4-4. Set Up Mode Tree



Set Averages

Four separate averages are calculated within the instrument. These are defined in units of seconds, minutes, hours and days. Any of the four averaging stacks can be used to provide the analog output of the instrument. Each averaging time can be set within predefined limits.

1. Press the ENTER key when this display is shown; the display will now show one of the averages. Use the ARROW keys to select the average time that requires changing, and press the ENTER key to change it. The value can now be changed using the ARROW keys and input by pressing the ENTER key.

5 SET AVERAGES

2. Set the seconds averaging stack to the required value. This is limited to within 10 to 60 seconds in10-second intervals.

5 SET AVERAGES
secs 60

3. Set the minutes averaging stack to the required value. This is limited to within 1 to 60 minutes in 1-minute intervals.

5 SET AVERAGES
mins 60

4. Set the hours averaging stack to the required value. This is limited to within 1 to 24 hours in 1-hour intervals.

5 SET AVERAGES
hours 24

5. Set the days averaging stack to the required value. This is limited to within 1 to 30 days in 1-day intervals.

5 SET AVERAGES
days 30

Configure O/P

The analog current loop output is set up from this mode. Press the ENTER key while this display is shown to select it, then press the ARROW keys to step through the available options. Press the ENTER key to enter each option and change the displayed parameter.

5 CONFIGURE O/P

Base of Output

An origin of 0 or 4 mA can be set for the current loop output. The ARROW keys will 'toggle' between these two options. Press the ENTER key to enter the new value.

5 CONFIGURE O/P
OUTPUT = 4 to 20mA

Averaging Time of the Output

Any of the four averaging stacks (seconds, minutes, hours and days) may be used for the analog output. They are selected by the ARROW keys and entered using the ENTER key.

5 CONFIGURE O/P	
Average	**0.1m**

Output Units

The analog output can represent the gas concentration in units of mg/m^3, mg/Nm^3 or ppm. The ARROW keys will 'toggle' between these three options. Press the ENTER key to enter the new value.

5 CONFIGURE O/P	
Units	**mg/m3**

Output Span

Select the required span using the ARROW keys for each digit. The ENTER key is pressed to enter the value of each digit. The units will be displayed in ppm, mg/m^3 or mg/Nm^3, depending on what has been selected beforehand. The current value will be displayed for 1 second when this option is entered. The display then defaults to zero; the span value must be re-entered for the unit to function correctly.

5 CONFIGURE O/P	
Span	0000mg/m3

Fault Indication

Should a fault condition occur, the current output of the instrument may be set to one of the following options:

5 CONFIGURE O/P	
Fault cond	ZERO

1. Set the output at 0 mA - ZERO.
2. Adjust the output to the calculated gas concentration even though a fault condition exists - MEAS.
3. Hold the last calculated gas concentration - HOLD.
4. Set the output to full scale (20 mA) - F.S.

One of these options can be selected by pressing the ARROW keys; when the desired option is displayed press the ENTER key.

Set mA Output

NOTE
This is set at the factory and should not be altered without due consideration.

From this option the current levels of the analog output are set up. Press the ENTER key to select it and the operator is prompted to set the current levels at 0 to 20 mA.

5 CONFIGURE O/P	
Set Zero	(007)

When this is displayed, the current output should be set to 0mA as measured with a calibrated current meter across the analog current loop terminals. Nothing else should be connected to these terminals when the output is being set up. The value is adjusted using the two arrow keys; the UP arrow will take the current output up and the DOWN arrow will take it down. Press the ENTER key when the correct output current is displayed on the ammeter.

NOTE
Zero mA should be set up no matter what has been selected as the base of the current output. This is factory set by Rosemount Analytical.

6. In a similar manner to above, the current output level should now be set to 20 mA.

5 CONFIGURE O/P	
Set Span	(247)

Parameters

Select this option by pressing the ENTER key. The ARROW keys will now display the available options from within this sub-mode. When the option that requires changing is displayed, press the ENTER key. When all required changes have been made, select the EXIT option and press ENTER.

5 PARAMETERS

Security Number

To prevent any unauthorized tampering with the set up information, it is important that the security code be changed from the factory setting. Each digit is selected with the ENTER key and changed with the ARROW keys.

5 PARAMETERS	
Security #	**0000**

NOTE
It is important to make a note of this number otherwise it will not be possible to change the instrument set up.

Identity Number

If the system is being used as part of an integral monitoring system and the serial input and outputs are being used, the central processor requires a 'Device Identity' to identify each instrument. This number must be unique for each equipment item, and can be set from 1 to 30 as required.

5 PARAMETERS	
Identity #	**30**

Measurement Path Length

NOTE
The current value entered for the path length will be displayed for 1 second, then the display will default to zero. The path length must be re-entered for the unit to calculate gas concentrations correctly.

The transmissivity of a sample of any gas depends both on the concentration and on the path length through which the radiation is transmitted. Similarly, the output of the CCO 5500 analyzer gas monitor also depends on the path length of the flue gas through which the radiation is transmitted.

5 PARAMETERS	
Pathlength	**0000mm**

The CCO 5500 analyzer is sensitive to the product of concentration x path length and in order to obtain a true value of concentration of gas, it is necessary to input the correct path length into the processor. This value is then used to produce a final value of gas concentration.

NOTE
The path length entered must represent the length of the actual gas pass, not the flange to flange dimension between the transmitter and receiver.

Alarm

A contact output is available to warn of a high gas concentration. This contact output may be triggered from any of the four averaging stacks. Select the source with the ARROW key and enter it with the ENTER key.

5 PARAMETERS
Alarm source 15m

Select the units for the alarm - these may be different to the units selected for the analog output.

5 PARAMETERS
Alarm mg/Nm3

After the source has been selected, the instrument requires a level that the output will be triggered. Set the desired level with the ARROW keys.

5 PARAMETERS
Alarm 0000mg/Nm3

Cal Factor

NOTE
Do not enter this mode without first recording the original cal factor - this value is displayed in Mode 4. Refer to Calibration Data. The Cal factor will be lost when this menu option is entered.

During the calibration routine, the instrument calculates a 'Cal Factor' which sets the basic calibration of the instrument. This value may be changed from this mode.

5 PARAMETERS
Cal Factor

NOTE
As this value controls the calibration of the instrument do not change it without due consideration.

Plant Status Input

Used to determine whether the plant is operating under correct conditions. If it is not, plant status will be OFF and the minutes, hours and days averaging stacks will not be updated. If data is stored while the plant status is OFF diluted overall readings will be registered.

There is a choice of three controls for plant status, logic input, serial input and multiple input, but only one can be used to control plant status at any one time. The multiple input has four options that may be configured for plant status; temperature threshold, oxygen threshold, water vapor threshold, and logic input. Any or all of these may be used to determine plant status.

5 PARAMETERS
Plant Status I/P

Logic Input — If the PS1 and PS2 terminals are linked in the signal processor the logic contact is made and the plant status is OFF. These terminals may be linked manually during a plant shut down, or they may be wired to a switch/contact outside the unit (e.g. a value that opens and closes the duct). Select this option by pressing ENTER when the 'Plant Status - Logic' screen is displayed.

Serial Input — If this option is selected the criteria controlling plant status are transmitted via the serial data link. Select this option by pressing ENTER when the 'Plant Status - Serial' screen is displayed.

Multiple — Four options are available here. Press ENTER when the 'Plant Status - Multiple' screen is displayed. The first option is displayed - Temperature. Use the arrow key to toggle YES or NO. NO will mean that the temperature threshold is not used to determine plant status. If YES is selected the display will enter the display below. Configure the instrument for temperature threshold, press ENTER when correctly configured and the display will move to the next option. Select YES or NO in a similar manner to above. After the last option has been set (Logic Input) the display will return to the 'PARAMETERS - Plant Status I/P' screen. Use the down arrow to scroll down to EXIT and press ENTER. The plant status is now fully configured.

Plant status will only be OFF if all options selected are registering plant status OFF. If any one of them is not fulfilling plant status OFF conditions, then the instrument will register plant status ON.

Temperature Threshold — A value is set here for the temperature threshold. While the temperature (taken from the normalizing temperature) is above the threshold value, plant status is ON. If the temperature drops below the threshold, plant status is OFF and only the seconds averaging stack will update.

Oxygen Threshold — Set and used in a similar manner to the temperature threshold. However, if the normalizing oxygen level rises above the threshold, plant status is OFF. For plant status ON, the oxygen level must be below the threshold set.

Water Vapor — Set and used in a similar manner to the temperature threshold. If the normalizing water vapor level falls below the threshold, plant status is OFF. For plant status ON, the water vapor level must be above the threshold set.

Logic Input — Select YES or NO and press ENTER. For plant status to be ON the logic input (PS1 and PS2) must be open circuit; for plant status to be OFF the logic input must be closed circuit. After this option has been configured the menu will exit to 'Multiple'. Use the down arrow to select EXIT and press ENTER.

Normalization

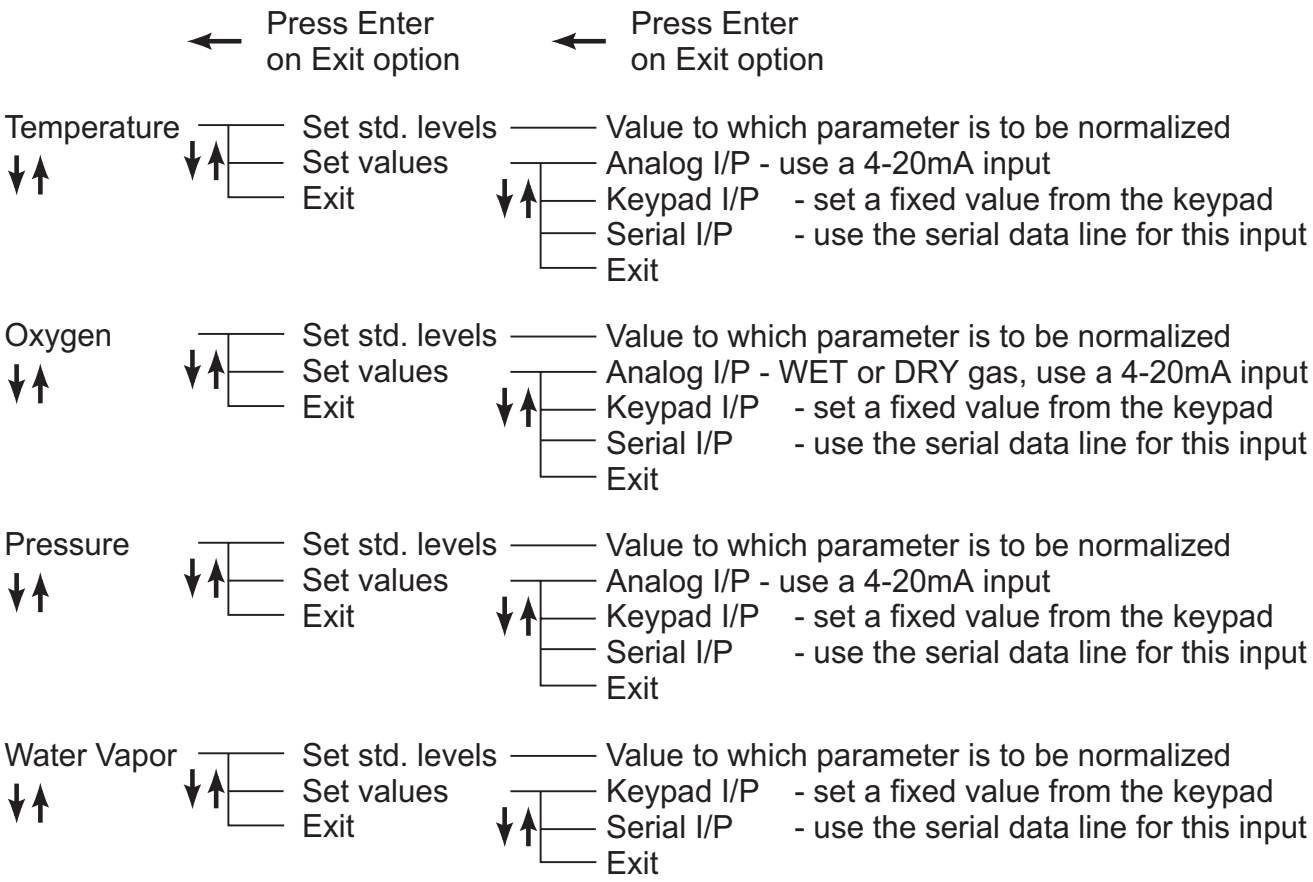
All of the normalization inputs and parameters are set up from this mode. Press ENTER to access the mode and the ARROW keys will select which of the normalizing inputs are to be changed, they are:

5 NORMALIZATION

1. Temperature
2. Oxygen
3. Pressure
4. Water Vapor

After selecting the normalizing parameter, the user may set the standard levels to which the measurement is to be normalized, and how the instrument reads the value, i.e. fixed keypad input, 4-20 mA input, or on the serial data line. Figure 4-5 illustrates the program tree for entering the normalization parameters.

Figure 4-5. Normalization Options



Setting the Normalizing Parameters

After selecting the parameter to be set up, the ARROW keys will select between entering the standard levels and how the normalization data is to be brought into the instrument.

Set Standard Levels

Each normalizing parameter normalizes the measured gas concentration to standard conditions of temperature, oxygen, pressure and water vapor. These levels are set from within this option. Use the ARROW keys to change each displayed normalizing standard value.

5 TEMP	**DegF**
std level	**000**

Set Values

The normalizing data can be brought into the instrument in one of 3 ways:

1. By entering a fixed value via the keypad. This is suitable where the value is stable to about ±5%.

5 TEMP	**DegF**
Keypad Input	

2. If an INPUT UNIT is being used, all normalizing data can be transmitted via the serial data line.

5 TEMP
Serial Input

3. Use the 4-20 mA inputs within the processor to receive a measurement transducer data. The values at 4 mA and at 20 mA will be requested should this option be selected.

5 TEMP	**DegF**
Analog Input	

With an integrated system the lead analyzer should have its normalizing parameters set to 4-20 mA inputs. Select the above analog screen and enter the values required for the 4 mA and 20 mA inputs. For the oxygen input the value must be selected as a wet or dry gas measurement. This is explained in more detail below. All the other analyzers in an integrated system must be set to the serial inputs and the normalization parameters will be transmitted down the serial data highway.

Temperature

An analog input should always be used for temperature correction - this ensures that the flue gas temperature is being measured continuously and accurately. Connect the analog output of the temperature transducer into the CCO 5500 analyzer and select the analog input option. This value is used to normalize the gas concentration measurement and to correct for the effects of temperature on the IR absorption spectrum.

If a fixed value input is used then at flue gas temperatures higher than 572^{o}F (300^{o}C) the compensation algorithm will become less precise and instrument accuracy will deteriorate accordingly. This is not recommended.

NOTE
If normalization is not required, the instrument must hold the temperature of the gas in the duct - analog input.

Oxygen

To correct the data to standard levels of oxygen, an estimate of the oxygen at the point of measurement is required. If the oxygen level is being continuously measured, connect the analog output of the oxygen analyzer into the CCO 5500 analyzer and select the analog input in the normalization menu. This input must be defined as either WET or DRY, depending on how the measurement is made. After the measurement has been defined as wet or dry, the analog input values need defining; set the 4 mA and 20 mA values. If the oxygen level is relatively constant through all firing conditions, then a fixed (keypad) input may be used.

NOTE
If normalization is not required, the instrument must have the normalizing parameters for oxygen set to 0% (standard level and keypad input).

With an integrated system the oxygen data can be taken to the CCO 5500 via the serial data line.

Pressure

To correct the data to a standard pressure - normally 14.65 psi (101 kPa), the pressure at the point of measurement needs to be determined. If the flue pressure is relatively constant through all firing conditions, then a fixed input may be used. If the pressure is not constant, it should be measured and brought into the CCO 5500 via the 4-20 mA input within the processor.

NOTE
If normalization is not required, the CCO 5500 must have the normalizing parameters for pressure set to 101 kPa (standard level and keypad input).

With an integrated system the pressure data can be taken to the CCO 5500 via the serial data line.

Water Vapor

An 'across the duct' monitor measures the gas concentration under wet conditions, that is, unlike a sampling system, the gas has not been preconditioned in any way before the measurement is made.

To normalize it to dry conditions, when the water vapor present is of a known and relatively fixed level, set the standard level to DRY and use a fixed value in the keypad option representing the expected water vapor produced for the fuel type. If the measurement is not to be normalized for water vapor, set the standard level to WET.

With an integrated system the water vapor data can be taken to the CCO 5500 via the serial data line.

Reset Averages

NOTE
The rolling average data will be cleared from memory - consider carefully before using this option.

5 RESET AVERAGES

The average values that are currently held in the four averaging stacks can be reset using this option; this will erase the current average that is held in all of the averaging stacks. Select this option by pressing the ENTER key and using the ARROW keys. Confirmation is requested before the averages are reset.

NOTE
If this option is selected, all data in the averaging stacks is reset and the data for as much as the last 30 days will be lost.

Calibrate

From this option the two detector levels may be displayed and a basic calibration conducted. While in this mode the gas cell is not moved; this gives an immediate response for setting up the detector levels. The basic calibration of the instrument is set by a 'CAL FACTOR' that is calculated during a calibration routine. Press the ENTER key while this is displayed and the following options are available:

```
5 CALIBRATE
```

Set Detectors

Both the D1 and D2 levels can be displayed; saturation counts are also displayed. To give an immediate response to any alterations that are required, the filters and gas cells are not moved during this operation.

```
5 D2 = 10534   # = 00000
  D1 = 15000   # = 00000
```

Refer to Section 3, Configuration and Startup and, Section 4, Diagnostic Mode for a discussion of these levels - detector level and saturation count.

Span Adjust

NOTE
The SPAN FACTOR is initially set at the factory; do not adjust it unless the instrument sensitivity is suspected. In any case it is recommended that before adjustments are made the original value is recorded.

Instrument sensitivity can be adjusted if a known concentration of measurement gas exists between the transmitter and receiver units, and instrument sensitivity is suspected. If a problem arises with this consult Rosemount Analytical.

```
5 Val = 250 –> 250ppm
Span Factor     1000
```

The SPAN FACTOR may need adjusting if new gas cells or filters have been fitted. Refer to Span Adjust.

CHECK CELL MODE

This mode is for use with a Rosemount Analytical check cell. It verifies the calibration and operation of the analyzer. For details of its use refer to “Notes for Using a Rosemount Analytical Check Cell” on page 4-21.

Press enter on viewing this display if the check cell mode is required. Use the arrow keys to toggle the display to YES and press enter again.

```
6 Ch’k Cell Mode
```

The check cell mode is now selected. Note that the display will default back to Mode 1 if YES is not selected within 5 seconds.

```
6 Ch’k Cell Mode
        YES
```

The check cell must not be inserted before this screen is accessed. Refer to Notes for Using a Rosemount Analytical Check Cell.

6 CO = 0060ppm
CO = 0121ppm.m

NORMAL SHUTDOWN PROCEDURE

The system should not need shutting down unless maintenance is being carried out. In this case, power down the power supply (and thus the signal processor and analyzer heads). Close the manually operated isolating valves on the analyzer heads and proceed with service. When satisfactorily completed, open the valves and power up the system. The system may need a calibration performed, depending on the type of maintenance carried out. For details refer to Section 6, Troubleshooting.

ROUTINE CHECKS

Notes for Using a Rosemount Analytical Check Cell

The check cell and holder are optional items available from Rosemount Analytical. The Rosemount Analytical check cell has been designed to verify the reading of Rosemount Analytical cross duct analyzers. When placed within the measurement path a known increase in gas concentration can be generated.

NOTE
The check cell should be placed at the receiver side.

Measurement Conditions

For absolute verification it is necessary to conduct a check on the instrument when there is no measurement gas present. If a background concentration of measurement gas is present, an increase will still be generated, but the net effect will be complex.

Mode 6

This mode of the analyzer is used in conjunction with a check cell to verify the calibration and operation of the monitor.

The ideal time to perform a check cell test is with the plant off, auto zero condition on, and the analyzer well stabilized at zero. Do not insert the check cell in any other mode than Mode 6.

The rolling averages of the analyzer will not update during use of Mode 6 - to prevent false readings being recorded - the check cell mode cannot be operated from the IEM system.

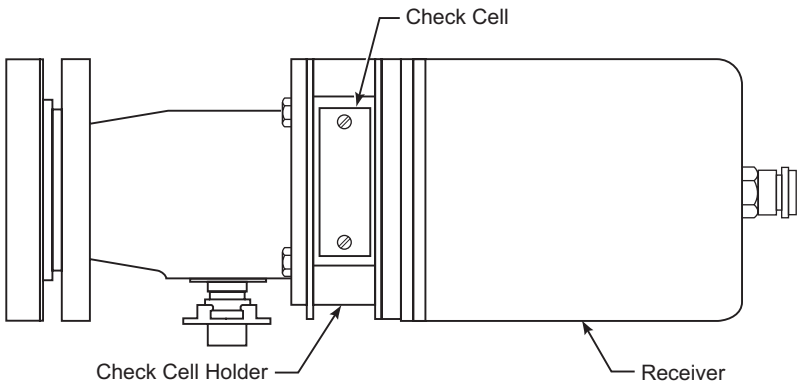
Check Cell Procedure

1. Enter Mode 6 on the signal processor before inserting the check cell into the analyzer. Press enter when Mode 6 is displayed.
2. Use an arrow key to toggle from NO to YES and press enter to access the check cell function. If this is not selected within 5 seconds the instrument returns to the normal operating mode.
3. When this screen is seen the check cell must be inserted observing the procedure outlined below.

6 Ch'k Cell Mode
YES

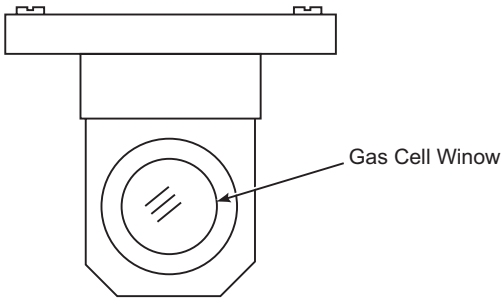
4. Remove the two screws retaining the cover on the check cell holder (Figure 4-5).

Figure 4-6. Check Cell Holder



5. Insert the check cell into the check cell holder and replace and tighten the screws. The cell can be inserted in either direction. Refer to Figure 4-7.

Figure 4-7. Check Cell



6. Introducing the check cell may cause an initial major disturbance to the instrument operation.
7. Wait for the instrument reading to settle - 5 to 10 minutes - and record the gas measurement with the cell in position.
8. Remove the check cell and wait for the analyzer to return to zero (another 5 to 10 minutes).
9. Replace the cover on the check cell holder and press the mode key on the signal processor. The instrument now returns to operation mode.
10. This test can be done with the plant on line, but any pollutant gas present (also it will probably be residing at a different temperature) will interfere with the check cell value.

NOTE
Do not insert the check cell in any other mode as this will influence the recorded rolling averages.

The calibration of the CCO 5500 analyzers is fixed at the point of manufacture. If gross errors exist this could suggest an instrument malfunction. If minor errors are observed, please check the procedure and if necessary return the gas cell for re-certification.

Alarms and Emergency Conditions

The alarm thresholds for the system are set as described in the normal operating mode. When an alarm condition is obtained the red LED on the signal processor will light up. This will go out when the alarm condition has cleared. If the analyzers are linked to the Integrated Emission Monitoring package that remotely monitors the system, the alarm will be displayed on the IEM system monitor. When the condition has cleared the fact that an alarm condition occurred will be recorded by the software. The 4 to 20 mA output from the analyzer will also alter according to the pollution levels detected.

Emergency Shutdown Procedure

The same as normal shutdown - remove power from the power supply and the whole system will close down. Close the isolating valves if required and stop the flow of air to air purges.

Isolation Procedure

Shut off power to the power supply. Shut off compressed air to the air purges and shut the isolating valves.

Interface with Integrated Emissions Monitoring System

If the system interfaces with a Rosemount Analytical IEM software package via a serial data line, central control unit (CCU) and pc, then details of configuration of this system are to be found in the operating manuals OPS.087 (Communication Equipment) and OPS.016 (IEM Software).

Section 5 Maintenance

⚠WARNING

Install all protective equipment covers and safety ground leads after equipment repair or service. Failure to install covers and ground leads could result in serious injury or death.

ROUTINE (PREVENTIVE) MAINTENANCE

The equipment is designed to keep levels of maintenance to an absolute minimum.

Cleaning Windows

It is important that the optical windows of both transmitter and receiver are kept reasonably clean and any mounting tubes free from build-up of dust and fly ash. We recommend that the windows are cleaned every six months, or more often for dirty processes, by removing the transmitter and receiver from their air purges and wiping their windows with a soft dry cloth.

⚠WARNING

Great care must be taken when removing the CCO 5500 from a positive pressure stack or duct. The source may be very hot, and there may be dangerous vapors present. Observe all required safety practices.

Replacement of the Heater Element

The heater element does have a limited life and at some stage will have to be replaced. The unit has been designed to give a minimum of two years continuous operation and when replacement does become necessary it can be replaced on site.

To replace an element proceed as follows:

1. Switch OFF power.
2. Remove the rear cover plate from the transmitter by removing the four retaining screws. Note that these screws are not captive.
3. Carefully remove the PCB now revealed by unscrewing the three retaining screws.
4. Disconnect the two wires from the terminals at the rear of the heater assembly by removing the two M3 nuts.
5. Remove the heater assembly by unscrewing the three screws. These are captive screws and cannot be removed completely. The heater assembly may then be withdrawn from the transmitter and discarded.
6. Refit a replacement unit by reversing the above procedure.
7. After completion, switch ON the power and allow fifteen minutes for the heater to attain temperature after which the equipment will start to calculate the gas levels.

Replacement of Chopper Motor Assembly

1. Turn the power OFF and remove the transmitter from its air purge.
2. Remove the four screws holding the transmitter front flange in position and remove the front flange.
3. Turn the three brass extended head screws counterclockwise (unscrew) to loosen assembly.
4. Carefully lift out the assembly and remove the center plate from the transmitter body.
5. De-solder the red and black wires attached to the chopper motor.
6. Remove the three screws holding the chopper motor to the center plate.
7. Replace the chopper motor and reverse the above procedure.
8. Turn the power ON and check the chopper motor frequency by viewing in Mode 4 - Diagnostics. Adjust using the trim potentiometer as described in “Transmitter Adjustments” on page 3-7.

Replacement of Gas Cells

Transmitter

1. Turn the power OFF and remove the transmitter from its air purge.
2. Remove the four screws holding the transmitter front flange in position and remove the front flange.
3. Turn the three brass extended head screws counterclockwise (unscrew) to loosen assembly.
4. Carefully lift out the assembly and ease the PCB off its supports.
5. Unscrew the M3 x 6 slotted screw (or grub screw on some models) at the end of the gas cell assembly.
6. Pry the gas cell off the stepper motor shaft.
7. Place the new gas cell in position and reverse the above process.
8. Turn ON the power and recalibrate. Refer to Section 4, Calibrate.

Receiver

1. Turn the power OFF and remove the receiver from its air purge.
2. Remove the receiver cover from the front flange.
3. Remove the four screws holding side detector PCB to the main body of the receiver (M4 x 16 screws).
4. Completely remove the four M6 bolts from the end detector PCB.
5. Slide out the gas cell assembly.
6. Replace the gas cell, ensuring that the same orientation is kept - the notch in the gas cell assembly should be facing away from the side on which the side detector PCB fits.
7. Reverse the above process being careful not to overtighten the four bolts (if these are too tight the gas cell may fracture).
8. Turn the power ON and recalibrate. Refer to Section 4, Calibrate.

Electronics

The electronics require no routine maintenance. They are all solid state and undergo a rigorous factory burn-in procedure. If there is any doubt about the equipment performance the signal processor may be interrogated from the keypad to determine whether or not the equipment is functioning normally. Refer to Section 6, Troubleshooting.

SPAN FACTOR ADJUSTMENT

The span factor does not normally need adjusting. However, if any of the following changes have taken place it may be necessary to adjust it:

1. Gas cell changed either in the receiver or the transmitter.
2. Interference filter changed in the receiver.

The procedure for changing the span factor in these cases is as follows:

1. Set the span factor to 1000 in Mode 5.
2. Calibrate the analyzer under zero conditions.
3. Obtain a check cell reading in Mode 6 [note that the check cell is defined at a temperature of 68^{o}F (20^{o}C) and a pathlength of 3.28 ft (1 m)].
4. Set the temperature input in Mode 5 normalization to Keypad 68^{o}F (20^{o}C).
5. Enter the pathlength in Mode 5. Note that the check cell reading must be less than 999 ppm.m; if it is greater than this, use a larger pathlength to reduce the effective ppm.m value of the check cell (i.e. select the pathlength such that ppm.m/pathlength <999).
6. In Mode 5 under the span factor menu enter the value read for the check cell in Mode 6. Note that if this value exceeded 999 ppm divide by the pathlength entered above.
7. Press Enter and wait for the second reading to appear under the span factor option. This should read the same as the value entered above.
8. Using the up and down arrow keys adjust the span factor until the second reading agrees with the certified check cell value (divided by the pathlength if appropriate).
9. Note the span factor value and press Enter.
10. Confirm the span factor is set by entering Mode 2 and checking span factor under the parameters menu option.

An example of resetting the span factor is outlined below:

- Certified check cell of 2880 ppm is inserted into the check cell holder with the analyzer in Mode 6 and a reading taken. This reading is 3240.
- Due to the value of the check cell exceeding 999 ppm a suitable pathlength needs to be used to reduce the effective value of the check cell. In this case a pathlength of 4 m is chosen, thus the effective value of the check cell in 720 ppm (2880/4).
- However, in Mode 6 it reads higher (3240); this value is effectively 810 ppm at a 4 m pathlength.
- 810 is keyed in as the first value in the span factor option.
- The span factor is then adjusted until the second value reads 720.
- Now press Enter to set the span factor.

Section 6 Troubleshooting

FAULT FINDING WITH THE KEYPAD

⚠WARNING

Install all protective equipment covers and safety ground leads after troubleshooting. Failure to install covers and ground leads could result in serious injury or death.

Should a fault occur the display switches from its current mode of operation to the diagnostic mode and displays the current fault condition - refer to Data Valid LED Out. If this fault clears, the display will stay in the diagnostic mode and display the 'All Clear'.

Enter the diagnostic mode from the keypad of the instrument; this can be done at any time without interrupting or disturbing the analog outputs of the equipment.

As an initial guide to equipment performance, typical values for instrument operation are given below:

	D2 min	D2 max	D1 min	D1 max	Set Cal min	Set Cal max
CCO 5500	3000	20,000	3000	20,000	2000	2900

where:

- Modulation Frequency = 30 to 45 Hz
- Mark/Space Ratio = 0.9 to 1.1
- Saturation Count = 50 maximum for all analyzers

Should the values be outside of the above ranges, the Data valid LED will extinguish, and the fault condition be displayed.

Data Valid LED Out

If one or more fault conditions occur, the data valid LED on the front panel will extinguish, the data valid relay will operate and the instrument will automatically enter the diagnostic mode to display the fault condition.

The following fault conditions are recognized by the instrument.

Table 6-1. Fault Conditions

Detector signals saturated *(Sat# over 50)*
Possible Causes
Incorrect detector gain adjustment.
Instrument condition during high opacity conditions which have now cleared.
Low detector levels *(D1 < 3,000)*
Possible Causes
High opacity in duct.
Dirty windows.
Incorrect detector gain adjustment.
Heater cartridge failure.
Cal factor out of range
Possible Causes
Calibration conducted during unstable duct conditions.
Poor alignment.
Incorrect detector gain adjustment.
Modulation frequency is below 30 Hz or above 45 Hz
Possible Causes
Poor supply voltage.
Faulty chopper motor.
Incorrect setting within transmitter.
Reference signal failure
Possible Causes
Chopper motor failure.

NOTE
If a fault condition is recognized by the instrument the minutes, hours and days averages will not be updated.

Further troubleshooting information is provided in Table 6-2 and Table 6-3.

TROUBLESHOOTING TABLES

The troubleshooting tables provide fault diagnosis, possible causes and the appropriate actions, if an instrument fault is suspected. Note the symptoms and when the fault has occurred and refer to the appropriate tables.

NOTE
Be sure to use the tables from the top down and pay particular attention to the 'proceed to next TEST or CAUSE' information.

If the fault cannot be rectified by the customer then the tables should indicate which of the four units are faulty:

- power supply
- signal processor
- transmitter
- receiver

The faulty unit can then be returned to Rosemount Analytical for repair.

Table 6-2. Configuration Problems

No display on signal processor			
Possible Cause	**Test**	**Result**	**Action**
Mains input failure	Check 110/220V selection switch in power supply	Setting correct	Proceed to next test
		Setting incorrect	Change setting & proceed to next test
	Check power indication LED in power supply	LED illuminated	Mains OK - proceed to next possible cause
		LED not illuminated	Proceed to next test
	Check fuse in power supply	Fuse OK	Proceed to next possible cause
		Fuse blown	Replace fuse
Power supply failure	Check power rail LEDs in signal processor	All LEDs illuminated	Supplies OK - proceed to next possible cause
		LEDs not illuminated	Proceed to next test
	Check fuse in signal processor	Fuse OK	Proceed to next possible cause
		Fuse blown	Replace fuse
Connection Problem	Check wiring between signal processor & power supply	Wiring OK	Proceed to next test
		Incorrect wiring	Correct wiring
	Check ribbon cable connections in signal processor	Connections OK	Proceed to next possible cause
		Connections loose	Secure connections
Signal processor failure	-	-	Contact your Rosemount Analytical supplier
Display nonsense on signal processor			
Possible Cause	**Test**	**Result**	**Action**
Micro-processor fault	Reset by interrupting mains supply	Fault clears	No further action
		Fault continues	Proceed to next possible cause
Program corruption/faulty micro PCB	-	-	Contact your Rosemount Analytical supplier

Display message 'Waiting for Reference'			
Possible Cause	**Test**	**Result**	**Action**
Reference wave failure	Checking wiring between power supply and signal processor and also between power supply and transmitter	Wiring OK	Proceed to next test
		Wiring incorrect	Correct wiring
	Check ref. wave in power supply - use oscilloscope @ terminals 4 and 5	37 Hz square wave approx. 12V - OK	Proceed to next test
		See above - not OK	Proceed to next possible cause
	Check ref. wave in signal processor - use oscilloscope @ terminals 2 and 5	37 Hz square wave approx. 12V - OK	Contact your Rosemount Analytical supplier
		See above - not OK	Check and rectify wiring/continuity between power supply and signal processor
Chopper motor failure in transmitter	Check if chopper blade is rotating	No	Proceed to next test
		Yes	Contact your Rosemount Analytical supplier
	Replace chopper motor	Fault clears	No further action
		Fault continues	Contact your Rosemount Analytical supplier
Data valid LED not illuminated			
Possible Cause	**Test**	**Result**	**Action**
Analyzer fault condition	Interrogate fault status in Mode 4	*All Clear*	Contact your Rosemount Analytical supplier
		Fault condition identified	Proceed to relevant symptom
Reference failure			
Possible Cause	**Test**	**Result**	**Action**
Reference wave failure	Proceed as for symptom 3	Fault clears	No further action
		Fault continues	Contact your Rosemount Analytical supplier

Low detector level			
Possible Cause	**Test**	**Result**	**Action**
Incorrect wiring	Checking wiring	Fault clears	No further action
		Fault continues	Proceed to next possible cause
Dirty windows or obstructed sight path	Check and clean the Rx and Tx windows - clear sight path between Rx and Tx	Detector levels in range	No further action
		Fault continues	Proceed to next possible cause
Misalignment	Realign Rx and Tx units	Detector levels in range	No further action
		Fault continues	Proceed to next possible cause
Incorrect gain settings	Adjust gains in signal processor and/or Rx	Detector levels in range	No further action
		Fault continues	Proceed to next possible cause
Transmitter failure	Check heater cartridge	Cartridge open circuit	Replace heater cartridge
		Cartridge OK	Proceed to next possible cause
Transmitter gas cell drive failure	Check drive LED in signal processor	LED flashing	Proceed to next test
		LED not flashing	Contact your Rosemount Analytical supplier
	Check gas cell/filter drive	No movement	Contact your Rosemount Analytical supplier
		Movement	Contact your Rosemount Analytical supplier
Detector saturated			
Possible Cause	**Test**	**Result**	**Action**
Incorrect gain settings	Adjust gain settings in signal processor and/or Rx	Saturation clears	No further action
		Fault continues	Proceed to next test
	Monitor detector levels from Rx	Signal OK	Contact your Rosemount Analytical supplier
		Signal faulty	Contact your Rosemount Analytical supplier

Modulation frequency out of range			
Possible Cause	**Test**	**Result**	**Action**
Chopper motor speed out of range	Adjust chopper motor speed	Mod. Frequency in range	No further action
		Unable to adjust	Proceed to next test
	Monitor ref. waveform across 10 and 11 in power supply using oscilloscope	30 - 45 Hz waveform OK	Contact your Rosemount Analytical supplier
		<30 or >45 Hz - waveform incorrect	Contact your Rosemount Analytical supplier
Set Call out of range			
Possible Cause	**Test**	**Result**	**Action**
Calibrated with incorrect target value or under fluctuating gas level	Calibrate with correct target value	Cal factor in range	No further action
		Cal factor out of range	Proceed to next possible cause
Poor alignment / window contamin-ation / path obscured	Proceed as for low detector level	Cal factor in range	No further action
		Cal factor out of range	Proceed to next possible cause
Tx gas cell drive failure	Proceed as for low detector level	Cal factor in range	No further action
		Cal factor out of range	Proceed to next possible cause
D2 detector/circuit failure	Check D2 signal level	OK	Proceed to next possible cause
		Not OK	Proceed to next test
	Monitor D2 signal from Rx	OK	Contact your Rosemount Analytical supplier
		Not OK	Contact your Rosemount Analytical supplier
Transmitter gas cell failure	Replace Tx gas cell	Cal factor in range	No further action
		Cal factor out of range	Proceed to the next possible cause
Receiver gas cell failure	Replace Rx gas cell	Cal factor in range	No further action
		Cal factor out of range	Contact your Rosemount Analytical supplier

Table 6-3. Operational Problems

Output reading permanently zero or full scale			
Possible Cause	**Test**	**Result**	**Action**
Incorrect normalizing parameter setting	Enter parameter mode and ensure all parameters are as required	Parameters correct	Proceed to next possible cause
		Parameters incorrect	Enter correct parameters
Incorrect calibration (Set Cal value) zero gas level	Enter diagnostic mode and observe the Y (60) figure	1800 <Y <2010	Instrument OK - true level of gas in duct (output permanently zero)
		Y <1800	Proceed to next possible cause
Detector levels low or saturated	Enter diagnostic mode and check the detector levels and saturation count	Detector levels OK	Proceed to next possible cause
		Detector levels out of tolerance	Reconfigure the instrument and consult the fault-finding table again
Output circuitry failure	Enter setup mode (configure output and attempt to set zero and span	Output responds correctly	Reconfigure the instrument and consult the fault-finding table again
		Output does not respond correctly	Replace signal processor
Averages not updated			
Possible Cause	**Test**	**Result**	**Action**
Fault condition exists	Enter diagnostic mode and check fault condition	Fault condition exists	Refer to Section 4, Fault Condition
		No fault condition	Proceed to next possible cause
Plant status contact in signal processor has been made	Check plant status input LED in signal processor	LED off	Operation correct - stable gas level
		LED on	Plant status in use - instrument will not update until plant on

COMPONENT TESTS

Some instrument components/operation can be verified as follows:

Heater Cartridge

Perform the steps for Section 5, Replacement of the Heater Element within the transmitter up to step 4. Remove one lead from the heater cartridge and measure the resistance across the two cartridge terminals. It should be about 3.5Ω. If the circuit is open the heater cartridge needs replacing.

Chopper Motor

1. Turn the power ON.
2. Observe the chopper motor and blade between the lens and heater cartridge. If the blade is spinning, the chopper motor is OK.
3. If the blade is not spinning, the supply to the chopper motor can be measured at the test points M+ and M– on the board to the front of the unit (nearest the lens) - it should be about 1V DC. If it is, the chopper motor assembly requires changing; if it is, not the transmitter unit is faulty.

LED INDICATIONS

If instrument malfunction is suspected, there are LEDs within the instrument indicating various power rails and equipment operations.

Signal Processor LEDs	
5V, -15, +15	Situated top/left of processor. Should all be ON, indicating that the power supplies to the instrument are functioning correctly.
M-DIR	Should operate approximately every 4 seconds.
SOL_MDRV	Supply to the solenoid that drives the filter into the optical path within the receiver pulses every time the M-DIR changes (approximately every 2 seconds).
+V1, -V1 and +12V	Middle bottom left of board. All should be ON. Power supplies to the isolated analog current output.
+12V	Bottom left of board. Should be ON. Indication of the isolated supply for the plant status input.
PS	Bottom left of board. In normal operation, this LED should be OFF. During plant-off periods, however, if the plant status input is being used, this LED will illuminate and the rolling averages not updated.
Receiver LEDs	
+V and -V	These LEDs should be ON indicating that the power supplies within the unit are functioning correctly.
Transmitter LEDs	
+V and -V	These LEDs should be ON indicating that the power supplies within the unit are functioning correctly.
Power Supply LED	
+12V	This LED should be ON indicating that the power supply unit is functioning correctly. This LED will extinguish should the supply voltage drop from 12 to 11V.

TEST POINTS

If further checks on instrument operation are required, there are various test points within the instrument. Many of these are simple DC voltages and so may be checked using a voltmeter set to DC volts, otherwise may be investigated using an oscilloscope:

Signal processor	
T1	D1 signal from receiver head with some conditioning in the processor, smoothed by a factor of divide by 10. Flattened saw-tooth, 32 to 45 Hz (modulation frequency) 1V pk-pk (maximum), centred on 0V. 0V for T1 to T6 may be taken from 0V test point, top left of board. Test-points T1 to T6 are to be found in the center of the board.
T2	D1 signal after amplification in processor. Flattened saw-tooth, 32 to 45 Hz, 3.5V pk-pk (maximum), centered on 0V. Amplitude may be varied by a trim pot. Refer to Section 4, Detector Levels.
T3	D1 output to the A/D converter within the micro-processor, offset by 2.5V. Flattened saw-tooth, 32 to 45 Hz, 3.5V pk-pk (maximum), centered on 2.5V.
T4	As T1 but for D2 signal.
T5	As T2 but for D2 signal.
T6	As T3 but for D2 signal.
T7	Receiver ambient temperature to the A/D converter with the micro-processor - 1mV represents 33.8ºF (1ºC).
T8	Normalizing input for pressure, before A/D converter 0.8 to 4.0V = 4 to 20 mA.
T9	As T8 except oxygen.
T10	As T8 except temperature.
+5 and 0V	Supply rails for the micro-processor. DC voltage.
12V	Supply rail for the plant status input.
+15V, -15V and 0VA	Supply rails for the analog current output.
VIN	Output from the D/A converter. 0 to 2.5V represents 0 to 20 mA (4 mA at 0.V).
-15V1, 0V and +15V1	Isolated supply for the analog current output.
0VB and +12VB	Isolated supply for the plant status input.
F	Reference wave from the transmitter unit (via the power supply). Square wave, 30 top 45 Hz, 5V pk-pk, centered on 2.5V.
Power Supply	
0V and +12V	Power supply for the instrument.
Receiver	
0V	0V for the receiver.
T1	Detector output without conditioning.
T2	Detector output after first stage of gain.
T3	Detector output after both stages of gain.
Transmitter	
S-	0V supply to the heater cartridge.
S+	12V supply to the heater cartridge.
M+ and M-	Supply to the chopper motor (+1V DC).
T3	Reference wave.
T4	Reference wave.

Section 7 Returning Material

If factory repair of defective equipment is required, proceed as follows:

1. Secure a return authorization number from a Rosemount Analytical sales office or representative before returning the equipment. Equipment must be returned with complete identification in accordance with Rosemount Analytical instructions or it will not be accepted.

   In no event will Emerson Process Management be responsible for equipment returned without proper authorization and identification.
2. Carefully pack defective unit in a sturdy box with sufficient shock absorbing material to ensure that no additional damage will occur during shipping.
3. In a cover letter, describe completely:
   a. The symptoms from which it was determined that the equipment is faulty.
   b. The environment in which the equipment has been operating (housing, weather, vibration, dust, etc.).
   c. Site from which equipment was removed.
   d. Whether warranty or nonwarranty service is requested.
   e. Complete shipping instructions for return of equipment.
   f. Reference the return authorization number.
4. Enclose a cover letter and purchase order and ship the defective equipment according to instructions provided in Rosemount Analytical Return Authorization, prepaid, to:

   Rosemount Analytical Inc.
   RMR Department
   Daniel Headquarters
   11100 Britmore Park Drive
   Houston, TX 77041

If warranty service is requested, the defective unit will be carefully inspected and tested at the factory. If failure was due to conditions listed in the standard Rosemount Analytical warranty, the defective unit will be repaired or replaced at Rosemount Analytical's option, and an operating unit will be returned to the customer in accordance with shipping instructions furnished in the cover letter.

For equipment no longer under warranty, the equipment will be repaired at the factory and returned as directed by the purchase order and shipping instructions.

Section 8 Replacement Parts

RECOMMENDED SPARE PARTS

Part Number		Description	Qty.
990.050	2 years	Heater cartridge	1
900.468*		Protective window	2
980-101	5 years	Center plate assembly (state serial no.)	1
980.063		Chopper motor and disc	1
980.051*		Purge assembly	2

Items marked * are not consumable; therefore, only one set of these items needs to be held as back-up spares for each analyzer type. All other items have a limited life and full quantities will be required for each individual analyzer.

PARTS LIST

Part Number	Description
990.210	Transmitter
990.211	Receiver
990.208	Signal Processor (state model type)
990.207	Power Supply
980.051	Purge Assembly

Appendix A Safety Data

SAFETY INSTRUCTIONS

IMPORTANT

SAFETY INSTRUCTIONS FOR THE WIRING AND INSTALLATION OF THIS APPARATUS

The following safety instructions apply specifically to all EU member states. They should be strictly adhered to in order to assure compliance with the Low Voltage Directive. Non-EU states should also comply with the following unless superseded by local or National Standards.

1. Adequate earth connections should be made to all earthing points, internal and external, where provided.
2. After installation or troubleshooting, all safety covers and safety grounds must be replaced. The integrity of all earth terminals must be maintained at all times.
3. Mains supply cords should comply with the requirements of IEC227 or IEC245.
4. All wiring shall be suitable for use in an ambient temperature of greater than 75°C.
5. All cable glands used should be of such internal dimensions as to provide adequate cable anchorage.
6. To ensure safe operation of this equipment, connection to the mains supply should only be made through a circuit breaker which will disconnect all circuits carrying conductors during a fault situation. The circuit breaker may also include a mechanically operated isolating switch. If not, then another means of disconnecting the equipment from the supply must be provided and clearly marked as such. Circuit breakers or switches must comply with a recognized standard such as IEC947. All wiring must conform with any local standards.
7. Where equipment or covers are marked with the symbol to the right, hazardous voltages are likely to be present beneath. These covers should only be removed when power is removed from the equipment - and then only by trained service personnel.

8. Where equipment or covers are marked with the symbol to the right, there is a danger from hot surfaces beneath. These covers should only be removed by trained service personnel when power is removed from the equipment. Certain surfaces may remain hot to the touch.

9. Where equipment or covers are marked with the symbol to the right, refer to the Operator Manual for instructions.

10. All graphical symbols used in this product are from one or more of the following standards: EN61010-1, IEC417, and ISO3864.

BELANGRIJK

Veiligheidsvoorschriften voor de aansluiting en installatie van dit toestel.

De hierna volgende veiligheidsvoorschriften zijn vooral bedoeld voor de EU lidstaten. Hier moet aan gehouden worden om de onderworpenheid aan de Laag Spannings Richtlijn (Low Voltage Directive) te verzekeren. Niet EU staten zouden deze richtlijnen moeten volgen tenzij zij reeds achterhaald zouden zijn door plaatselijke of nationale voorschriften.

1. Degelijke aardingsaansluitingen moeten gemaakt worden naar alle voorziene aardpunten, intern en extern.
2. Na installatie of controle moeten alle veiligheidsdeksels en -aardingen terug geplaatst worden. Ten alle tijde moet de betrouwbaarheid van de aarding behouden blijven.
3. Voedingskabels moeten onderworpen zijn aan de IEC227 of de IEC245 voorschriften.
4. Alle bekabeling moet geschikt zijn voor het gebruik in omgevingstemperaturen, hoger dan 75°C.
5. Alle wartels moeten zo gedimensioneerd zijn dat een degelijke kabel bevestiging verzekerd is.
6. Om de veilige werking van dit toestel te verzekeren, moet de voeding door een stroomonderbreker gevoerd worden (min 10A) welke alle draden van de voeding moet onderbreken. De stroomonderbreker mag een mechanische schakelaar bevatten. Zoniet moet een andere mogelijkheid bestaan om de voedingsspanning van het toestel te halen en ook duidelijk zo zijn aangegeven. Stroomonderbrekers of schakelaars moeten onderworpen zijn aan een erkende standaard zoals IEC947.
7. Waar toestellen of deksels aangegeven staan met het symbool is er meestal hoogspanning aanwezig. Deze deksels mogen enkel verwijderd worden nadat de voedingsspanning werd afgelegd en enkel door getraind onderhoudspersoneel.

8. Waar toestellen of deksels aangegeven staan met het symbool is er gevaar voor hete oppervlakken. Deze deksels mogen enkel verwijderd worden door getraind onderhoudspersoneel nadat de voedingsspanning verwijderd werd. Sommige oppper-vlakken kunnen 45 minuten later nog steeds heet aanvoelen.

9. Waar toestellen of deksels aangegeven staan met het symbool gelieve het handboek te raadplegen.

10. Alle grafische symbolen gebruikt in dit produkt, zijn afkomstig uit een of meer van devolgende standaards: EN61010-1, IEC417 en ISO3864.

VIGTIGT

Sikkerhedsinstruktion for tilslutning og installering af dette udstyr.

Følgende sikkerhedsinstruktioner gælder specifikt i alle EU-medlemslande. Instruktionerne skal nøje følges for overholdelse af Lavsspændingsdirektivet og bør også følges i ikke EU-lande medmindre andet er specificeret af lokale eller nationale standarder.

1. Passende jordforbindelser skal tilsluttes alle jordklemmer, interne og eksterne, hvor disse forefindes.
2. Efter installation eller fejlfinding skal alle sikkerhedsdæksler og jordforbindelser reetableres.
3. Forsyningskabler skal opfylde krav specificeret i IEC227 eller IEC245.
4. Alle ledningstilslutninger skal være konstrueret til omgivelsestemperatur højere end 75°C.
5. Alle benyttede kabelforskruninger skal have en intern dimension, så passende kabelaflastning kan etableres.
6. For opnåelse af sikker drift og betjening skal der skabes beskyttelse mod indirekte berøring gennem afbryder (min. 10A), som vil afbryde alle kredsløb med elektriske ledere i fejlsitua-tion. Afbryderen skal indholde en mekanisk betjent kontakt. Hvis ikke skal anden form for afbryder mellem forsyning og udstyr benyttes og mærkes som sådan. Afbrydere eller kontakter skal overholde en kendt standard som IEC947.
7. Hvor udstyr eller dæksler er mærket med dette symbol, er farlige spændinger normalt forekom-mende bagved. Disse dæksler bør kun afmonteres, når forsyningsspændingen er frakoblet - og da kun af instrueret servicepersonale.

8. Hvor udstyr eller dæksler er mærket med dette symbol, forefindes meget varme overflader bagved. Disse dæksler bør kun afmonteres af instrueret servicepersonale, når forsyningsspænding er frakoblet. Visse overflader vil stadig være for varme at berøre i op til 45 minutter efter frakobling.

9. Hvor udstyr eller dæksler er mærket med dette symbol, se da i betjeningsmanual for instruktion.

10. Alle benyttede grafiske symboler i dette udstyr findes i én eller flere af følgende standarder:- EN61010-1, IEC417 & ISO3864.

BELANGRIJK

Veiligheidsinstructies voor de bedrading en installatie van dit apparaat.

Voor alle EU lidstaten zijn de volgende veiligheidsinstructies van toepassing. Om aan de geldende richtlijnen voor laagspanning te voldoen dient men zich hieraan strikt te houden. Ook niet EU lidstaten dienen zich aan het volgende te houden, tenzij de lokale wetgeving anders voorschrijft.

1. Alle voorziene interne- en externe aardaansluitingen dienen op adequate wijze aangesloten te worden.
2. Na installatie, onderhouds- of reparatie werkzaamheden dienen alle beschermdeksels /kappen en aardingen om reden van veiligheid weer aangebracht te worden.
3. Voedingskabels dienen te voldoen aan de vereisten van de normen IEC 227 of IEC 245.
4. Alle bedrading dient geschikt te zijn voor gebruik bij een omgevings temperatuur boven 75°C.
5. Alle gebruikte kabelwartels dienen dusdanige inwendige afmetingen te hebben dat een adequate verankering van de kabel wordt verkregen.
6. Om een veilige werking van de apparatuur te waarborgen dient de voeding uitsluitend plaats te vinden via een meerpolige automatische zekering (min.10A) die alle spanningvoerende geleiders verbreekt indien een foutconditie optreedt. Deze automatische zekering mag ook voorzien zijn van een mechanisch bediende schakelaar. Bij het ontbreken van deze voorziening dient een andere als zodanig duidelijk aangegeven mogelijkheid aanwezig te zijn om de spanning van de apparatuur af te schakelen. Zekeringen en schakelaars dienen te voldoen aan een erkende standaard zoals IEC 947.
7. Waar de apparatuur of de beschermdeksels/kappen gemarkeerd zijn met het volgende symbool, kunnen zich hieronder spanning voerende delen bevinden die gevaar op kunnen leveren. Deze beschermdeksels/ kappen mogen uitsluitend verwijderd worden door getraind personeel als de spanning is afgeschakeld.

8. Waar de apparatuur of de beschermdeksels/kappen gemarkeerd zijn met het volgende symbool, kunnen zich hieronder hete oppervlakken of onderdelen bevinden. Bepaalde delen kunnen mogelijk na 45 min. nog te heet zijn om aan te raken.

9. Waar de apparatuur of de beschermdeksels/kappen gemarkeerd zijn met het volgende symbool, dient men de bedieningshandleiding te raadplegen.

10. Alle grafische symbolen gebruikt bij dit produkt zijn volgens een of meer van de volgende standaarden: EN 61010-1, IEC 417 & ISO 3864.

TÄRKEÄÄ

Turvallisuusohje, jota on noudatettava tämän laitteen asentamisessa ja kaapeloinnissa.

Seuraavat ohjeet pätevät erityisesti EU:n jäsenvaltioissa. Niitä täytyy ehdottomasti noudattaa jotta täytettäisiin EU:n matalajännitedirektiivin (Low Voltage Directive) yhteensopivuus. Myös EU:hun kuulumattomien valtioiden tulee nou-dattaa tätä ohjetta, elleivät kansalliset standardit estä sitä.

1. Riittävät maadoituskytkennät on tehtävä kaikkiin maadoituspisteisiin, sisäisiin ja ulkoisiin.
2. Asennuksen ja vianetsinnän jälkeen on kaikki suojat ja suojamaat asennettava takaisin pai-koilleen. Maadoitusliittimen kunnollinen toiminta täytyy aina ylläpitää.
3. Jännitesyöttöjohtimien täytyy täyttää IEC227 ja IEC245 vaatimukset.
4. Kaikkien johdotuksien tulee toimia >75°C lämpötiloissa.
5. Kaikkien läpivientiholkkien sisähalkaisijan täytyy olla sellainen että kaapeli lukkiutuu kun-nolla kiinni.
6. Turvallisen toiminnan varmistamiseksi täytyy jännitesyöttö varustaa turvakytkimellä (min 10A), joka kytkee irti kaikki jännitesyöttöjohtimet vikatilanteessa. Suojaan täytyy myös sisältyä mekaaninen erotuskytkin. Jos ei, niin jännitesyöttö on pystyttävä katkaisemaan muilla keinoilla ja merkittävä siten että se tunnistetaan sellaiseksi. Turvakytkimien tai kat-kaisimien täytyy täyttää IEC947 standardin vaatimukset näkyvyydestä.
7. Mikäli laite tai kosketussuoja on merkitty tällä merkillä on merkinnän takana tai alla hengenvaarallisen suuruinen jännite. Suojaa ei saa poistaa jänniteen ollessa kytkettynä laitteeseen ja poistamisen saa suorittaa vain alan asian-tuntija.

8. Mikäli laite tai kosketussuoja on merkitty tällä merkillä on merkinnän takana tai alla kuuma pinta. Suojan saa poistaa vain alan asiantuntija kun jännite-syöttö on katkaistu. Tällainen pinta voi säilyä kosketuskuumana jopa 45 mi-nuuttia.

9. Mikäli laite tai kosketussuoja on merkitty tällä merkillä katso lisäohjeita käyt-töohjekirjasta.

10. Kaikki tässä tuotteessa käytetyt graafiset symbolit ovat yhdestä tai useammasta seuraavis-ta standardeista: EN61010-1, IEC417 & ISO3864.

IMPORTANT

Consignes de sécurité concernant le raccordement et l'installation de cet appareil.

Les consignes de sécurité ci-dessous s'adressent particulièrement à tous les états membres de la communauté européenne. Elles doivent être strictement appliquées afin de satisfaire aux directives concernant la basse tension. Les états non membres de la communauté européenne doivent également appliquer ces consignes sauf si elles sont en contradiction avec les standards locaux ou nationaux.

1. Un raccordement adéquat à la terre doit être effectuée à chaque borne de mise à la terre, interne et externe.
2. Après installation ou dépannage, tous les capots de protection et toutes les prises de terre doivent être remis en place, toutes les prises de terre doivent être respectées en permanence.
3. Les câbles d'alimentation électrique doivent être conformes aux normes IEC227 ou IEC245.
4. Tous les raccordements doivent pouvoir supporter une température ambiante supérieure à 75°C.
5. Tous les presse-étoupes utilisés doivent avoir un diamètre interne en rapport avec les câbles afin d'assurer un serrage correct sur ces derniers.
6. Afin de garantir la sécurité du fonctionnement de cet appareil, le raccordement à l'alimentation électrique doit être réalisé exclusivement au travers d'un disjoncteur (minimum 10A.) isolant tous les conducteurs en cas d'anomalie. Ce disjoncteur doit également pouvoir être actionné manuellement, de façon mécanique. Dans le cas contraire, un autre système doit être mis en place afin de pouvoir isoler l'appareil et doit être signalisé comme tel. Disjoncteurs et interrupteurs doivent être conformes à une norme reconnue telle IEC947.
7. Lorsque les équipements ou les capots affichent le symbole suivant, cela signifie que des tensions dangereuses sont présentes. Ces capots ne doivent être démontés que lorsque l'alimentation est coupée, et uniquement par un personnel compétent.

8. Lorsque les équipements ou les capots affichent le symbole suivant, cela signifie que des surfaces dangereusement chaudes sont présentes. Ces capots ne doivent être démontés que lorsque l'alimentation est coupée, et uniquement par un personnel compétent. Certaines surfaces peuvent rester chaudes jusqu'à 45 mn.

9. Lorsque les équipements ou les capots affichent le symbole suivant, se reporter au manuel d'instructions.

10. Tous les symboles graphiques utilisés dans ce produit sont conformes à un ou plusieurs des standards suivants: EN61010-1, IEC417 & ISO3864.

WICHTIG

Sicherheitshinweise für den Anschluß und die Installation dieser Geräte.

Die folgenden Sicherheitshinweise sind in allen Mitgliederstaaten der europäischen Gemeinschaft gültig. Sie müssen strickt eingehalten werden, um der Niederspannungsrichtlinie zu genügen. Nichtmitgliedsstaaten der europäischen Gemeinschaft sollten die national gültigen Normen und Richtlinien einhalten.

1. Alle intern und extern vorgesehenen Erdungen der Geräte müssen ausgeführt werden.
2. Nach Installation, Reparatur oder sonstigen Eingriffen in das Gerät müssen alle Sicherheitsabdeckungen und Erdungen wieder installiert werden. Die Funktion aller Erdverbindungen darf zu keinem Zeitpunkt gestört sein.
3. Die Netzspannungsversorgung muß den Anforderungen der IEC227 oder IEC245 genügen.
4. Alle Verdrahtungen sollten mindestens bis 75°C ihre Funktion dauerhaft erfüllen.
5. Alle Kabeldurchführungen und Kabelverschraubungen sollten in Ihrer Dimensionierung so gewählt werden, daß diese eine sichere Verkabelung des Gerätes ermöglichen.
6. Um eine sichere Funktion des Gerätes zu gewährleisten, muß die Spannungsversorgung über mindestens 10 A abgesichert sein. Im Fehlerfall muß dadurch gewährleistet sein, daß die Spannungsversorgung zum Gerät bzw. zu den Geräten unterbrochen wird. Ein mechanischer Schutzschalter kann in dieses System integriert werden. Falls eine derartige Vorrichtung nicht vorhanden ist, muß eine andere Möglichkeit zur Unterbrechung der Spannungszufuhr gewährleistet werden mit Hinweisen deutlich gekennzeichnet werden. Ein solcher Mechanismus zur Spannungsunterbrechung muß mit den Normen und Richtlinien für die allgemeine Installation von Elektrogeräten, wie zum Beispiel der IEC947, übereinstimmen.

7. Mit dem Symbol sind Geräte oder Abdeckungen gekennzeichnet, die eine gefährliche (Netzspannung) Spannung führen. Die Abdeckungen dürfen nur entfernt werden, wenn die Versorgungsspannung unterbrochen wurde. Nur geschultes Personal darf an diesen Geräten Arbeiten ausführen.

8. Mit dem Symbol sind Geräte oder Abdeckungen gekennzeichnet, in bzw. unter denen heiße Teile vorhanden sind. Die Abdeckungen dürfen nur entfernt werden, wenn die Versorgungsspannung unterbrochen wurde. Nur geschultes Personal darf an diesen Geräten Arbeiten ausführen. Bis 45 Minuten nach dem Unterbrechen der Netzzufuhr können derartig Teile noch über eine erhöhte Temperatur verfügen.

9. Mit dem Symbol sind Geräte oder Abdeckungen gekennzeichnet, bei denen vor dem Eingriff die entsprechenden Kapitel im Handbuch sorgfältig durchgelesen werden müssen.
10. Alle in diesem Gerät verwendeten graphischen Symbole entspringen einem oder mehreren der nachfolgend aufgeführten Standards: EN61010-1, IEC417 & ISO3864.

IMPORTANTE

Norme di sicurezza per il cablaggio e l'installazione dello strumento.

Le seguenti norme di sicurezza si applicano specificatamente agli stati membri dell'Unione Europea, la cui stretta osservanza è richiesta per garantire conformità alla Direttiva del Basso Voltaggio. Esse si applicano anche agli stati non appartenenti all'Unione Europea, salvo quanto disposto dalle vigenti normative locali o nazionali.

1. Collegamenti di terra idonei devono essere eseguiti per tutti i punti di messa a terra interni ed esterni, dove previsti.
2. Dopo l'installazione o la localizzazione dei guasti, assicurarsi che tutti i coperchi di protezione siano stati collocati e le messa a terra siano collegate. L'integrità di ciscun morsetto di terra deve essere costantemente garantita.
3. I cavi di alimentazione della rete devono essere secondo disposizioni IEC227 o IEC245.
4. L'intero impianto elettrico deve essere adatto per uso in ambiente con temperature superiore a 75°C.
5. Le dimensioni di tutti i connettori dei cavi utilizzati devono essere tali da consentire un adeguato ancoraggio al cavo.
6. Per garantire un sicuro funzionamento dello strumento il collegamento alla rete di alimentazione principale dovrà essere eseguita tramite interruttore automatico (min.10A), in grado di disattivare tutti i conduttori di circuito in caso di guasto. Tale interruttore dovrà inoltre prevedere un sezionatore manuale o altro dispositivo di interruzione dell'alimentazione, chiaramente identificabile. Gli interruttori dovranno essere conformi agli standard riconosciuti, quali IEC947.
7. Il simbolo riportato sullo strumento o sui coperchi di protezione indica probabile presenza di elevati voltaggi. Tali coperchi di protezione devono essere rimossi esclusivamente da personale qualificato, dopo aver tolto alimentazione allo strumento.

8. Il simbolo riportato sullo strumento o sui coperchi di protezione indica rischio di contatto con superfici ad alta temperatura. Tali coperchi di protezione devono essere rimossi esclusivamente da personale qualificato, dopo aver tolto alimentazione allo strumento. Alcune superfici possono mantenere temperature elevate per oltre 45 minuti.

9. Se lo strumento o il coperchio di protezione riportano il simbolo, fare riferimento alle istruzioni del manuale Operatore.

10. Tutti i simboli grafici utilizzati in questo prodotto sono previsti da uno o più dei seguenti standard: EN61010-1, IEC417 e ISO3864.

VIKTIG

Sikkerhetsinstruks for tilkobling og installasjon av dette utstyret.

Følgende sikkerhetsinstruksjoner gjelder spesifikt alle EU medlemsland og land med i EØS-avtalen. Instruksjonene skal følges nøye slik at installasjonen blir i henhold til lavspenningsdirektivet. Den bør også følges i andre land, med mindre annet er spesifisert av lokale- eller nasjonale standarder.

1. Passende jordforbindelser må tilkobles alle jordingspunkter, interne og eksterne hvor disse forefinnes.
2. Etter installasjon eller feilsøking skal alle sikkerhetsdeksler og jordforbindelser reetableres. Jordingsforbindelsene må alltid holdes i god stand.
3. Kabler fra spenningsforsyning skal oppfylle kravene spesifisert i IEC227 eller IEC245.
4. Alle ledningsforbindelser skal være konstruert for en omgivelsestemperatur høyere en 750°C.
5. Alle kabelforskruvninger som benyttes skal ha en indre dimensjon slik at tilstrekkelig avlastning oppnåes.
6. For å oppnå sikker drift og betjening skal forbindelsen til spenningsforsyningen bare skje gjennom en strømbryter (minimum 10A) som vil bryte spenningsforsyningen til alle elektriske kretser ved en feilsituasjon. Strømbryteren kan også inneholde en mekanisk operert bryter for å isolere instrumentet fra spenningsforsyningen. Dersom det ikke er en mekanisk operert bryter installert, må det være en annen måte å isolere utstyret fra spenningsforsyningen, og denne måten må være tydelig merket. Kretsbrytere eller kontakter skal oppfylle kravene i en annerkjent standard av typen IEC947 eller tilsvarende.
7. Der hvor utstyr eller deksler er merket med symbol for farlig spenning, er det sannsynlig at disse er tilstede bak dekslet. Disse dekslene må bare fjærnes når spenningsforsyning er frakoblet utstyret, og da bare av trenet servicepersonell.

8. Der hvor utstyr eller deksler er merket med symbol for meget varm overflate, er det sannsynlig at disse er tilstede bak dekslet. Disse dekslene må bare fjærnes når spenningsforsyning er frakoblet utstyret, og da bare av trenet servicepersonell. Noen overflater kan være for varme til å berøres i opp til 45 minutter etter spenningsforsyning frakoblet.

9. Der hvor utstyret eller deksler er merket med symbol, vennligst referer til instruksjonsmanualen for instrukser.

10. Alle grafiske symboler brukt i dette produktet er fra en eller flere av følgende standarder: EN61010-1, IEC417 & ISO3864.

IMPORTANTE

Instruções de segurança para ligação e instalação deste aparelho.

As seguintes instruções de segurança aplicam-se especificamente a todos os estados membros da UE. Devem ser observadas rigidamente por forma a garantir o cumprimento da Directiva sobre Baixa Tensão. Relativamente aos estados que não pertençam à UE, deverão cumprir igualmente a referida directiva, exceptuando os casos em que a legislação local a tiver substituído.

1. Devem ser feitas ligações de terra apropriadas a todos os pontos de terra, internos ou externos.
2. Após a instalação ou eventual reparação, devem ser recolocadas todas as tampas de segurança e terras de protecção. Deve manter-se sempre a integridade de todos os terminais de terra.
3. Os cabos de alimentação eléctrica devem obedecer às exigências das normas IEC227 ou IEC245.
4. Os cabos e fios utilizados nas ligações eléctricas devem ser adequados para utilização a uma temperatura ambiente até 75ºC.
5. As dimensões internas dos bucins dos cabos devem ser adequadas a uma boa fixação dos cabos.
6. Para assegurar um funcionamento seguro deste equipamento, a ligação ao cabo de alimentação eléctrica deve ser feita através de um disjuntor (min. 10A) que desligará todos os condutores de circuitos durante uma avaria. O disjuntor poderá também conter um interruptor de isolamento accionado manualmente. Caso contrário, deverá ser instalado qualquer outro meio para desligar o equipamento da energia eléctrica, devendo ser assinalado convenientemente. Os disjuntores ou interruptores devem obedecer a uma norma reconhecida, tipo IEC947.
7. Sempre que o equipamento ou as tampas contiverem o símbolo, é provável a existência de tensões perigosas. Estas tampas só devem ser retiradas quando a energia eléctrica tiver sido desligada e por Pessoal da Assistência devidamente treinado.

8. Sempre que o equipamento ou as tampas contiverem o símbolo, há perigo de existência de superfícies quentes. Estas tampas só devem ser retiradas por Pessoal da Assistência devidamente treinado e depois de a energia eléctrica ter sido desligada. Algumas superfícies permanecem quentes até 45 minutos depois.

9. Sempre que o equipamento ou as tampas contiverem o símbolo, o Manual de Funcionamento deve ser consultado para obtenção das necessárias instruções.

10. Todos os símbolos gráficos utilizados neste produto baseiam-se em uma ou mais das seguintes normas: EN61010-1, IEC417 e ISO3864.

IMPORTANTE

Instrucciones de seguridad para el montaje y cableado de este aparato.

Las siguientes instrucciones de seguridad, son de aplicacion especifica a todos los miembros de la UE y se adjuntaran para cumplir la normativa europea de baja tension.

1. Se deben preveer conexiones a tierra del equipo, tanto externa como internamente, en aquellos terminales previstos al efecto.
2. Una vez finalizada las operaciones de mantenimiento del equipo, se deben volver a colocar las cubiertas de seguridad aasi como los terminales de tierra. Se debe comprobar la integridad de cada terminal.
3. Los cables de alimentacion electrica cumpliran con las normas IEC 227 o IEC 245.
4. Todo el cableado sera adecuado para una temperatura ambiental de 75ºC.
5. Todos los prensaestopas seran adecuados para una fijacion adecuada de los cables.
6. Para un manejo seguro del equipo, la alimentacion electrica se realizara a traves de un interruptor magnetotermico (min 10 A), el cual desconectara la alimentacion electrica al equipo en todas sus fases durante un fallo. Los interruptores estaran de acuerdo a la norma IEC 947 u otra de reconocido prestigio.
7. Cuando las tapas o el equipo lleve impreso el simbolo de tension electrica peligrosa, dicho alojamiento solamente se abrira una vez que se haya interrumpido la alimentacion electrica al equipo asimismo la intervencion sera llevada a cabo por personal entrenado para estas labores.

8. Cuando las tapas o el equipo lleve impreso el simbolo, hay superficies con alta temperatura, por tanto se abrira una vez que se haya interrumpido la alimentacion electrica al equipo por personal entrenado para estas labores, y al menos se esperara unos 45 minutos para enfriar las superficies calientes.

9. Cuando el equipo o la tapa lleve impreso el simbolo, se consultara el manual de instrucciones.
10. Todos los simbolos graficos usados en esta hoja, estan de acuerdo a las siguientes normas EN61010-1, IEC417 & ISO 3864.

VIKTIGT

Säkerhetsföreskrifter för kablage och installation av denna apparat.

Följande säkerhetsföreskrifter är tillämpliga för samtliga EU-medlemsländer. De skall följas i varje avseende för att överensstämma med Lågspännings direktivet. Icke EU medlemsländer skall också följa nedanstående punkter, såvida de inte övergrips av lokala eller nationella föreskrifter.

1. Tillämplig jordkontakt skall utföras till alla jordade punkter, såväl internt som externt där så erfordras.
2. Efter installation eller felsökning skall samtliga säkerhetshöljen och säkerhetsjord återplaceras. Samtliga jordterminaler måste hållas obrutna hela tiden.
3. Matningsspänningens kabel måste överensstämma med föreskrifterna i IEC227 eller IEC245.
4. Allt kablage skall vara lämpligt för användning i en omgivningstemperatur högre än 75ºC.
5. Alla kabelförskruvningar som används skall ha inre dimensioner som motsvarar adekvat kabelförankring.
6. För att säkerställa säker drift av denna utrustning skall anslutning till huvudströmmen endast göras genom en säkring (min 10A) som skall frånkoppla alla strömförande kretsar när något fel uppstår. Säkringen kan även ha en mekanisk frånskiljare. Om så inte är fallet, måste ett annat förfarande för att frånskilja utrustningen från strömförsörjning tillhandahållas och klart framgå genom markering. Säkring eller omkopplare måste överensstämma med en gällande standard såsom t ex IEC947.
7. Där utrustning eller hölje är markerad med vidstående symbol föreliggerisk för livsfarlig spänning i närheten. Dessa höljen får endast avlägsnas när strömmen ej är ansluten till utrustningen - och då endast av utbildad servicepersonal.

8. När utrustning eller hölje är markerad med vidstående symbol föreligger risk för brännskada vid kontakt med uppvärmd yta. Dessa höljen får endast avlägsnas av utbildad servicepersonal, när strömmen kopplats från utrustningen. Vissa ytor kan vara mycket varma att vidröra även upp till 45 minuter efter avstängning av strömmen.

9. När utrustning eller hölje markerats med vidstående symbol bör instruktionsmanualen studeras för information.

10. Samtliga grafiska symboler som förekommer i denna produkt finns angivna i en eller flera av följande föreskrifter:- EN61010-1, IEC417 & ISO3864.

ΠΡΟΣΟΧΗ

Οδηγίες ασφαλείας για την καλωδίωση και εγκατάσταση της συσκευής.

Οι ακόλουθες οδηγίες ασφαλείας εφαρμόζονται ειδικά σε όλες τις χώρες μέλη της Ευρωπαϊκής Κοινότητας. Θα πρέπει να ακολουθούνται αυστηρά ώστε να εξασφαλιστεί η συμβατότητα με τις οδηγίες για τη Χαμηλή Τάση. Χώρες που δεν είναι μέλη της Ευρωπαϊκής Κοινότητας θα πρέπει επίσης να ακολουθούν τις οδηγίες εκτός εάν αντικαθίστανται από τα Τοπικά ή Εθνικά Πρότυπα.

1. Επαρκείς συνδέσεις γείωσης θα πρέπει να γίνονται σε όλα τα σημεία γείωσης, εσωτερικά και εξωτερικά όπου υπάρχουν.

2. Μετά την εγκατάσταση ή την εκσφαλμάτωση όλα τα καλύματα ασφαλείας και οι γειώσεις ασφαλείας πρέπει να επανεγκαθίστανται. Η καλή κατάσταση όλων των ακροδεκτών γείωσης πρέπει να ελέγχεται και να συντηρείται διαρκώς.

3. Τα καλώδια τροφοδοσίας πρέπει να πληρούν τις απαιτήσεις των IEC227 ή IEC245.

4. Ολες οι καλωδιώσεις θα πρέπει είναι κατάλληλες για χρήση σε ατμοσφαιρική θερμοκρασία χώρου υψηλότερη από 75°C.

5. Ολοι οι στυπιοθλίπτες θα πρέπει να είναι τέτοιων εσωτερικών διαστάσεων ώστε να παρέχουν επαρκή στερέωση των καλωδίων.

6. Για τη διασφάλιση ασφαλούς λειτουργίας της σύνδεσης τροφοδοσίας αυτής της συσκευής θα πρέπει να γίνεται μόνο μέσω ασφαλειοδιακόπτη (ελάχιστο 10A) ο οποίος θα αποσυνδέει όλους του ηλεκτροφόρους αγωγούς στη διάρκεια κατάστασης σφάλματος.
   Ο ασφαλειοδιακόπτης μπορεί επίσης να περιλαμβάνει μηχανικό διακόπτη απομόνωσης. Εάν δεν περιλαμβάνει, τότε άλλα μέσα αποσύνδεσης της συσκευής από την τροφοδοσία πρέπει να παροχηθούν και σαφώς να σημανθούν σαν τέτοια. Οι ασφαλειοδιακόπτες ή διακόπτες πρέπει να συμφωνούν με αναγνωρισμένα πρότυπα όπως το IEC947.

7. Οπου συσκευές ή καλύματα είναι σημασμένα με το σύμβολο επικίνδυνες τάσεις ενυπάρχουν κάτω από αυτά.
   Αυτά τα καλύματα θα πρέπει να αφαιρούνται μόνο όταν έχει αφαιρεθεί η τροφοδοσία από τη συσκευή και τότε μόνο από ειδικευμένο τεχνικό προσωπικό.

8. Οπου συσκευές ή καλύματα είναι σημασμένα με το σύμβολο υπάρχει κίνδυνος από καυτές επιφάνειες κάτω από αυτά.
   Αυτά τα καλύματα θα πρέπει να αφαιρούνται μόνο από ειδικευμένο τεχνικό προσωπικό, όταν η τροφοδοσία έχει αφαιρεθεί από από τη συσκευή. Τέτοιες επιφάνειες μπορούν να παραμείνουν ζεστές στην αφή έως και 45 λεπτά αργότερα.

9. Οπου συσκευές ή καλύματα είναι σημασμένα με το σύμβολο αναφερθείται στις οδηγίες χρήσης της συσκευής.

10. Ολα τα γραφικά σύμβολα που χρησιμοποιούνται σε αυτό το προϊόν είναι από ένα ή περισσότερα από τα έχης πρότυπα: **EN61010-1**, **IEC417** και **ISO3864**.

WARRANTY

Rosemount Analytical warrants that the equipment manufactured and sold by it will, upon shipment, be free of defects in workmanship or material. Should any failure to conform to this warranty become apparent during a period of one year after the date of shipment, Rosemount Analytical shall, upon prompt written notice from the purchaser, correct such nonconformity by repair or replacement, F.O.B. factory of the defective part or parts. Correction in the manner provided above shall constitute a fulfillment of all liabilities of Rosemount Analytical with respect to the quality of the equipment.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF QUALITY WHETHER WRITTEN, ORAL, OR IMPLIED (INCLUDING ANY WARRANTY OF MERCHANTABILITY OF FITNESS FOR PURPOSE).

The remedy(ies) provided above shall be purchaser's sole remedy(ies) for any failure of Rosemount Analytical to comply with the warranty provisions, whether claims by the purchaser are based in contract or in tort (including negligence).

Rosemount Analytical does not warrant equipment against normal deterioration due to environment. Factors such as corrosive gases and solid particulates can be detrimental and can create the need for repair or replacement as part of normal wear and tear during the warranty period.

Equipment supplied by Rosemount Analytical Analytical Inc. but not manufactured by it will be subject to the same warranty as is extended to Rosemount Analytical by the original manufacturer.

At the time of installation it is important that the required services are supplied to the system and that the electronic controller is set up at least to the point where it is controlling the sensor heater. This will ensure, that should there be a delay between installation and full commissioning that the sensor being supplied with ac power and reference air will not be subjected to component deterioration.

CCO 5500

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