Rosemount™ CCO 5500

Carbon Monoxide (CO) Analyzer
Essential instructions

Read this page before proceeding!

Emerson™ designs, manufactures, and tests its Rosemount™ 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 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 this product. If this instruction manual is not the correct manual, call 1-855-724-2638, and we will provide the requested manual. Save this manual for future reference.
- If you do not understand any of the instructions, contact your Emerson 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 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 people, to prevent electrical shock and personal injury.

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

Warranty

Rosemount™ 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 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 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 OR FITNESS FOR PURPOSE).

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

Rosemount 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 but not manufactured by it will be subject to the same warranty as is extended to Rosemount 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, the sensor being supplied with ac power and reference air will not be subjected to component deterioration.

Preface

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

Some sections may describe equipment not used in your configuration. Become thoroughly familiar with the operation of this module before operating it. Read this reference manual completely.

Definitions

The following definitions apply to WARNINGS, CAUTIONS, and NOTICES found throughout this publication.
**WARNING!**

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

---

**NOTICE**

Highlights an essential operating procedure, condition, or statement.

---

**Symbols**

- Earth (ground) terminal
- Protective conduit or terminal
- Risk of electrical shock
- Warning: Refer to Instruction Manual
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1 Description and specifications

1.1 Component checklist

A typical Rosemount™ CCO 5500 Carbon Monoxide Analyzer should contain the items shown in Figure 1-1. Record the part number, serial number, and order number for your system.
Figure 1-1: Typical System Package

A. Control unit
B. Quick Start Guide
C. Power supply
D. Hardware
E. Receiver
F. Interconnect cable
G. 33 ft. (10 m) cables
H. Source
I. Gaskets (4)

Also, use the product matrix in Section 1.5 to compare your order number against your unit. Ensure the features and options specified by your order number are on or included with the unit.
1.2 Overview

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

The Rosemount™ CCO 5500 Carbon Monoxide (CO) analyzer is designed to operate on duct widths of less than 26 ft. (8 m) at flue gas temperatures up to 572 °F (300 °C).

**NOTICE**

The instrument can achieve temperatures up to 1200 °F (650 °C), but degradation in instrument accuracy will occur.

The rugged construction makes installation extremely simple, and through the use of microprocessor technology, the Rosemount CCO 5500 has many advanced features:

- Serial data facility to allow communication between analyzers and a central data logging station.
- User-definable output in either mg/m³, mg/Nm³, 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 off periods.

1.3 System description

The Rosemount™ CCO 5500 Analyzer consists of four items (*Figure 1-2)*:

- An infrared source unit to project a beam of infrared radiation across the duct.
- A receiver to measure radiation.
- A power supply unit to provide the necessary power rails.
- A control unit to compute the gas concentration from the signals provided by the receiver unit.

Each of these units is designed to be rugged and flexible. They are all fully sealed to IP65 standards and are suitable for outside mounting without the need for further weatherproof enclosures.
**Figure 1-2: Typical System Layout**

A. Source  
B. Air purge  
C. Site mounting flange  
D. Receiver  
E. Pressure regulator  
F. Purge air  
G. Isolation valve (by customer if used)  
H. Cable 33 ft. (10 m) standard (by Rosemount)  
I. Control unit  
J. Analog outputs, normalizing inputs, and serial data port  
K. AC power in and relay contact outputs  
L. Power supply unit

**NOTICE**

The maximum cable length allowed between the power supply and the receiver is 82 ft (25 m). The maximum cable length allowed between the power supply and the transmitter is 33 ft (10 m).
## 1.4 Specifications

### Table 1-1: System Measurement Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span</td>
<td>Selectable 0-100 ppm to 0-10,000 ppm within the range of 200 to 6,000 ppm.m</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±2% of measurement or ±5 ppm, whichever is greater</td>
</tr>
<tr>
<td>Path length</td>
<td>1.6 to 26.2 ft. (0.5 to 8 m)</td>
</tr>
<tr>
<td>Process temperature range</td>
<td>32 to 1202 °F (0 to 650 °C)</td>
</tr>
<tr>
<td>Display units</td>
<td>ppm</td>
</tr>
<tr>
<td></td>
<td>mg/m³ (measured)</td>
</tr>
<tr>
<td></td>
<td>mg/Nm³ (normalized)</td>
</tr>
<tr>
<td>Averaging</td>
<td>Four averages selectable from 10 sec to 30 days</td>
</tr>
</tbody>
</table>

### Table 1-2: Environmental Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material of construction</td>
<td>Cast aluminum, fully sealed to IP65</td>
</tr>
<tr>
<td>Ambient temperature limits</td>
<td>-4 to 158 °F (-20 to 70 °C)</td>
</tr>
</tbody>
</table>

### Table 1-3: Installation Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe mounting</td>
<td>6.5 in. (165 mm) flange with 4.9 in. (125 mm) bolt circle</td>
</tr>
<tr>
<td>Inputs</td>
<td>Temperature: 4 - 20 mA</td>
</tr>
<tr>
<td></td>
<td>Pressure: 4 - 20 mA</td>
</tr>
<tr>
<td></td>
<td>Plant status dry contact relay</td>
</tr>
<tr>
<td>Outputs</td>
<td>Analog 4 - 20 mA isolated, 500 Ω max.</td>
</tr>
<tr>
<td>Power requirements</td>
<td>85-132/170-264 Vac, 50/60 Hz, 50 VA</td>
</tr>
<tr>
<td>Air purge consumption</td>
<td>1 liter/sec at 1 bar (compressed air)</td>
</tr>
<tr>
<td></td>
<td>5 liter/sec (blower air)</td>
</tr>
</tbody>
</table>
1.5  **Rosemount™ CCO 5500 ordering information**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCO 5500</td>
<td>Carbon Monoxide Analyzer - across-the-stack</td>
</tr>
</tbody>
</table>

**Level 1 power requirements**

<table>
<thead>
<tr>
<th>01</th>
</tr>
</thead>
<tbody>
<tr>
<td>110/220 Vac, 50/60 Hz</td>
</tr>
</tbody>
</table>

**Level 2 control module display/keypad**

<table>
<thead>
<tr>
<th>01</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
</tr>
</tbody>
</table>

**Level 3 calibration options**

<table>
<thead>
<tr>
<th>00</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Calibration check cell and holder</td>
</tr>
</tbody>
</table>


2 Install

**WARNING!**
Before installing this equipment, read *Essential Instructions*. Failure to follow safety instructions could result in serious injury or death.

**WARNING!**
ELECTRICAL HAZARD
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!**
ELECTRIC SHOCK
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.

2.1 Unpack the equipment
A typical Rosemount™ CCO 5500 Carbon Monoxide (CO) Analyzer should contain the following items.

Refer to *Figure 1-1* for an illustration of each of these components. Record the part number, serial number, and order number for each major component of your system.

1. Source with 33 ft. (10 m) of cable and air purge
2. Receiver with 33 ft. (10 m) of cable and air purge
3. Interconnect cable 3 ft. (0.91 m)
4. Control unit
5. Power supply
6. Gaskets (four)
7. Selected screws and washers

2.2 Safety considerations
Power is supplied to the whole system via the power supply unit. During installation, do not connect the system to the facility power source until all units are in place and fully wired. If used, keep the isolating valves closed. You must turn off the compressed air
supplied to the purges until the full installation is complete. If you do any servicing or rewiring, ensure that the power supply is isolated. During configuration, the system requires electrical power, compressed air, and open isolating valves.

### 2.3 Cable requirements

1. Power supply to signal processor - seven-core, overall screen, multi-stranded, 6/0.2 mm. 0.5 mm².

   **NOTICE**
   Although shielded cable is specified for the interconnecting cable, it is not necessary to ground the cable.

2. Current loop output - any suitable two-conductor cable, maximum length depends on keeping output load within the 500 ohm maximum load requirement.

3. Contact outputs - any two-conductor cable capable of supplying the power to the warning device/relay, etc. 250 V, 10 A maximum.

4. A.C. power - any suitable three-conductor power cable capable of transmitting 50 VA.

5. Serial data link (if required) - twin twisted pair shielded cable.

6. Analog inputs - any suitable two-conductor cable; Rosemount™ instruments have an internal impedance of 240 ohms for these inputs.

### 2.4 Selecting location

Rosemount™ designed the equipment for mounting on boiler ducting or stacks open to the weather. The instrument is fully sealed and requires no further enclosures or protection. The specific location of the instrument depends on the application and user requirements. Consider the following when choosing a site.

Refer to Figure 1-2 for a typical system arrangement.

1. The site must be accessible at both sides of the duct for servicing the source and receiver.

2. The site should be as free from extremes of temperature and vibration as possible. Permissible ambient temperature range is -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.

   **NOTICE**
   The instrument can achieve temperatures up to 1200 °F (600 °C), but degradation in instrument accuracy will occur.

4. There must be an uninterrupted sight path available between the source and receiver.
5. The maximum cable length allowed between the power supply and the source is 33 ft. (10 m).
6. The maximum cable length between the power supply and the receiver is 82 ft. (25 m).

2.4.1 Points to consider

Path length
1. Too long [> 26 ft (8 m)]: low energy available.
2. Too short [< 1.6 ft (0.5 m): optical problems

Flue gas temperature
1. Too low (< dewpoint): potential water droplets.
2. Too high [> 572 °F (> 300 °C): reduced sensitivity.

Ambient temperature
2. Too high [> 158 °F (> 70 °C): potential instrument problems.

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

**NOTICE**
10 ppm CO = 12.5 mg/m³

2. For increased sensitivity (reduced uncertainty of measurement), the path length must be maximized.
3. Maximum range is 6,000 ppm-meters.

**NOTICE**
To correct ppm-meters to effective ppm, divide the path length (in meters).

2.5 Mechanical installation

The transmitter and receiver units are mounted on a site mounting flange on opposite sides of the duct. To protect operators, Rosemount™ recommends using an isolating valve for ducts that operate at a higher than atmospheric pressure.

Use a stand-off pipe [nominal bore 3 in. (75 mm) - not supplied] 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.
2.5.1 Mount flange assemblies

Complete the following steps to mount the flange assemblies for the analyzer.

1. Form two mounting holes on opposite sides of the stack according to the considerations in Section 2.4.

   These holes should accept a slip fit with the stand-off pipe.

2. Weld the stand-off pipes to the site mounting flanges as shown in Figure 2-1.

Figure 2-1: Site Mounting Flange Assembly

A. Duct wall
B. Lagging
C. Stand-off pipe (if used) 2.95 in. (75 mm) dia. nominal
D. ØM8 hole 4.92 in. (125 mm) BC (4) places
E. Site mounting flange
F. Bracing fillets

3. With the stand-off pipes and site mounting flanges welded together, insert the mounting flange assemblies into their mounting holes.

4. Position the mounting flange assemblies so the four threaded mounting holes are located as shown in Figure 2-1.
5. Look through one of the mounting flange assemblies.

If the you can see the orifice across the stack clearly, the alignment is satisfactory. The alignment of these holes is not critical; an integral adjustable mount can compensate for up to 4 degrees of misalignment.

6. Weld the assemblies in place.

To avoid vibration and movement, you may need to fit spreader plates or bracing fillets on the mounting flange assembly as shown in Figure 2-1.

2.5.2 Isolating valves

To protect operators, Rosemount™ recommends that you use customer supplied isolating valves (Figure 2-2) for ducts that operate at higher than atmospheric pressure. Valve selection and installation is your responsibility.

Figure 2-2: Isolating Valve and Air Purge Arrangement

A. Isolating valve (customer supplied)
B. Adjusting nuts
C. Locking nuts
D. Air purge port
E. Pressure regulator assembly
F. Rear flange
G. Front flange
H. Site mounting flange
After the isolating valves are installed in the site mounting flanges, connect the purge air supply and install air purge units according to the following instructions.

2.5.3 Purge air supply

The purpose of the purge air is to keep the windows of the source and the receiver clean. Always connect the purge air supply to the air purge units before you install the air purge units on the process duct. Purge air may be supplied by one of the following three methods.

Negative pressure duct

If the duct operates at a negative pressure under all firing conditions, you may simply leave the air purge inlets open and allow the negative draft in the duct to draw in ambient air.

You must supply the air purge units for positive pressure ducts with compressed air or blower air to prevent contamination of the source and receiver units.

Compressed air

You may use compressed air to provide the air 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. Use a fine control flow regulator and filter.

Blower air

You may use a blower to provide the air to the air purge. Customers may specify their own blower. The blower should deliver 11 cfm (5 liters/second) per purge against the working pressure of the duct.
2.5.4 Air purge units

Use the general procedure that follows to install the air purge units on the site mounting flanges or on the exposed flanges of the customer supplied isolating valves, if used.

⚠️ **CAUTION!**

**CONTAMINATION**

Always connect and turn on the purge air supply to both air purge units before mounting the air purge units. Failure to flow purge air may allow the optical surfaces of the source and receiver units to become severely contaminated.

**Procedure**

1. Remove the four locking nuts holding the front flange to the rear flange (*Figure 2-3*).
2. Carefully work and pull the front flange from the air purge unit.
3. Align the four holes on the front flange with the four holes on the site mounting flange.
4. Fasten the front flange to the site mounting flange with the four countersunk screws and gaskets provided.
5. Connect and turn on a compressed air or blower air supply to the purge unit. Always flow purge air before installing an air purge unit on the duct.
6. Install the air purge unit on the front flange as shown.
7. Install and tighten the four locking nuts removed in Step 1.

2.5.5 Source and receiver units

Use the following procedure to install the source and receiver units on the air purge units.
1. Insert a flexible gasket between the air purge unit and the source or receiver unit.
2. Dowel pins (Figure 2-4) ensure that the source and receiver units and the air purge units mount in a fixed rotary position. Align the dowel pin and dowel pin hole.

3. Attach the source or receiver to the rear face of the air purge and install the four screws provided (Figure 2-5).
2.5.6 Control unit

Rosemount™ supplies adequate cable to locate the control unit up to 33 ft. (10 m) from the receiver. Do not exceed the 33 ft. (10 m) cable length.

1. Loosen the four captive cover screws and remove the cover.
2. Unplug the ribbon cable connector on the cover side.
3. Fasten the control unit to a firm vertical support. Install four mounting screws in the mounting holes provided.

Refer to Figure 2-6 for mounting dimensions.
Figure 2-6: Mounting Dimensions for the Control and Power Supply Units

A. Cover seal - Note that the mounting holes are outside the extent of the seal.
B. Cover
C. Base
D. 4 Holes for M6 mounting screws
E. Cable gland entry blanking page
F. Approx. 6 in. (150 mm) free space required below box for cables
G. Assembled box 4.3 in. (110 mm) deep

**NOTICE**
The unit mounting holes are located outside the seal. You do not need to seal the mounting holes after installation or to remove the circuit boards from the unit prior to mounting.

2.5.7 Power supply unit

Rosemount supplies adequate cable to locate the power supply unit up to 33 ft. (10 m) from the source unit. You may use a maximum cable length of 82 ft. (25 m) to connect the power supply unit to the receiver. Do not exceed the 82 ft. (25 m) maximum cable length.

Dimensions and mounting hole locations are identical to the control unit and are shown in *Figure 2-6*. 
2.6 **Electrical data**

2.6.1 **AC supplies**
You can power the Rosemount™ CCO 5500 Analyzer from either 85-135 Vac or 170-264 Vac at 50/60 Hz. A switch within the power supply unit selects the input voltage, and an internal 2 A fuse protects the instrument. The analyzer tolerates voltage fluctuations within these ranges without losing performance. The total power requirement for the analyzer is less than 50 VA.

2.6.2 **Outputs**
Three analyzer outputs are available:

1. Selectable, fully isolated 4-20 mA or 0-20 mA % CO concentration, 500 ohms maximum load.
2. Single pole, switching relays (rated 250 V, 10 A) for the following outputs:
   - Alarm trigger at a selectable gas threshold.
   - Data-valid indication active during power failure and any equipment fault condition. See Chapter 6 for further details.
3. Four-wire serial data link for two-way communication between the control unit and a distributed control system or other process control system.

2.6.3 **Normalizing inputs**
The analyzer can hold pressure, temperature, and oxygen values to normalize the calculated gas value to standard conditions. The instrument may read these values using the following methods:

1. Fixed value from the keypad.
2. 4-20 mA outputs from measurement transducers. You can set the ranges represented by these inputs from within the processor. These are analog process inputs to the control unit.
3. When the analyzer is part of an integrated system, the serial data line can carry the normalizing values.

2.6.4 **Plant status input**
The plant status input parameter is available to prevent the rolling average data from being diluted by measurements made while the plant is shut down. The parameter is governed by one of three choices:

1. Serial input (from an integrated system)
2. Logic input (terminals PS1 and PS2 in the control unit)
3. Multiple (five variables)
   a. Temperature
b. Oxygen
c. Pressure
d. Water vapor
e. Logic input

You can set these parameters in Mode 5. Chapter 4 describes each of these parameters.

During normal operation, the plant status registers as ON. However, if the plant status input is lost, the status changes to OFF, and the averaging data (seconds, minutes, hours, days) is not updated.

**NOTICE**

During normal operation, do not link terminals PS1 and PS2 together.

## 2.7 Electrical connections

All equipment wiring must conform to local and national codes. Read and observe the following instructions before making electrical connections.

**WARNING!**

**ELECTRIC SHOCK**

Disconnect and lock out power before connecting the power supply to the analyzer.

**WARNING!**

**ELECTRIC SHOCK**

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

**WARNING!**

**ELECTRIC SHOCK**

To meet the safety requirements of IEC 1010 (EC requirement) and ensure safe operation of this equipment, connect to the main electrical power supply through a circuit breaker (min. 10 A) which will disconnect all current-carrying conductors during a fault situation. This circuit breaker should also include a mechanically operated isolating switch. If not, then locate another external means of disconnecting the supply from the equipment close by. Circuit breakers or switches must comply with a recognized standard, such as IEC 947.

**NOTICE**

To maintain proper earth grounding, ensure a positive connection exists between the transmitter housing and earth. The connecting ground wire must be 14 AWG minimum.
2.7.1 Installation of cables

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

Install power cables 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. Do not modify the cables without consulting Rosemount.

2.7.2 Cable connections

Use the following procedure to make cable connections between the source, receiver, power supply unit, and control unit. *Figure 2-7* displays a system wiring diagram. *Figure 2-8* displays the location of power supply and control unit connectors, etc.
Figure 2-7: System Wiring Diagram

Install 20 Rosemount CCO 5500
Figure 2-8: Wiring Connector Locations (Power Supply Board)

A. 110/220 Vac power in
B. Data-valid relay contacts
C. Alarm relay contacts
D. Interconnect cable contacts
**Figure 2-9: Wiring Connector Locations (Control Board)**

A. **Plant status in**  
B. **Analog out**  
C. **Receiver cable in**  
D. **Serial data input**

**Procedure**

1. Install the receiver cable in the center rear cable port of the control unit enclosure. Provide adequate free wire length for making connections to the control board terminals 16 through 22. Tighten the cable gland nut.

2. Connect the receiver cable wires to the control board terminals 16 through 22 according to the wiring diagram, *Figure 2-7*. 

Do not connect the receiver cable shield wire at the control unit.
3. Install the source cable in the right front cable port of the control unit enclosure. Provide adequate free wire length for making connections to the control board terminals 8 through 12. Tighten the cable gland nut.

4. Connect the source cable wires to the control board terminals 8 through 12 according to the wiring diagram, Figure 2-7.
   Do not connect the source cable shield wire at the control unit.

5. Install one end of the power supply to control unit interconnect cable in the center front cable port of the control unit enclosure. Provide adequate free wire length for making connections to the control board terminals 1 through 7. Tighten the cable gland nut.

6. Connect the cable wires to the control board terminals 1 through 7 according to the wiring diagram, Figure 2-7.
   Do not connect the cable shield wire at the control unit.

7. Install the opposite end of the power supply to control unit interconnect cable in one of the right hand cable ports of the power supply unit enclosure. Provide adequate free wire length for making connections to the power supply board terminals 1 through 7. Tighten the cable gland nut.

8. Connect the cable wires to the power supply board terminals 1 through 7 according to the wiring diagram, Figure 2-7.
   Do not connect the cable shield wire at the power supply unit.

9. Install the 110/220 Vac power cable in one of the left hand cable ports of the power supply unit enclosure. Provide adequate free wire length for making connections to the power supply board terminals: L, N, and E. Tighten the cable gland nut.

10. Connect the cable wires to the power supply board terminals L, N, and E according to the wiring diagram, Figure 2-7.
    Do not connect the power cable to the facility power source at this time.

11. Verify that the power switch is in the correct position.
    The voltage position selected must match the voltage supplied to the Rosemount™ CCO 5500 Analyzer at your facility.

12. Connect two separate earth ground leads to the ground screws located on the left hand side of the power supply unit and control unit enclosures.

**NOTICE**

To maintain proper earth grounding, ensure a positive connection exists between the enclosures and the earth. The connecting ground wires must be 14 AWG minimum.
3  Configuration and startup

3.1  Introduction

You may need two hours or more to configure the instrument, and you need to complete the following tasks:

- Power up
- Alignment*
- Gain adjustment*
- Set operating parameters
- Calibration*

---

**Note**
*Perform these operations when a clean stack condition exists.*

3.2  Safety considerations

The power supply unit supplies power to the analyzer system. Before removing any equipment covers, lock out and tag out power to the supply unit.

---

**WARNING!**

**ELECTRIC SHOCK**

Disconnect and lock out power before connecting power to the analyzer.

---

3.3  Power up the Rosemount™ CCO 5500 Analyzer

Use the following procedure to power up the analyzer.

1. Make sure that the voltage and frequency of the AC power supply match the required power specifications.
2. With the AC power supply locked out and tagged off, unscrew and remove the power supply unit cover.
3. Select the correct power supply voltage using the AC power selector switch shown in *Figure 3-1*.
4. Power up the Rosemount CCO 5500 Analyzer and verify that the power supply rail indication LED (Figure 3-1) lights up.

5. Install and fasten the power supply unit cover.

6. Check that the LCD display is functioning at the control unit.

While the source unit is warming up, the LCD display shows WAITING FOR REFERENCE. When the source unit reaches an adequate temperature for the reference to be detected, the LCD display shows the message STABILIZING REF, along with the frequency and mark/space ratio. See Section 4.9 for further details.

The reference frequency takes some time to stabilize (about five minutes from cold startup). When the reference frequency is within tolerance for 10 consecutive measurement cycles, the instrument automatically changes to the OPERATING mode. This is Mode 1 and is indicated by a number 1 appearing in the top left corner of the LCD display. The display shows a reading in ppm; this is not an accurate reading until all configuration and startup procedures are completed.

Before conducting the alignment procedure, allow 30 minutes for the source temperature to become stable.

3.4 Alignment

For the instrument to operate properly, the source and receiver units must be aligned. Rosemount™ has built in a degree of optical redundancy; normal duct movements do not affect the operation of the instrument. Read and understand this entire procedure before starting the alignment.
1. See Figure 2-5. Unscrew the four screws that secure the receiver to the air purge. Remove and place the receiver in a safe location.

2. Go to the source unit location. To align the source, turn the adjusting nuts (Figure 3-2). Use opposing adjusting nuts to align the source unit in one plane, then the other.

**Note**
You can achieve receiver alignment by monitoring the output of the detector directly. Use a voltmeter set to AC volts (10 V max.) to measure across test points S0V and S2 for D3, and S0V and S1 for D1 on the receiver control board (Figure 3-3). This alignment method is useful when the receiver is not located near the control unit.

**Figure 3-2: Alignment Features**

A. Adjusting nuts  
B. Locking nuts  
C. Air purge  
D. Rear flange  
E. Front flange
3. Adjust the alignment until the bright red disc of the source is located centrally in the field of view when viewed from the receiver air purge. When the source unit is aligned, tighten the locking nuts.

4. Install and tighten the receiver on its air purge using the four screws removed in Step 1.

5. At the control unit keypad, press MODE four times to select SET UP mode (Mode 5). When 5 (SET UP) is displayed on the LCD, press ENTER to access the SET UP mode.

**Note**
The analyzer uses a security code to prevent unauthorized alteration of settings. The default code set at the factory is 0000.

The keypad cursor flashes over the first digit of the security code.
6. Use the arrow keys to enter the desired value for this digit. Press ENTER to select the displayed value; the cursor moves to the second digit. Select the value for the second digit and press ENTER. Continue this process for each digit of the security code.

When the fourth digit is correctly entered, the processor enters Mode 5.

7. When in Mode 5, select Calibrate using the keypad arrow keys; press ENTER to access the Calibrate menu.

8. Use the arrow keys to select SET DETECTORS; press ENTER.

The display shows the D1 and D2 detector levels.

**CAUTION!**

If the analyzer is not in SET UP mode, the gas cell at the source unit periodically interrupts the IR beam and make alignment difficult.

9. Adjust the receiver alignment, using the adjusting nuts, Figure 3-2. Adjust in one plane, then in the other.

As a rule, the D2 detector level is affected to a greater extent by adjustment in one particular plane. The D1 detector level is affected more by adjustment in the other plane.

10. Make sure the maximum possible values of both D1 and D2 are reached. After you achieve alignment, tighten the locking nuts.

**Note**

The alignment of the receiver unit is important. Make sure to obtain the maximum values of D1 and D2.

11. If the displayed detector level is below 5000, increase the gain at the control unit to between 12000 and 14000. If the detector level is above 15000, reduce the gain to between 12000 and 14000.

Refer to Section 3.5 for details.

12. To fine tune the alignment, repeat adjustments of Step 9 at the source unit. Again, make sure the values of D1 and D2 are appropriate. Lock the source unit in place when the maximum values are achieved.

13. When you have properly completed the alignment, there is rarely any need for further alignment adjustments.

### 3.5 Detector levels

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

1. In the receiver, two potentiometers set the gain. Refer to Section 3.5.1.
2. In the control unit trim, potentiometers adjust the level of the D1 and D2 signals before they enter the microprocessor. Refer to Section 3.5.1.

It is essential that you properly conduct the alignment procedure and obtain a maximum detector signal before attempting to optimize the detector levels.

### 3.5.1 Receiver gain adjustment

To give an optimum signal-to-noise ratio, the detector levels must be maximized. For the best signal-to-noise ratio, you must set the gain of the detector signals in the receiver to a maximum without saturating. Rosemount™ sets the gains at a path length of 6.5 ft (2 m). If the path length is above 13 ft (4 m) or below 5 ft (1.5 m), you may need to adjust to optimize the detector levels.

1. Enter **Mode 5 → Calibrate → Set Detectors** and display the value of D2/D1.
2. Loosen the receiver cable gland so the receiver cable can slip when you remove the window plate.
3. Pull the window plate (Figure 3-4) from the receiver to access the detectors.

**Figure 3-4: Receiver Trim Pots**

![Receiver Trim Pots](image)

A. Trim pot for end detector D1
B. Trim pot for side detector D2

4. Trim potentiometer(s) set the gain.

An AC voltmeter measures the gain levels.

5. Connect the voltmeter to the test points on the control unit (18/20 for D1 and 19/20 for D2). Increase the gain using the trim pot at the end detector D2 until the voltage is between 1 - 4 Vac.
6. Repeat Step 5 for the side detector D1 measuring across the test points.
7. When the detector levels are satisfactory, replace the cover.

---

**Note**
If the duct is operating and a high opacity may be in the path, reduce the set voltages to 2 V rms maximum. This should prevent saturation should the opacity level drop off.

---

### 3.5.2 Control unit gain adjustment

After you have optimized the detector level(s) at the receiver, optimize the levels within the microprocessor. Make the adjustment with two trim potentiometers in the control unit.

1. Set the gain to a minimum by turning the D2 detector trim pot (Figure 3-5) fully clockwise.
   
   D2 is a 20-turn potentiometer.
2. Enter **Mode 5 → Set Detectors** 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 should prevent saturation should the opacity level drop off.
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. Reduce the gain until a SAT # of 0 is displayed.

4. If saturation is indicated with the trim pot turned fully clockwise, reduce the gain in the receiver and repeat the procedure.

5. Repeat Step 1 through Step 3 for the D1 level using the D1 trim pot.

---

**Note**

Rosemount™ has designed the circuits so that wherever saturation occurs (receiver or control unit), the microprocessor always detects it. If the displayed detector levels cannot be set to within this band or saturation cannot be avoided, optimize the detector levels at the receiver. Refer to Section 3.5.1.

---

### 3.6 Source adjustments

Two trim potentiometers within the source unit allow adjustments to be made to the intensity of the source and to the frequency of the chopper motor. Rosemount™ sets these at the factory, and they rarely need adjustment. Rosemount recommends that you consult the company before making any adjustments within the source unit.

**CAUTION!**

**DECREASED SOURCE LIFE**

*Increasing source intensity may severely reduce the source life.*

---

#### 3.6.1 Source intensity

Complete the following steps to adjust the source intensity in the analyzer.

1. Loosen and slide the source unit cable gland so the cable can slip when the rear cover plate is removed.
2. Unscrew and remove the rear cover plate.
3. A trim pot (*Figure 3-6*) allows adjustment to the intensity of the source. Turn the trim pot clockwise to increase the source intensity.
3.6.2 Chopper frequency

Complete the following steps to adjust the analyzer’s chopper frequency.

1. Unscrew and remove the source from the air purge.
2. Unscrew and pull the window plate from the front of the source unit.

See Figure 3-7. A trim pot (VR1) allows you to adjust the frequency of the chopper motor.
To increase the chopper frequency, turn the trim pot counterclockwise.

3.7 Set up mode

To prevent any unauthorized changes, you must enter a four digit security code to enter the set up mode.

You must set operating parameters in the instrument for proper analyzer operation. All operating parameters are set within the control unit using the SET UP mode. In the SET UP mode, parameters are held in non-volatile memory and retained in the event of a power loss.

Even if the measured data is not going to be normalized, you must set the normalizing parameters to ensure proper analyzer operation.

Note
When you select SET UP mode, the instrument suspends motor operations, and the Data Valid LED goes dim. If no key is pressed within five seconds after selecting SET UP mode, the instrument control reverts to OPERATING mode.

Chapter 4 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, Rosemount recommends completing to provide a record of the instrument setup.
Procedure

1. Press MODE until the number 5 is displayed in the top left corner.

   After you correctly enter the security code, there are six submodes of operation from which the set up parameters may be changed. These six submodes are:

   a. Set Averages: The four averaging stack times (seconds, minutes, hours, and days) may be set as required.

   b. Configure O/P - Analog output setup: Origin, units, span, rolling average, and fault condition.

   c. Parameters: The following are set from this mode: security code, identity number, path length, alarm level, cal factor, and plant status.

   d. Normalization: You may set up all normalization parameters from this mode.

   e. Reset Average: Select this submode to reset the four averaging stacks.

   f. Calibrate: Set the outputs of the detectors and the basic calibration for the instrument.

2. Use the arrow keys to toggle between these six options and press ENTER when the desired option is displayed.

3.7.1 Enter security code

Complete the following steps to enter the security code.

1. Once the display is as shown here, press ENTER to gain access to SET UP mode.

   The cursor flashes over the first digit of the security code number.

2. Select the required first digit with the arrow keys and press ENTER.

3. Repeat this procedure for the remaining three numbers.

   If the code is correct after you press ENTER on the last digit, the sequence is continued. If it is not correct, the instrument returns to OPERATING mode. Refer to Section 3.7.4 for further details.

   **Note**

   Rosemount™ sets the code number to 0000 at the factory; you should change it in SET UP mode.

3.7.2 Set averages

The instrument calculates four separate averages. These are defined in units of seconds, minutes, hours, and days. You can use any of the four averaging stacks to provide the instrument’s analog output. You can set each averaging time within predefined limits.
1. Press **ENTER** when this display is shown.

   **5 SET AVERAGES**

   The display now shows one of the averages.

2. Use the arrow keys to select the average time that you need to change and press **ENTER** to change it.

   You can now change the value using the arrow keys and confirm it by pressing **ENTER**.

3. Set the seconds averaging stack to the required value.

   **5 SET AVERAGES**
   
   **secs 60**

   This is limited to within 10 to 60 seconds in 10-second intervals.

4. Set the minutes averaging stack to the required value.

   **5 SET AVERAGES**
   
   **mins 60**

   This is limited to within 1 to 60 minutes in 1-minute intervals.

5. Set the hours averaging stack to the required value.

   **5 SET AVERAGES**
   
   **hours 24**

   This is limited to within 1 to 24 hours in 1-hour intervals.

6. Set the days averaging stack to the required value.

   **5 SET AVERAGES**
   
   **days 30**

   This is limited to within 1 to 30 days in 1-day intervals.

### 3.7.3 Configure O/P

You can set up the analog loop output from this mode.

1. Press **ENTER** while this display is shown to access it.
2. Press the arrow keys to step through the available options.
3. Press ENTER to access and change the displayed parameters of each of the six available options listed below:
   a. Output
   b. Averages
   c. Units
   d. Output Span
   e. Fault Condition
   f. Set mA Output

Output
You can set an origin of 0 or 4 mA for the current loop output. The arrow keys toggle between these two options. Press ENTER to enter the new value.

Average
You may use any of the four averaging stacks (seconds, minutes, hours, and days) for the analog output. You can select them with the arrow keys and enter them with the ENTER key.

Units
The analog output can represent the gas concentration in units of mg/m$^3$, mg/Nm$^3$, or vpm. The arrow keys toggle between these three options. Press ENTER to enter the new value.

Output Span
Select the required span using the arrow keys for each digit. Press ENTER to enter the value of each digit. The units are displayed in vpm, mg/m$^3$, or mg/Nm$^3$, depending on what has been selected beforehand.
Note
Once you select Output Span, the current value is displayed for one second. The first digit of the display then defaults to zero; thus you must re-enter the span value for the unit to function correctly.

Fault condition
If a fault condition occurs, you may set the current output of the instrument to one of the following options:

Procedure
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 selected gas concentration - HOLD.
4. Set the output to full scale (20 mA) - F.S.

Press the arrow keys to select one of these options; when the desired output is displayed, press ENTER to confirm.

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 ENTER to select it, and the instrument prompts you to set the current levels at 0 and 20 mA.

When this is displayed, set the current output to 0 mA as measured with a calibrated current meter across the analog output loop terminals; do not connect anything else to these terminals when setting up the output.

Use the two arrow keys to adjust the value; the UP arrow takes the current output up, and the DOWN arrow takes it down. Press ENTER when the correct output is displayed on the ammeter.
Zero mA should be set up no matter what has been selected as the base of the current output. This is factory set.

In a similar manner to the above, set the current output level to 20 mA.

3.7.4 Parameters

Complete the following steps to set the parameters.

1. With this option displayed, press ENTER to access the list of six available options.

2. When the option you need to change is displayed, press ENTER.

3. When you have made all required changes, select EXIT and press ENTER.

The six available options are:

a. Security Number
b. Identity Number
c. Path Length
d. Alarm
e. Cal. Factor
f. Plant Status Input

Security Number

To prevent any unauthorized tampering with the setup information, it is important to change the security code from the factory setting.

Select each digit with ENTER and change it with the arrow keys.

Note
It is important to make note of this number; otherwise, it will not be possible to change the instrument set up.
Identity Number

If you are using the system as part of an integral monitoring system and are using the serial input and outputs, 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 |

Path Length

Note

Once you select path length, the instrument displays the current value for one second. The first value of the display then defaults to zero; therefore, you must re-enter the value to calculate the gas concentrations correctly.

The transmissivity of any gas depends both on the concentration and on the path length through which the radiation is transmitted. Similarly, the output of the Rosemount™ 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 |

Refer to Section 2.4.1.

The Rosemount CCO 5500 Analyzer is sensitive to the product of concentration and path length. In order to obtain a true value of concentration of gas, you must input the correct path length into the processor. The processor then uses the value 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 source and receiver.

Alarm

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

| 5 PARAMETERS | 
| Alarm source | 15m |
Select the units for the alarm; these may be different than the units selected for the analog output.

```
5 PARAMETERS
Alarm         mg/Nm3
```

After you select the source, the instrument requires a level that will trigger the output. Set the desired level with the arrow keys.

```
5 PARAMETERS
Alarm         0000mg/Nm3
```

### Cal Factor

**Note**

First, record the original Cal Factor before entering this mode as displayed in Mode 4 → Calibration Data. The Cal Factor is lost when the menu option is entered.

During the calibration routine, the instrument calculates a *Cal Factor* which sets the basic calibration of the instrument. You may change this value from this mode.

```
5 PARAMETERS
Cal Factor
```

**Note**

Since this value controls the calibration of the instrument, only change if necessary.

### Plant Status Input

Use this to determine whether the plant is operating under correct conditions.

There is a choice of three controls for plant status: Logic Input, Serial Input, and Multiple. You can only use one to control plant status at any one time.

```
5 PARAMETERS
Plant Status I/P
```

- **Logic Input**
  
  If the PS1 and PS2 terminals are linked in the control unit, the logic contact is made, and the plant status is OFF. You may link these terminals manually during a plant shut down, or you may wire them to a switch/contact outside the unit (e.g., a value that opens and closes the duct). Press ENTER to select this option when the Plant Status → Serial Input option is displayed.

- **Serial input**
If you select this option, the criteria controlling plant status are transmitted via the serial data link. Press ENTER when the **Plant Status I/P → Serial Input** option is displayed to select this option.

- **Multiple**

Four options are available here. Press ENTER when the **Plant Status I/P → Multiple** option is displayed, and the first option Temperature is displayed. Use the arrow keys to toggle YES or NO. NO means that the temperature threshold is not used to determine plant status. If you select YES, the display enters the display below. Configure the instrument for temperature threshold. Press ENTER when it is correctly configured, and the display moves to the next option Oxygen. After you set the last option, the Logic Input display returns to the **PARAMETERS → Plant Status I/P** option. Use the DOWN arrow to scroll down to **EXIT** and press ENTER. The plant status is now full configured.

Plant status is only 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 registers plant status ON.

- **Temperature**
  
  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 updates.

- **Oxygen**
  
  Oxygen is 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.

- **Water Vapor**
  
  This is 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.

- **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 you configure this option, the menu exits to the Multiple option. Use the DOWN arrow to select **EXIT** and press ENTER.

### 3.7.5 Normalization

Complete the following steps to set the Normalization parameters.

1. Press **ENTER** to access one of the four normalizing parameters listed below.
2. Use the arrow keys to cycle through the four options and press ENTER once the desired option is selected.

   a. Temperature
   b. Oxygen
   c. Pressure
   d. Water Vapor

Once selected, each of the above normalizing parameters have the same suboptions: Set Standard Levels and Set Values. Under Set Values, are three more suboptions that determine how the instrument reads the data: Analog Input, Serial Input, and Keypad Input.

Set Standard Levels

Each normalizing parameter normalizes the measured gas concentration to standard conditions of temperature, oxygen, pressure, and water vapor. Set these levels within this option. Use the arrow keys to change each displayed normalizing standard value.

Temperature

Always use an analog input 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™ 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 you use the Keypad Input, and the gas temperature is higher than 572 ° F (300 °C), the compensation algorithm becomes less precise, and instrument accuracy deteriorates accordingly. Rosemount does not recommend this.

**Note**

If normalization is not required, the instrument must hold the temperature of the gas in the duct using the Analog Input option.

Press ENTER with the Temperature option selected to access Set Standard Levels and Set Values. Use the arrow keys to toggle between these options and Exit.

Set Values

You can bring the normalizing data into the instrument in one of three ways:

- Analog Input
This uses the 4-20 mA inputs within the processor to receive the measured transducer data. The values at 4 mA and 20 mA will be requested should this option be selected.

- **Serial Input**

  If you use an input unit, all normalizing data can be transmitted via the serial data line.

- **You can enter a fixed value via the keypad. This is suitable where the value is stable to about ±5%.**

With an integrated system, set the lead analyzer’s normalizing parameters to the 4-20 mA inputs. Then set all the other analyzers to serial, and the normalization parameters are transmitted down the serial data highway.

### Oxygen

To correct the data to standard levels of oxygen, you must enter an estimate of the oxygen at the point of measurement. If the oxygen level is being continuously measured, connect the analog output of the oxygen analyzer into the Rosemount™ CCO 5500 Analyzer and select Analog Input. You must define this input as either WET or DRY depending on how the measurement is made. After you define the wet or dry, you need to define the Analog Input values; set the 4 mA and 20 mA values. If the oxygen level is relatively constant through all firing conditions, you may use a fixed keypad input.

With an integrated system, you can take the oxygen data to the instrument via the serial data line.

**Note**

If normalization is not required, you must set the normalizing parameters for oxygen in the instrument.

### Pressure

To correct the data to a standard pressure, normally 14.7 psi (101 kPa), you must determine the pressure at the point of measurement. If the flue pressure is relatively constant through all firing conditions, then you may use a fixed keypad input. If the pressure is not constant, measure it and bring it into the instrument via the 4-20 mA analog input within the processor.
Note
If normalization is not required, set the normalizing parameters for pressure in the instrument to 14.7 psi (101 kPa) (Standard Level and Keypad Input).

With an integrated system, you can take the pressure data to the instrument via the serial data line.

**Water Vapor**

An across the duct monitor measures the gas concentration under wet conditions. Unlike a sampling system, the gas has not been preconditioned in any way before you make a measurement.

When the water vapor is at a relatively fixed level, set the standard level to DRY to normalize it to dry conditions. 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, you can take the water vapor data to the instrument via the serial data line.

### 3.7.6 Reset averages

**Nota**
Resetting averages causes the rolling average data to be cleared from memory.

You can reset the average values that are currently held in the four averaging stacks using this option; this erases the current average that is held in all of the averaging stacks. Select this option by pressing ENTER and using the arrow keys. The instrument requests confirmation before the averages are reset.

Note
If you select this option, all the data in the averaging stacks is reset, and the data for as much as 30 days is lost.

### 3.7.7 Calibrate

From this option, you may display the two detector levels and conduct a basic calibration. While in this mode, the gas cell is not moved; this gives an immediate response for setting up the detector levels. A Cal Factor that is calculated during a calibration routine sets the basic calibration of the instrument. Press ENTER while this is displayed to see the following options:

1. Set Detectors
2. Span Adjust
3. Calibrate

**Set detectors**

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

\[
\begin{align*}
D2 &= 10534 \quad \# = 00000 \\
D1 &= 15000 \quad \# = 00000
\end{align*}
\]

Refer to *Section 3.5* for a discussion of the detector level and saturation count.

**Span adjust**

---

**Note**

Rosemount™ initially sets the span factor at the factory; do not adjust it unless the instrument sensitivity is suspected. In any case, Rosemount recommends that you record the original value before making adjustments.

You can adjust instrument sensitivity if a known concentration of gas exists between the source and receiver units and instrument sensitivity is suspected. If a problem arises, consult Rosemount.

\[
\begin{align*}
\text{Value} &= 250 \rightarrow 250 \text{ppm} \\
\text{Span Factor} &= 1000
\end{align*}
\]

You may need to adjust the span factor if you have fitted new gas cells or filters.

**Calibrate**

Re-enter the *Mode 5 CALIBRATE* menu and proceed to the Calibrate option.

\[
\begin{align*}
\text{CALIBRATE} \\
\text{Calibrate}
\end{align*}
\]

You can calculate the basic calibration of the instrument 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, the instrument can calibrate to a known value of the gas concentration - the calibration target.
Set the calibration target either to a known value of the gas concentration or to zero. Then set the desired number of cycles over which the calibration factor is determined (Rosemount™ recommends a minimum of 30). Now run the calibration, and the display will show a countdown during its execution. When the calibration is complete, the new Cal Factor is displayed for about five seconds, and the instrument exits the calibration routine.

Note
You must run the calibration routine 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, record the Cal Factor from the Parameters option before running the calibration.

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>Averages</td>
<td></td>
</tr>
<tr>
<td>Seconds</td>
<td></td>
</tr>
<tr>
<td>Minutes</td>
<td></td>
</tr>
<tr>
<td>Hours</td>
<td></td>
</tr>
<tr>
<td>Days</td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td></td>
</tr>
<tr>
<td>0 or 4 mA base</td>
<td></td>
</tr>
<tr>
<td>Units</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
</tr>
</tbody>
</table>
Table 3-1: Instrument Settings (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault condition</td>
<td></td>
</tr>
<tr>
<td>Parameters</td>
<td></td>
</tr>
<tr>
<td>Path length</td>
<td></td>
</tr>
<tr>
<td>Alarm source</td>
<td></td>
</tr>
<tr>
<td>Alarm units</td>
<td></td>
</tr>
<tr>
<td>Alarm levels</td>
<td></td>
</tr>
<tr>
<td>Normalization</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>Standard level °F (°C)</td>
<td></td>
</tr>
<tr>
<td>I/P °F (°C) @ 4 mA</td>
<td></td>
</tr>
<tr>
<td>I/P °F(°C) at 20 mA</td>
<td></td>
</tr>
<tr>
<td>Keypad input °C (not ideal)</td>
<td></td>
</tr>
<tr>
<td>Serial input</td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td></td>
</tr>
<tr>
<td>Standard level %</td>
<td></td>
</tr>
<tr>
<td>Wet or dry gas</td>
<td></td>
</tr>
<tr>
<td>I/P % @ 4 mA</td>
<td></td>
</tr>
<tr>
<td>I/P % @ 20 mA</td>
<td></td>
</tr>
<tr>
<td>Keypad input %</td>
<td></td>
</tr>
<tr>
<td>Serial input</td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td></td>
</tr>
<tr>
<td>Standard level psi (kPa)</td>
<td></td>
</tr>
<tr>
<td>I/P psi (kPa) @ 4 mA</td>
<td></td>
</tr>
<tr>
<td>I/P psi (kPa) @ 20 mA</td>
<td></td>
</tr>
<tr>
<td>Keypad input</td>
<td></td>
</tr>
<tr>
<td>Serial input</td>
<td></td>
</tr>
<tr>
<td>Water vapor</td>
<td></td>
</tr>
<tr>
<td>Standard level (wet %/dry)</td>
<td></td>
</tr>
<tr>
<td>Keypad input %</td>
<td></td>
</tr>
<tr>
<td>Measured value</td>
<td></td>
</tr>
</tbody>
</table>

After the instrument calibrates, it calculates a cal factor; this determines the calibration of the instrument. The instrument displays the cal factor for a few seconds after calibrating, and you can also interrogate the cal factor from Mode 4 (DIAGNOSTIC mode). Enter the cal factor into the table below as a record of instrument operation.
Note
Rosemount™ obtained factory settings under the following conditions:

- 2 m path length
- Clean conditions

### Table 3-2: Calibration Data

<table>
<thead>
<tr>
<th>Detector outputs</th>
<th>Factory</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>D2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calibration data

- Cal factor
- Span factor

Output calibration

- Set zero
- Set span

3.8 Current output calibration

Now set up the current output using a calibrated multimeter set to DC current, 20 mA max. Conduct this procedure as follows:

Note
Rosemount™ sets the current output at the factory; do not alter it.

**Procedure**

1. Connect the multimeter to the output terminals within the control unit terminals +mA and -mA.
2. Enter **Mode 5 → Configure Output → Fault Condition → Set Zero** and adjust the level using the arrow keys until 0 mA is recorded. Record the value in brackets on the display in *Table 3-2*.
3. Enter **Mode 5 → Configure Output → Fault Condition → Set Span** and adjust the level using the arrow keys until 20 mA is recorded. Record the value in brackets on the display in *Table 3-2*. 
4  Operation

4.1  Introduction

After you configure the Rosemount™ CCO 5500, it measures the gas levels between the source and receiver and produces an output proportional to the gas levels. An integral 32-character LCD display also shows the calculated levels.

The Rosemount CCO 5500 Analyzer allows you to interrogate the microprocessor to observe the system parameters and to change them if required.

The Rosemount CCO 5500 uses a menu-based program; you can gain access to it by the key panel mounted on the lid of the control unit (Figure 4-1).

Figure 4-1: Control Unit Keypad

A. 32-character liquid crystal display
B. Keypad
C. Data valid and alarm LEDs

4.1.1  Measurement

Once the analyzer has completed configuration, it measures the absorption of IR radiation and calculates a parameter Y.
Refer to Section A.7. The analyzer uses this value 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.

4.1.2 Calibration

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

4.2 Startup and operation

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, you will see a reading on the control unit display. This should be in normal OPERATING mode, Mode 1 (shown by a number 1 at the top left corner of the LCD); the display also shows a reading in vpm, mg/m$^3$, or Nmg/m$^3$. If this appears, the system is functioning properly.

4.3 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: Parameters
Displays operating parameters.

Mode 3: Normalization
Displays normalization data.

Mode 4: Diagnostics
Investigates instrument operation. The instrument continually checks itself; if a complication exists, the instrument automatically selects this mode and displays the fault on the display.

Mode 5: Set up Mode
Sets operating parameters. You must enter the opening parameters for the instrument to function correctly. You can only access this mode using a security code.
**Mode 6: Check Cell Mode**

Used to verify the instrument’s operation and calibration.

---

**Note**

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

---

## 4.4 Keypad operation

You can access each mode sequentially by each push of the **MODE** key.

*Figure 4-1* illustrates the display and keys of the control unit. After you select a mode, use the arrow keys to select the various options within these modes. Use the **ENTER** key to input the displayed value and step the cursor to the next option where applicable.

1. **MODE** key: Press the **MODE** key to 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:** Press the arrow keys to do one of two things, depending on the position in the program:
   - It increases ↑ or decreases ↓ the displayed value. If you hold down the key, it scrolls quickly to the desired value.
   - It steps through the available options within a mode or submode.
3. **ENTER** key: Press the **ENTER** key to do one of two things, depending on the position in the program:
   - It inputs the displayed parameter value.
   - It selects the displayed mode or option from within a mode or submode.

---

**Note**

Allow time for the instrument to respond to a key instruction; otherwise, it may record a double key entry.

---

## 4.5 Menu tree

*Figure 4-2* shows the arrangement of the Rosemount™ CCO 5500 Analyzer menu tree.
Figure 4-2: Rosemount CCO 5500 Analyzer Menu Tree

Operating mode
- vpm, mg/m³, mg/Nm³
- Measure
- Normalized
- Sec, Min, Hour, Day

Parameters
- Identification
  - Analyzer type
  - EPROM program ID
  - Identity number
- Parameters
  - Path length
  - Span factor
  - O/P fault
- Averages
  - Sec, Min, Hour, Day

Normalization
- Temperature
- Oxygen
- Pressure
- Water vapor

Diagnostics
- Temperature threshold
- Oxygen threshold
- Water vapor threshold

Set up mode
- Security code
  - 0000 to 9999
- Set averages
  - Seconds: 10 to 60 s @ 10 s intervals
  - Minutes: 01 to 60 m @ 01 m intervals
  - Hours: 01 to 24 h @ 01 h intervals
  - Days: 01 to 30 d @ 01 d intervals
- Configure O/P
  - Output Average
  - Units
  - vpm, mg/m³, mg/Nm³
  - Set span
    - 0 to 9999 span
  - Fault condition
    - Zero, Mea, Hold, F.S.
  - Set mA O/P
    - Set zero
    - Set span
  - Exit
4.6 Operating mode

From this mode of operation, you may alter the averaging time of the displayed gas concentration to one of the other averaging stacks and observe the measured/normalized gas measurements. When in this mode, the display appears similar to that shown below. If the display is not similar to this, press **MODE** until number 1 appears at the top left corner of the display.
To change the data displayed, press ENTER, and a flashing cursor appears at the beginning of the concentration units, i.e., vpm or mg/Nm$^3$. The arrow keys now change the highlighted parameter. Each push of ENTER selects another of the parameters in the following order:

1. Concentration units: vpm, mg/m$^3$ (or mg/Nm$^3$).
2. Measured or normalized display.
3. Averaging time: seconds, minutes, hours, or days.

Press ENTER when the cursor is flashing on the averaging time, and the cursor disappears from the display. You may press ENTER again if required to bring the cursor back onto the display.

### 4.7 Parameters

In this mode, you can examine the parameters set within the SET UP mode, but you cannot change them. Press MODE until the number 2 appears in the top left corner of the display; then press ENTER. Use the arrow keys to scroll through the available options; press ENTER to display one of the selected options below.

1. Identification
2. Parameters
3. Averages
4. Output Alarm
5. Plant Status

Press ENTER again to exit from each option.

Refer to Section 4.10 for further details of the display information and how to change the held parameters.

#### 4.7.1 Identification

You can display the analyzer type, identity number, and EPROM program ID from this option. Use the arrow keys to scroll between these options.

#### 4.7.2 Parameters

You can display the following parameters from this option; select them using the arrow keys.

1. Path Length: The path length currently used to calculate the gas calculation.
2. Span Factor: You can adjust the sensitivity of the instrument from the **SET UP mode → CALIBRATE** option. Rosemount™ initially set the span factor at the factory using known gas concentrations.

3. O/P (Output) Fault: Should a fault condition occur, you can set the analog input from one of four options.

### 4.7.3 Averages

Select this option to display the times set for each of the four averaging stacks: seconds, minutes, hours, and days.

### 4.7.4 Output

You can display the base, span, and averaging of the analog output from this option.

### 4.7.5 Alarm

A changeover relay contact output is available to indicate a high gas concentration. You can examine the level at which the output is operated and the averaging stack from which the gas value is obtained from this display.

### 4.7.6 Plant status

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

---

**Note**

When the plant status is **OFF**, pollutant levels are zero. It is not normally permitted to use plant **OFF** zero levels to reduce the recorded mean entitled pollutant levels.

You can use this function to ensure data is only collected when the plant is fully operational. You can use three options to determine plant status **ON** or **OFF**: Logic Input, Serial Input, and Multiple. Multiple has four options: Temperature threshold, Oxygen threshold, Water Vapor threshold, and Logic Input. You can view the plant status and its governing factor from this display.

### 4.8 Normalization

Complete the following steps to display and/or edit the normalization parameters for the analyzer.

1. Press **MODE** until you see the number 3 in the top left corner of the display.

   From this mode, you can display the normalization parameters currently used.

2. Press **ENTER** to enter the routine and use the arrow keys to select which of the normalizing parameters to display.
Listed below are the four normalizing parameters accessible through this mode:

a. Temperature  
b. Oxygen  
c. Pressure  
d. Water Vapor

3. When you see the required normalizing parameter, press **ENTER** to display the normalization data. Press **ENTER** again to exit the parameter.

For each of the four normalizing parameters, the display appears similar to that shown below.

---

**Figure 4-3: Normalization Example**

- **A.** Selected parameter
- **B.** Units
- **C.** Standard level required (wet or dry for water vapor)
- **D.** Parameter source  
  - **k** = keypad input  
  - **a** = analog input  
  - **s** = serial data input  
  - **m** = measured input

---

### 4.9 Diagnostic mode

You may examine the detector levels, chopper blade frequency, Y parameter, and the fault condition from this mode. Press **MODE** until the number **4** appears in the top left corner of the display and press **ENTER** to access this mode. Once in Diagnostics, the five suboptions are as follows:

1. Detector outputs  
2. Modulation Frequency  
3. Yval and CO ppm  
4. Calibration Data  
5. Fault Conditions

#### 4.9.1 Detector outputs

This mode displays detector levels from the detector. D1 is the reference level and should always be less than D2. The level of D2 should be between 10,000 and 20,000.
E1 and E2 are the detector levels with the gas cell within the source unit in the sight path and will be roughly ½ of the D2 and D1 levels. The analyzer may also display smoothed detector values; these are noted as d1, d2, e1, and e2.

Sat. # indicates whether the detector signals are saturating within the micro-processor (this value should always be zero). If it displays a number other than zero, it indicates saturation, and you should adjust the detector gain. Refer to Section 3.5.

Phase is the time correction applied for the calculation of the detector levels. This will be between 0.1 and 5.9 milliseconds. The instrument calculates this value, and you may not adjust it.

### 4.9.2 Modulation (chopper motor) frequency

The chopper blade should *chop* the IR radiation at a frequency of about 37 Hz. The processor measures this frequency and displays it from this option.

As the chopper blades interrupt the IR beam, they split the radiation 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:

\[
\text{Mark/space} = \frac{\text{Time IR beam obscured}}{\text{Time IR beam clear}}.
\]

### 4.9.3 YVals and CO ppm

A parameter Y determines the calculation of the gas concentration; refer to Section A.7.5.

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

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 data before averaging for the corresponding Y values. You can also display the Z values by pressing the arrow keys. The Z values are the adjusted Y values used to compensate for cross sensitivities in the measurement range.
4.9.4  Calibration data

You can examine the calibration factors determined during the calibration routine (SCcal) and the value currently being used (SCwkg) from this display. If the two values are 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.

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

4.9.5  Fault condition

To display the current fault condition, press ENTER while this is displayed.

The instrument automatically selects this display mode if a fault condition occurs. The instrument recognized the following fault conditions:

1. ALL CLEAR: No fault condition.
2. Det. Saturated: The detector level gain within either the receiver or the control unit 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 source unit.
6. Cal. Fact. O.R.: After the calibration routine, the calculated Set Cal factor is out of range. Refer to Chapter 6.

Press the arrow key to observe the previous fault condition.

Note
If a fault condition exists, the instrument does not update the minutes, hours, and days averages. Refer to Section 6.1.1.
4.10 Set up mode

You can change all operating parameters (averaging times, output settings, normalization parameters, path length, calibration, etc.) from this mode. To prevent any unauthorized changes, you must enter a four digit code before you can enter this mode.

Note
After you select this mode, the instrument suspends its operation and extinguishes the Data Valid LED. If you don't press a key within five seconds after selecting this mode, the Rosemount™ CCO 5500 Analyzer will revert to the normal OPERATING mode.

Rosemount recommends that you complete Table 4-1 to provide a record of the instrument setup in order to aid configuration and to record any subsequent changes to the operating parameters.

Press MODE until the number 5 is displayed in the top left corner. After you have correctly entered the security code, there are six submodes of operation from which you can change the setup parameters. These six submodes are listed below:

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

Use the arrow keys to toggle between these six options and press ENTER when the desired option is displayed.

4.10.1 Enter security code

Complete the following steps to enter the security code.

1. Once the display is as shown here, press ENTER to gain access to SET UP mode.

```
5 SET UP MODE
Security # 0000
```

The cursor flashes over the first digit of the security code number.

2. Select the required first digit with the arrow keys and press ENTER.
3. Repeat this procedure for the remaining three numbers.
If the code is correct after you press ENTER on the last digit, the sequence is continued. If it is not correct, the instrument returns to OPERATING mode. Refer to Section 3.7.4 for further details.

**Note**
Rosemount™ sets the code number to 0000 at the factory; you should change it in SET UP mode.

### 4.10.2 Set averages

The instrument calculates four separate averages. These are defined in units of seconds, minutes, hours, and days. You can use any of the four averaging stacks to provide the instrument's analog output. You can set each averaging time within predefined limits.

1. Press ENTER when this display is shown.

   ![5 SET AVERAGES]

   The display now shows one of the averages.

2. Use the arrow keys to select the average time that you need to change and press ENTER to change it.

   You can now change the value using the arrow keys and confirm it by pressing ENTER.

3. Set the seconds averaging stack to the required value.

   ![5 SET AVERAGES secs 60]

   This is limited to within 10 to 60 seconds in 10-second intervals.

4. Set the minutes averaging stack to the required value.

   ![5 SET AVERAGES mins 60]

   This is limited to within 1 to 60 minutes in 1-minute intervals.

5. Set the hours averaging stack to the required value.

   ![5 SET AVERAGES hours 24]

   This is limited to within 1 to 24 hours in 1-hour intervals.

6. Set the days averaging stack to the required value.
4.10.3 Configure O/P

You can set up the analog loop output from this mode.

1. Press **ENTER** while this display is shown to access it.

2. Press the arrow keys to step through the available options.

3. Press **ENTER** to access and change the displayed parameters of each of the six available options listed below:
   a. Output
   b. Averages
   c. Units
   d. Output Span
   e. Fault Condition
   f. Set mA Output

**Output**

You can set an origin of 0 or 4 mA for the current loop output. The arrow keys toggle between these two options. Press **ENTER** to enter the new value.

**Average**

You may use any of the four averaging stacks (seconds, minutes, hours, and days) for the analog output. You can select them with the arrow keys and enter them with the **ENTER** key.
**Units**

The analog output can represent the gas concentration in units of mg/m$^3$, mg/Nm$^3$, or vpm. The arrow keys toggle between these three options. Press **ENTER** to enter the new value.

![Units Configuration](image)

**Output Span**

Select the required span using the arrow keys for each digit. Press **ENTER** to enter the value of each digit. The units are displayed in vpm, mg/m$^3$, or mg/Nm$^3$, depending on what has been selected beforehand.

![Output Span Configuration](image)

**Note**

Once you select **Output Span**, the current value is displayed for one second. The first digit of the display then defaults to zero; thus you must re-enter the span value for the unit to function correctly.

**Fault condition**

If a fault condition occurs, you may set the current output of the instrument to one of the following options:

![Fault Condition Configuration](image)

**Procedure**

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 selected gas concentration - **HOLD**.
4. Set the output to full scale (20 mA) - **F.S**.

Press the arrow keys to select one of these options; when the desired output is displayed, press **ENTER** to confirm.

**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 ENTER to select it, and the instrument prompts you to set the current levels at 0 and 20 mA.

When this is displayed, set the current output to 0 mA as measured with a calibrated current meter across the analog output loop terminals; do not connect anything else to these terminals when setting up the output.

Use the two arrow keys to adjust the value; the UP arrow takes the current output up, and the DOWN arrow takes it down. Press ENTER when the correct output 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.

In a similar manner to the above, set the current output level to 20 mA.

4.10.4 Parameters

Complete the following steps to set the parameters.

1. With this option displayed, press ENTER to access the list of six available options.

   The arrow keys cycle through these options.

2. When the option you need to change is displayed, press ENTER.

3. When you have made all required changes, select EXIT and press ENTER.

   The six available options are:
   a. Security Number
   b. Identity Number
   c. Path Length
   d. Alarm
   e. Cal. Factor
   f. Plant Status Input
Security Number
To prevent any unauthorized tampering with the setup information, it is important to change the security code from the factory setting.
Select each digit with ENTER and change it with the arrow keys.

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

Identity Number
If you are using the system as part of an integral monitoring system and are using the serial input and outputs, 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.

Path Length

Note
Once you select path length, the instrument displays the current value for one second. The first value of the display then defaults to zero; therefore, you must re-enter the value to calculate the gas concentrations correctly.

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

Refer to Section 2.4.1.

The Rosemount CCO 5500 Analyzer is sensitive to the product of concentration and path length. In order to obtain a true value of concentration of gas, you must input the correct path length into the processor. The processor then uses the value 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 source and receiver.
**Alarm**

A contact output is available to warn of a high gas concentration. You may trigger the contact output from any of the four averaging stacks. Select the source with the arrow key and enter it with **ENTER**.

<table>
<thead>
<tr>
<th>5 PARAMETERS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm source</td>
<td>15m</td>
</tr>
</tbody>
</table>

Select the units for the alarm; these may be different than the units selected for the analog output.

<table>
<thead>
<tr>
<th>5 PARAMETERS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm</td>
<td>mg/Nm3</td>
</tr>
</tbody>
</table>

After you select the source, the instrument requires a level that will trigger the output. Set the desired level with the arrow keys.

<table>
<thead>
<tr>
<th>5 PARAMETERS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm</td>
<td>0000mg/Nm3</td>
</tr>
</tbody>
</table>

**Cal Factor**

**Note**

First, record the original Cal Factor before entering this mode as displayed in **Mode 4 → Calibration Data**. The Cal Factor is lost when the menu option is entered.

During the calibration routine, the instrument calculates a **Cal Factor** which sets the basic calibration of the instrument. You may change this value from this mode.

<table>
<thead>
<tr>
<th>5 PARAMETERS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal Factor</td>
<td></td>
</tr>
</tbody>
</table>

**Note**

Since this value controls the calibration of the instrument, only change if necessary.

**Plant Status Input**

Use this to determine whether the plant is operating under correct conditions.

There is a choice of three controls for plant status: Logic Input, Serial Input, and Multiple. You can only use one to control plant status at any one time.
5 PARAMETERS
Plant Status I/P

• Logic Input

If the PS1 and PS2 terminals are linked in the control unit, the logic contact is made, and the plant status is OFF. You may link these terminals manually during a plant shut down, or you may wire them to a switch/contact outside the unit (e.g., a value that opens and closes the duct). Press ENTER to select this option when the Plant Status → Serial Input option is displayed.

• Serial input

If you select this option, the criteria controlling plant status are transmitted via the serial data link. Press ENTER when the Plant Status I/P → Serial Input option is displayed to select this option.

• Multiple

Four options are available here. Press ENTER when the Plant Status I/P → Multiple option is displayed, and the first option Temperature is displayed. Use the arrow keys to toggle YES or NO. NO means that the temperature threshold is not used to determine plant status. If you select YES, the display enters the display below. Configure the instrument for temperature threshold. Press ENTER when it is correctly configured, and the display moves to the next option Oxygen. After you set the last option, the Logic Input display returns to the PARAMETERS → Plant Status I/P option. Use the DOWN arrow to scroll down to EXIT and press ENTER. The plant status is now full configured.

Plant status is only 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 registers plant status ON.

- Temperature

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 updates.

- Oxygen

Oxygen is 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.

- Water Vapor
This is 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.

- 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 you configure this option, the menu exits to the Multiple option. Use the DOWN arrow to select EXIT and press ENTER.

4.10.5 Normalization

Complete the following steps to set the Normalization parameters.

1. Press ENTER to access one of the four normalizing parameters listed below.

   5 NORMALIZATION

2. Use the arrow keys to cycle through the four options and press ENTER once the desired option is selected.

   a. Temperature
   b. Oxygen
   c. Pressure
   d. Water Vapor

Once selected, each of the above normalizing parameters have the same suboptions: Set Standard Levels and Set Values. Under Set Values, are three more suboptions that determine how the instrument reads the data: Analog Input, Serial Input, and Keypad Input.

Set Standard Levels

Each normalizing parameter normalizes the measured gas concentration to standard conditions of temperature, oxygen, pressure, and water vapor. Set these levels within this option. Use the arrow keys to change each displayed normalizing standard value.

5 TEMP DegF
std level = 000

Temperature

Always use an analog input 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™ 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 you use the Keypad Input, and the gas temperature is higher than 572 °F (300 °C), the compensation algorithm becomes less precise, and instrument accuracy deteriorates accordingly. Rosemount does not recommend this.

**Note**

If normalization is not required, the instrument must hold the temperature of the gas in the duct using the Analog Input option.

Press ENTER with the Temperature option selected to access Set Standard Levels and Set Values. Use the arrow keys to toggle between these options and Exit.

**Set Values**

You can bring the normalizing data into the instrument in one of three ways:

- **Analog Input**
  
  This uses the 4-20 mA inputs within the processor to receive the measured transducer data. The values at 4 mA and 20 mA will be requested should this option be selected.

- **Serial Input**
  
  If you use an input unit, all normalizing data can be transmitted via the serial data line.

- **Keypad Input**
  
  You can enter a fixed value via the keypad. This is suitable where the value is stable to about ±5%.

With an integrated system, set the lead analyzer’s normalizing parameters to the 4-20 mA inputs. Then set all the other analyzers to serial, and the normalization parameters are transmitted down the serial data highway.

**Oxygen**

To correct the data to standard levels of oxygen, you must enter an estimate of the oxygen at the point of measurement. If the oxygen level is being continuously measured, connect the analog output of the oxygen analyzer into the Rosemount™ CCO 5500 Analyzer and select Analog Input. You must define this input as either WET or DRY depending on how the...
measurement is made. After you define the wet or dry, you need to define the Analog Input values; set the 4 mA and 20 mA values. If the oxygen level is relatively constant through all firing conditions, you may use a fixed keypad input.

With an integrated system, you can take the oxygen data to the instrument via the serial data line.

**Note**
If normalization is not required, you must set the normalizing parameters for oxygen in the instrument.

**Pressure**

To correct the data to a standard pressure, normally 14.7 psi (101 kPa), you must determine the pressure at the point of measurement. If the flue pressure is relatively constant through all firing conditions, then you may use a fixed keypad input. If the pressure is not constant, measure it and bring it into the instrument via the 4-20 mA analog input within the processor.

**Note**
If normalization is not required, set the normalizing parameters for pressure in the instrument to 14.7 psi (101 kPa)(Standard Level and Keypad Input).

With an integrated system, you can take the pressure data to the instrument via the serial data line.

**Water Vapor**

An across the duct monitor measures the gas concentration under wet conditions. Unlike a sampling system, the gas has not been preconditioned in any way before you make a measurement.

When the water vapor is at a relatively fixed level, set the standard level to DRY to normalize it to dry conditions. 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, you can take the water vapor data to the instrument via the serial data line.

**4.10.6 Reset averages**

**Note**
Resetting averages causes the rolling average data to be cleared from memory.
You can reset the average values that are currently held in the four averaging stacks using this option; this erases the current average that is held in all of the averaging stacks. Select this option by pressing ENTER and using the arrow keys. The instrument requests confirmation before the averages are reset.

**Note**  
If you select this option, all the data in the averaging stacks is reset, and the data for as much as 30 days is lost.

### 4.10.7 Calibrate

From this option, you may display the two detector levels and conduct a basic calibration. While in this mode, the gas cell is not moved; this gives an immediate response for setting up the detector levels. A Cal Factor that is calculated during a calibration routine sets the basic calibration of the instrument. Press ENTER while this is displayed to see the following options:

1. Set Detectors
2. Span Adjust
3. Calibrate

**Set detectors**

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

<table>
<thead>
<tr>
<th>5 D2 = 10534</th>
<th># = 00000</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1 = 15000</td>
<td># = 00000</td>
</tr>
</tbody>
</table>

Refer to *Section 3.5* for a discussion of the detector level and saturation count.

**Span adjust**

**Note**  
Rosemount™ initially sets the span factor at the factory; do not adjust it unless the instrument sensitivity is suspected. In any case, Rosemount recommends that you record the original value before making adjustments.
You can adjust instrument sensitivity if a known concentration of gas exists between the source and receiver units and instrument sensitivity is suspected. If a problem arises, consult Rosemount.

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

You may need to adjust the span factor if you have fitted new gas cells or filters.

**Calibrate**

Re-enter the Mode 5 CALIBRATE menu and proceed to the Calibrate option.

```
5 CALIBRATE
Calibrate
```

You can calculate the basic calibration of the instrument 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, the instrument can calibrate to a known value of the gas concentration - the calibration target.

```
5 CALIBRATE
Target  0000ppm
```

Set the calibration target either to a known value of the gas concentration or to zero. Then set the desired number of cycles over which the calibration factor is determined (Rosemount™ recommends a minimum of 30). Now run the calibration, and the display will show a countdown during its execution. When the calibration is complete, the new Cal Factor is displayed for about five seconds, and the instrument exits the calibration routine.

```
5 CALIBRATE
Set # cycles = 30

5 cycle # 30
CAL IN PROGRESS

5 CAL COMPLETE
Cal FACT  K = 9054
```

**Note**

You must run the calibration routine 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, record the Cal Factor from the Parameters option before running the calibration.

To aid configuration and to record any subsequent changes to the operating parameters, [link](#xd_5bc5da84c7ce5b06--2a6d55ac-163c9dfb12c--7ead/table_jlb_4y5_b2b) lists all of the options available and can be used as a record of the operating parameters.

### Table 4-1: Instrument Settings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Averages</strong></td>
<td></td>
</tr>
<tr>
<td>Seconds</td>
<td></td>
</tr>
<tr>
<td>Minutes</td>
<td></td>
</tr>
<tr>
<td>Hours</td>
<td></td>
</tr>
<tr>
<td>Days</td>
<td></td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
</tr>
<tr>
<td>0 or 4 mA base</td>
<td></td>
</tr>
<tr>
<td>Units</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>Fault condition</td>
<td></td>
</tr>
<tr>
<td><strong>Parameters</strong></td>
<td></td>
</tr>
<tr>
<td>Path length</td>
<td></td>
</tr>
<tr>
<td>Alarm source</td>
<td></td>
</tr>
<tr>
<td>Alarm units</td>
<td></td>
</tr>
<tr>
<td>Alarm levels</td>
<td></td>
</tr>
<tr>
<td><strong>Normalization</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>Standard level °F (°C)</td>
<td></td>
</tr>
<tr>
<td>I/P °F (°C) @ 4 mA</td>
<td></td>
</tr>
<tr>
<td>I/P °F(°C) at 20 mA</td>
<td></td>
</tr>
<tr>
<td>Keypad input °C (not ideal)</td>
<td></td>
</tr>
<tr>
<td>Serial input</td>
<td></td>
</tr>
<tr>
<td><strong>Oxygen</strong></td>
<td></td>
</tr>
<tr>
<td>Standard level %</td>
<td></td>
</tr>
<tr>
<td>Wet or dry gas</td>
<td></td>
</tr>
<tr>
<td>I/P % @ 4 mA</td>
<td></td>
</tr>
<tr>
<td>I/P % @ 20 mA</td>
<td></td>
</tr>
<tr>
<td>Keypad input %</td>
<td></td>
</tr>
<tr>
<td>Serial input</td>
<td></td>
</tr>
</tbody>
</table>
Table 4-1: Instrument Settings (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td></td>
</tr>
<tr>
<td>Standard level psi (kPa)</td>
<td></td>
</tr>
<tr>
<td>I/P psi (kPa) @ 4 mA</td>
<td></td>
</tr>
<tr>
<td>I/P psi (kPa) @ 20 mA</td>
<td></td>
</tr>
<tr>
<td>Keypad input</td>
<td></td>
</tr>
<tr>
<td>Serial input</td>
<td></td>
</tr>
<tr>
<td>Water vapor</td>
<td></td>
</tr>
<tr>
<td>Standard level (wet %/dry)</td>
<td></td>
</tr>
<tr>
<td>Keypad input %</td>
<td></td>
</tr>
<tr>
<td>Measured value</td>
<td></td>
</tr>
</tbody>
</table>

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

**Note**
Rosemount™ obtained factory settings under the following conditions:
- 2 m path length
- Clean conditions

Table 4-2: Calibration Data

<table>
<thead>
<tr>
<th>Detector outputs</th>
<th>Factory</th>
<th>Config</th>
</tr>
</thead>
<tbody>
<tr>
<td>D2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Calibration data**
Cal factor
Span factor

**Output calibration**
Set zero
Set span
4.11 Check Cell mode

Use this mode with a Rosemount™ check cell. It verifies calibration and operation of the analyzer.
For details for this mode's use, refer to Section 4.13.1.

Procedure

1. Press ENTER on viewing this display if you need to use the CHECK CELL mode.

2. Use the arrow keys to toggle the display to YES and press ENTER again.

You have now selected the CHECK CELL mode. Note that the display will default back to Mode 1 if you don't select YES within five seconds. Do not insert a the check cell before accessing this option. Refer to Section 4.13.1.

4.12 Shutdown procedure

You do not need to shut down the system unless you are performing maintenance.

1. In this case, power down the power supply (and thus the control unit and analyzer heads).
2. Close the manually operated isolating valves on the analyzer heads.
3. Proceed with service.
4. When completed, open the valves and power up the system.

Postrequisites

You may need to calibrate the system depending on the type of maintenance you are doing. For details, refer to Chapter 6.

4.13 Routine checks

4.13.1 Notes for using a Rosemount™ check cell

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

Note
Place the check cell at the receiver side.

Measurement conditions
For absolute verification, you must check the instrument when no measurement gas is 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
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 analyzer does not update rolling averages while in Mode 6.

Procedure
1. Enter Mode 6 on the control unit 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 you don’t select this within five seconds, the instrument returns to the normal OPERATING mode.

3. When you see this option, insert the check cell observing the procedure outlined below.
4. Remove the two screws retaining the cover on the check cell holder (Figure 4-4).
5. Insert the check cell into the check cell holder and replace and tighten the screws. You can insert the cell in either direction. Refer to **Figure 4-5**.

---

**Figure 4-4: Check Cell Holder**

A. Check cell cover  
B. Receiver  
C. Check cell holder

---

6. Wait for the instrument reading to settle (five to ten minutes) and record the gas measurement with the cell in position.

7. Remove the check cell and wait for the analyzer to return to zero (another five to ten minutes).

8. Replace the cover on the check cell holder and place **MODE** on the control unit. The instrument now returns to **OPERATING** mode.

---

**Figure 4-5: Check Cell**

A. Gas cell window

---

Introducing the check cell may cause an initial major disturbance to the instrument operation.
You can do this test with the plant on line, but any pollutant gas present (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.

Rosemount fixes the calibration of the Rosemount CCO 5500 Analyzer at the point of manufacture. If gross errors exist, this could suggest an instrument malfunction. If you observe minor errors, please check the procedure and if necessary, return the gas cell for recertification.

### 4.13.2 Alarms and emergency conditions

The alarm thresholds for the system are set as described in the normal OPERATING mode. When an alarm condition occurs, the red LED on the control unit lights up. This goes out when the alarm condition has cleared. When the condition has cleared, the software records the fact that an alarm condition occurred. The 4 to 20 mA output from the analyzer will also alter according to the pollution levels detected.

### 4.13.3 Emergency shutdown procedure

This is the same as normal shutdown.

1. Remove power from the power supply.
   The whole system closes down.

2. Close the isolating valves if required and stop the flow of air to the air purges.

### 4.13.4 Isolation procedure

Complete the following steps to isolate the analyzer.

1. Shut down power to the power supply.

2. Shut off compressed air to the air purges and close the isolating valves.
5 Maintenance

5.1 Preventative maintenance

Rosemount designs this equipment to keep maintenance to an absolute minimum.

5.1.1 Cleaning windows

It is important that you keep the optical windows of both the source and receiver reasonably clean. Keep any mounting tubes free from build-up of dust and fly ash. Clean the optical window (Figure 5-1) every six months and more frequently for dirty processes.

![Figure 5-1: Optical Window](image)

A. Air purge  
B. Source  
C. Window

**WARNING!**

**HIGH TEMPERATURE AND DANGEROUS VAPORS**  
Take great care when removing the Rosemount™ CCO 5500 Analyzer 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.

**Procedure**

1. Unbolt and remove the source and receiver from their air purges.
2. Wipe the windows with a soft dry cloth.
5.2 Corrective maintenance

The following maintenance procedures describe the necessary steps for removing and replacing failed elements of the Rosemount™ CCO 5500 Analyzer.

**WARNING!**

**ELECTRIC SHOCK**

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.

5.2.1 Replace heater element

The heater element has a finite life and at some stage you will have to replace it. Rosemount™ designed the unit to give a minimum of two years continuous operation; you can replace the heater element on site when necessary.

Replace a failed heater element according to the following procedure.

**Procedure**

1. Shut down and lock out power to the Rosemount CCO 5500 Analyzer.
2. Unbolt and remove the source unit from the air purge.
3. Loosen the source unit cable gland (*Figure 5-2*) so the cable can slip when the rear cover plate is removed.

**Figure 5-2: Source Rear Cover Plate**

4. Unscrew and remove the rear cover plate.
5. Unscrew and remove the circuit board (*Figure 5-3*).
6. Remove the terminal nuts (Figure 5-4) and remove the heater wires.

7. Unscrew the three captive screws.
8. Remove and discard the heater assembly.
9. Install the new heater assembly and tighten the three captive screws.

---

**Figure 5-3: Source Unit Circuit Board**

| A. Circuit board mounting screw |
| B. Circuit board                |

**Figure 5-4: Heater Element**

| A. Terminal nuts             |
| B. Captive screw            |
| C. Heater                   |
10. Install the two wires and terminal nuts removed in Step 6.
11. Install the circuit board and retaining screws removed in Step 5.
12. Install and fasten the rear cover plate.
13. Power up the Rosemount CCO 5500 Analyzer and allow fifteen minutes for the heater to reach operating temperature.
The analyzer starts to monitor the gas levels.

5.2.2 Replace chopper motor assembly

Complete the following steps to replace the chopper motor assembly in the analyzer.
1. Shut down and lock out power to the Rosemount™ CCO 5500 Analyzer.
2. Unbolt and remove the source unit from the air purge.
3. Remove the window plate (Figure 5-5) from the source unit.

Figure 5-5: Source Unit Circuit Board and Center Plate Assembly

A. Black wire (M-)
B. Red wire (M+)
C. Window plate
D. Circuit board and center plate assembly
E. Brass screws
4. Unscrew the three brass screws that secure the circuit board and center plate assembly.
5. Lift the circuit board and center plate assembly out of the source unit.
6. De-solder the red and black chopper motor power wires from the circuit board.
7. Unscrew and remove the three chopper motor screws (Figure 5-6).

**Figure 5-6: Chopper Motor Assembly**

A. Chopper motor assembly
B. Chopper motor retaining screws
C. Center plate

8. Install the new chopper motor and retaining screws removed in Step 7.
9. Solder the chopper motor power wires to the circuit board. Solder the red wire to the M+ terminal and the black wire to the M- terminal.
10. Install the center plate and circuit board assembly. Secure the assembly with the three brass crews removed in Step 4.
11. Line up and install the window plate onto the source unit. Fully seat the window plate flange in the source unit.
12. Secure the source unit to the air purge using the four screws removed in Step 2. Tighten the screws evenly.
13. Power up the Rosemount CCO 5500 Analyzer and check the chopper motor frequency in Mode 4 (DIAGNOSTICS). Adjust using the trim potentiometer as described in Section 3.6.
5.2.3 Replace source unit gas cell

Replace the source unit gas cell according to the following procedure.
1. Shut down and lock out power to the Rosemount™ CCO 5500 Analyzer.
2. Unbolt and remove the source from the air purge.
3. Remove the window plate (Figure 5-5) from the source unit.
4. Unscrew the three brass screws that secure the circuit board and center plate assembly.
5. Lift the circuit board and center plate assembly out of the source unit.
6. Loosen the setscrew at the end of the gas cell assembly (Figure 5-7).
7. Pry the gas cell from the stepper motor shaft.
8. Insert a new gas cell onto the stepper motor shaft and tighten the setscrew.
9. Install the center plate and circuit board assembly and secure with the three brass screws removed in Step 4.
10. Line up and install the window plate onto the source unit. Fully seat the window plate flange in the source unit.
11. Secure the source unit to the air purge using the four screws removed in Step 2. Tighten the screws evenly.

12. Power up and recalibrate the Rosemount CCO 5500 Analyzer. Refer to Calibrate.

5.2.4 Replace receiver unit gas cell

Replace the receiver unit gas cell according to the following procedure.

1. Shut down and lock out power to the Rosemount™ CCO 5500 Analyzer.

2. Unbolt and remove the receiver unit from its air purge.

3. Loosen the receiver unit cable gland so the cable can slip when the window plate is removed.

4. Unscrew and pull the window plate (Figure 5-8) from the front of the receiver unit.

**Figure 5-8: Receiver Gas Cell**

![](image)

A. End detector PCB
B. Window plate
C. M6 bolts
D. M4 x 16 screws
E. Side detector PCB
F. Gas cell assembly

5. Use a marker pen to match-mark all components of the receiver stack.

6. Remove the four M4x16 screws that secure the side detector PCB to the receiver stack.
7. Remove the four M6 bolts that secure the detector stack components.
8. Observe the orientation of the gas cell assembly in the detector stack.
9. Slide the gas cell assembly out of the detector stack.
10. Replace the gas cell using the same orientation observed in Step 8.
    (The notch in the gas cell assembly should be nearest to the large circuit board
    secured to the detector stack).
11. Place the end detector on top of the detector stack.

   **CAUTION!**
   **EQUIPMENT DAMAGE**

   Do not overtighten the detector stack mounting bolts. Over-tightening the mounting
   bolts may fracture the gas cell.

12. Install and gently tighten the M6 mounting bolts removed in Step 7.
13. Position the side detector against the receiver stack. Install and tighten the M4x16
    side detector mounting screws.
14. Line up and install the window plate onto the receiver unit. Fully seat the window
    plate flange in the receiver unit.
15. Secure the receiver unit to the air purge using the four screws removed in Step 2.
    Tighten the screws evenly.
16. Power up and recalibrate the Rosemount CCO 5500 Analyzer.

    Refer to *Calibrate*.

### 5.2.5 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 electronics' performance,
interrogate the control unit from the keypad to determine whether or not they are functioning properly.

Refer to *Chapter 6*.

### 5.3 Adjust span factor

The span factor does not require periodic adjustment. However, if either of the following repair actions are performed, you may need to adjust the span factor.

- Gas cell changed either in the receiver or source.
- Interference filter changed in the receiver.

Use the following procedure to adjust the span factor.
**Procedure**

1. At the control unit keypad, select **Mode 5 → Configure O/P → Set Span**.
2. Set the span factor to 1000.
3. Calibrate the analyzer under zero conditions.
   Refer to **Calibrate**.
4. Select **Mode 5 → Normalization**. Set the temperature to 68 °F (20 °C).
5. Select **Mode 5 → Parameters → Pathlength** to enter the 3.28 ft. (1 m) path length.

**Note**
The check cell reading must be less than 999 ppm\_m. If greater than 999 ppm\_m, you must enter a larger path length to reduce the effective ppm\_m value of the check cell. Select a path length such that ppm\_m/path length is less than 999.

6. Select **Mode 5 → Configure O/P → Set Span**. Enter the span factor indicated for the check cell in Mode 6. If this value exceeds 999 ppm, divide by the path length entered above to determine the span.
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 in **Step 6**.
8. Using the up and down arrow keys, adjust the span factor until the second reading agrees with the certified check value (divided by the path length if appropriate).
9. Record the span factor and press **ENTER**.
10. Confirm the span factor by selecting **Mode 2 → Parameters → Span Factor** and checking the value.

**5.3.1 Reset span factor**

An example of resetting the span factor is outlined below.

1. You insert a certified check cell of 2880 ppm into the check cell holder with the analyzer in Mode 6. You take a reading of 3240.
   
   Due to the value of the check cell exceeding 999 ppm, you need to use a suitable path length to reduce the effective value of the check cell.
2. In this case, you choose a path length of 13.1 ft. (4 m); thus the effective value of the check cell is 720 ppm (2880/4).
   
   However, in Mode 6 it reads higher (3240); this value is effectively 810 ppm at a 13.1 ft. (4 m) path length.
3. You key 810 in as the first value in the span factor option.
4. Then you adjust the span factor until the second value reads 720.
5. Press **ENTER** to set the span factor.
6 Troubleshooting

6.1 Finding faults with the keypad

**WARNING!**

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

If a fault occurs, the control unit display switches from its current mode of operation to the **DIAGNOSTICS** mode and displays the current fault condition. Refer to Section 6.1.1 for further information on the fault conditions. If the fault clears, the display stays in **DIAGNOSTICS** mode and displays **All Clear**.

Enter **DIAGNOSTICS** mode from the instrument’s keypad; you can do this 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.

<table>
<thead>
<tr>
<th></th>
<th>D2 min</th>
<th>D2 max</th>
<th>D1 min</th>
<th>D1 max</th>
<th>Set Cal min</th>
<th>Set Cal max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosemount™ CCO 5500</td>
<td>3,000</td>
<td>20,000</td>
<td>3,000</td>
<td>20,000</td>
<td>2,000</td>
<td>2,900</td>
</tr>
</tbody>
</table>

where:

- Modulation frequency = 30 to 45 Hz
- Mark/space ratio = 0.9 to 1.1
- Saturation count = 50 maximum for all analyzers

If the values are outside of the above ranges, the **Data valid** LED extinguishes, and the fault condition is displayed.

6.1.1 Data valid LED out

If one or more fault conditions occur, the data valid LED on the front panel extinguishes, the data valid relay operates, and the instrument automatically enters the **DIAGNOSTICS** mode to display the fault condition.

**Table 6-1: Fault Conditions**

<table>
<thead>
<tr>
<th>Fault condition</th>
<th>Possible causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector signal saturated (Sat # over 50)</td>
<td>Incorrect detector gain adjustment.</td>
</tr>
</tbody>
</table>
Table 6-1: Fault Conditions (continued)

<table>
<thead>
<tr>
<th>Fault condition</th>
<th>Possible causes</th>
</tr>
</thead>
</table>
| Instrument condition during high opacity condi-
  tions which have now cleared.                |                                                                                 |
| Low detector levels (D1 < 3,000)              | High opacity in duct.                                                          |
|                                               | Dirty windows.                                                                 |
|                                               | Incorrect detector gain adjustment.                                            |
| Cal factor out of range                       | Calibration conducted during unstable duct conditions.                        |
|                                               | Poor alignment.                                                                |
|                                               | Incorrect detector gain adjustment.                                            |
| Modulation frequency is below 30 Hz or above 45 Hz. | Poor supply voltage.                                                         |
|                                               | Faulty chopper motor.                                                         |
|                                               | Incorrect setting within the source unit.                                      |
| Reference signal failure                      | Chopper motor fails.                                                           |

Note
If the instrument recognizes a fault condition, it does not update the minutes, hours, and day averages.

6.2 Troubleshooting tables

The troubleshooting tables provide fault diagnosis, possible causes, and the appropriate actions if you suspect an instrument fault. Note the symptoms and when the fault has occurred. Refer to the appropriate tables.

Note
Be sure to use the tables from the top down and pay particular attention when ‘proceed to next test’ and ‘proceed to next possible cause’ are indicated.

The troubleshooting tables indicate which of the four units failed:
- Source unit
- Control unit
- Receiver unit
- Power supply unit

You can then return the faulty unit to Rosemount™ for repair.
## Table 6-2: Configuration Problems

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Test</th>
<th>Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No display on control unit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power input failure</td>
<td>Check 110/220 V selection switch.</td>
<td>Setting correct</td>
<td>Go to next test.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Setting incorrect</td>
<td>Change setting and go to next test.</td>
</tr>
<tr>
<td></td>
<td>Check power indication LED in control unit.</td>
<td>LED illuminated</td>
<td>Power OK - go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LED not illuminated</td>
<td>Go to next test.</td>
</tr>
<tr>
<td></td>
<td>Check fuse in power supply unit.</td>
<td>Fuse OK</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuse blown</td>
<td>Replace fuse.</td>
</tr>
<tr>
<td>Power supply failure</td>
<td>Check power rail LEDs in power supply unit.</td>
<td>All LEDs illuminated</td>
<td>Supplies OK - proceed to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LEDs not illuminated</td>
<td>Go to next test.</td>
</tr>
<tr>
<td></td>
<td>Check fuse in control unit.</td>
<td>Fuse OK</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuse blown</td>
<td>Replace fuse.</td>
</tr>
<tr>
<td>Connection problem</td>
<td>Check wiring between control unit and power supply unit.</td>
<td>Wiring OK</td>
<td>Go to next text.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incorrect wiring</td>
<td>Correct wiring.</td>
</tr>
<tr>
<td></td>
<td>Check ribbon cable connections in control unit.</td>
<td>Connections OK</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connections loose</td>
<td>Secure connections</td>
</tr>
<tr>
<td>Control unit failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Display nonsense on control unit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microprocessor fault</td>
<td>Reset by interrupting mains supply.</td>
<td>Fault clears.</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fault continues.</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td>Program corruption, failed micro PCB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Display message Waiting for Reference</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reference wave failure</td>
<td>Check wiring between power supply unit and control unit and also between power supply unit and source unit.</td>
<td>Wiring OK</td>
<td>Go to next text.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wiring incorrect</td>
<td>Correct wiring.</td>
</tr>
<tr>
<td></td>
<td>Check reference wave in power supply unit - use oscilloscope at terminals 4 and 5</td>
<td>37 Hz square wave approx. 12 V - OK</td>
<td>Go to next test.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>37 Hz square wave approx. 12 V - not OK</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td></td>
<td>Check reference wave in control unit - use oscilloscope at terminals 2 and 5.</td>
<td>37 Hz square wave approx. 12 V - OK</td>
<td>Contact Rosemount.</td>
</tr>
</tbody>
</table>
### Table 6-2: Configuration Problems (continued)

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Test</th>
<th>Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chopper motor failure in source unit</td>
<td>Check if chopper blade is rotating.</td>
<td>No</td>
<td>Go to next test.</td>
</tr>
<tr>
<td></td>
<td>Replace chopper motor.</td>
<td>Fault clears.</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fault continues.</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td>Data Valid LED not illuminated</td>
<td>Analyzer fault condition</td>
<td>Interrogate fault status in</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td></td>
<td>Mode 4.</td>
<td>All Clear</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fault condition identified</td>
<td>Go to relevant symptom.</td>
</tr>
<tr>
<td>Reference failure</td>
<td>Reference wave failure</td>
<td>Proceed as for symptom 3</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td>(display message Waiting for Reference)</td>
<td>Fault clears.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fault continues.</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td>Low detector level</td>
<td>Incorrect wiring</td>
<td>Check wiring.</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fault clears.</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td>Dirty windows or obstructed sight path</td>
<td>Clean and check the Rx and</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tx windows; clear sight path</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>between receiver unit and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>source unit.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Misalignment</td>
<td>Realign receiver and source</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>units.</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td>Incorrect gain settings</td>
<td>Adjust gains in control unit</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and/or receiver unit.</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td>Source failure</td>
<td>Check heater cartridge.</td>
<td>Replace heater cartridge.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cartridge open circuit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Source gas cell drive failure</td>
<td>Check drive LED in control</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>unit.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LED flashing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LED not flashing</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No movement</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Movement</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td>Detector saturated</td>
<td>Incorrect gain settings</td>
<td>Adjust gain settings in</td>
<td>Saturation clears.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>control unit and/or receiver</td>
<td>No further action.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>unit.</td>
<td>Go to next test.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Monitor detector levels</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>from receiver unit.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Signal OK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Signal faulty</td>
<td></td>
</tr>
</tbody>
</table>
### Table 6-2: Configuration Problems (continued)

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Test</th>
<th>Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulation frequency out of range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chopper motor speed out of range</td>
<td>Adjust chopper motor speed.</td>
<td>Modulation frequency in range</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unable to adjust</td>
<td>Go to next test.</td>
</tr>
<tr>
<td></td>
<td>Monitor reference waveform across test points 10 and 11 in power supply unit using oscilloscope</td>
<td>30 - 45 Hz waveform OK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 30 or &gt; 45 Hz: waveform incorrect</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td>Set call out of range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibrated with incorrect target value or under fluctuating gas level</td>
<td>Calibrate with correct target value.</td>
<td>Cal factor in range</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cal factor out of range</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td>Poor alignment / window contamination / path obscured</td>
<td>Proceed as for low detector level</td>
<td>Cal factor in range</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cal factor out of range</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td>Source unit gas cell drive failure</td>
<td>Proceed as for low detector level.</td>
<td>Cal factor in range</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cal factor out of range</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td>D2 detector/circuit failure</td>
<td>Check D2 signal level.</td>
<td>OK</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not OK</td>
<td>Go to next test.</td>
</tr>
<tr>
<td></td>
<td>Monitor D2 signal from Rx.</td>
<td>OK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not OK</td>
<td>Contact Rosemount.</td>
</tr>
<tr>
<td>Source gas cell failure</td>
<td>Replace source unit gas cell.</td>
<td>Cal factor in range</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cal factor out of range</td>
<td>Go to the next possible cause.</td>
</tr>
<tr>
<td>Receiver gas cell failure</td>
<td>Replace receiver unit gas cell.</td>
<td>Cal factor in range</td>
<td>No further action</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cal factor out of range</td>
<td>Contact Rosemount.</td>
</tr>
</tbody>
</table>

### Table 6-3: Operational Problems

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Test</th>
<th>Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output reading permanently zero or full scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect normalizing parameter setting</td>
<td>Enter parameter mode and ensure all parameters are as required.</td>
<td>Parameters correct</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parameters incorrect</td>
<td>Enter correct parameters.</td>
</tr>
<tr>
<td>Incorrect calibration (Set Cal value) zero gas level</td>
<td>Enter DIAGNOSTICS mode and observe the Y(60) value.</td>
<td>1800 &lt; Y &lt; 2010</td>
<td>Instrument OK: true level of gas in duct (output permanently zero)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y &lt;1800</td>
<td>Go to next possible cause.</td>
</tr>
</tbody>
</table>
### Table 6-3: Operational Problems (continued)

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Test</th>
<th>Result</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector levels low or saturated</td>
<td>Enter DIAGNOSTICS mode and check the detector levels and saturation count.</td>
<td>Detector levels OK</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Detector levels out of tolerance</td>
<td>Reconfigure the instrument and consult the fault-finding table again.</td>
</tr>
<tr>
<td>Output circuitry failure</td>
<td>Enter SET UP mode (configure output and attempt to set zero and span).</td>
<td>Output responds correctly.</td>
<td>Reconfigure the instrument and consult the fault-finding table again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Output does not respond correctly.</td>
<td>Replace control unit.</td>
</tr>
<tr>
<td>Averages not updated</td>
<td>Enter DIAGNOSTICS mode and check fault condition.</td>
<td>Fault condition exits.</td>
<td>Refer to Section 4.9.5.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No fault condition</td>
<td>Go to next possible cause.</td>
</tr>
<tr>
<td>Plant status contact in control unit</td>
<td>Check plant status input LED in control unit.</td>
<td>LED off</td>
<td>Operation correct - stable gas level.</td>
</tr>
<tr>
<td>has been made.</td>
<td></td>
<td>LED on</td>
<td>Plant status in use - instrument will not update until plant on.</td>
</tr>
</tbody>
</table>

### 6.3 Component tests

Some instrument components/operation can be verified as follows:

#### 6.3.1 Heater cartridge

Complete the following steps to check the analyzer's heater cartridge.

1. Perform steps 1 through 4 in Section 5.2.1.
2. Remove one lead from the heater cartridge and measure the resistance across the two cartridge terminals.
   - It should be about 3.5 ohms. If the circuit is open, you need to replace the heater cartridge.

#### 6.3.2 Chopper motor

Complete the following steps to check the analyzer's chopper motor.

1. Power up the Rosemount™ CCO 5500 Analyzer.
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, measure the supply to the chopper motor voltage at the test points M+ and M- on the circuit board (Figure 5-5).

The voltage should read approximately 1 Vdc. If the voltage is good, replace the chopper motor. If the voltage is not 1 Vdc, the source unit electronics are suspect.

### 6.4 LED indications

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

<table>
<thead>
<tr>
<th>LEDs</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control unit LEDs</strong></td>
<td></td>
</tr>
<tr>
<td>5 V, -15, +15</td>
<td>Situated top/left of processor. Should all be ON, indicating that the power supplies to the instrument are functioning correctly.</td>
</tr>
<tr>
<td>M-DIR</td>
<td>Should operate approximately every 4 seconds.</td>
</tr>
<tr>
<td>SOL_MDRV</td>
<td>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).</td>
</tr>
<tr>
<td>+V1, -V1, and +12 V</td>
<td>Middle bottom left of board. All should be ON. Power supplies to the isolated analog current output.</td>
</tr>
<tr>
<td>+12 V</td>
<td>Bottom left of board. Should be ON. Indication of the isolated supply for the plant status input.</td>
</tr>
<tr>
<td>PS</td>
<td>Bottom left of the board. In normal operation, this LED should be OFF. During plant-off periods, however, if the plant status is being used, this LED illuminates, and the rolling averages are not updated.</td>
</tr>
<tr>
<td><strong>Receiver LEDs</strong></td>
<td></td>
</tr>
<tr>
<td>+V and -V</td>
<td>These LEDs should be ON indicating that the power supplies within the unit are functioning correctly.</td>
</tr>
<tr>
<td><strong>Source LEDs</strong></td>
<td></td>
</tr>
<tr>
<td>+V and -V</td>
<td>These LEDs should be ON indicating that the power supplies within the unit are functioning correctly.</td>
</tr>
</tbody>
</table>
### LEDs

<table>
<thead>
<tr>
<th>Power supply LED</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+12 V</td>
<td>This LED should be ON indicating that the power supply unit is functioning correctly. This LED extinguishes if the supply voltage drops from 12 to 11 V.</td>
</tr>
</tbody>
</table>

### 6.5 Test points

If you need to do further checks on instrument operation, there are various test points within the instrument. Many of these are simple DC voltages, and you may check them using a voltmeter set to DC volts; if they are not DC voltages, you can investigate them using an oscilloscope.

<table>
<thead>
<tr>
<th>Control unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>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), 1 V peak to peak (maximum), centered on 0 V. You can take 0 V to T1 to T6 from the 0 V test point, top left of board. Test points T1 to T6 are in the center of the board.</td>
</tr>
<tr>
<td>T2</td>
<td>D1 signal after amplification in the processor. Flattened, saw-tooth, 32 to 45 Hz, 3.5 V peak to peak (maximum), centered on 0 V. Amplitude may vary by a trim put. Refer to Section 4.9.1.</td>
</tr>
<tr>
<td>T3</td>
<td>D1 output to the A/D converter within the micro-processor offset by 2.5 V. Flattened saw-tooth, 32 to 45 Hz, 3.5 V peak to peak (maximum), centered on 2.5 V.</td>
</tr>
<tr>
<td>T4</td>
<td>As T1 but for D2 signal.</td>
</tr>
<tr>
<td>T5</td>
<td>As T2 but for D2 signal.</td>
</tr>
<tr>
<td>T6</td>
<td>As T3 but for D2 signal.</td>
</tr>
<tr>
<td>T7</td>
<td>Receiver ambient temperature to the A/D converter with the micro-processor - 1 mV represents 33.8 °F (1 °C).</td>
</tr>
<tr>
<td>T8</td>
<td>Normalizing input for pressure before A/D converter 0.8 to 0.4 V = 4 to 20 mA.</td>
</tr>
<tr>
<td>T9</td>
<td>As T8 except oxygen.</td>
</tr>
<tr>
<td>T10</td>
<td>As T8 except temperature.</td>
</tr>
<tr>
<td>+5 and 0 V</td>
<td>Supply rails for micro-processor. DC voltage.</td>
</tr>
</tbody>
</table>
### Power supply

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 V and +12 V</td>
<td>Power supply for the instrument.</td>
</tr>
</tbody>
</table>

### Receiver

<table>
<thead>
<tr>
<th>Receiver</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 V</td>
<td>0 V for the receiver.</td>
</tr>
<tr>
<td>T1</td>
<td>Detector output without conditioning.</td>
</tr>
<tr>
<td>T2</td>
<td>Detector output after first stage of gain.</td>
</tr>
<tr>
<td>T3</td>
<td>Detector output after both stages of gain.</td>
</tr>
</tbody>
</table>

### Source

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-</td>
<td>0 V supply to the heater cartridge</td>
</tr>
<tr>
<td>S+</td>
<td>12 V supply to the heater cartridge</td>
</tr>
<tr>
<td>M+ and M-</td>
<td>Supply to the chopper motor (+1 Vdc).</td>
</tr>
<tr>
<td>T3</td>
<td>Reference wave.</td>
</tr>
<tr>
<td>T4</td>
<td>Reference wave.</td>
</tr>
</tbody>
</table>
Spare parts

Contact Rosemount™ customer service center with the serial number of your instrument, and they will make recommendations based on your system. Below are typical spares that you should consider.

Table 7-1: Rosemount CCO 5500 Analyzer Recommended Spare Parts

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A99995H01</td>
<td>Source unit assembly</td>
</tr>
<tr>
<td>1A99995H02</td>
<td>Receiver unit assembly</td>
</tr>
<tr>
<td>1A99995H03</td>
<td>Power supply assembly</td>
</tr>
<tr>
<td>1A99995H04</td>
<td>Control unit assembly</td>
</tr>
<tr>
<td>1A99995H05</td>
<td>Purge assembly</td>
</tr>
<tr>
<td>1A99995H06</td>
<td>Site mounting flanges (set of 2), 6.5 in. (165 mm) OD, 4 M8 holes on 4.9 in. (125 mm) BC</td>
</tr>
<tr>
<td>1A99995H07</td>
<td>Heater cartridge</td>
</tr>
<tr>
<td>1A99995H08</td>
<td>Protection window</td>
</tr>
<tr>
<td>1A99995H09</td>
<td>Gasket, source/receiver to air purge assembly</td>
</tr>
<tr>
<td>1A99995H10</td>
<td>Gasket, source/receiver to site flange</td>
</tr>
<tr>
<td>1A99995H11</td>
<td>Chopper motor and disk</td>
</tr>
<tr>
<td>1A99995H12</td>
<td>Stepper motor and gearbox</td>
</tr>
<tr>
<td>1A99995H20</td>
<td>IR detector</td>
</tr>
<tr>
<td>1A99995H21</td>
<td>Calibration check cell holder (no cell)</td>
</tr>
<tr>
<td>1A99995H22</td>
<td>CO calibration check cell (specify value)</td>
</tr>
<tr>
<td>1A99995H23</td>
<td>Span gas cell, 10 mm</td>
</tr>
<tr>
<td>1A99995H24</td>
<td>100% gas cell, 5 mm</td>
</tr>
<tr>
<td>1A99995H25</td>
<td>Lens</td>
</tr>
</tbody>
</table>

Reference Manual
Appendix A
Theory of operation

A.1 Infrared source unit

At the heart of this unit is a small heater assembly designed to give a high intensity uniform source of infrared energy. The heater assembly can provide in excess of two years of 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 aluminum cartridge. In the infrequent event of failure, you can easily replace the complete heater assembly on site.

A motor-drive disc then chops the radiation emitted by the heater, and a lens focuses the radiation across the duct. A small DC motor drives the chopper disc. A radiation detector monitors the phase and frequency of the chopper disc to provide a reference signal that the control unit uses.

A stepper motor and gear box assembly swing a small calibration cell containing pure reference gas (CO) into the sight path to enable continuous calibration updates. 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 ware detector.

*Figure A-1* illustrates the operation of the source and receiver units.
A.2 Infrared receiver unit

The precision and reliability with which the CO concentration levels are measured governs the performance of the instrument. For this reason, Rosemount™ has concentrated design efforts to produce an extremely simple and robust receiver unit. It contains no moving parts, is fully sealed, and is designed to give many years of trouble-free and maintenance-free operation.

The unit includes a lens to focus radiation received from across the duct, followed by a precision interference filter to limit the band wave of energy used. This filter’s 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 beam-splitter transmits the other half of the radiation 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 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 the background radiation from the flue or flue gas. The detector signals are amplified and fed to the control unit.
A.3 **Control unit**

The control 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.

Enter all operation data via a surface-mounted keypad. A 32-character LCD provides you with measurement details and diagnostic information.

If required, inputs are available to receive the 4-20 mA outputs from the normalizing measurement transducers (oxygen, temperature, and pressure). You can also enter this data 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.

A.4 **Power supply unit**

The power supply unit is housed in a fully-sealed cast aluminum enclosure. A supply voltage switch allows you to select from either 110 or 220 V. This provides an extremely stable power source able to cope with large fluctuations in the supply voltage. Also, the data valid and high gas alarm contact outputs are located in the unit.

A.5 **Air purge**

The air purge unit has an integral adjustable mount and provides the interface between the site mounting flange and the source/receiver units. Rosemount™ designed the air purge to provide a steady laminar flow of air away from the instrument lens to prevent optical contamination.

A supply of air to the purge is essential. See *Section 1.4* for details.

A.6 **Isolating valves**

If you need to, you may attach isolating valves between the air purge units and the site mounting flanges. Use the customer supplied isolating valves to provide protection for personnel servicing instruments on high pressure ducts.
A.7 Principles and modes of operation

A.7.1 Calculation of gas concentration

The analyzer determines gas levels by measuring the absorption of infrared radiation transmitted through the flue gas. The wave bands from the infrared radiation are sensitive to absorption by the measurement gas. The Rosemount™ CCO 5500 Analyzer has two detectors: one measures the radiation directly to provide a live output, sensitive to the measurement gas. The second detector measures the radiation after passing through a gas cell fitted with pure reference gas (CO). This provides a reference measurement completely unaffected by the measurement gas.

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

\[ Y = G - K \left( \frac{D_2}{D_1} \right) \]

Where:
- \( D_1 \) = the reference output from the detector
- \( D_2 \) = the live output from the detector
- \( G \) = a scaling factor (16000)
- \( K \) = a constant, known as the zero correction factor, set so that when there is zero measurement gas in the duct, \( Y = 0 \)

thereby, \( K = G \left( \frac{D_{1_0}}{D_{2_0}} \right) \)

The analyzer then smooths, linearizes, and compensates the parameter \( Y \) for effects of path length and flue gas temperature to produce a measurement of CO gas concentration in the flue gas.

A.7.2 Error compensation

The accurate determination of gas concentration depends on the measurement of the radiation levels received by the detectors. Any error in the measurement caused by detector drift will produce errors in the calculation of the gas level. In order to maintain accuracy, it is necessary to compensate for such drifts. The Rosemount™ CCO 5500 Analyzer uses a technique of repeated calibration adjustments.

The operating cycle of the instrument is in two parts. First, the instrument obtains measurements from the two detector outputs, \( D_1 \) and \( D_2 \). It then positions the calibration cell containing pure CO in the sight path and measures the two detector outputs again to give readings \( E_1 \) and \( E_2 \).

From the basic scale shape equation:

\[ Y = G - K \left( \frac{D_1}{D_2} \right) \]

and from the calibration equation:

\[ Y_0 = G - K \left( \frac{E_2}{E_1} \right) \]

or \( K = (G - Y_0) \left( \frac{E_1}{E_2} \right) \)
When substituting the value of K into the scale shape equation:

\[ Y = G - (G-Y_0)(E_1/E_2)(D_2/D_1) \]

The two ratios E1/D1 and E2/D2, being derived each from one detector, are independent of any detector drift. This makes 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, repeats continuously and provides an effective continuous calibration update to enable accuracy to be maintained at all times.

**A.7.3 Calculation sequence**

During each operating cycle, the instrument performs the calculations given below:

- Measure D1 & D2
- Measure E1 & E2
- Compute Y
- Smooth Y
- Linearize and correct for path length
- Normalize the measurement
- Smooth the result to produce a final %CO output

**A.7.4 Normalization equations**

Normalization of data collected by the analyzer is essential to compare emission levels of pollutants into the atmosphere. Software in the Rosemount™ CCO 5500 Analyzer performs all calculations and provides results in various units, vpm, mg/m\(^3\), and mg/Nm\(^3\). The following paragraphs describe the derivation of these results.

The Rosemount CCO 5500 Analyzer is a cross-duct type that measures the quantity (number of molecules) of gas within its sight path. It converts this measurement into a concentration that fully compensates for the expansion effects of temperature, while assuming constant atmospheric pressure. The basic measurement is referred to as ppm (parts per million). However, to achieve 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 kPa.

**Conversion to mass concentration**

The next stage in the process is to determine the mass concentration. The conversion at STP uses conversion factors determined as follows:
where: \( N = \text{conversion factor} \)

\( RMM = \text{Relative molecular mass of the gas} \)

\( V = 22.4 \) (the standard volume of ideal gas)

**Conversion factors (N)**

The conversion factors (N) for the analyzer are as follows:

Relative molecular mass (RMM) = 12 + 16 = 28

1 vpm = \( \frac{28}{22.5} \) - 1.25 mg/m³

The mass concentration of the gas at STP is calculated as:

mg/m³ @ STP = N (vpm)

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

**Correction for oxygen and water vapor**

Finally, you need to consider the effects of water vapor and oxygen. Because the instrument has already normalized the vpm measurement for temperature and pressure, further normalization is required only for the dilution effects of water vapor and oxygen. These are straightforward calculations:

\[
\text{mg/m}^3 = \frac{100 \times \text{mg/m}^3 \times \frac{\text{20.9\% - \%O}_2 \text{ standard}}{\text{20.9\% - \%O}_2 \text{ measured dry}}}{100 \times \%\text{H}_2\text{O}}
\]

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

When the measured \%O₂ is a wet measurement, the instrument must correct it to a dry measurement. When the measured O₂ concentration is defined as a wet measurement in the analyzer software, the software automatically performs this correction using this equation:

\[
\%\text{O}_2 \text{ measured dry} = \%\text{O}_2 \text{ measured wet} \times \frac{100}{100 - \%\text{H}_2\text{O}}
\]

When no correction for a wet measurement is required:

standard \%\text{O}_2 = \%\text{O}_2 \text{ measured}

When no correction is required for water vapor:

\%\text{H}_2\text{O} = 0

After the instrument has performed all calculations, the resulting measurement is the effective mass concentration (mg/Nm³) of the pollutant normalized to standard conditions.
Measured conditions

Where measured values are required (e.g., to calculate rates of emissions) they need to be recalculated for measured temperature and pressure using the equation:

\[
\text{mg/m}^3 = \text{Nppm} \times \frac{273}{\text{T}} \times \frac{\text{measured pressure (abs)}}{\text{standard pressure (abs)}}
\]

by substituting the correction for standard pressure:

\[
\text{Nppm} = \text{ppm} \times \frac{\text{standard pressure (abs)}}{\text{measured pressure (abs)}}
\]

the measured mass concentration of the CO gas is:

\[
\text{mg/m}^3 = \text{Nppm} \times \frac{273}{\text{T}}
\]

A.7.5 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 that 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 infrared absorption spectrum

Carbon monoxide absorbs infrared energy in a band between wavelengths of approximately 4.5 and 4.9 µm. The absorption spectrum is complex and is illustrated in Figure A-2 below.

---

Figure A-2: CO Infrared Absorption Spectrum
However, carbon dioxide and water vapor also absorb energy within this wave band. Fortunately, at 4.7 µm, IR absorption by each of these gases is at a minimum. Figure A-3 demonstrates how the absorption spectra of CO₂, CO, and water vapor affects wavelengths between 4.5 and 4.9 µm.

Absorption spectra of CO, CO₂, and water vapor

A narrow band pass filter only passes IR energy at wavelengths around 4.7 µm. By using this filter, correctly designed CO analyzers are able to ignore the effects of water vapor and CO₂. No other flue gases absorb IR energy in the band. The filter characteristics are shown in Figure A-3.

Figure A-3: Comparison of Spectra

Transmissivity of CO within the 4.7 µm band

The concentration of CO affects the IR energy’s transmission through the gas at about 4.7 µm. Figure A-4 illustrates how the energy within the selected band varies with CO concentration.
The characteristics of the 4.7 µm filter fix the shape of this curve, and the shape cannot change. The curve is practically flat at CO concentrations 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 (in meters) over which it has been measured.

**Carbon monoxide calculation**

The Rosemount CCO 5500 Analyzer takes two measurements of IR energy in the narrow band around 4.7 µm. It takes both measurements after the beam has passed through the gas to be measured. One beam, however, also passes through a cell containing pure CO (the gas cell shown in Figure A-1). The beam absorbs all the energy capable of being absorbed by CO and provides a reference that is unaffected by any CO in the duct. However, any other material (e.g., dust) which reduces the energy received from the source unit will affect the beam.

The second beam does not pass through the cell and is very sensitive to changes in CO within the duct.

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

\[ Y = G \cdot K(D2/D1) \]

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 A-5* shows the parameter Y plotted for the change in CO concentration.
This is the calibration curve for the instrument, opposite in shape to the transmissivity curve shown in Figure A-4. Characteristics of the 4.7 µm filter fix each curve, and the curves cannot change. Rosemount 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 = 0 when the CO level = 0) any drift in the measurement can only be due to a change in some optical or electronic gain. You can always correct the drift 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 A-5 that at high CO levels the parameter Y becomes completely insensitive to changing CO levels in the duct, such that:

Y = a when CO > b

By making Y = a when CO > b and Y = 0 when CO - 0, you can eliminate all errors.

You can introduce 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 every few seconds to continuously check and (if necessary) modify the zero position.
Appendix B
Return equipment to the factory

If you need the factory to repair defective equipment, proceed as follows:

1. Secure a return authorization number from a Rosemount™ sales office or representative before returning the equipment.

   You must return equipment with complete identification in accordance with Rosemount instructions or Rosemount will not accept it. In no event, will Emerson™ 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 you 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 non-warranty 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 Return Authorization, prepaid to:

   Rosemount, Inc.
   PAD Repair Center
   C/O Rosemount Analytical, Inc.
   10241 West Little York, Ste 200
   Houston, Texas 77040
   Attn: Christi Kluna

   If you request warranty service, Rosemount will carefully inspect and test the equipment at the factory. If failure was due to conditions listed in the standard Rosemount warranty, Rosemount will repair or replace the equipment at its option and will return an operating unit to the customer in accordance with the shipping instructions furnished in the cover letter.

   For equipment no longer under warranty, Rosemount will repair the equipment at the factory and return it as directed by the purchase order and shipping instructions.
Return equipment to the factory