Installation, Operations, and Maintenance Manual
D-7010-0045, Rev C
January 2018

Rosemount™ CT5400 Continuous Gas Analyzer

ROSEMOUNT™

EMERSON™

Preface

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If you require additional technical assistance, request help from Cascade Technical Support (*qcl.csc@emerson.com*) or Emerson distribution partners.

General inquiries about this or other Cascade Technologies products should be sent to *qcl.csc@emerson.com*.

Important information

NOTICE

This section is in accordance with IEC 60079-0: 2011 Clause 30. This section must not be changed, amended, or removed.

IMPORTANT: Users must read, understand and comply with the following information before proceeding.

All users, installers, operators, and maintainers must be familiar with operating the analyzer. To install, start up, operate, maintain and service the analyzer in a safe manner, it is MANDATORY to read all additional instruction manuals shipped with the analyzer. The following instruction manual(s) are available and / or referenced within this manual:

Rosemount CT5400 Quick Start Guide: D-7010-0061

All instructions must be saved for future use. Contact your local service center or sales office if you are missing documents.

User information

NOTICE

This section is in accordance with IEC 60079-0: 2011 Clause 30. This section must not be changed, amended, or removed.

Important

All users must read this page before proceeding!

Emerson (Rosemount) designs, manufactures, and tests its products to meet many national and international standards. The Rosemount CT5400 is a sophisticated technical product, and to ensure it continues to operate as designed and within normal specifications, it MUST be installed, used, and maintained correctly. The following instructions MUST be adhered to and integrated into your safety program when installing, using, and maintaining Emerson (Rosemount) products.

- Failure to follow the proper instructions may cause:
  - Loss of life
  - Personal injury
  - Damage to property
  - Damage to this instrument
  - Warranty invalidation
- Read all instructions prior to installing, operating, and servicing the product.
- If you do not understand any of the instructions, contact your Emerson (Rosemount) 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 in accordance with 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 Emerson (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.
- To prevent electrical shock and personal injury, all equipment doors must be closed and protective covers in place, except when maintenance is being performed by qualified personnel.
- The information contained in this document is subject to change without notice.

General safety notice/residual risk

Installation, operation, and maintenance of the analyzer must be in accordance with these instructions.

When operated as intended and all applicable safety instructions are observed, an element of risk will remain, including, but not limited to, the following:

- Explosion protection measures may become ineffective on the occurrence of one failure (for Category 3 instruments).
- The emission of gases hazardous to health may be possible when all gas connections have been correctly made.

To avoid exposure to the dangers of residual risks, take particular care when installing, operating, maintaining, and servicing the analyzer.

Authorized personnel

NOTICE

This section is in accordance with IEC 60079-0: 2011 Clause 30. This section must not be changed, amended, or removed.

In-depth specialist knowledge is an absolute requirement for working with and on the analyzer. Personnel installing, operating, servicing, and maintaining the analyzer must be instructed, trained, qualified, and authorized for hazardous areas with the operating company and the manufacturer. It is the operating company's responsibility to:

- Train staff.
- Observe safety regulations.
- Follow the safety instructions and procedures in the product manual.

Operators must:

- Be trained.
- Read and understand all relevant sections of the product manual before commencing work.
- Know the safety mechanisms and regulations.

⚠ WARNING!

To avoid explosions, loss of life, personal injury, and damage to this equipment and on-site property, do not install, operate, maintain, or service this instrument before reading and understanding this instruction manual and receiving appropriate training.

Regulations and standards

Regulations / Standards	Description
2014/35/EU	The Low Voltage Directive
2014/30/EU	The Electromagnetic Compatibility Directive
2012/19/EU	Waste Electrical and Electronic Equipment (WEEE) Directive
USA 21 CFR 1040.1	Laser products
NEC 505	National Electrical Code (issued by ANSI: American National Standards Institute and NFPA 70: National Fire Protection Association)
EN 6223: 2008	EMC Safety Standard
BS EN 60825-1:2007	Safety of laser products. Equipment classification and requirements (identical to IEC 608250-1 2007).
BS EN 61010-1 2010 IEC 61010-1 2010	Safety requirements for electrical equipment for measurements, control, and laboratory use. General requirements.
BS EN 61326-1: 2013	Electrical equipment for measurement, control, and laboratory use. EMC requirements. General requirements.

Associated publications

Quick Start Guide: D-7010-0061

Compliance approvals

This product complies with USA 21 CFR 1040.10. It is also designed and manufactured under an approved quality management system to ISO 9001:2008.

Emerson and the Rosemount CT5400 Gas Analyzer have satisfied the requirements for applying the CE marking to the Rosemount CT5400 Gas Analyzer.

This equipment meets all requirements of the EMC and Low Voltage directives.

Waste disposal

Do not dispose of measuring tools into household waste.

Only for EC countries:

In accordance with European Directive 2012/19/EU for Waste Electrical and Electronic Equipment and its implementation into national right, measuring tools that are no longer usable must be collected separately and disposed of in an environmentally correct manner.

Safety and information notices

⚠ DANGER!

WILL CAUSE DEATH

Failure to follow this warning will result in death or serious injury to personnel.

⚠ WARNING!

DANGER TO PERSONNEL

Failure to follow this warning may result in serious injury to personnel.

⚠ CAUTION!

MAY CAUSE DAMAGE TO EQUIPMENT

Failure to follow this warning may result in damage to the equipment.

NOTICE

Important or tip messages will appear in this format.

Safety Information

All authorized users, including installation, operation, and maintenance personnel, must observe the following safety precautions and warnings.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ DANGER!

FAILURE TO LOCK-OUT GAS HANDLING SYSTEM MAY CAUSE DEATH.

Always lock out the gas handling system when shutting down the analyzer. Unauthorized operation of the gas handling system when maintenance is being performed on the analyzer or its associated pipes/hoses may result in highly flammable gas being released, causing fire or explosion.

⚠ DANGER!

FAILURE TO VENT SAMPLE GAS MAY CAUSE DEATH.

The sample gas in the system must be vented to prevent fire or explosion during maintenance and to prevent damage to the analyzer during startup.

The sample gas in the pipes leading to the analyzer must be purged to prevent hazards to personnel during maintenance. Purging the sample gas must be done in accordance with the safe working procedures for the site.

Allow the analyzer and system for returning the sample gas to run for five minutes to allow any sample gas in the system to be returned to the exhaust.

⚠ WARNING!

ELECTRICAL SHOCK HAZARD

Do not operate without covers secure.

Do not open while energized.

Installation requires access to live parts which can cause death or serious injury.

For safety and proper performance, this instrument must be connected to a properly grounded three-wire source of power.

⚠ WARNING!

LASER OPTICAL RADIATION EXPOSURE HAZARD

The analyzer contains lasers. Opening the analyzer and attempting to perform adjustments or procedures other than those specified in this manual may result in hazardous optical radiation exposure.

All lasers used within the analyzer are Class 1. The emitted laser light is invisible (mid-infrared) and the combined laser powers are sufficiently low at the first accessible aperture that the unprotected eye will not be damaged. This class is eye safe under all operating conditions.

It is, however, possible to cause damage to the eye through not following correct procedures. Do not look at the laser with any kind of magnifier or optical measuring device.

The use of control or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

⚠ WARNING!

HAZARDOUS SUBSTANCES

The analyzer may contain hazardous substances. Always handle the analyzer assemblies and components with extreme caution.

Gas handling components within the analyzer will contain particulate matter residue from the sample gases. Over the life of the analyzer, the concentration of particulate matter will become enriched within the gas handling components. When performing repairs and maintenance on the analyzer:

- **Handle used gas handling components with extreme caution.**
- **Avoid direct skin contact with used gas handling components.**
- **Do not smoke, drink, or eat in the work area.**
- **Wear goggles or eye shields.**
- **Wear a suitable face mask to protect against inhalation of particulate matter.**
- **Do not wet fingers, eyes, or any exposed skin.**
- **Pack used gas handling components for disposal in sealed packaging and label them *Contaminated*.**

Dispose of contaminated items as hazardous material according to the applicable local, national, or international health and safety regulations and pollution regulations.

⚠ WARNING!

EXPLOSION HAZARD

Always lock-out tag-out the gas handling system when shutting down the analyzer. Unauthorized operation of the gas handling system when maintenance is being performed on the analyzer or its associated pipes/hoses may result in highly flammable gas being released, causing fire or explosion.

⚠ WARNING!

HEAVY ITEM

Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Always use suitable lifting/moving equipment when moving the analyzer. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

HAZARDOUS GAS

The product stream that the analyzer is examining may be hazardous even at low concentrations. Therefore, take special care to ensure that the sample gas return port either returns the sample gas to the product stream or discharges the sample gas to a location that will not cause a hazard.

⚠ WARNING!

HIGH PRESSURE GAS AND AIR

The calibration gas supply and compressed air supply operate at a pressure that can cause injury, e.g., damage to eyes and skin punctures from debris blown by the high pressure gas or compressed air.

Always lock out or tag off the calibration gas supply and compressed air supply when shutting down the analyzer.

⚠ WARNING!

EXPLOSION HAZARD

The sample gas in the system must be vented to prevent fire or explosion during maintenance and to prevent damage to the analyzer during startup.

The sample gas in the pipes leading to the analyzer must be purged to prevent hazards to personnel during maintenance. Purging the sample gas must be done in accordance with the safe working procedures for the site.

Allow the analyzer and system for returning the sample gas to run for five minutes to allow any sample gas in the system to be returned to the exhaust.

⚠ WARNING!

EXPLOSION

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type.

⚠ CAUTION!

EQUIPMENT DAMAGE

Always follow the startup procedure. Damage to the analyzer may result from a failure to follow this procedure.

Failure to perform pre-system startup checks may cause damage to equipment.

⚠ CAUTION!

EQUIPMENT DAMAGE

Always follow the shutdown procedure. Damage to the analyzer may result from a failure to follow this procedure.

⚠ CAUTION!

UNSERVICEABLE EQUIPMENT

If the pressure and temperature measurements are out of tolerance, refer to *Chapter 7* for guidance.

⚠ CAUTION!

EMC

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case you may be required to take adequate measures.

⚠ CAUTION!

EQUIPMENT DAMAGE

Ensure that the local power voltage where the unit is to be installed corresponds to the unit's nominal voltage as given on the name plate label.

⚠ CAUTION!

EQUIPMENT DAMAGE

Do not power up or try to operate the analyzer unless it is physically secure and all electrical and pneumatic connections to the analyzer are in place.

Before commencing the start-up process, it is important to ensure that electrical power, sample gas handling facilities, and any calibration gases that are required are available to the analyzer.

Safety and system labels and annotation

The labels and annotation applied to the analyzer are specified in the table below.

Label type	Example	Location
Identification label (including serial number, model number, and USA FDA compliance label	Made in the UK Manufactured Sept. 2015 Rosemount CT5400 Continuous Gas Analyzer Serial number: CT5400-10008 Model number: CT5400 Glendevon House Castle Business Park Stirling, FK9 4TZ United Kingdom Tel. +44 (0)1786 447 721 *Emerson.com/RosemountGasAnalysis* 	Rear panel
CAUTION - Hot label		1. Cell insulation 2. Both heated lines 3. Rack lid, near ventilation holes
Laser radiation CAUTION label		Baseplate
Laser module identification label		On each laser module housing
Earth identification label		Back plate
WARNING statement		Rear panel

Label type	Example	Location
CAUTION Laser Radiation safety statement	 CAUTION Laser Radiation. Do not stare into beam. Class II laser product.	Rear panel
AC power supply voltage label	 240V	On analysis cell insulation
AC power supply Danger label	 Danger 230 Volts	1. Rear panel, above mains power input socket 2. On reverse of front panel, next to *On/Off* switch
AC power supply label	230VAC 50Hz 1KW MAX.	Rear panel, below power socket

Abbreviations

The following abbreviations are used in this manual.

Abbreviation	Description
©	Copyright
%	Percent
<	Less than
°	Degree
AC	Alternating current
Barg	Pressure, in units of bars, above or below atmospheric pressure
BS	British Standard
C	Celsius
CE	European Conformity
CFR	Code of Federal Regulations
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
DC	Direct current
Deg	Degree (temperature)
e.g.	For example
EC	European Community
EMC	Electromagnetic compatibility
EU	European Union
Hrs	Hours
Hz	Hertz
H_2O	Water
ICL	Interband Cascade Laser
IEC	International Electro-technical Commission
in.	Inches
IP	Ingress protection
IPxx	Ingress protection (xx are numbers that define the protection level)
IS	Intrinsically safe
ISO	International Organization for Standardization
k	Thousand
kg	Kilogram
kHz	Kilo hertz
L	Liter
lb	Pound

Abbreviation	Description
LCD	Liquid crystal display
LED	Light emitting diode
L/min	Liters per minute
m	Meter
m^3	Cubic meter
mA	Milliamp
Max	Maximum
mBar	milli-Bar
mbps	Megabits per second
mg	Milligram
mg/m^3	Microgram/cubic meter
Mid IR	Mid Infrared
min	Minute
mm	Millimeter
N_2	Nitrogen
NEC	National Electrical Code
NFPA	National Fire Protection Association
nm	Nanometer
NO	Nitric oxide
NO_2	Nitrogen dioxide
N_2O	Nitrous oxide
NH_3	Ammonia
No.	Number
O_2	Oxygen
PC	Personal computer
PM	Preventative maintenance
ppm	Parts per million
psi	Pounds per square inch
QCL	Quantum Cascade Laser
TDL	Tunable Diode Laser
Torr	Unit of pressure defined as exactly 1/760 of a standard atmosphere
UKAS	United Kingdom Accreditation Service
USA	United States of America
USB	Universal serial bus
V	Volt
VA	Volt-ampere
Vac	Volt alternating current
Vdc	Volt direct current
W	Watt

Abbreviation	Description
WEEE	Waste electrical and electronic equipment
µm	Micro-meter

Contents

Appendices and reference

1 Plan

1.1 Description

The Rosemount™ CT5400 Continuous Gas Analyzer, hereafter referred to as the Rosemount CT5400 or the analyzer, is an electronic sensor that uses laser spectroscopy to perform analysis of process gas streams.

The function of the analyzer is to detect and measure up to twelve different types of gas at concentrations ranging from parts per million (ppm) to percentage levels in the process gas stream. The analyzer is designed to be mounted in a standard 482.6 mm (19 in.) rack.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

This manual is intended for the personnel who install, operate, and maintain the equipment.

1.2 Equipment purpose and role

The analyzer is a gas sensor system that can be configured to measure the concentrations of multiple small molecules in a gas sample that is provided to the analyzer via a sample line.

The types of molecules that are measured depend on the system configuration.

Figure 1-1: Rosemount CT5400

The analyzer can be configured to detect and measure up to twelve different gases, depending on the combination of laser modules fitted.

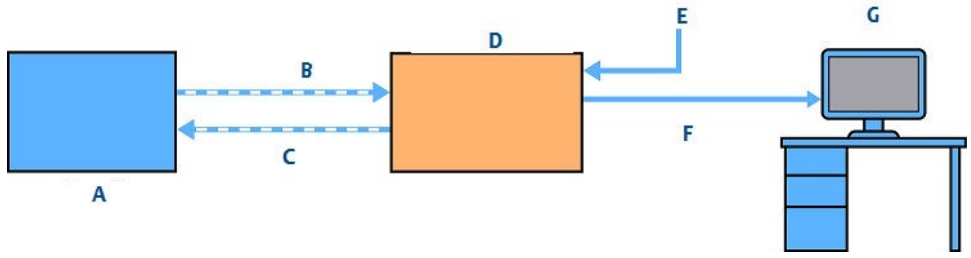
1.3 System overview

A complete Rosemount CT5400 system consists of a gas handling system, the analyzer, and the associated interconnecting wiring and gas piping.

Measurement data from the analyzer can be displayed in the process control center. You must provide the gas handling system and interconnecting wiring and gas piping; Emerson supplies the CT5400.

In *Figure 1-2*, the items supplied by Emerson are colored orange; the items supplied by you are colored blue. *Table 1-1* lists the main items of the system.

Figure 1-2: Complete Rosemount CT5400 Gas Analysis System



A. Gas handling system
B. Sample supply line
C. Sample return (exhaust) line
D. Rosemount CT5400 Gas Analyzer
E. Electrical power
F. Measurement data
G. Control center

The analyzer contains an optical system with multiple lasers and a series of optical components that provide an optical path, a heated multi-pass analysis cell, and sample and outlet ports that can be connected to a gas handling system, and control and analysis electronics. The number of lasers installed depends upon customer requirements. The complete system operates from a 240 Vac 50 Hz supply.

Gas concentrations are measured using mid-infrared optical absorption spectroscopy. The light sources are quantum cascade lasers (QCLs), which are operated to produce wavelength sweeps that cover the absorption lines of the gases. The light from each laser is routed through an optical path to the analysis cell, which provides measurement of low concentrations of the subject gases. An external sample handling system conditions the sample gas and draws it through the analysis cell. The light exits the multi-pass analysis cell and is directed to a receiver in the analyzer. The variation in the intensity of light in the vicinity of the absorption lines is measured, and the concentration is determined using a comprehensive spectral fitting routine.

There is no sample conditioning provided within the analyzer; the sampled gas must be brought within the parameters shown in *Section 1.9* before entering the analyzer. Detailed characteristics of the analyzer are also given in *Section 1.9*.

Table 1-1: Main Items of the Rosemount CT5400 System

Item	Name or description	Supplied by	Part number	Quantity	Notes
1	Rosemount CT5400	Emerson	CT5400	1	
2	Rosemount CT5400 software package, version 5.x.x	Emerson	N/A	1	Software is embedded in PC board. Version described in manual
3	Gas handling system	Customer	Customer choice	1	

Table 1-1: Main Items of the Rosemount CT5400 System *(continued)*

Item	Name or description	Supplied by	Part number	Quantity	Notes
4	Heated gas sample line hose	Customer	Customer choice	1	
5	Exhaust line hose (for sample gas)	Customer	Customer choice	1	
6	Reference gas cylinders (instrument gas) for calibration purposes	Customer	Customer choice	Dependent upon number of gases being measured	
7	Pressure regulator	Customer	Customer choice	1 per gas cylinder	Required for calibration
8	Pneumatic T-piece	Customer	Customer choice	2	Required for calibration
9	Excess flow line	Customer	Customer choice	1	Required for calibration
10	240 Vac power cable	Customer	Customer	1	
11	Cable from analyzer to control center	Customer	Customer choice	1	1
12	482.6 mm (19 in.) rack system	Customer	Customer choice	1	Holds the CT5400

1.4 Customer information

This manual contains all the important information that must be followed to ensure the correct operation and safety of personnel when operating the analyzer.

All personnel must read this manual carefully before commencing any work on the analyzer.

For information regarding installation, consult *Chapter 2* and the Quick Start Guide (D-7010-0052).

Emerson is committed to continuously improving its products and documentation. Every effort will be made to include in the documentation any modifications by the manufacturer. However, it should be noted that this document reflects the supplied sensor at the revision date on the front cover.

Should you require further information, or should particular problems arise that are not covered in this manual, you can request additional help from Cascade Technical Support (*qcl.csc@emerson.com*) or Emerson distribution partners. Further contact details for Emerson can be found on the back page of this manual.

1.5 Safety precautions and conditions for safe use

⚠ WARNING!

Before installing or performing any maintenance on the analyzer, read and understand the safety information given in the preliminary information of this manual.

The analyzer described in this manual has been quality control tested and left the manufacturer in pristine condition. To achieve the correct and safe operation of this product, it must be transported, installed, operated, and maintained as described by the manufacturer.

All lasers used within the instrument are Class 1. The emitted laser light is invisible (mid-infrared) and the pulse duration so short that the unprotected eye will not be damaged. The nature of the laser beam path and beam width further ensures that it should be impossible to cause any eye damage. The instrument has warning labels at appropriate positions in accordance with USA 21 CFR 1040.10.

Conditions for safe use

- This equipment has flamepaths which differ from those in IEC60079-1/EN 60079-1. Cascade Technologies, Ltd (*qcl.csc@emerson.com*) must be contacted for guidance when maintaining the flamepaths.
- The fasteners which secure the cover are non-standard and shall therefore only be replaced by fasteners supplied by the manufacturer for this purpose. The fasteners must always be fitted with the washer supplied by the manufacturer.
- The equipment has non-conductive surfaces which are a potential electrostatic charging hazard - see instructions for guidance.
- The process gas flow rate is limited to a maximum of 6 liters per minute.
- The equipment shall only be used with process gases which are in gas groups B, C or D (Divisions) or IIB + H 2 (Zones) and must not contain oxygen or any other oxidizer in concentrations greater than that found in normal air.

CSA Certificate North American conditions

- The equipment has flameproof joints with dimensions which are other than those specified in Table 2 of ANSI/UL 60079-1: 6th edition and Table 3 of CSA C22.2 60079-1:16. These flameproof joints are not intended to be repaired, but where necessary the original manufacturer shall be contacted for guidance and information on the dimensions of the flameproof joints.
- The fasteners which secure the cover are non-standard and shall therefore only be replaced by fasteners supplied by the manufacturer for this purpose. The fasteners must always be fitted with the washer supplied by the manufacturer.
- The equipment has non-conductive surfaces which are a potential electrostatic charging hazard – see the instructions for guidance.
- The user shall ensure that the flow of process gas is limited to a mazimum flow rate of 6 liters per minute.

- The equipment shall only be used with process gases which are in gas groups B, C or D (Divisions) or IIB + H_2 (Zones) and must not contain oxygen or any other oxidizer in concentrations greater than that found in normal air.
- This assessment does not cover reliable function, performance, or other properties of the equipment not related to safety.
- The equipment is to be installed using wire no larger than 1mm^2 (18 AWG).
- The equipment is only to be installed by manufacturer trained personnel.
- If at any time there is a conflict between the system safety provisions and any relevant local (national or regional) requirements, local requirements always take precedence.
- The equipment is not to be used with flammable liquids.

1.6 Qualified personnel

This manual provides installation, operation, and maintenance personnel with the level of knowledge required to safely start, operate, and switch off the analyzer.

Only technically qualified personnel in the field of instrumentation and control who are familiar with this manual and have been specially trained on the analyzer should install, operate, switch off, and service the analyzer. Only qualified and trained persons have the required specific knowledge to correctly interpret the general safety information, warnings, and procedures given in this manual and apply them to this particular application. Emerson or its distribution partners can provide this training on request.

Knowledge of the safety information within this manual and its technically correct implementation are prerequisites for danger-free installation, operation, and maintenance of the analyzer.

1.7 Software version

The analyzer includes software that is used to control the operation of the instrument. This manual describes software version 5.x.x.

1.8 Gas detection

The analyzer is highly configurable in the gases that can be detected and their range of concentrations.

1.9 Detailed system specifications

Table 1-2 gives the physical characteristics of the analyzer. Schematic diagrams of the sensor and mounting points are shown in *Figure 1-3*, *Figure 1-4*, and *Figure 1-5*. *Table 1-3* gives the general characteristics of the instrument.

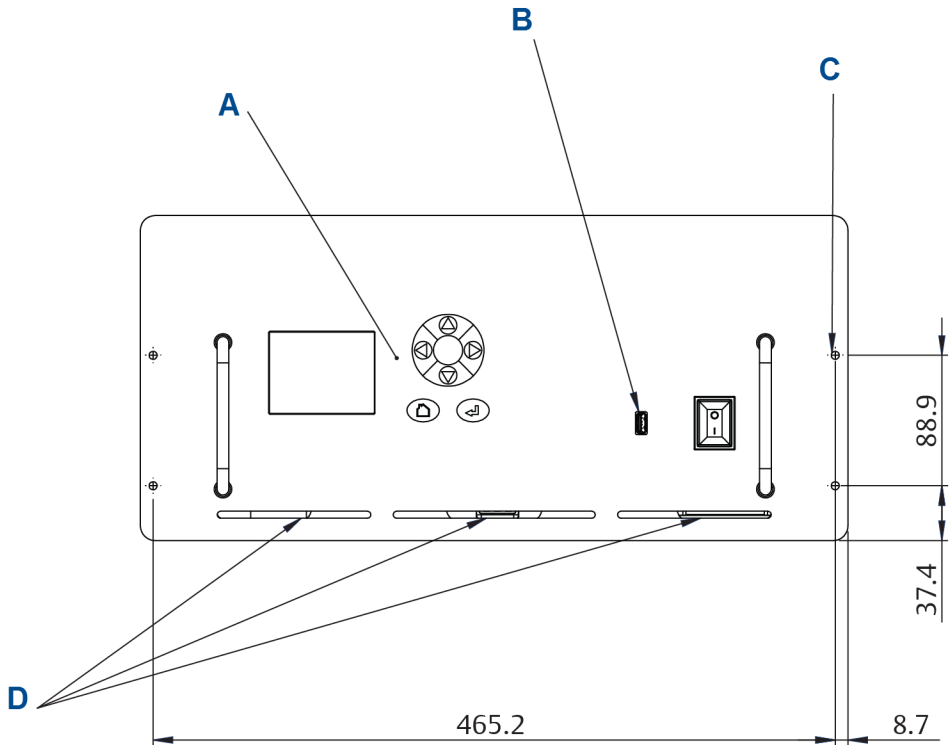
Table 1-2: Physical Characteristics

Rosemount CT5400	Value	Units	Comment
External dimensions	482.6 x 673 x 221.5 19 x 26.5 x 8.7	mm in.	Length x Width x Height Nominal dimensions
Weight	31 68.34	kg lb	Approximate weight

Table 1-3: General Characteristics

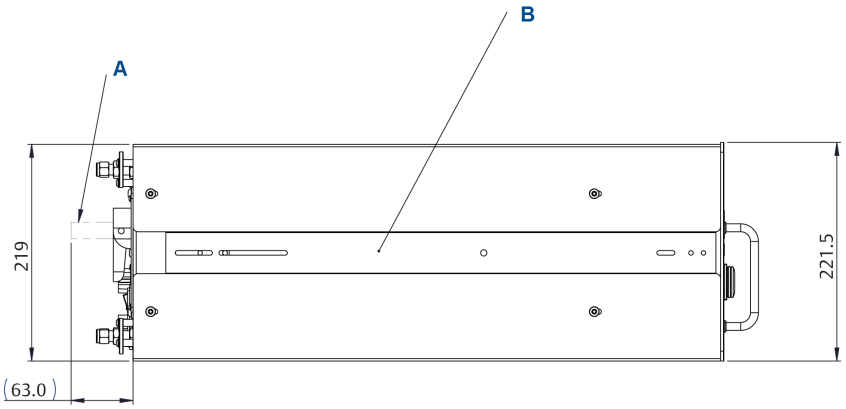
Rosemount CT5400	Value	Units	Comment
Supply voltage	240	Vac	50 Hz
Peak power consumption	600	W	Max consumption
Continuous steady-state power consumption	300	W	Once the gas analyzer has stabilized and the analysis cell has reached the temperature set point
Frame and structure material	-	-	Anodized and powder coated aluminum
Housing material	-	-	Powder coated steel
Wetted materials			PFA coated aluminum, 315 stainless steel, FKM and FFKM seals, CaF2 and BaF2 windows, protected gold coated aluminum mirrors
Measurement technique	-	-	Mid IR absorption spectroscopy
Mid IR source	-	-	Quantum Cascade Laser
Laser classification	Class 1		BS EN 60825-1: 2007 safety of laser products. Equipment classification and requirements (identical to IEC 60825-1 2007)
Inlet gas port connector	6 1/4	mm in.	Swagelok type, factory-configured, specify on order
Outlet (exhaust) gas port connector	6 1/4	mm in.	Swagelok type, factory-configured, specify on order
Measurement result signals	4 to 20	mA	4 or 8 channel outputs, specify on order
Warm-up time	90	minutes	

Figure 1-3: Dimensions - Front View



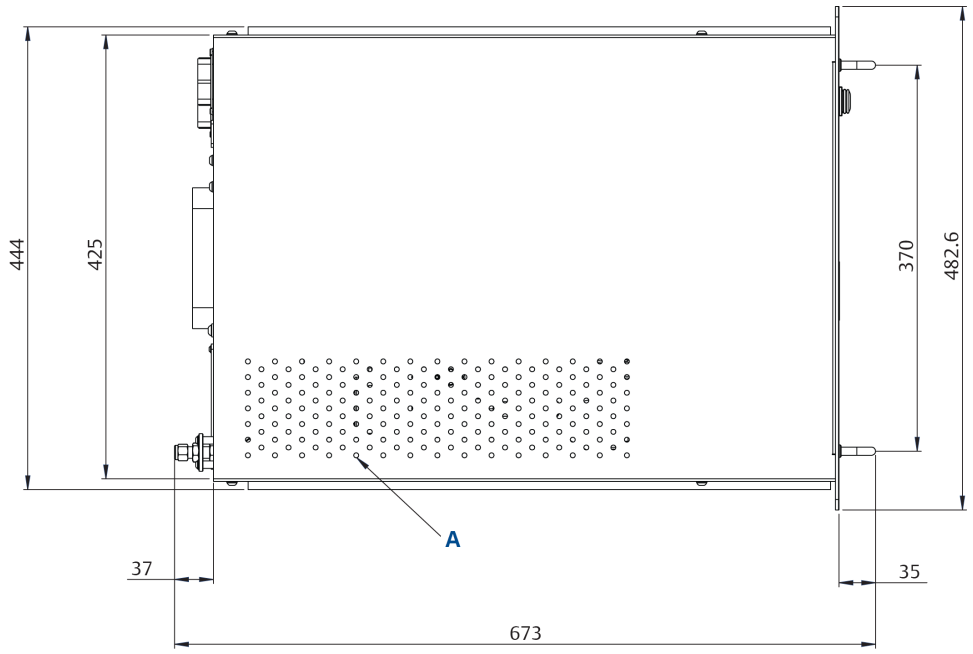
A. User interface
B. Data extraction port
C. 4 off Ø system locking holes
D. Ventilation. Do not obstruct.

Figure 1-4: Dimensions - Side View



A. Handle swings out 63 mm (2.5 in.)
B. 2 off telescopic slide, 610 mm (24 in.) long, 55 kg (121.3 lb.) max load. 50.8 mm (2 in.) over travel. 9.6 mm (.4 in.) slide thickness. Lock-out. Front disconnect.

Figure 1-5: Dimensions - Top View



A. Ventilation. Do not obstruct.

Table 1-4: Environmental Characteristics

Environmental characteristic	Value	Units	Comment
Operating temperature range	0 to 45 32 to 113	°C °F	Ambient temperature
Sample gas temperature range	50 to 195 122 to 383	°C °F	Factory set, specify on order
Sample gas particulate density	5	mg/m^3	Maximum
Sample gas particulate size	10	µm	Maximum
Sensor humidity range	10 to 95	%	Relative humidity (non-condensing) at 45 °C (113 °F)

Note

The CT5400 Continuous Gas Analyzer is suitable for indoor use only

1.9.1 Optical description

The laser modules are located in the core of the analyzer. Each laser module produces a separate light beam, and these beams are combined linearly as the modules are aligned in the system. The combined beams are closely coupled, parallel, and coaxial about a virtual line. The laser light beams pass through a baseplate onto an optical steering assembly, which directs the laser beam through the sample cell.

The sample cell contains a set of mirrors to create a path through the sample gas that is between 2 m and 5 m through multiple reflections along the length of the cell. The laser beams exit the cell at the opposite end from where they entered and are directed using a second optical block to a receiver.

By measuring and analyzing the light detected by the receiver unit, it is possible to accurately determine the concentrations of the target molecules within the gas sample cell.

1.10 Unpacking the analyzer

This procedure may require a minimum of two people to safely remove the equipment from the shipping container.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

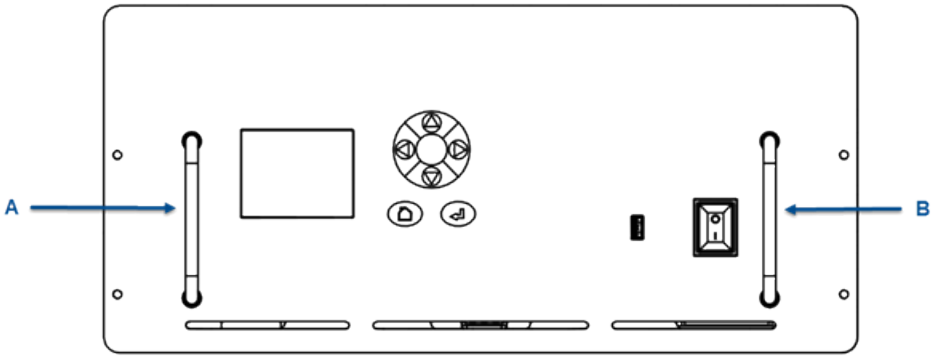
TRANSPORTATION HAZARD
Use safety-approved lifting equipment. You must ensure safe lifting procedures for the weight and mass of the equipment are followed.

Failure to use proper lifting procedures may cause injury to personnel or damage the analyzer.

Procedure

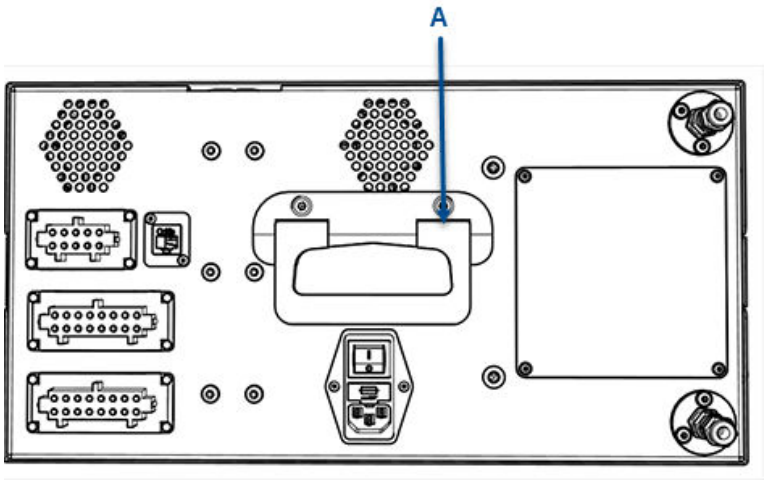
1. Visually inspect the exterior of the analyzer for signs of damage, corrosion, gas leaks, or signs of previously overheating.
2. Report anything found to the maintenance organization.
3. One person carefully guides and assists the other person lifting the equipment from the container.
4. If necessary, use safety approved and tested lifting equipment to remove the analyzer from the shipping container.

Figure 1-6: Front View Showing Lifting Handles



A. Front panel left-side handle
B. Front panel right-side handle

Figure 1-7: Rear View Showing Lifting Handle



A. Rear panel handle

5. Place the analyzer on a solid, level surface and prepare to rack mount the analyzer.

2 Install

2.1 Site selection

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

Procedure

1. Install the analyzer in a standard 482.6 mm (19 in.) rack.

   NOTICE

   Fitting the analyzer into the rack and securing it are your responsibilities.

2. Install the analyzer in a suitable shelter to protect it from environmental elements and water. The Ingress Protection rating (IP) for the analyzer is IP-44 per the IEC 60529 standard.

   ⚠ DANGER!

   FLAMMABLE SUBSTANCES

   Some parts of the analyzer may reach temperatures of 190 °C (374 °F) and may present an ignition source. Exercise care when using oil, paint, cleaning rags, and other flammable substances near the analyzer. A fire may result if this precaution is not observed. Always assume that the interior of a analyzer is hot unless it has been switched off and allowed to cool down.

2.2 Rack mounting the analyzer

This procedure may require two people to safely move and rack mount the Rosemount CT5400.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

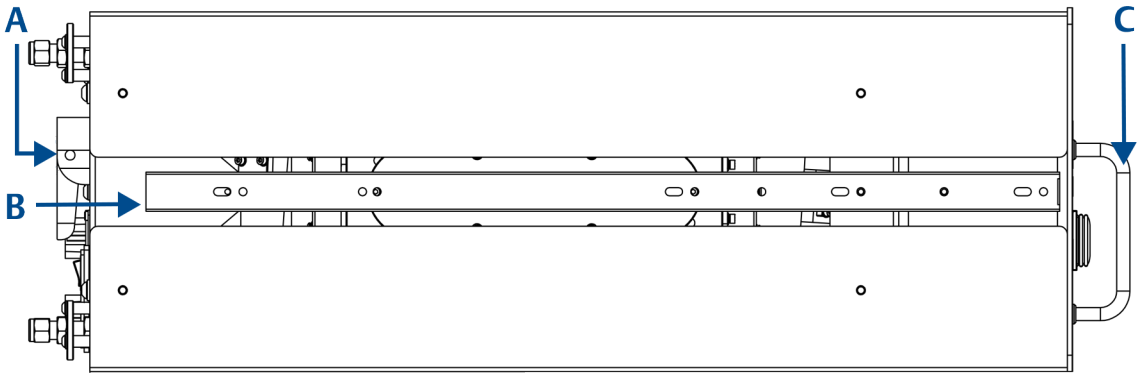
Failure to properly handle the analyzer may cause injury to personnel.

Note
You must supply the rack.

Procedure

1. One person aligns the analyzer's telescoping slide rails on the unit as the other person carefully guides the analyzer into the rack using the front panel and rear handles (see *Figure 2-1*).

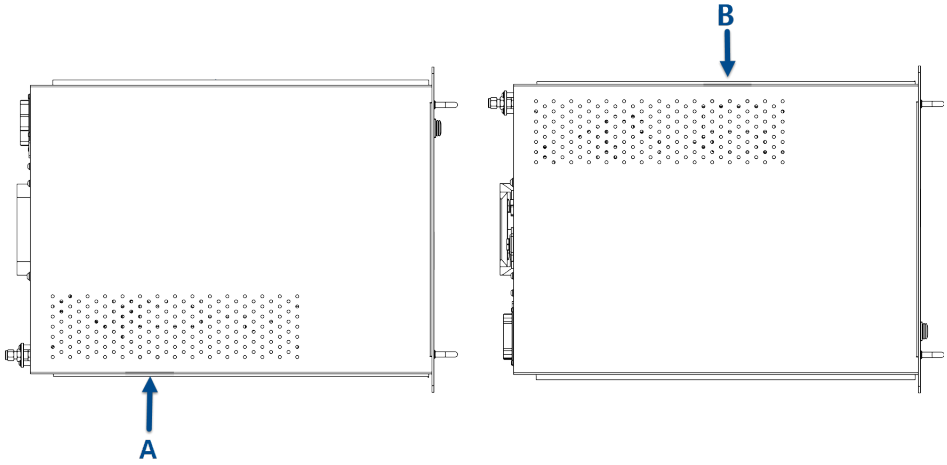
Figure 2-1: Left Side View - Lifting Handles and Telescopic Slide Rails



A. Rear panel handle
B. Telescopic slide for rack mount units
C. Front panel handles

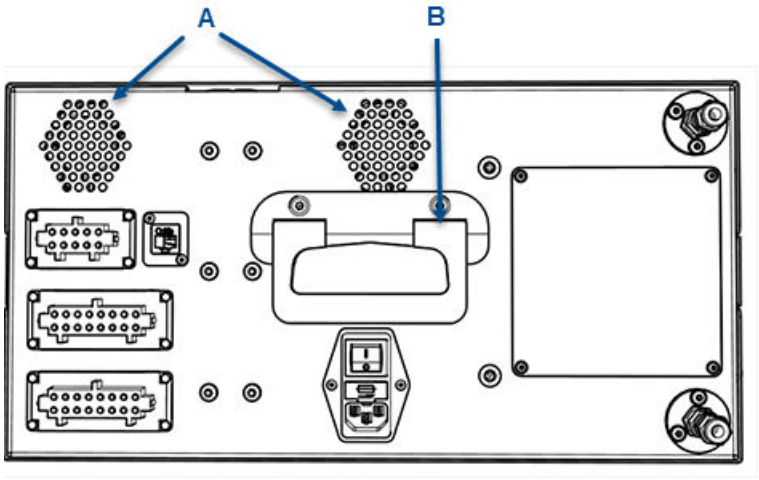
2. Make sure the chassis ventilation holes in the front, top, rear, and bottom are not obstructed.

Figure 2-2: Top and Bottom View - Ventilation



A. Top ventilation holes
B. Bottom ventilation holes

Figure 2-3: Rear View - Ventilation and Handle



A. Rear ventilation holes
B. Rear panel handle

3. Inspect the analyzer and ensure the unit is correctly mounted in the rack and glides easily on the telescoping slide rails.

   The analyzer must slide in and out of the rack to make the power, analog, digital, Ethernet, and gas connections.

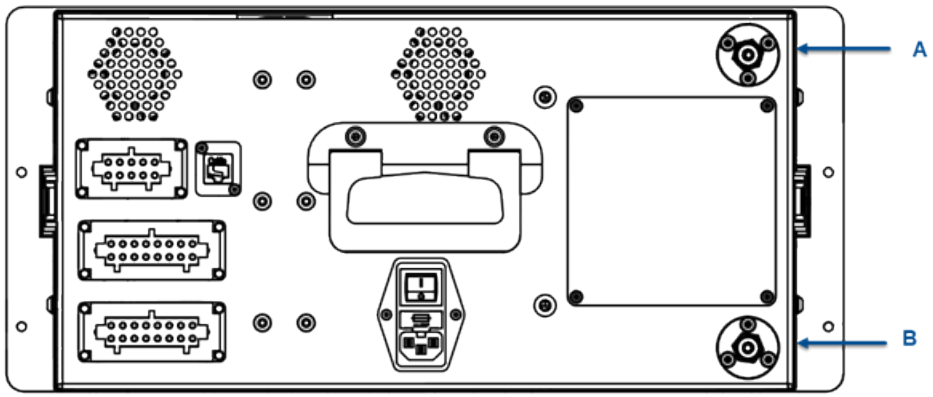
2.3 Gas inputs and outputs

The analyzer has one gas input and one gas output, both of which are located on the rear panel of the instrument (*Figure 2-4*).

Procedure

1. The gas sample that is to be measured for impurities enters the instrument through the sample gas input port (A) .
2. Once the gas sample has been examined for impurities, it is expelled from the instrument through the sample gas return port (B).

Figure 2-4: Gas Inlet and Outlet Connectors



A. Sample gas input port
B. Sample gas return port

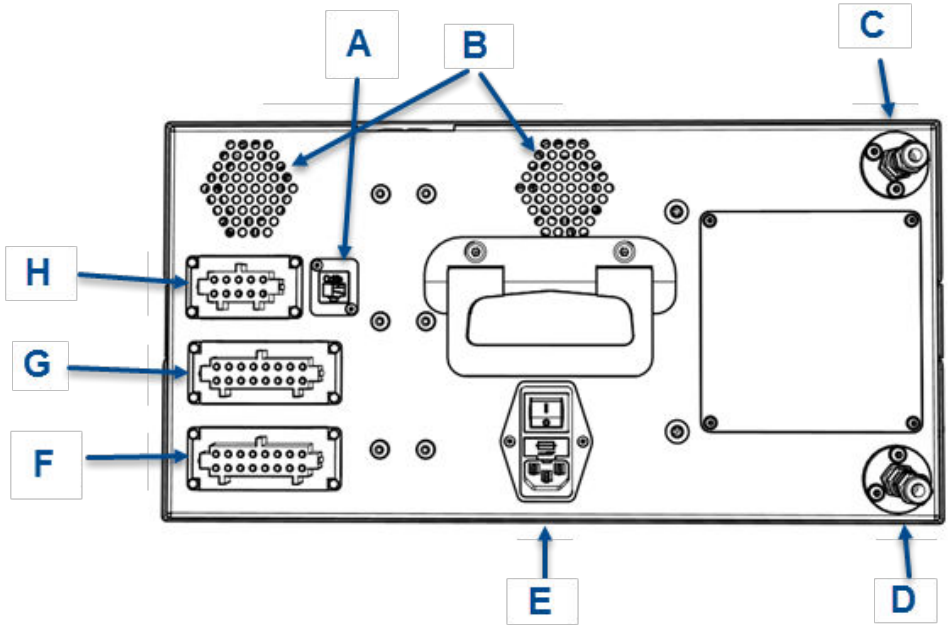
3. The sample supply line must be heated all the way to the sample gas input port on the analyzer to prevent condensation forming at any point in the sample supply line.

⚠ WARNING!

HAZARDOUS GAS
The product stream that the analyzer is examining may be hazardous even at low concentrations. Therefore, take special care to ensure that the sample gas return port either returns the sample gas to the product stream or discharges the sample gas to a location that will not cause a hazard.

2.4 Connecting the electrical/electronic inputs and outputs

Figure 2-5: Electrical / Electronic Connectors



A. Ethernet connector
B. Ventilation holes
C. Sample supply (stainless steel tubing)
D. Sample return (stainless steel tubing)
E. Main power supply
F. Analog outputs (4-20 mA)
G. Digital outputs
H. Status output (10 way connector)

Electrical/electronic signal connections to the analyzer are made through electrical connectors located on the rear panel of the instrument, as shown in *Figure 2-5*. Use the wiring diagram to make the electrical connections as shown in *Appendix C*.

Table 2-1: Status outputs, 10 way socket (H)

Pins	Function
1-6	Status output 1 (check function), optional
2-7	Status output 2 (maintenance required), optional
3-8	Status output 3 (out of specification), optional

Table 2-1: Status outputs, 10 way socket (H) *(continued)*

Pins	Function
4-9	Status output 4 (failed), optional

Table 2-2: Digital outputs, 16 way socket (G)

Pins	Function
1-9	Reading valid channel 0, set in config file
2-10	Reading valid channel 1, set in config file
3-11	Reading valid channel 2, set in config file
4-12	Reading valid channel 3, set in config file
5-13	Reading valid channel 4, set in config file
6-14	Reading valid channel 5, set in config file
7-15	Reading valid channel 6, set in config file
8-16	Reading valid channel 7, set in config file

Table 2-3: Analog outputs, 16 way socket (F)

Pins	Function
1-9	Analog channel 0, set in config file
2-10	Analog channel 1, set in config file
3-11	Analog channel 2, set in config file
4-12	Analog channel 3, set in config file
5-13	Analog channel 4, set in config file
6-14	Analog channel 5, set in config file
7-15	Analog channel 6, set in config file
8-16	Analog channel 7, set in config file

⚠ CAUTION!

EQUIPMENT DAMAGE

Make sure that the mains supply cable used is of a suitable rating for the unit power requirements. Failure to do so may result in damage to property.

The Ethernet connector (*Figure 2-5*, A) provides an Ethernet output from the instrument that may be used for downloading data for failure diagnosis purposes.

The results of the gas analysis are output from the instrument through the 4-20 mA analog outputs (*Figure 2-5*, F) and sent to your process control center.

The status outputs (H) provide fault indications to your process control center. Each digital output is connected to a normally closed relay, located inside the analyzer, which will open in response to the detection of a specific fault. The possible causes of a fault indication are:

1. The sample gas concentration is outside of specification, i.e., the sample gas concentration has exceeded the measurement range of the instrument.
2. The analyzer is out of specification or has developed a fault.

⚠ WARNING!

HIGH VOLTAGE
Voltages up to 250 Vac, 50 Hz may be present on the digital output terminals.

External circuits should be installed in accordance with national wiring regulations.

Failure to obey the wiring regulations may result in serious injury to personnel.

⚠ WARNING!

ELECTRIC SHOCK
The analyzer passed electromagnetic compatibility (EMC) tests based on all electrical cables and harnesses attached to the instrument having a length of 3 m (9.8 ft.) Attaching cables and wiring harnesses longer than 3 m (9.8 ft.) may cause injury to personnel.

2.5 Commissioning the analyzer

Once the analyzer is fully installed as described, it should be commissioned according to local government regulations and the commissioning plan agreed upon between you and Emerson.

3 Startup procedure

3.1 Introduction

⚠ CAUTION!

EQUIPMENT DAMAGE

Always follow the startup procedure. Damage to the Rosemount™ CT5400 may result from a failure to follow this procedure.

The Rosemount CT5400 normally operates continuously. It should only be necessary to start up the instrument under the following circumstances.

- When the Rosemount CT5400 is first switched on following installation.
- Following repair or maintenance.
- When it has been switched off as part of a plant shutdown or maintenance.

3.2 Preparation for use

The analyzer must be installed and fully commissioned prior to startup.

⚠ CAUTION!

EQUIPMENT DAMAGE

Do not power up or try to operate the analyzer unless it is physically secure and all electrical and pneumatic connections to the analyzer are in place.

Before commencing the start-up process, it is important to ensure that electrical power, sample gas handling facilities, and any calibration gases that are required are available to the analyzer.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

3.3 Startup procedure

NOTICE

The gases shown in the screenshots and the measurements thereof may be different from those shown in your particular analyzer. They indicate the functionality of the software, which is the same regardless of the gases being measured.

NOTICE

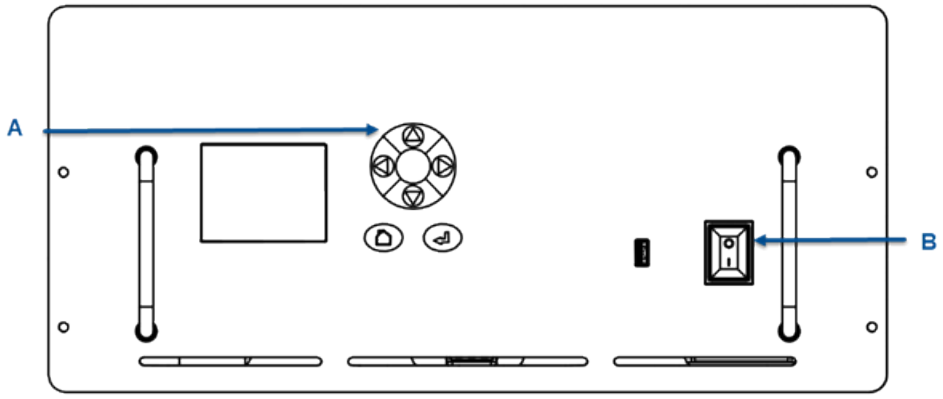
To stop the startup procedure at any time, set the main circuit breaker to *OFF*.

To start up the analyzer, perform the following steps:

Procedure

1. Visually inspect the exterior of the analyzer for signs of damage, corrosion, gas leaks, or overheating. Report anything found to the maintenance organization.
2. Make sure that the analyzer has been correctly installed (see *Chapter 2*).
3. Make sure that the rack lid is fitted to the analyzer. If it is not, report it to the maintenance organization and do not proceed further until the rack lid has been fitted.
4. Make sure that the *On/Off* switch at the rear of the analyzer is set to *I* (ON).
5. On the front panel (*Figure 3-1*) of the analyzer, set the *On/Off* switch (B) to *I* (ON). Check that the switch illuminates.

Figure 3-1: Front panel

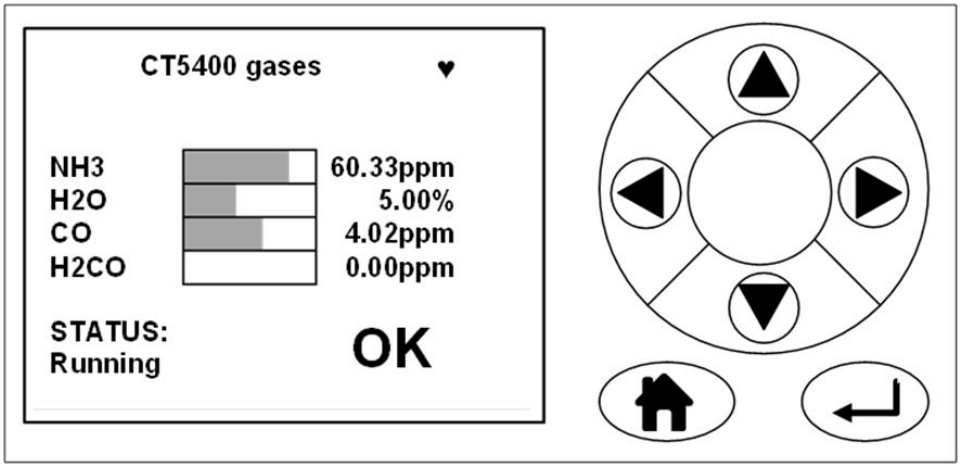


A. Display controller
B. Illuminated On/Off switch

The startup sequence commences automatically under software control.

After a few seconds, the *Gas Sensor Main* screen (*Figure 3-2*) appears on the display controller. If it does not, report the fault to the maintenance organization.

Figure 3-2: Gas Sensor Main screen



6. Start up the system for returning the sample gas.
7. Start up the gas handling system that conditions the sample gas before it is fed into the analyzer. Allow the analyzer to warm up in accordance with *Table 1-3* before the sample gas supply is turned on.

4 Operating the analyzer

4.1 Introduction

This section describes the normal operation of the analyzer and how to use the display controller located on the front panel of the analyzer.

NOTICE

The gas concentrations shown in the following screenshots may be different from those shown in your particular analyzer. The screenshots indicate the functionality of the software, which is the same regardless of the gases or gas concentrations being measured.

4.2 Normal operation

The analyzer is designed for long term continuous operation, and therefore its normal state is to be switched on and performing gas measurements. The analyzer is usually only switched off for maintenance. The shutdown procedure used to switch off the analyzer is described in *Chapter 8* of this manual.

Provided that the start-up procedure described in *Chapter 3* has been followed, the analyzer does not require any human intervention during normal operation other than occasional calibration checks.

During normal operation, either the *Gas Sensor Main* screen (*Figure 4-1*) or the *Pressure and Temperature* screen (*Figure 4-2*) is shown on the display controller. To toggle between these two screens, press ↵.

Figure 4-1: Gas Sensor Main screen

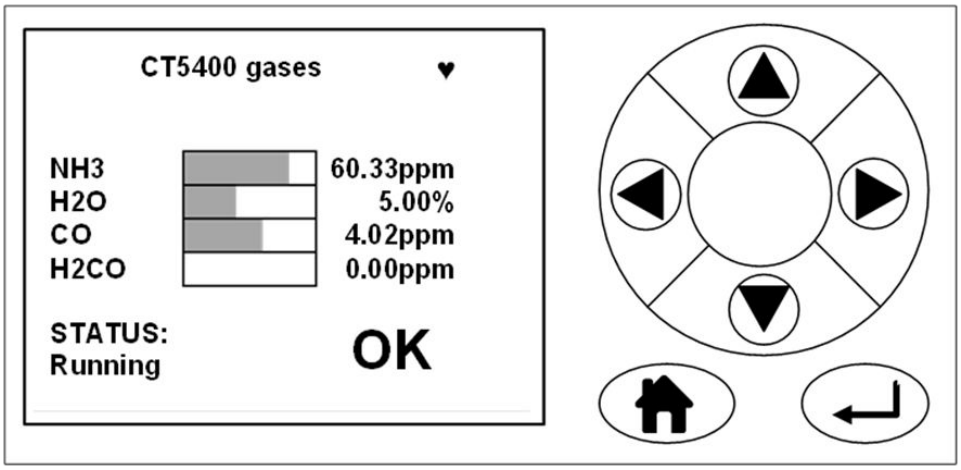
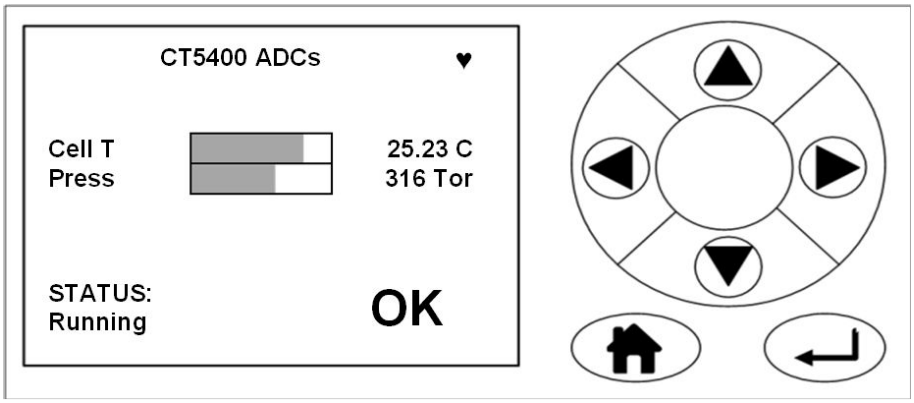


Figure 4-2: Pressure and Temperature screen



⚠ CAUTION!

UNSERVICEABLE EQUIPMENT

If the pressure and temperature measurements are out of tolerance, refer to *Chapter 7* for guidance.

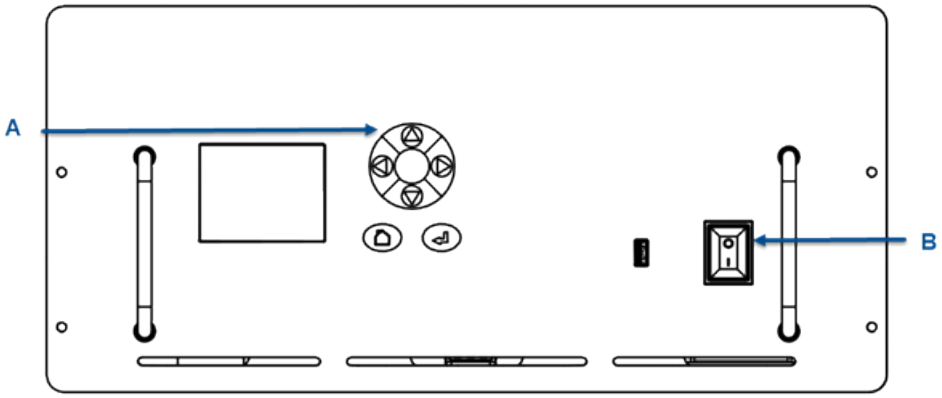
On both the *Gas Sensor Main* screen and the *Pressure and Temperature* screen, ▲ has no function when the analyzer is operating correctly. If, however, the software detects a fault and an error message is displayed, press ▲ to get further information on the error.

On both the *Gas Sensor Main* screen and the *Pressure and Temperature* screen, if the analyzer makes more measurements than can fit on the display, use ▲ and ▼ to scroll down the list.

4.3 Front panel controls and indicators

There are two controls located on the front panel (*Figure 4-3*): the display controller (A) and the illuminated *On/Off* switch (B).

Figure 4-3: Front panel



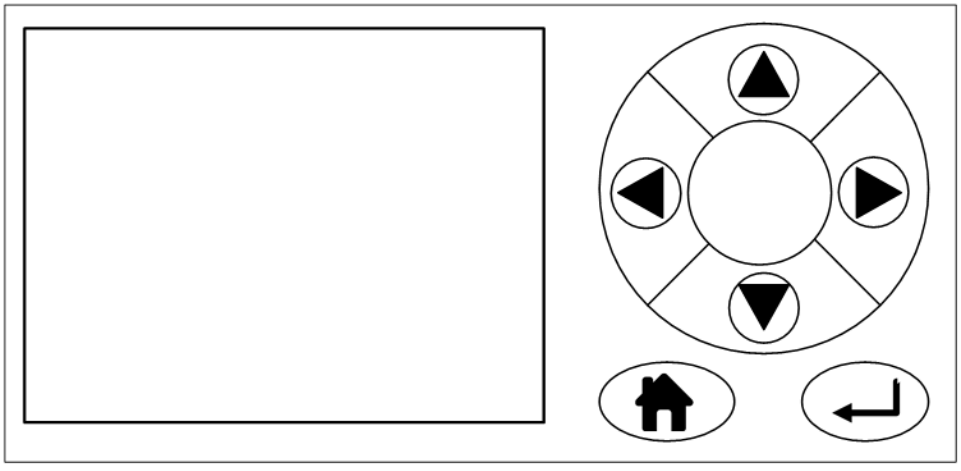
A. Display controller
B. Illuminated On/Off switch

The front panel **On/Off** switch (*Figure 4-3*, B) controls the application of electrical power to the electronic circuits inside the instrument. On the switch, **I** identifies the On position and **O** identifies the Off position. The switch includes an indicator that illuminates red when the switch is set to On.

Note that setting the front panel **On/Off** switch to Off does *not* remove all electrical power from the instrument. Part of the power distribution circuit will remain live. To remove all electrical power from the instrument, set the **On/Off** switch on the rear panel (refer to *Section 4.4*) to *Off*.

Operation of the analyzer is controlled primarily through the display controller (*Figure 4-4*).

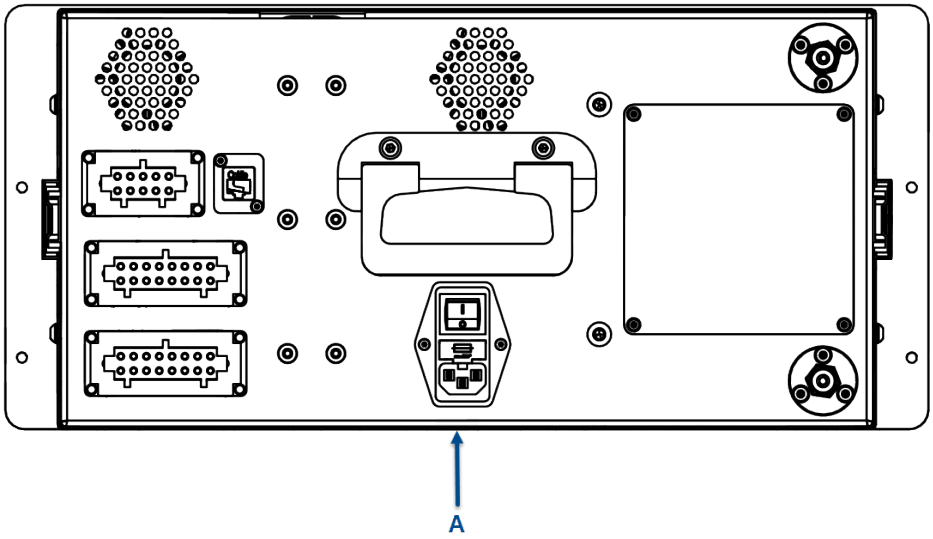
Figure 4-4: Display controller



4.4 Rear panel controls

There is only one control on the rear panel (*Figure 4-5*), a fused socket (A) that incorporates an **On/Off** switch. The function of the rear panel **On/Off** switch is to control the application of electrical power to the complete instrument.

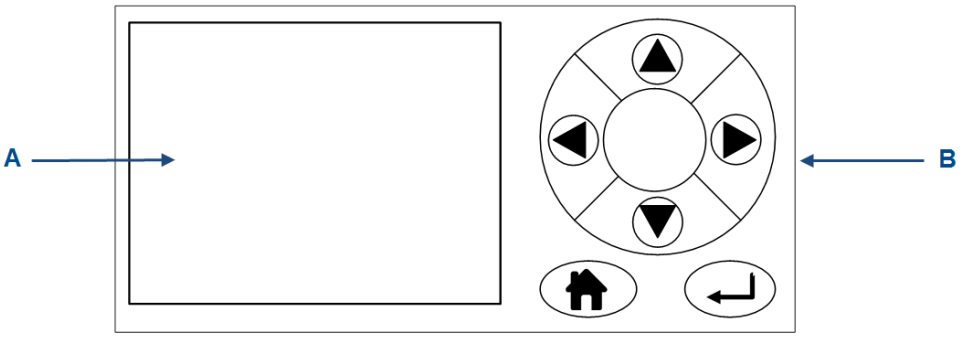
Figure 4-5: Rear Panel



*A. **On/Off** switch - fused socket*

4.5 Display controller

Figure 4-6: Front Panel Display Controller



A. LCD display
B. Navigation buttons

You can control the analyzer through six navigation buttons (*Figure 4-6*, B) on the display controller.

The LCD display (A) can be used to display:

1. Gas concentration measurements obtained
2. Operating temperature and pressure
3. Help screens
4. Step-by-step calibration
5. Diagnostics

The navigation buttons (B) are configured to perform different functions according to which software screen is shown on the LCD display.

Table 4-1: Display Controller Navigation Button Functions

Button	Description
	Normally used to scroll up. Referred to as *UP*.
	Normally used to scroll down. Referred to as *DOWN*.
	Normally used to select. Also accesses the *Main Menu* from the *Home* screen. Referred to as *RIGHT*.
	Used to go back to the previous screen. No function from the *Home* screen. Referred to as *LEFT*.
	Used to access the context sensitive *Help* pages. Referred to as *HOME*.
	Generally used to select an alternative function. Also allows you to toggle between gas and physical measurements from the *Home* screen. Referred to as *ENTER*.

The analyzer employs *Intelligent Device Management* which enables self-monitoring and diagnostics. This ensures that operators are made aaware of malfunctions so they can take appropriate action. *Table 4-2* defines the symbols that may be displayed.

Table 4-2: Diagnostic symbols

	System running
	Maintenance required: still valid output signal
	Out of specification: signal out of the specified range
	Indicates the analyzer is performing a calibration or validation or that the software has been deliberately stopped.
	Failure: non-valid output signal

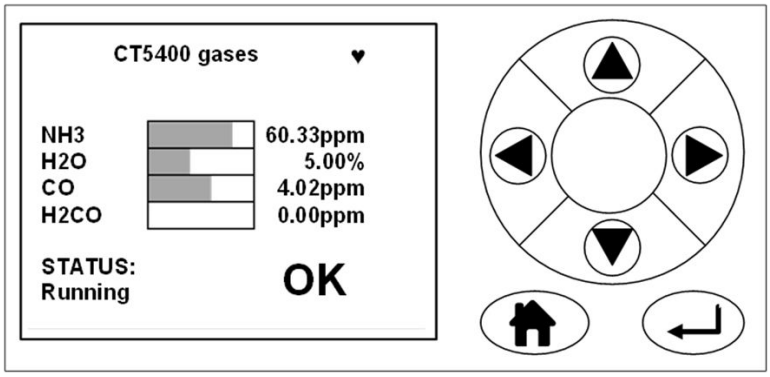
4.6 Gas Sensor Main screen

When the analyzer is switched on, at the end of the startup procedure, the *Gas Sensor Main* screen (*Figure 4-7*) appears. The *Gas Sensor Main* screen is the screen that is normally displayed.

NOTICE

The gas concentrations shown in the following screenshots may be different from those shown in your particular analyzer. The screenshots indicate the functionality of the software, which is the same regardless of the gases or gas concentrations being measured.

Figure 4-7: Gas Sensor Main screen



The *Gas Sensor Main* screen displays the gas concentration measurements obtained by the analyzer. In the example shown in *Figure 4-7*, the gases ammonia (NH_3), water (H_2O), carbon monoxide (CO), and formaldehyde (H_2CO) are being measured, and for each gas, the concentration detected is in parts per million (ppm).

At the end of the startup procedure, the gas measurements initially appear as *0.00* until the first readings are taken. After a few seconds, the initial gas concentrations are displayed.

The *Gas Sensor Main* screen also shows the status of the analyzer. In the example shown in *Figure 4-7*, the instrument is *Running* and *OK* (i.e., no faults have been identified).

If a fault is identified, ? is displayed; if maintenance is required, is displayed.

is a link between the *Gas Sensor Main* screen (*Figure 4-7*) and the *Pressure and Temperature* screen (*Figure 4-8*). Press to toggle between the two screens.

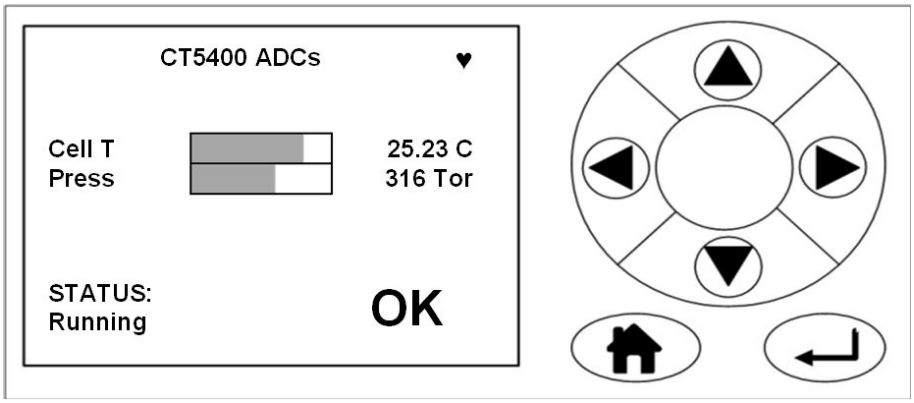
is a link to the Help system. Press to go to a *Help* screen (described in *Section 4.8*).

On the *Gas Sensor Main* screen, ▲ has no function when the analyzer is operating correctly. If, however, the software detects a fault, an error message is displayed. Press ▲ to get further information on the error.

4.7 Pressure and Temperature screen

The *Pressure and Temperature* screen (*Figure 4-8*) shows pressure and temperature measurements taken inside the analyzer.

Figure 4-8: Pressure and Temperature Screen



The *Cell* reading is the temperature, in °C, of the analysis cell.

The *Press* reading is the pressure, in Torr, inside the analysis cell.

NOTICE

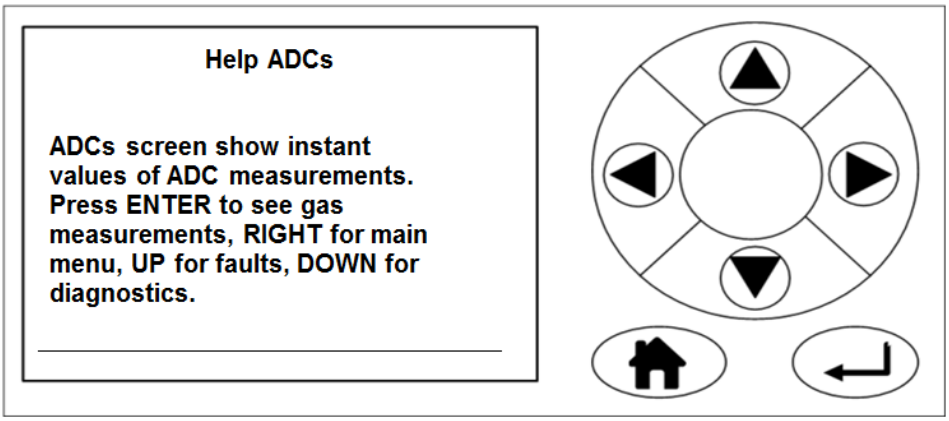
A Torr is a non-SI unit of pressure defined as 1/760 of standard atmospheric pressure and is equal to the fluid pressure of 1 mm of mercury.

4.8 Help system

The analyzer software includes a context-sensitive help system. Press 🏠, which is available on most of the software screens, to open the Help system.

The help system contains a number of different *Help* screens, each conveying a different message. As the help system is context-sensitive, the help screen that appears is the one that is most appropriate to the software function engaged when 🏠 was pressed. *Figure 4-9* shows an example of a help screen.

Figure 4-9: Example of a Help Screen

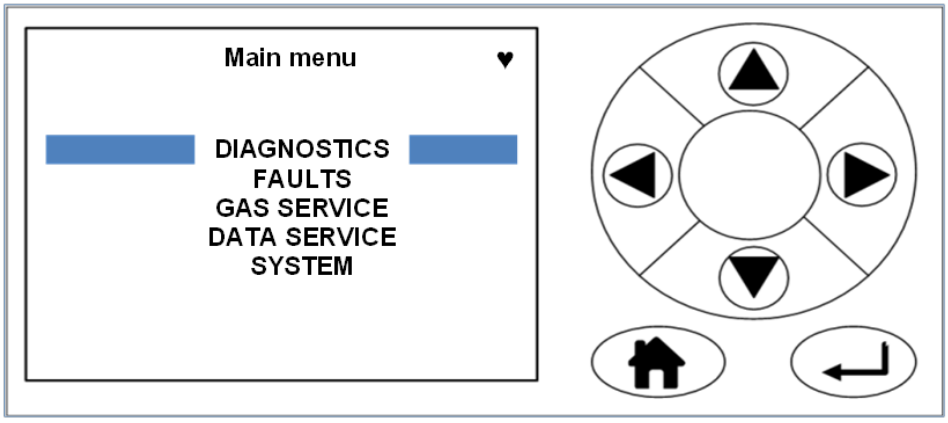


4.9 Main menu

To access the *Main menu* (*Figure 4-10*), press ▶ on either the *Gas Sensor Main* screen (*Figure 4-7*) or the *Pressure and Temperature* screen (*Figure 4-8*). The *Main menu* options are:

- DIAGNOSTICS: Displays various parameters used in the internal calculations and compares desired and actual parameters, for example, the analysis cell pressure and temperature. The diagnostics routines and screens are used to perform fault diagnosis.
- FAULTS: Takes you to a screen that lists any faults affecting the analyzer. This option is used as part of the failure diagnosis procedures.
- GAS SERVICE: Allows you to check the sensor readings against a known gas source (verification) or, if necessary, to calibrate the analyzer against that known gas source (calibration).
- DATA SERVICE: Takes you to a screen that allows data to be downloaded from the instrument. The downloaded data is used to diagnose faults.
- SYSTEM: Takes you to a screen that allows you to shut down the analyzer or access system information, such as software versions or IP addresses. The main motherboard IP address can also be changed from this menu. Some of these options are not available on older analyzers.

Figure 4-10: Main menu



4.10 BACK button

On most of the software screens, ◀ is configured as a *BACK* button. Press ◀ to return to the previous screen.

5 Verifying Gas Concentrations

5.1 Verification

Verification flows the known gas concentration through the analyzer and gives you a display of the measurement, the cylinder value, and the difference between the two. You can use verification to confirm that the analyzer is within tolerance. If it is out of tolerance, perform a calibration (see *Section 6.3*).

5.1.1 Zero verification

Zero verification confirms that when no sample gas is flowing through the analyzer, the gas concentrations measured by the instrument are zero. Zero verification is done by comparing the analyzer measurements to a known sample gas using the following procedure:

Prerequisites

Run the analyzer at a stable temperature for at least thirty minutes prior to commencing this procedure.

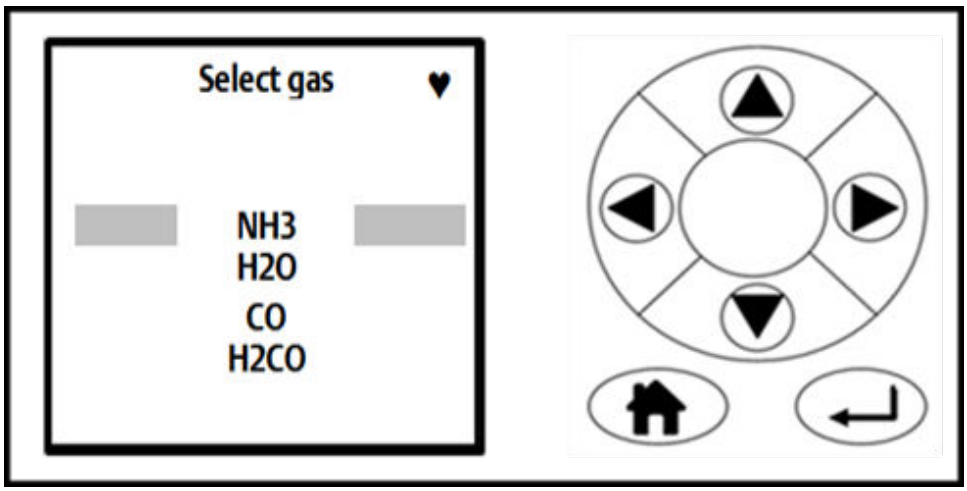
Use nitrogen gas of *instrument gas* purity as the zero verification gas.

Procedure

1. Make sure that a pressure regulator is connected to the nitrogen gas bottle.
2. Connect a hose from the nitrogen gas bottle through a T-piece to the sample supply port on the rear of the analyzer. Connect an excess flow line to the unused port on the T-piece and route the excess flow line to a suitable extractor.
3. On the display controller of the analyzer, browse to the *Main menu* as described in *Section 4.9*.
4. Refer to *Figure 4-10*. Using ▲ and ▼, select *GAS SERVICE*.
5. Press ▼.

   The *Select gas* screen (*Figure 5-1*) opens.

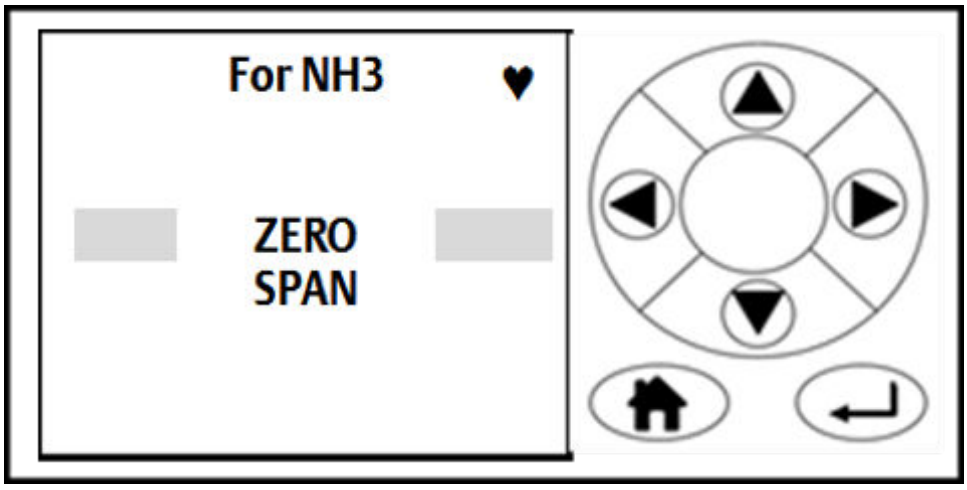
Figure 5-1: Select gas Screen



6. Use ▲ and ▼ to move the cursor until the gas that you wish to zero verify is selected. Press ▶.

   The *Select Type* screen (*Figure 5-2*) opens.

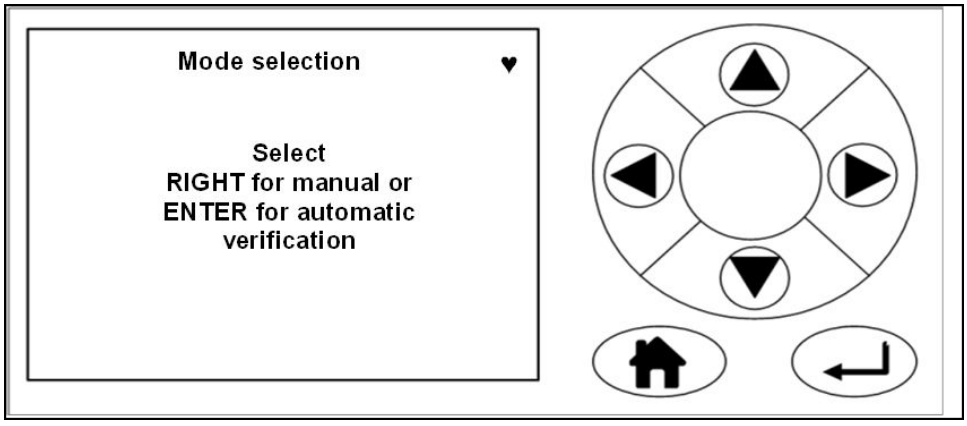
Figure 5-2: Select Type Screen



7. Use ▲ and ▼ to move the cursor until the *ZERO* verification option is selected, as shown in *Figure 5-2*.
8. To perform a verification, press ▶.

   The *Manual/Automatic* screen (*Figure 5-3*) opens.

Figure 5-3: Manual/Automatic Screen



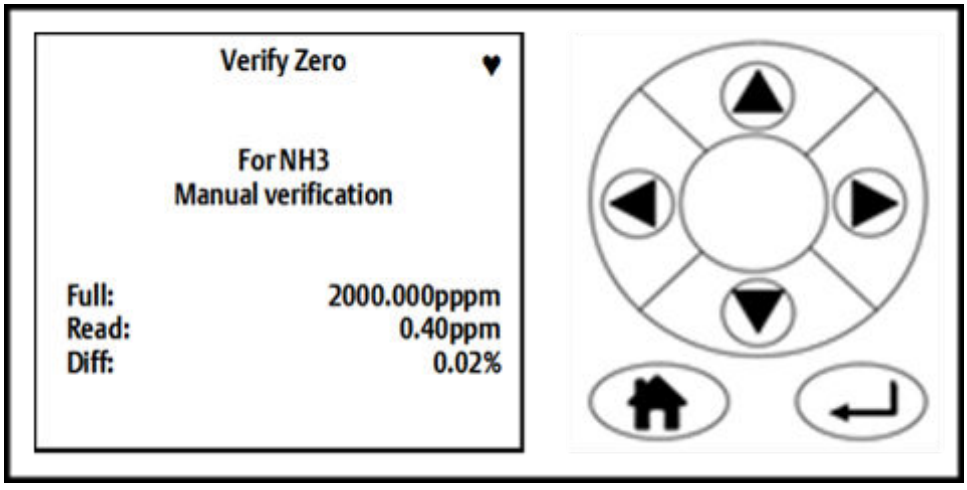
9. Press ▶ for manual verification. Press ↵ for automatic verification.

NOTICE

Pressing ↵ will automatically allow configuration verification in a future release of GasSensor-3 software.

The *Verify Zero* screen (*Figure 5-4*) opens.

Figure 5-4: Verify Zero Screen



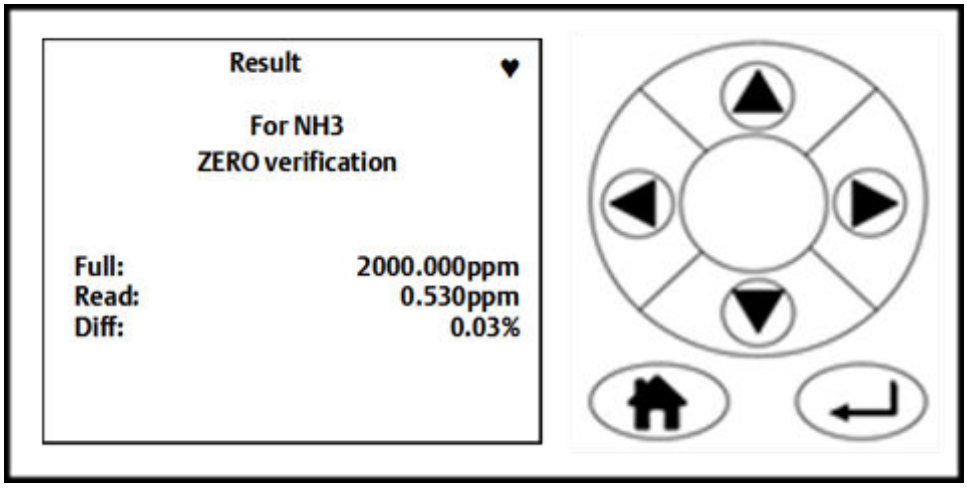
10. Allow the concentrations to stabilize and wait for two minutes after stabilization.

This screen gives a reading of the concentration of the selected gas that is present as an impurity in the nitrogen calibration gas, as measured by the instrument. In the example (*Figure 5-4*), the gas being measured is NH_3 (ammonia), and the instrument has detected a concentration of 0.40 ppm.

11. If the reading is within tolerance, no further action is required. Press ▶ to end the zero verification process.

    The display controller proceeds to the *Result* screen (*Figure 5-5*).

Figure 5-5: Result Screen

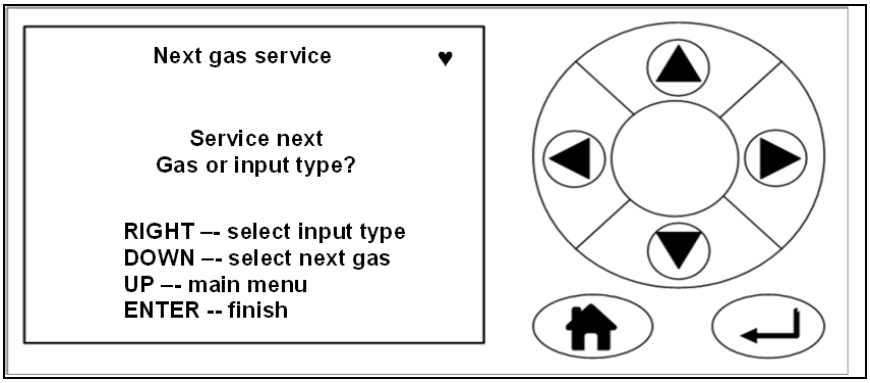


12. If the reading is outside tolerance, the instrument should be zero calibrated.

    Refer to *Section 6.3.1*.

13. In either case, press ▶ to return to the *Calibration / Verification Complete* screen (*Figure 5-6*).

Figure 5-6: Calibration / Verification Complete Screen



14. To perform a zero verification for another gas, press ▼.

    The software returns to the *Select gas* screen (*Figure 5-1*).

15. Repeat the actions in steps 6-13 for the next gas.

16. To perform a span verification, press ▼. Then follow the span verification procedure in *Section 5.1.2*.

17. If you are finished verifying the analyzer, press ↵.

    The software returns to the *Gas Sensor Main* screen (*Figure 4-7*).

5.1.2 Span verification

To verify the span gas concentrations measured by the analyzer when reference gas is flowing, use the following procedure.

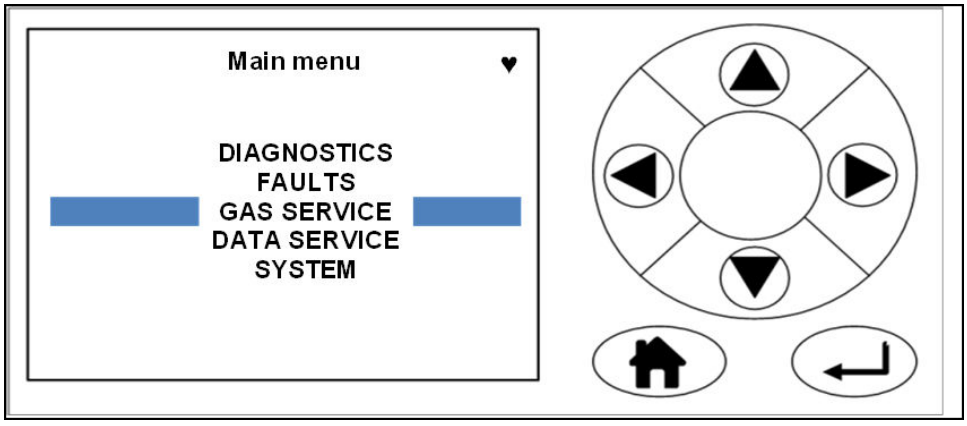
Prerequisites

Run the analyzer at a stable temperature for at least thirty minutes prior to commencing this procedure.

Procedure

1. Use a certified reference gas cylinder as the source of the span verification gas.
2. Make sure that a pressure regulator is connected to the reference gas bottle.
3. Connect a hose from the reference gas bottle, through a T-piece, to the sample supply port on the rear panel of the analyzer.
4. Connect an excess flow line to the unused port on the T-piece and route the excess flow line to a suitable extractor.
5. On the display controller, browse to the Main menu as described in *Section 4.9*.
6. Using ▲ and ▼, select GAS SERVICE (*Figure 5-7*).

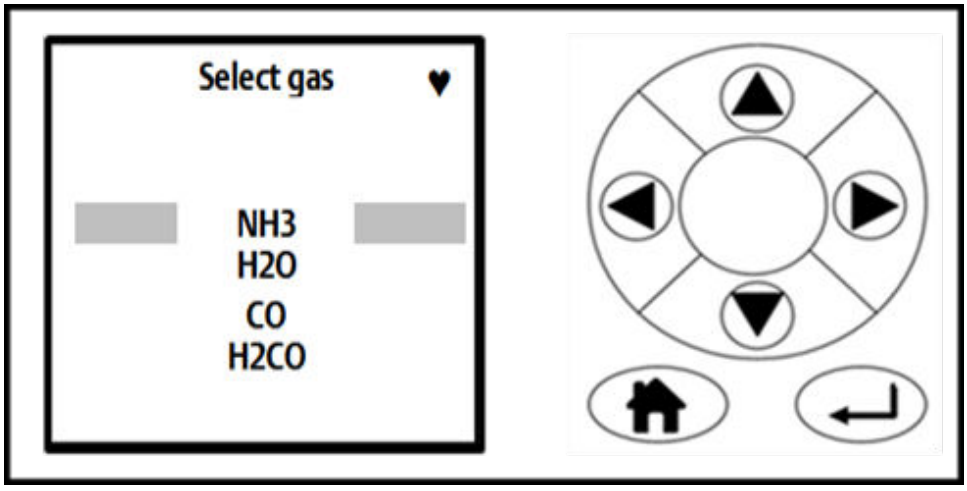
Figure 5-7: Main menu



7. Press ▶.

   The *Select gas* screen (*Figure 5-8*) opens.

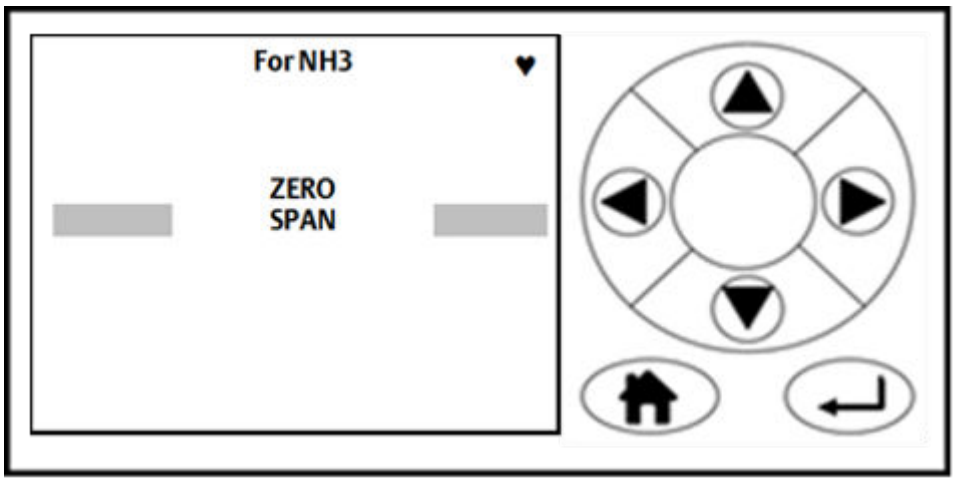
Figure 5-8: Select gas Screen



8. Use ▲ and ▼ to move the cursor until the gas that you wish to span verify is selected. Press ▶.

   The Select Type screen (*Figure 5-9*) opens.

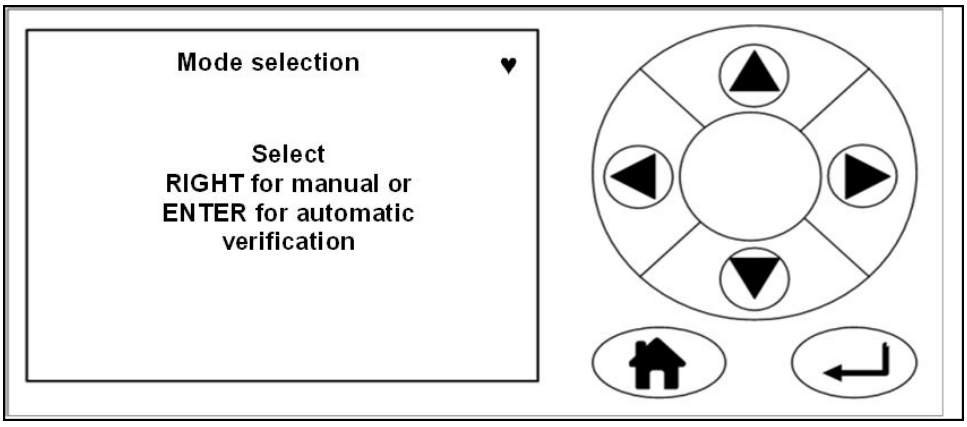
Figure 5-9: Select Type screen



9. Use ▲ and ▼ until the *SPAN* verification option is selected, as shown in *Figure 5-9*. To perform a verification, press ▶.

   The Mode selection screen opens (*Figure 5-10*) for manual or automatic verification.

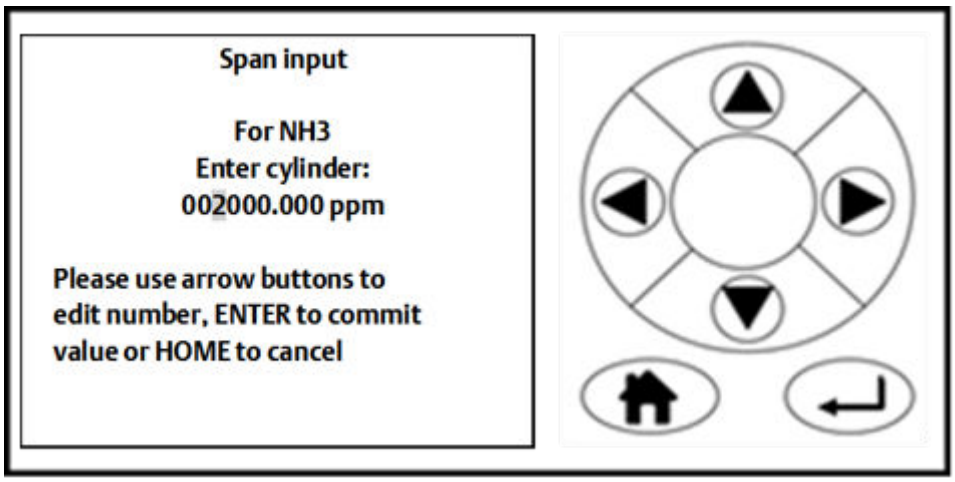
Figure 5-10: Mode selection Screen



10. Press ▶ for manual verification.

    The Span input screen (*Figure 5-11*) opens.

Figure 5-11: Span input Screen



11. Use ◀ and ▶ to highlight each digit in turn; then use ▲ and ▼ to increase or decrease the value until the concentration displayed matches the cylinder you are using.

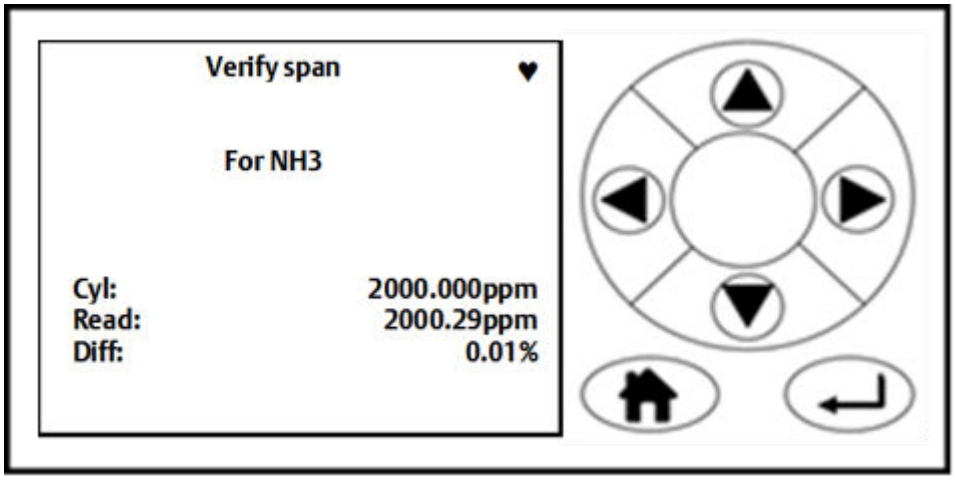
NOTICE

The cylinder concentration must be entered in ppm.

12. Press ↵ to proceed to the next step.

The Verify span screen (*Figure 5-12*) opens.

Figure 5-12: Verify span Screen



13. Press ▲ to cancel the manual verification.
14. Press ↵ to finish.
15. Repeat steps 5-9.
16. Press ↵ for automatic verification.

    This opens the valve (where applicable) and flows the span gas.

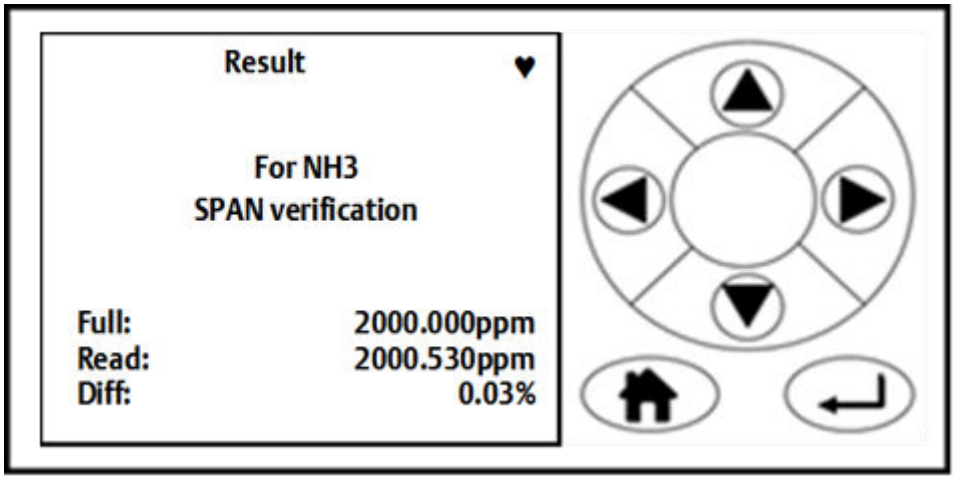
17. Allow the concentrations to stabilize and wait for two minutes after stabilization.

    This screen gives a reading of the concentration of the selected gas that is present, as measured by the instrument. In the example shown in *Figure 5-12*, the gas being measured is NH_3 (ammonia), and the instrument has detected a concentration of 2000.29 ppm.

18. If the reading is within tolerance, no further action is required. Press ▶ to end the span verification process.

    The display controller proceeds to the Result screen (*Figure 5-13*).

Figure 5-13: Result Screen

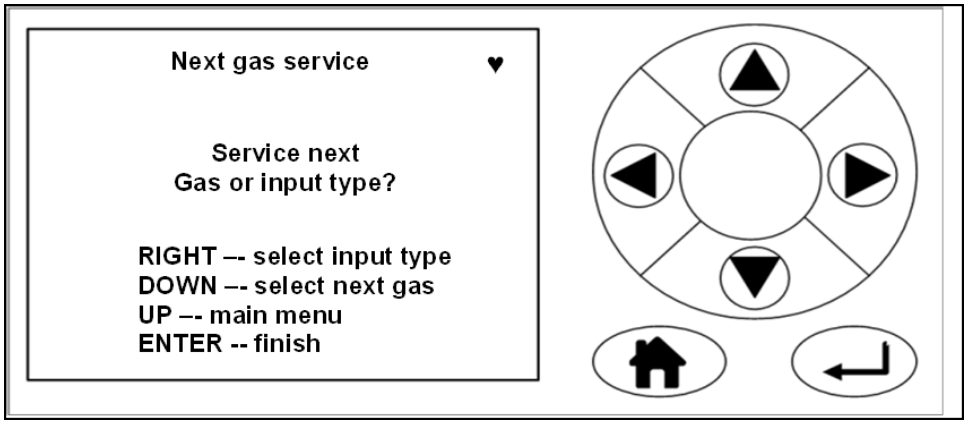


19. If the reading is outside tolerance, the instrument should be span calibrated.

    Refer to *Section 6.3.2*.

20. Press ▶ to return to the screen shown in *Figure 5-14*.

Figure 5-14: Calibration / Verification Screen



21. If you wish to perform a span for another gas, press ▼.

    The software returns to the *Select gas* screen (*Figure 5-1*) Repeat steps 8 - 16 for the next gas.

22. If you wish to perform a zero verification, press ▶. Then follow the zero verification procedure in *Section 5.1.1*.

23. If you are finished verifying the analyzer, press ↵.

    The software returns to the *Gas Sensor Main* screen (*Figure 4-7*).

The span verification procedure is now complete.

6 Gas Calibration Procedures

6.1 Required tools

To calibrate the analyzer, you need the following items:

- Nitrogen gas of *instrument gas* purity for use as a zero calibration gas
- Suitable span calibration gases for each gas measured
- Gas bottle pressure regulators
- Interconnecting hoses to connect the gas bottles to the analyzer
- A T-piece and excess flow line

NOTICE

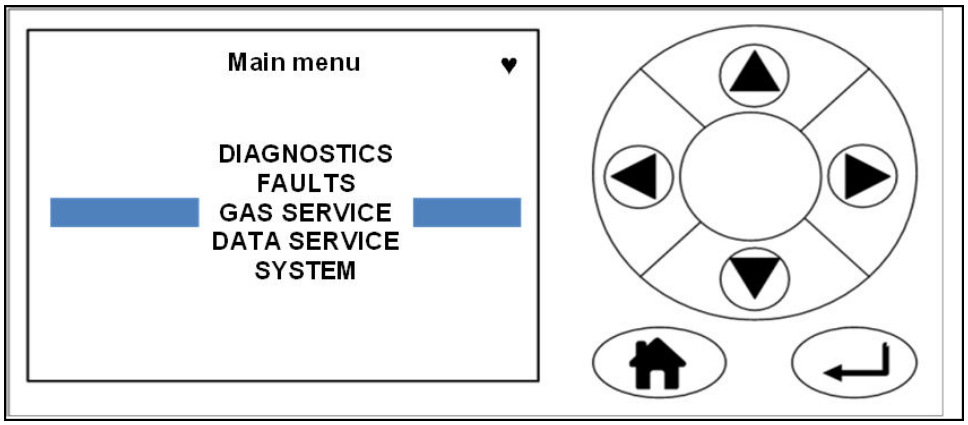
In the case of gases such as H_2O, where it is not normally possible to obtain calibrated gas cylinders, it will usually be measured by the same laser as some other gas. Validating the other gases measured by the analyzer (particularly any which are measured by the same laser as H_2O) can demonstrate that the system is functioning correctly, meaning there is no need to calibrate the water measurement directly.

If calibration must be carried out (e.g., for legal requirements), it can be calibrated by using a water vapor generator to supply a known concentration of water vapor.

6.2 Main menu

The calibration functions are accessed through the *Main menu* (*Figure 6-1*). To get to the *Main menu*, press *MENU* on either the *Gas Sensor Main* screen or the *Pressure and Temperature* screen, as described in *Section 4.9*.

Figure 6-1: Main menu



The *Main menu* is used to access the software routines and screens that are used for calibration and maintenance. Five options are presented (*Figure 6-1*). For more information about the options on the *Main menu*, see *Section 4.9*.

On the *Main menu*, ▲ and ▼ can be used to scroll between the menu options (A). When the option you want is highlighted (*GAS SERVICE* is the example shown in *Figure 6-1*), press ▶ to go to the first screen of that software routine.

6.3 Calibration

Calibration flows the known cylinder gas through the analyzer and then adjusts the readout until the measurement matches the cylinder. This adjustment is then applied to all measurements until the next calibration. There are two circumstances in which you may want to calibrate.

1. After you verify (see *Chapter 5*) and find that the analyzer readings are outside of tolerance
2. At regular intervals, such as once a day or once a shift

6.3.1 Zero calibration

Zero calibration is calibrating the analyzer so that when no sample gas is flowing through it, the gas concentrations measured by the instrument are zero. Zero calibration is done by calibrating the analyzer measurements against a known sample gas using the following procedure:

Prerequisites

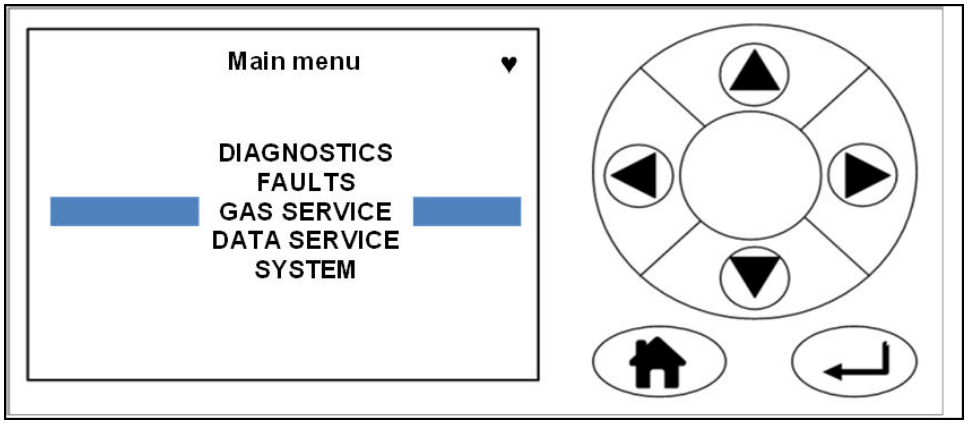
Run the analyzer at a stable temperature for at least thirty minutes prior to commencing this procedure.

Use nitrogen gas of *instrument gas* purity as the zero calibration gas.

Procedure

1. Make sure that a pressure regulator is connected to the nitrogen gas bottle.
2. Connect a hose from the nitrogen gas bottle through a T-piece to the sample supply port on the rear of the analyzer. Connect an excess flow line to the unused port on the T-piece and route the excess flow line to a suitable extractor.
3. On the display controller of the analyzer, browse to the Main menu as described in *Section 4.9*.

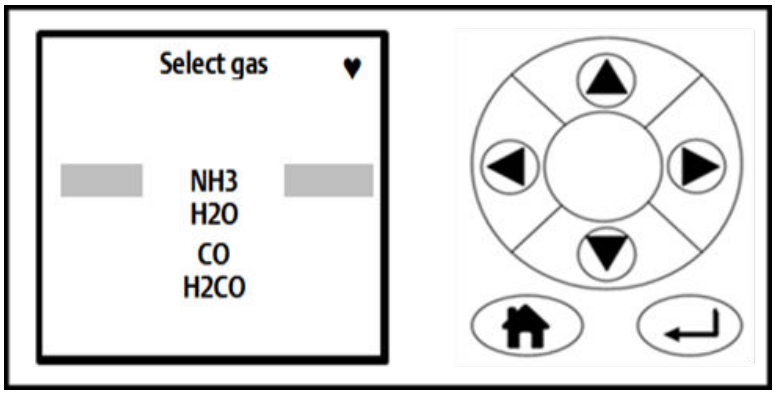
Figure 6-2: Main menu



4. Using ▲ and ▼,select GAS SERVICE.
5. Press ▶.

   The Select gas screen (*Figure 6-3*) opens.

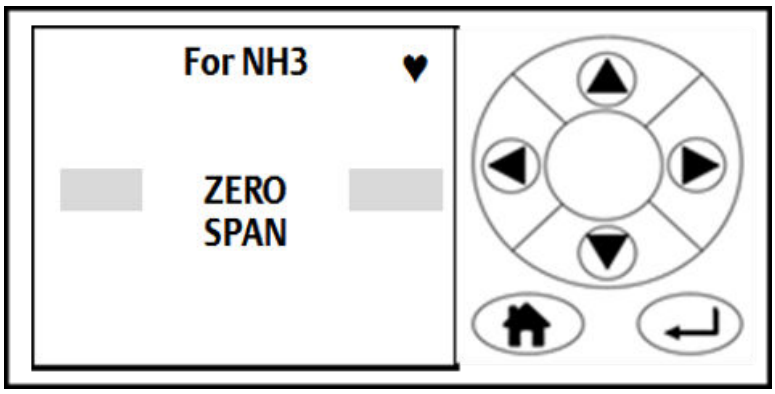
Figure 6-3: Select gas Screen



6. Use ▲and ▼ to move the cursor until the gas that you wish to zero calibrate is selected. Press ▶.

   The Select Type screen (*Figure 6-4*) opens.

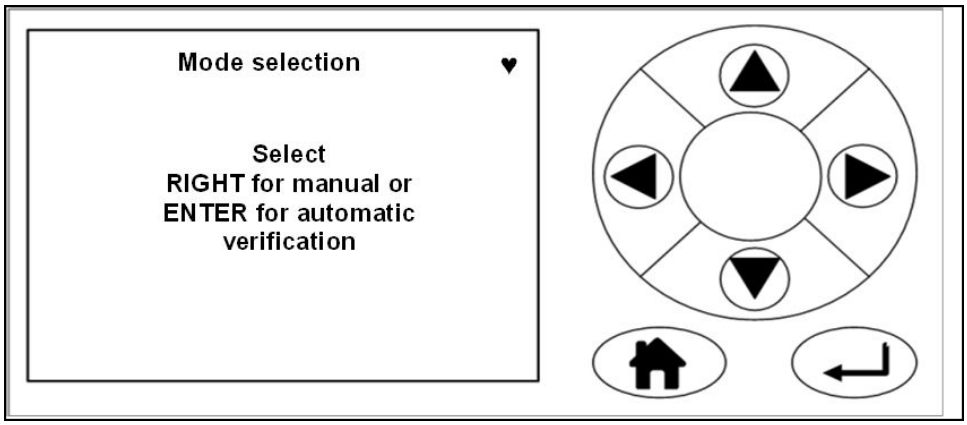
Figure 6-4: Select Type Screen



7. Use ▲ and ▼ to move the cursor until the ZERO calibration option is selected (see *Figure 6-4*).
8. To perform a calibration, press ↵.

   The Mode selection screen (*Figure 6-5*) opens.

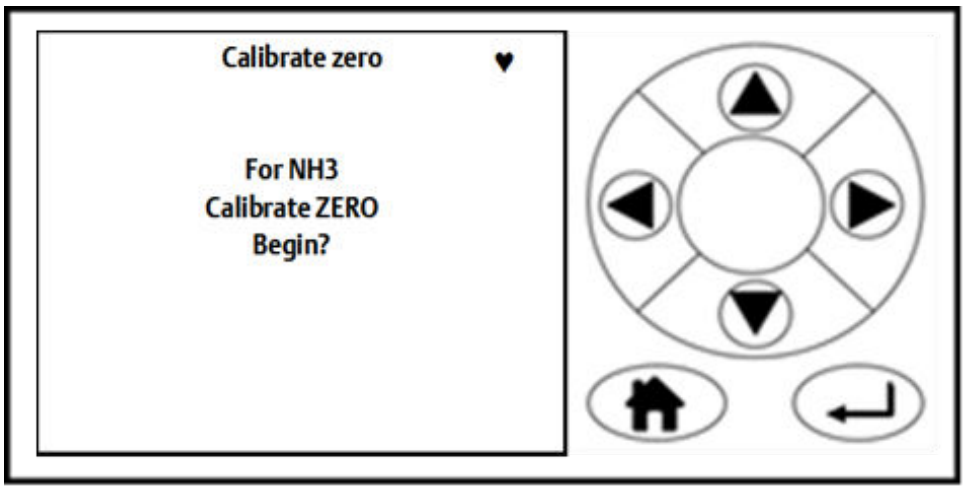
Figure 6-5: Mode selection Screen



9. Press ▶ for manual calibration. Press ↵ for automatic calibration.

   The Calibrate zero screen (*Figure 6-6*) displays.

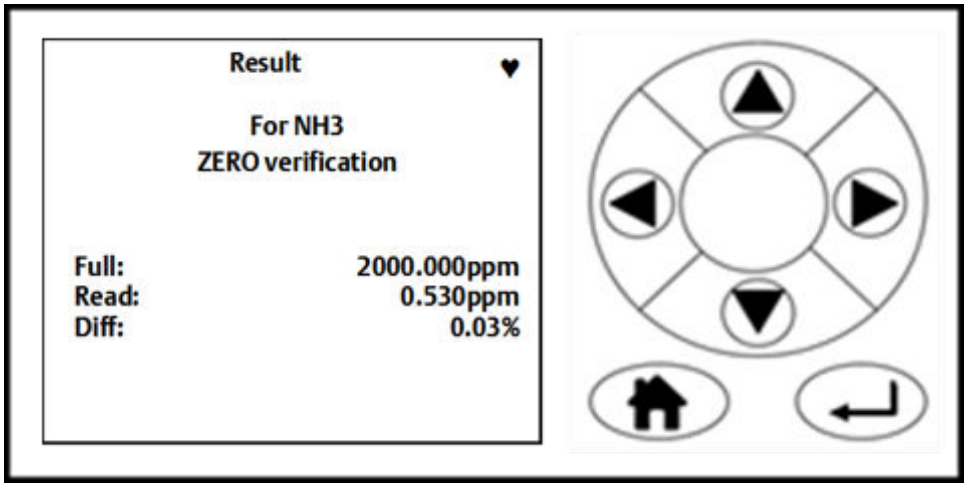
Figure 6-6: Calibrate zero Screen



10. Press ▶ to confirm.

    The Result screen (*Figure 6-7*) displays.

Figure 6-7: Result Screen



11. Press ↵ to finish the process.
12. Allow the concentrations to stabilize and wait for two minutes after stabilization.

    This screen gives a reading of the concentration of the selected gas that is present as an impurity in the nitrogen calibration gas, as measured by the instrument. In the example shown (*Figure 6-7*), the gas being measured is NH_3 (ammonia), and the instrument has detected a concentration of 0.530 ppm (vol).

13. If the reading is within tolerance, no further action is required. Press ▲ to end the zero calibration process.

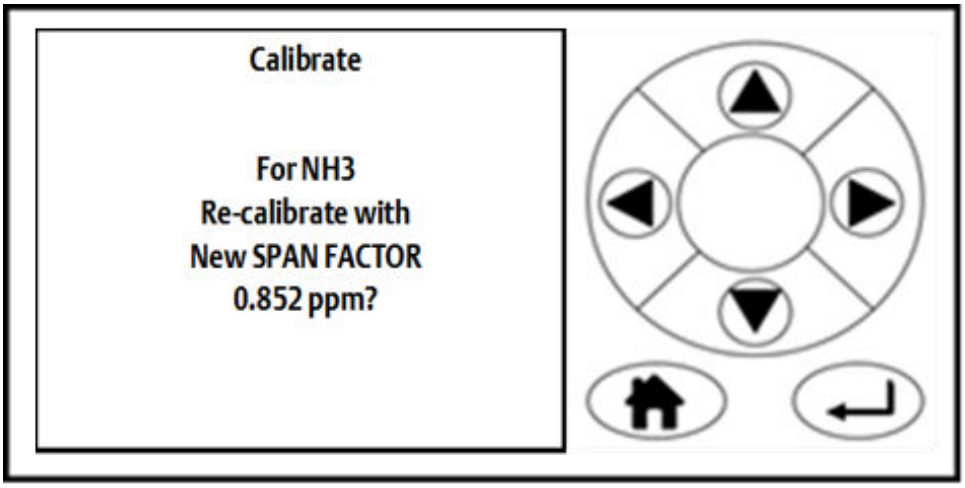
14. If the reading is outside tolerance, press ↵.

    The analyzer returns to its factory set calibration. Allow a minute to ensure the readings are stable.

15. If the reading is now within tolerance, no further action is required. Press ▲ or ▼ to abort the *Zero Calibration* process.

16. If the calibration of the analyzer remains outside of tolerance, press ▶ to display the Calibrate screen (*Figure 6-8*) to re-calibrate with a new zero offset value.

Figure 6-8: Calibrate screen (Confirmation)



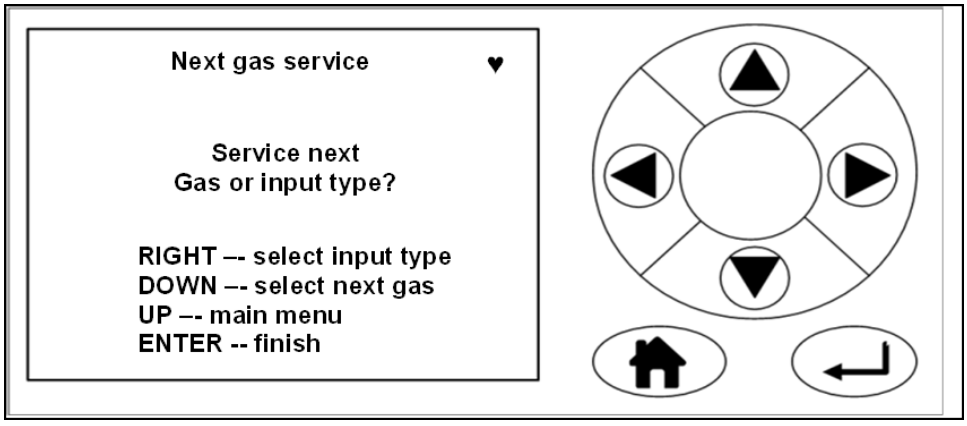
17. To proceed with the automatic re-calibration, press ▶.

    The automatic re-calibration of the instrument's zero point starts, and the offset shown on the screen (*-0.852 ppm (vol)* in *Figure 6-8*) is applied to the instrument.

    Press the **UP** ▲ or **DOWN** ▼ button to abort the calibration process.

    When the calibration is complete, *Figure 6-9* is displayed.

Figure 6-9: Calibration Complete Screen



18. Press ▶ to display the Calibrate gas screen (*Figure 6-4*) and perform a span calibration on the same gas (see *Section 6.3.2*).

19. Press ▼ to perform a zero calibration for another gas.

    The software Select gas screen (*Figure 5-1*) displays.

20. Repeat steps 7 - 17 for the next gas.

21. If you are finished calibrating the analyzer, press ▶ .

    The Main menu (*Figure 6-2*) displays.

6.3.2 Span calibration

The span gas concentrations measured by the analyzer when reference gas is flowing can be verified and, if necessary, calibrated against the known reference gas by using the following procedure.

Prerequisites

Run the analyzer at a stable temperature for at least thirty minutes prior to commencing this procedure.

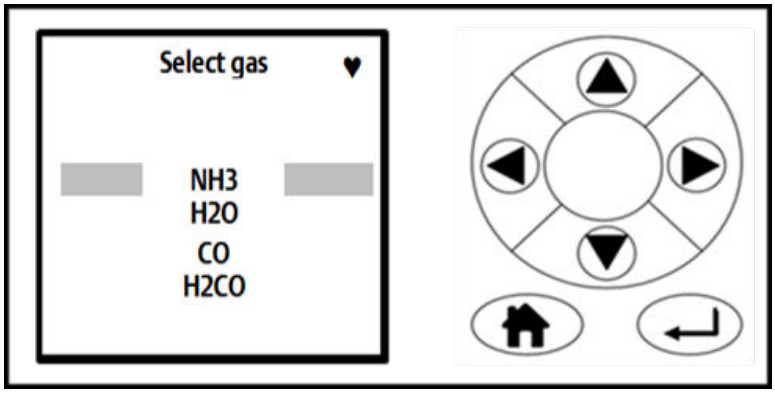
Procedure

1. Use a certified reference gas cylinder as the source of the span calibration gas.
2. Make sure that a pressure regulator is connected to the reference gas bottle.
3. Connect a hose from the reference gas bottle, through a T-piece, to the sample supply port on the rear panel of the analyzer. Connect an excess flow line to the unused port on the T-piece and route the excess flow line to a suitable extractor.
4. On the display controller of the analyzer, browse to the Main menu as described in *Section 4.9*.

5. Refer to *Figure 6-2*. Using ▲ and *DOWN* ▼, select **GAS SERVICE**.
6. Press ▶.

   The Select gas screen (*Figure 6-10*) opens.

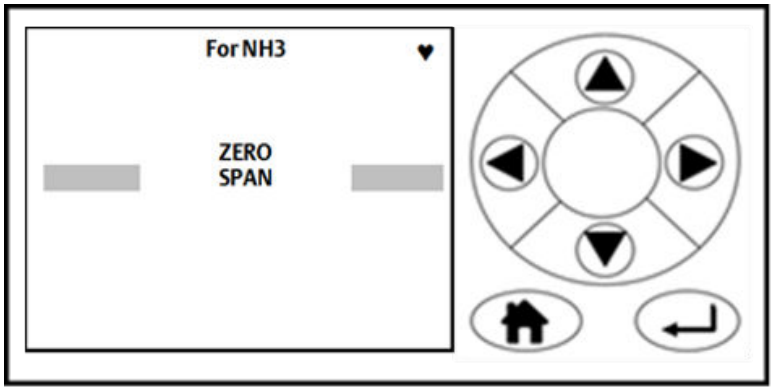
Figure 6-10: Select gas Screen



7. Use ▲ and ▼ to move the cursor until the gas that you wish to span calibrate is highlighted by the cursor. Press ▶.

   The *Select type* screen (*Figure 6-11*) opens.

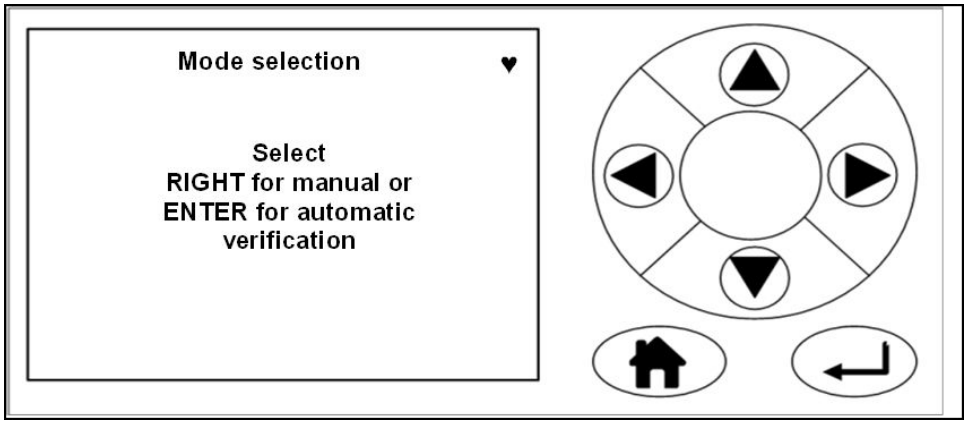
Figure 6-11: Select Type Screen



8. Use ▲ and ▼ to move the cursor until SPAN is selected (*Figure 6-11*). To perform a calibration, press ↵.

   The Mode selection screen (*Figure 6-12*) opens.

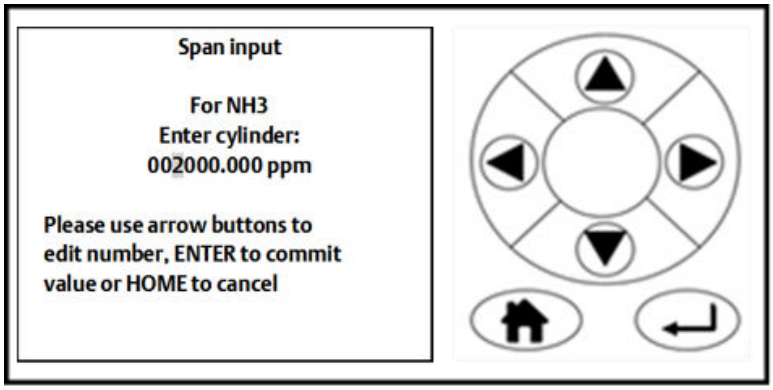
Figure 6-12: Mode selection screen



9. Press ▶ to perform a manual calibration.

   The Span input screen (*Figure 6-13*) opens.

Figure 6-13: Span input Screen



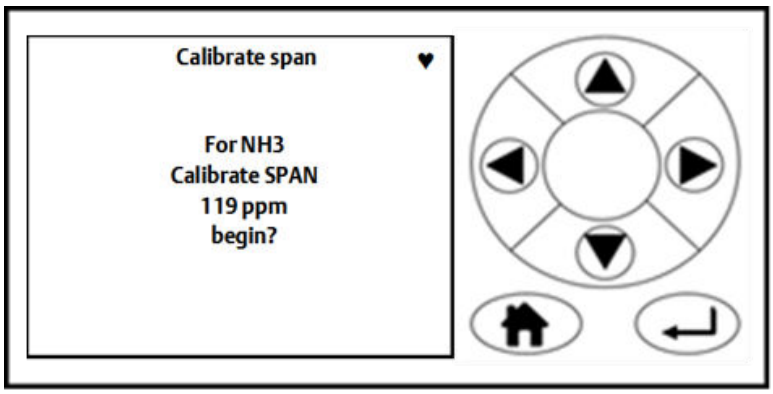
10. Use ◀ and ▶ to highlight each digit in turn; then use ▲ and ▼ to increase or decrease the value until the concentration displayed matches the cylinder you are using. Press ↵ to proceed to the next step.

NOTICE

The cylinder concentration must be entered in ppm.

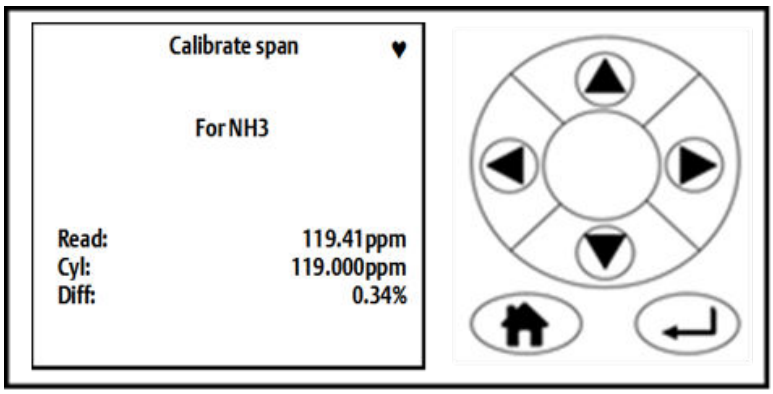
The begin Calibrate span screen (*Figure 6-14*) opens.

Figure 6-14: Begin Calibrate span Screen



11. Press ▶ to confirm. The Calibrate span screen *Figure 6-15* opens.

Figure 6-15: Calibrate span Result Screen



12. Allow the concentrations to stabilize and wait for two minutes after stabilization.

    This screen gives a reading of the concentration of the selected gas that is present, as measured by the instrument. In *Figure 6-15*, the gas being measured is NH_3 (ammonia), and the instrument has detected a concentration of 119.41 ppm (vol).

13. If the reading is within tolerance, no further action is required. Press ▲ or ▼ to abort the span calibration process.

14. If the reading is outside tolerance, press *ENTER* ↵.

    The analyzer returns to its factory-set calibration.

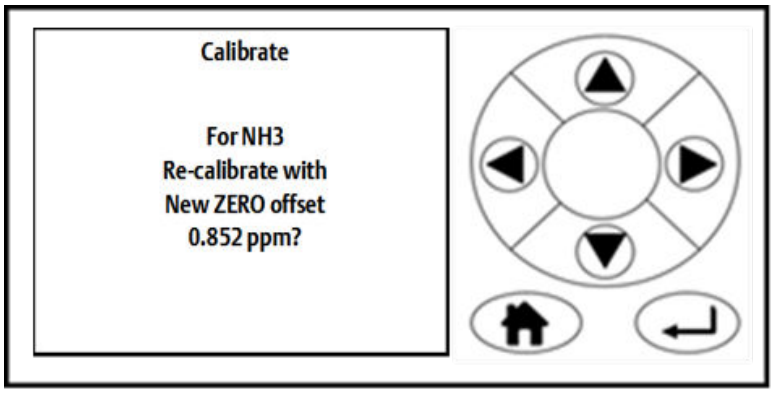
15. Allow a minute to ensure the readings are stable.

16. If the reading is now within tolerance, no further action is required. Press ▲ or ▼ to abort the span calibration process.

17. If the calibration of the analyzer remains outside of tolerance, you can adjust the calibration by pressing ▶.

    This brings up a Calibrate screen (*Figure 6-16*).

Figure 6-16: Calibrate - re-calibrate with New ZERO offset screen



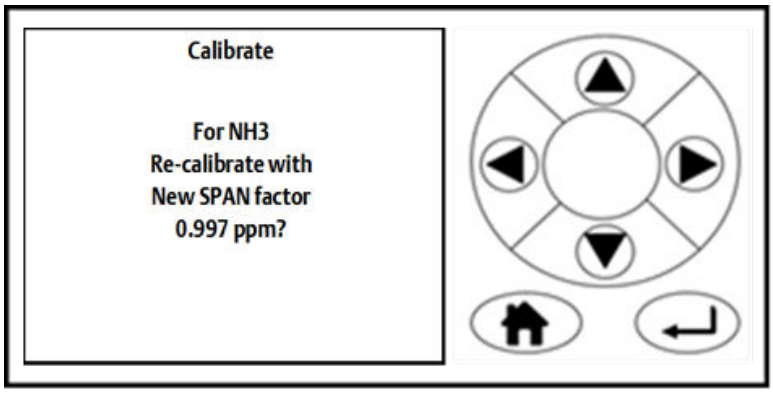
18. To proceed with the automatic re-calibration, press ▶.

    The automatic re-calibration of the instrument's span calibration starts, and the offset shown on the screen (in *Figure 6-17* it is 0.997) is applied to the instrument.

    Press ▲ or ▼ to abort the calibration process.

    When the calibration or verification is complete, the screen shown in *Figure 6-17* is displayed.

Figure 6-17: Calibrate Complete Screen



19. If you wish to perform a span calibration for another gas, press ▼.

    The software returns to the Select gas screen (*Figure 6-10*). Repeat steps 7-18 for the next gas.

20. If you are finished calibrating the analyzer, press ↵. The software returns to the *Main menu* shown in *Figure 6-2*.

6.4 Reference gas - suggested concentration ranges

Calibration gas ranges are recommended to be between 80% and 100% of the full range of the analyzer. Please contact Emerson if you require assistance.

7 Troubleshooting and diagnostics

7.1 Troubleshooting, repairs, and failure diagnostics

Failure diagnosis of the analyzer comprises interpretation of system fault messages shown on the LCD display, visual examination, performing failure diagnostic tests, and downloading performance data and sending that data to Emerson for analysis.

In the failure diagnosis procedures, all controls and indicators are on the analyzer unless otherwise indicated.

The analyzer is specifically designed to run unattended for long periods, to automatically resolve system issues, and to recover from power failures and return to a normal working state. This troubleshooting guide is intended to assist maintenance personnel when the analyzer has not appeared to be working normally for a period of more than five minutes. If the procedures given in this chapter fail to return the analyzer to normal operations or do not identify a repairable fault, notify your Customer Care Representative for further assistance.

Observe and obey all safety precautions when performing preventative maintenance on the analyzer.

Important

The troubleshooting and failure diagnosis procedures described in this chapter assume that any host equipment provided by you is fully functional. Always make sure that the host equipment is fully serviceable before performing failure diagnosis on the analyzer.

Failure diagnosis, repair, and maintenance must only be performed by:

- Maintenance engineers who have the necessary skills and training , and who have been authorized to perform maintenance on the analyzer.
- Emerson™ customer care engineers

In all the cases described in this chapter, maintenance personnel must perform the repairs by directly replacing the faulty item with a known serviceable spare part supplied by Emerson. All other items must be repaired or replaced by the manufacturer.

You can gain access to repairable and replaceable parts by removing the top and or bottom covers of the analyzer. There is no need to remove any other parts.

DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson recommends that the analyzer is only moved and lifted by a minimum of two people when lifting and transporting the equipment. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

WARNING!

FIRE AND EXPLOSION
Do not open the Ex d enclosure of the analyzer unless the atmosphere in the area is known to be below the ignitable concentration of combustible gases or materials.

Failure to observe this precaution will cause death, personal injury, and/or damage to persons.

WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

⚠ WARNING!

HAZARDOUS SUBSTANCES
The analyzer may contain hazardous substances. Always handle the analyzer assemblies and components with extreme caution.

Gas handling components within the analyzer will contain particulate matter residue from the sample gases. Over the life of the analyzer, the concentration of particulate matter will become enriched within the gas handling components. When performing repairs and maintenance on the analyzer:

- **Handle used gas handling components with extreme caution.**
- **Avoid direct skin contact with used gas handling components.**
- **Do not smoke, drink, or eat in the work area.**
- **Wear goggles or eye shields.**
- **Wear a suitable face mask to protect against inhalation of particulate matter.**
- **Do not wet fingers, eyes, or any exposed skin.**
- **Pack used gas handling components for disposal in sealed packaging and label them *Contaminated*.**
- **Dispose of contaminated items as hazardous material according to the applicable local, national, or international health and safety regulations and pollution regulations.**

7.2 Using the Built-in-Test (BIT) fault diagnostics

The analyzer has a limited BIT diagnostics function.

Prerequisites

The BIT function can be used to perform failure diagnosis of some functions in situations where there is a fault other than a complete failure of the equipment. The BIT is accessed and controlled through the display controller mounted on the front panel.

Procedure

1. The *STATUS* information can be displayed from either the Gas Sensor Main screen (see *Figure 7-1*) or the Pressure and Temperature screen (see *Figure 7-2*)

Figure 7-1: Gas Sensor Main Screen

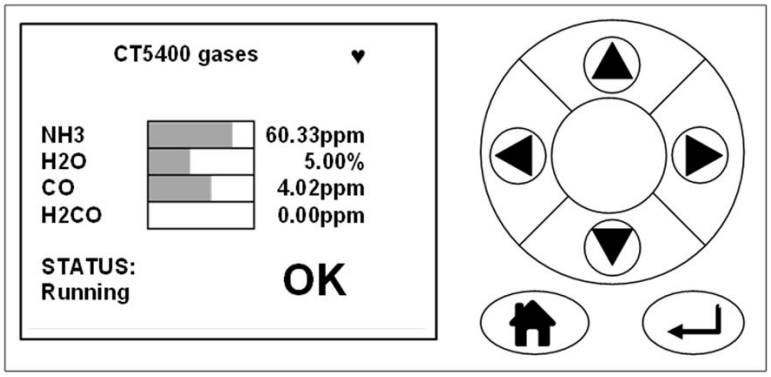
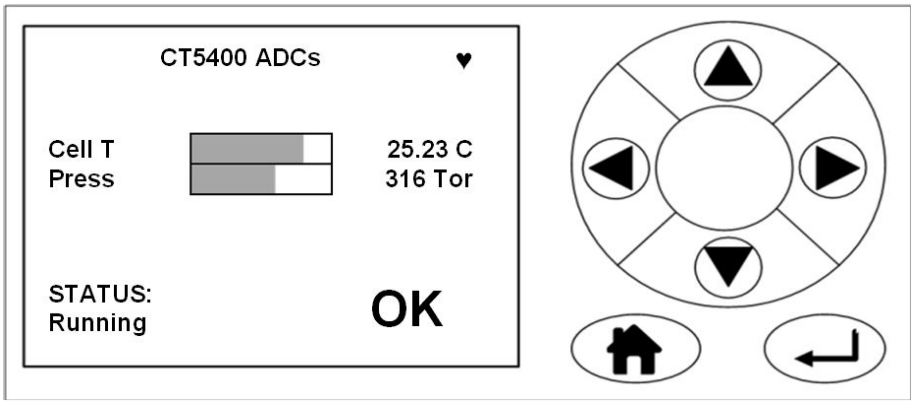
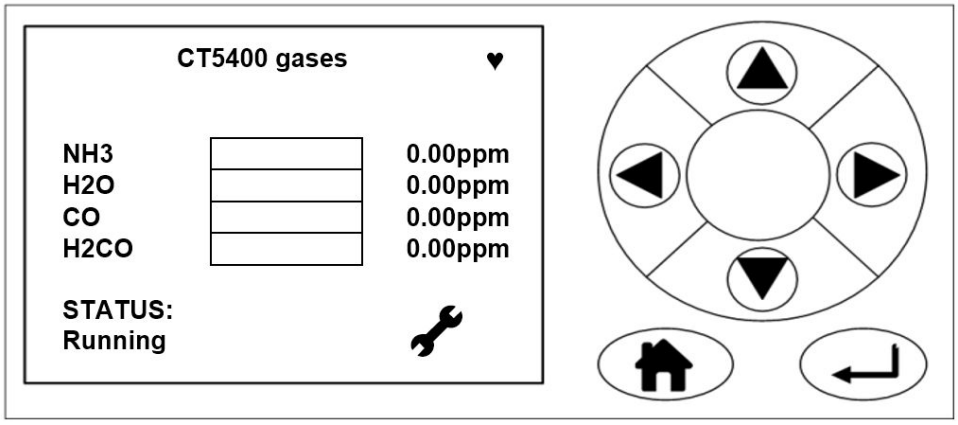


Figure 7-2: Pressure and Temperature Screen



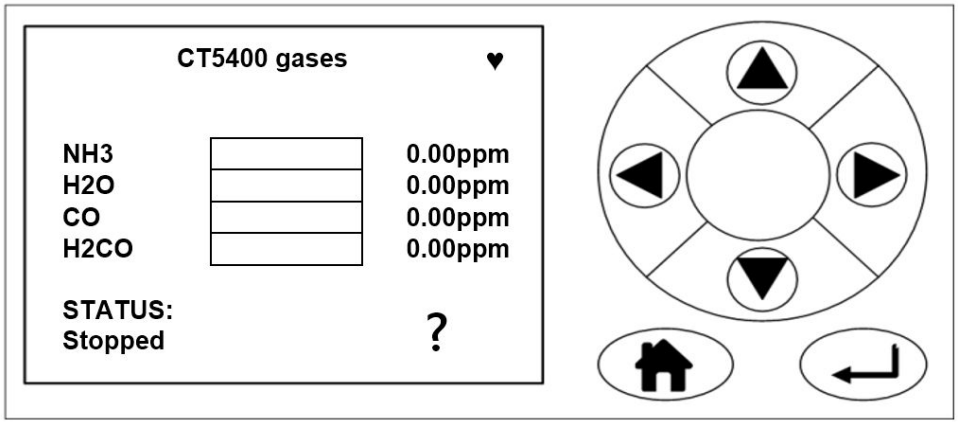
2. When the analyzer is running correctly, the `STATUS` displays `Running` and `OK` (see *Figure 7-1*).
3. If a fault is detected the `STATUS` display in the bottom left-hand corner of the screen changes from `OK` to a flashing **X** .

Figure 7-3: Fault Status - Analyzer Running Screen



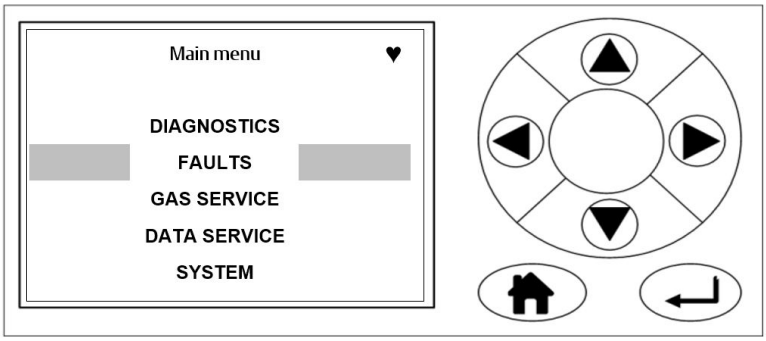
If the analyzer stops the `STATUS` changes to `Stopped`, and `OK` changes to a **?**.

Figure 7-4: Fault Status - Analyzer Stopped



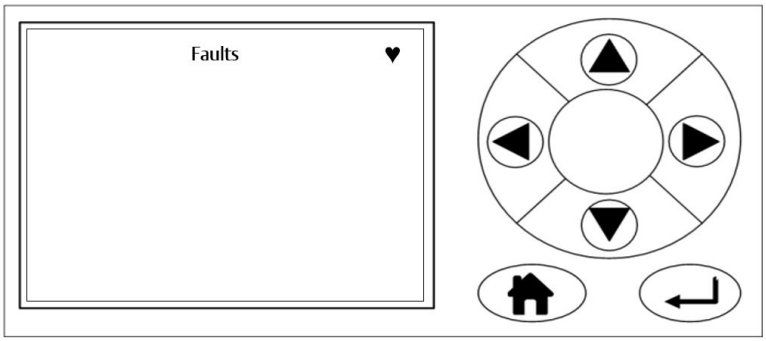
4. From either the Gas sensor main screen (see *Figure 7-1*) or the Pressure and Temperature screen (see *Figure 7-2*), press ▶ to go to the Main menu.
5. Press ▲ and ▼ to scroll to the Faults screen.

Figure 7-5: Main menu - FAULTS Screen



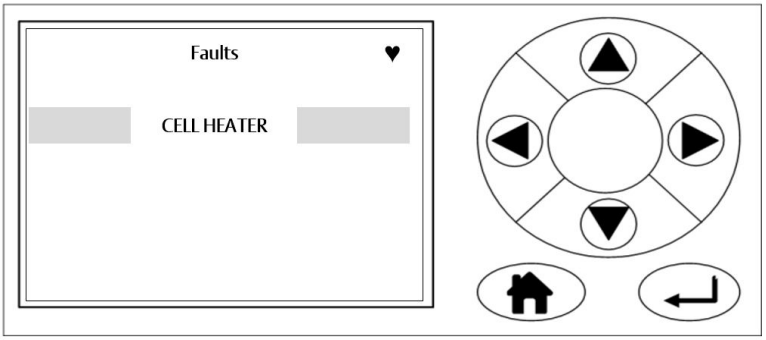
If the no faults have been identified by the BIT the central area of the Faults screen is blank.

Figure 7-6: Faults Screen - No Faults Detected



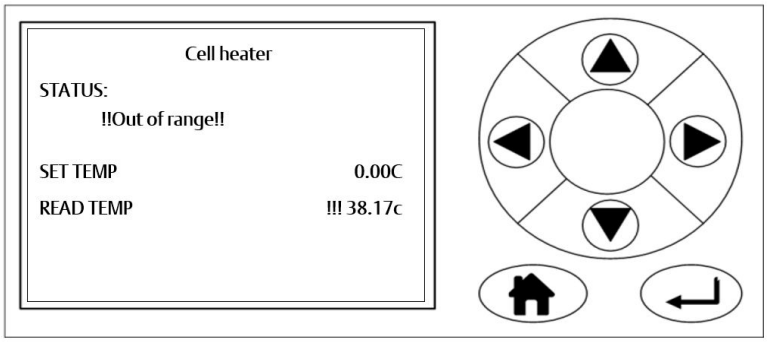
If the faults are identified by the BIT, the display controller indicates the fault. The precise data displayed varies depending upon where the fault has occurred in the analyzer.

Figure 7-7: Faults Detected Screen



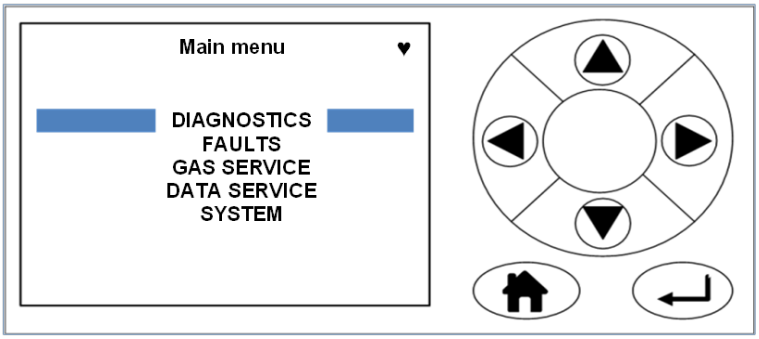
6. Press ▲ and ▼ to list the fault listed.
7. Press ▶ to display the *Fault* diagnostic information screen.

Figure 7-8: Cell heater Temperature Out of Range



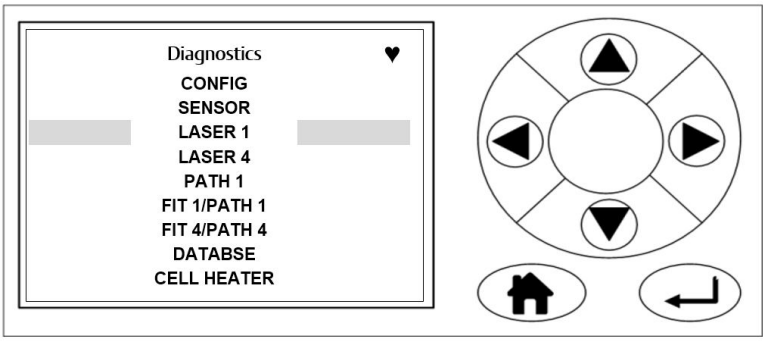
8. Examine the data shown on the Fault screen to determine if the suspect component has failed or is operating outside of its correct parameters. If you do not have the necessary information to determine if the suspect component is faulty, contact your local Customer Care representative.
9. From the Main menu, press ▲ and ▼ to scroll to DIAGNOSTICS.

Figure 7-9: Main Menu



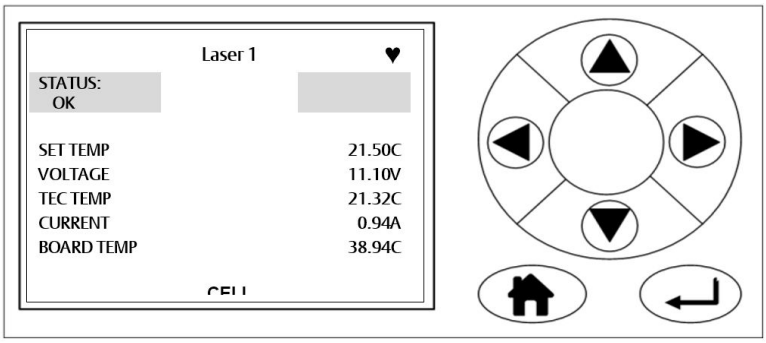
The Diagnostics screen lists those main components of the analyzer where problems can be diagnosed using the BIT system. The Diagnostics screen also enables you to check on the status and, where appropriate, the values of any of the listed components.

Figure 7-10: Diagnostics Menu



10. Press ▲ and ▼ to scroll to the component for further troubleshooting.
11. Press ▶ to display the component's diagnostic information. See *Figure 7-11* for a diagnostics example for Laser 1.

Figure 7-11: Laser 1 Component Diagnostics Screen



The parameters data displayed varies depending upon which component was selected for diagnosis.

12. Examine the data shown on the Component Diagnostic screen to determine if the suspect component has failed or is operating outside of its correct parameters. If you do not have the necessary information to determine if the suspect component is faulty, contact your local Customer Care representative.

7.3 Visual examination

A visual examination of the analyzer is recommended as the next step in failure diagnosis if the BIT fails to identify the problem.

DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Power down the analyzer and allow it to cool.
2. Visually examine the exterior of the analyzer for signs of damage.
3. Perform a visual inspection of the optical and electrical components inside the analyzer.
4. If any loose connections are found in the electrical compartment, refer to the wiring diagrams (see *Appendix C*) to identify and repair the connection.

7.4 Failure diagnostics

If the BIT and the visual examination fail to identify the fault, perform the failure diagnostics and recommended actions.

General troubleshooting and diagnostics information

To assist with failure diagnosis, use the wiring diagrams (see *Appendix C*) to locate the position of a wiring connector should it become disconnected.

Table 7-1: Functional failure diagnostics table

Step	Symptom	Test	Result	Recommended actions	Result	Cause
1	Gas reading abnormal.	Check measurement validity flag.	Reading invalid.	Refer to step 3.		
			Reading valid.	Perform a new zero and span calibration to ensure calibration factors are correct.	Readings return to normal.	Sensor required calibration.
					Abnormal readings persist.	Unknown. Contact Cascade Technologies, Ltd.
2A	Calibration/validation drift	Check measurement validity flag.	Reading invalid.	Refer to step 3.		
			Reading valid.	Perform a new zero and span calibration to ensure calibration factors are correct.	Readings return to normal.	Sensor required calibration.
					Drift persists.	Refer to step 2B.
2B		Check calibration cylinder.	Cylinder near empty.	Replace cylinder.	Readings return to normal.	Cylinder was empty.
					Drift persists.	Refer to step 2C.
2C		Check calibration pipework.	Pipework damaged.	Replace pipework.	Readings return to normal.	Pipework was damaged.
					Drift persists.	Unknown. Contact Cascade Technologies, Ltd
3	Measurement invalid flag	Check display controller to assess which measurements are invalid.	All gas readouts invalid.	Use the display controller to check pressure and cell temperature.	Pressure and temperature are both in range.	Hardware failure. Contact Cascade Technologies, Ltd.
					Pressure or temperature is out of range.	Refer to steps 5 or 6 as appropriate.
			One gas readout invalid.	Refer to step 4.		
4	Single gas reading invalid.	Check which gas.	Any gas.	Check fault reading.	Fault reading active.	Use Fault to access further diagnostic information; contact Cascade Technologies, Ltd.

Table 7-1: Functional failure diagnostics table *(continued)*

Step	Symptom	Test	Result	Recommended actions	Result	Cause
					Fault reading not displayed.	Unknown. Contact Cascade Technologies, Ltd.
5	Analysis cell pressure out of range.	Adjust inlet valve to change pressure.	Pressure returns to normal.	No further action required.	Pressure returns to normal.	Pressure was out of range.
			Pressure is unstable or impossible to adjust.	Contact Cascade Technologies Ltd.		
6	Analysis cell temperature out of range	Read cell temperature from display controller.	Temperature too low.	Allow system time to heat up.	System heats up with time.	System was recently started from cold.
					System does not heat up.	Heater failure. Contact Cascade Technologies, Ltd.
			Temperature too high.	Contact Cascade Technologies Ltd.		
7	Sensor frozen or unresponsive.	Attempt a reboot.	System reboots successfully.	No further action required.	System reboots successfully.	Computer freeze-up or connection failure. Contact Cascade Technologies Ltd. if this recurs.
			System does not reboot.			PC or HMI failure. Contact Cascade Technologies, Ltd.
8	Other error not covered above.	Unknown. Contact Cascade Technologies Ltd.				

7.5 Repairable items

The major items that are repairable without Emerson's assistance are listed in Spare parts list. In all cases, the repair is by direct replacement of the faulty item with a known serviceable item purchased from Emerson . If any items other than those listed require service, Emerson must perform the repair.

Before commencing any repair on the analyzer, allow it to cool down as detailed in the safety precautions below.

⚠ WARNING!

BURNS
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- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

Only standard hand tools are required to perform the tasks described in this section.

7.6 Tools and test equipment required for troubleshooting

The following tools are required to remove and replace components

Table 7-2: Required Tools

3 mm	Hex key needed to open the box
2.5 mm	Hex Socket (Allan key)
4.0 mm	Hex Socket (Allan key)

Table 7-2: Required Tools *(continued)*

5.0 mm	Hex Socket (Allan key)
7.0 mm	Spanner
8.0 mm	Spanner
14 mm	Spanner
16 mm	Spanner
Small snap on ratchet	
Small flat blade screwdriver (used for wiring terminals)	
Multi-meter - used to perform continuity checks on electrical wiring during an inspection.	
Control drawing	
Wiring diagrams - *Appendix C*	

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

7.7 Removing the top cover

Remove the top cover to access the interior of the analyzer.
Observe all safety precautions before starting this procedure.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON/OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ WARNING!

ELECTRIC SHOCK
Do not operate without covers secure.

Do not open while energized.

Installation requires access to live parts which can cause death or serious injury.

For safety and proper performance, this instrument must be connected to a properly grounded three-wire source of power.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson recommends that the analyzer is only moved and lifted by a minimum of two people when lifting and transporting the equipment. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

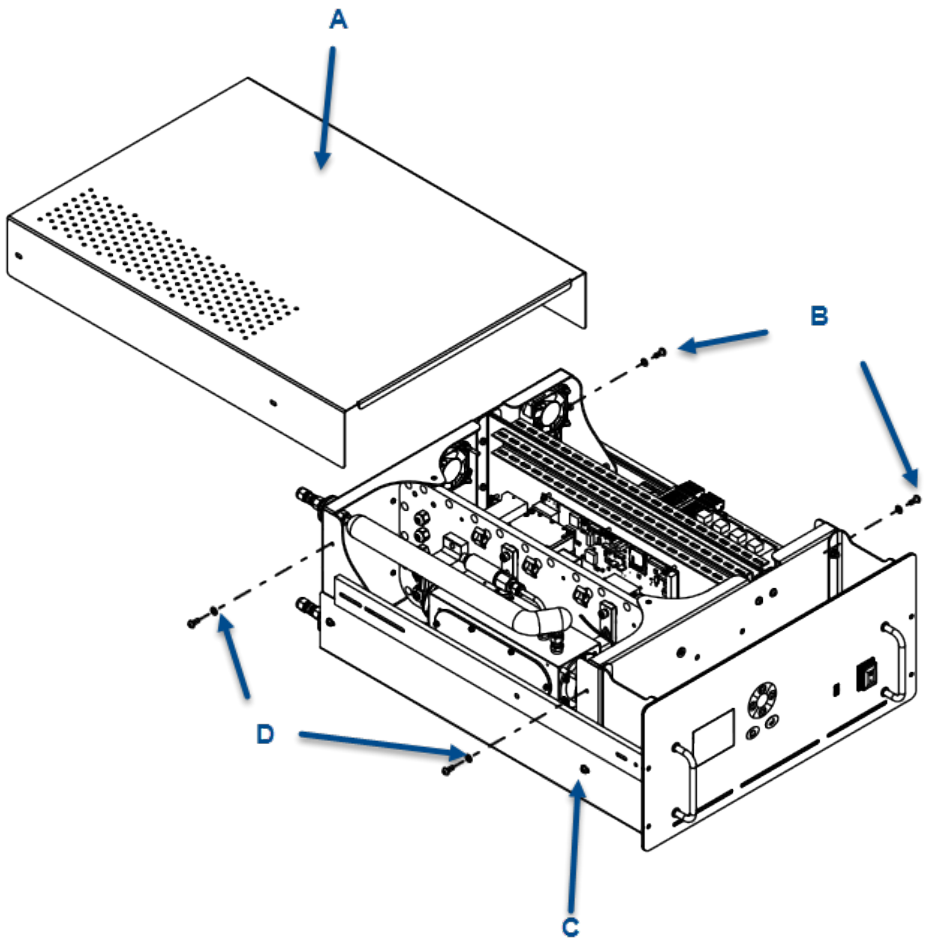
BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

To gain access to the electrical, pneumatic, and optical components, it may be necessary to remove the top cover.

Figure 7-12: Removing the Top Cover



A. Top cover
B. M5 x 12 mm button head socket screws (4)
C. Chassis assembly
D. M5 flat washers (4)

Procedure

1. Set the *ON/OFF* switches on the front and back panel to **OFF**.
2. Allow the analyzer to cool for at least two hours. Allow it to cool for twelve hours if replacing the analysis cell.
3. Disconnect all external cables.

   Tag if necessary.
4. Remove the analyzer from the rack and place on a flat, stable surface that can accommodate the weight. This step requires two people to lift and transport the analyzer.

5. Remove and retain the four M5 button head socket screws and associated flat washers.
6. Lift the cover vertically, clear of the chassis assembly. Set it aside, out of the working area.
7. Examine the cover for signs of physical damage. If it is undamaged, retain and reinstall it when all repairs are complete. Minor paintwork may be retouched.

7.8 Removing the bottom cover

To gain access to the electrical, pneumatic, and optical components, it may be necessary to remove the bottom cover.
Observe all safety precautions before starting this procedure.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

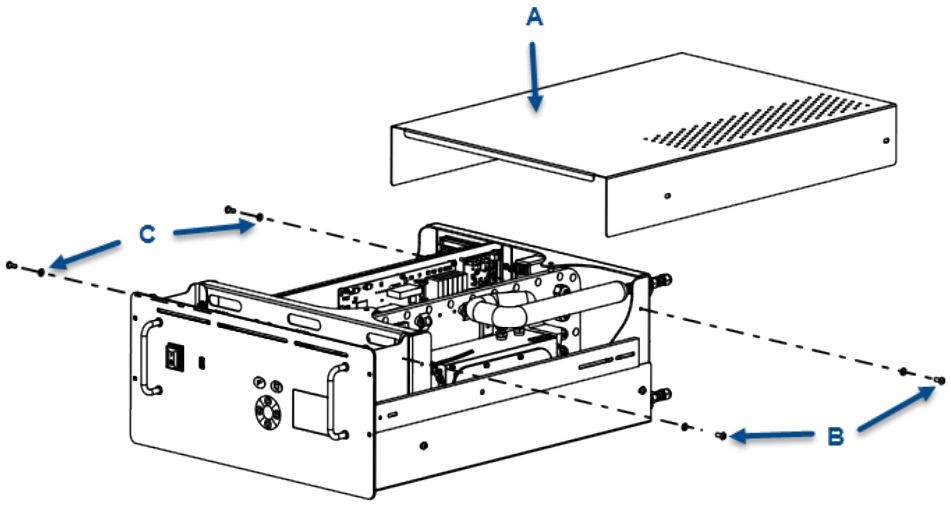
BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Refer to *Figure 7-13* and proceed as follows:

Figure 7-13: Removing the Bottom Cover



A. Bottom cover
B. M5 x 12 mm button head socket screws (4)
C. M5 flat washers (4)

Procedure

1. Set the *ON/OFF* switches on the front and back panel to OFF.
2. Allow the analyzer to cool for at least two hours. Allow to cool for twelve hours if replacing the analysis cell.
3. Disconnect all external cables.

   Tag if necessary
4. Remove the analyzer from the rack and place it upside down on a flat, stable surface that can accommodate the weight. This step requires two people to lift and transport the analyzer.
5. Remove and retain the four button head socket screws and associated flat washers.
6. Lift the cover vertically, clear of the chassis assembly. Set it aside, out of the working area.
7. Examine the cover for signs of physical damage. If it is undamaged, retain and reinstall when all repairs are complete. Minor paintwork may be re-touched.

7.9 Replacing the LCD display

To replace the display, complete the following instructions.

DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

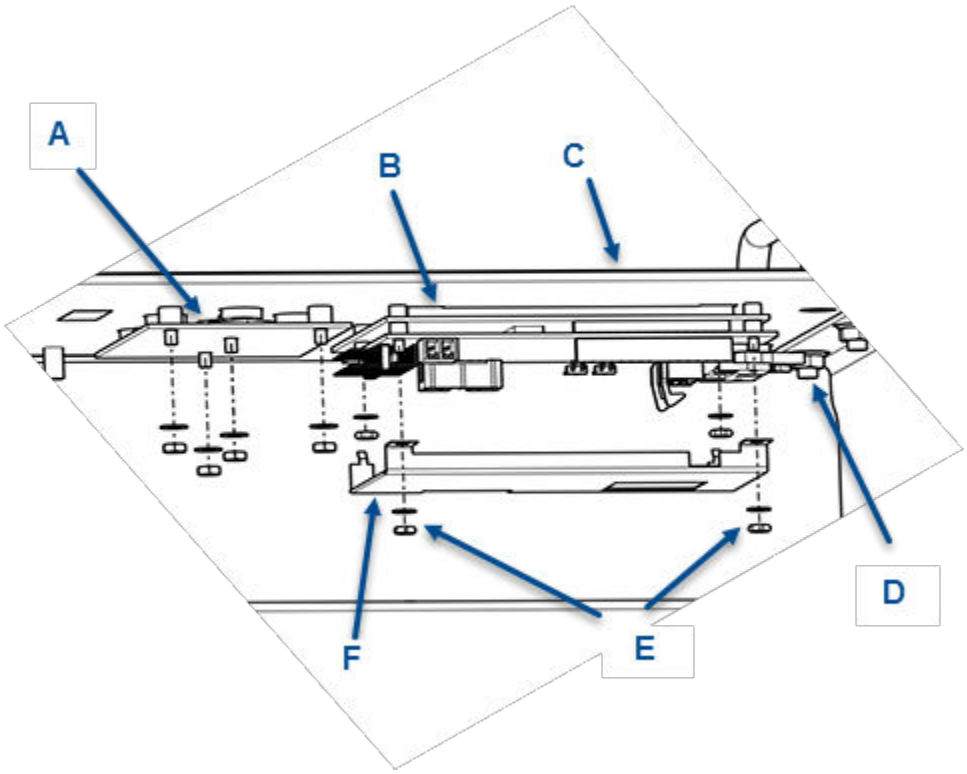
- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Power down the analyzer by switching the *ON*/*OFF* switches on the front and rear panel to the OFF position and allow the core to cool for twelve hours.
2. Remove the analyzer from the rack using two people to lift the analyzer and place it on a clean workbench.
3. Remove the four screws and associated washers attaching the top cover to the chassis. Vertically lift the cover from the chassis and set aside.

Figure 7-14: Replacing the LCD Display



A. Display controller PCB
B. LCD display
C. Front panel
D. Ribbon cable connection
E. 3 M hex nuts and plain washers
F. Display back cover

4. Disconnect the ribbon cables and wiring harness from the display.
5. Using a small spanner, remove and retain the two M3 hex nuts and plain washers (E), holding the display back cover (F) in place.
6. Remove the back cover (F) from the rear of the display. If necessary, pry it off with a small, flat-bladed screwdriver.
7. Remove the display (B) and the display controller PCB (A) by pulling them out to the rear from the front panel.
8. Make sure the display bezel seal is present and free from cuts.
9. Unpack and visually inspect the replacement LCD display for damage. If damage has occurred, contact your local Emerson Customer Care Representative.
10. Insert the display into the front panel.
11. Replace the eight M3 plain washers and M3 hex nuts retained when removing the display.
12. Plug in the ribbon cables.

13. Apply power to restart the analyzer.

7.10 Replacing the USB circuit board

The USB printed circuit board (PCB), located on the rear of the front panel, is a replaceable part. Replace the USB PCB as follows:
Observe all safety precautions before starting this procedure.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ WARNING!

ELECTRIC SHOCK
Do not operate without covers secure.

Do not open while energized.

Installation requires access to live parts which can cause death or serious injury.

For safety and proper performance, this instrument must be connected to a properly grounded three-wire source of power.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson recommends that the analyzer is only moved and lifted by a minimum of two people when lifting and transporting the equipment. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

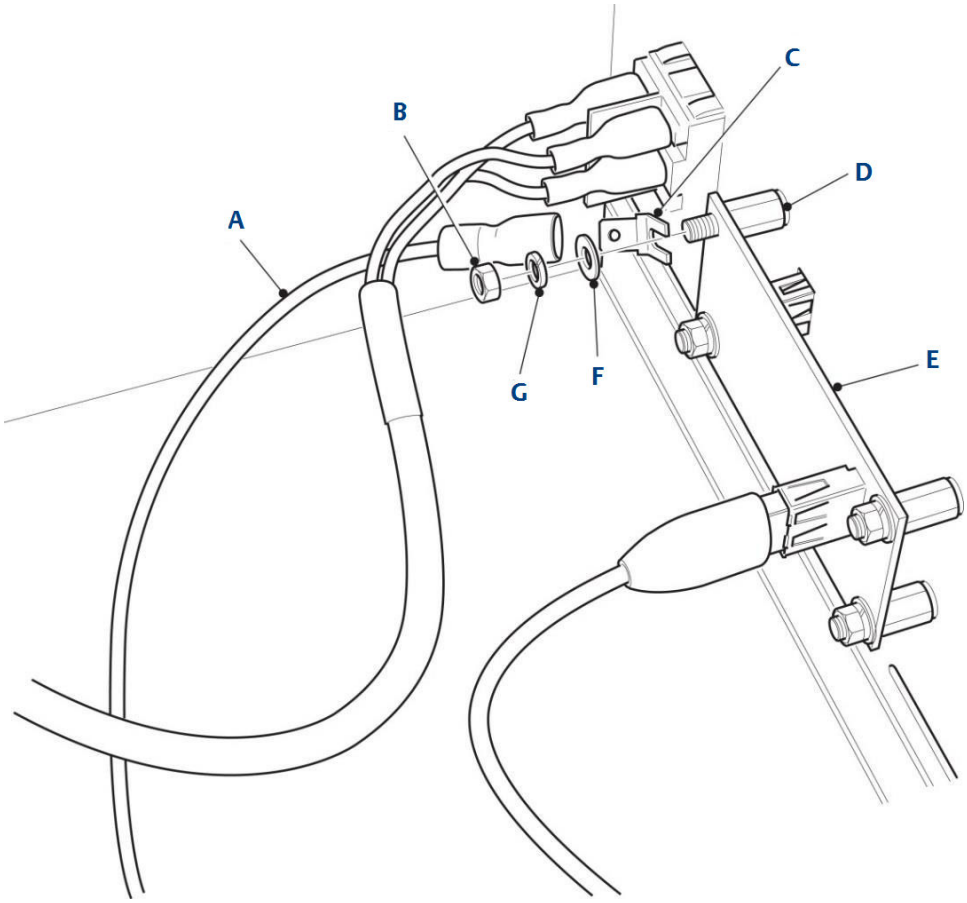
- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Power down the analyzer and allow it to cool.
2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport it to the workbench.
3. Remove and retain the top cover as described in *Section 7.7*.
4. Refer to *Figure 7-15*. Disconnect the spade connector on the end of the Earth lead (A) from the tag clip (C).

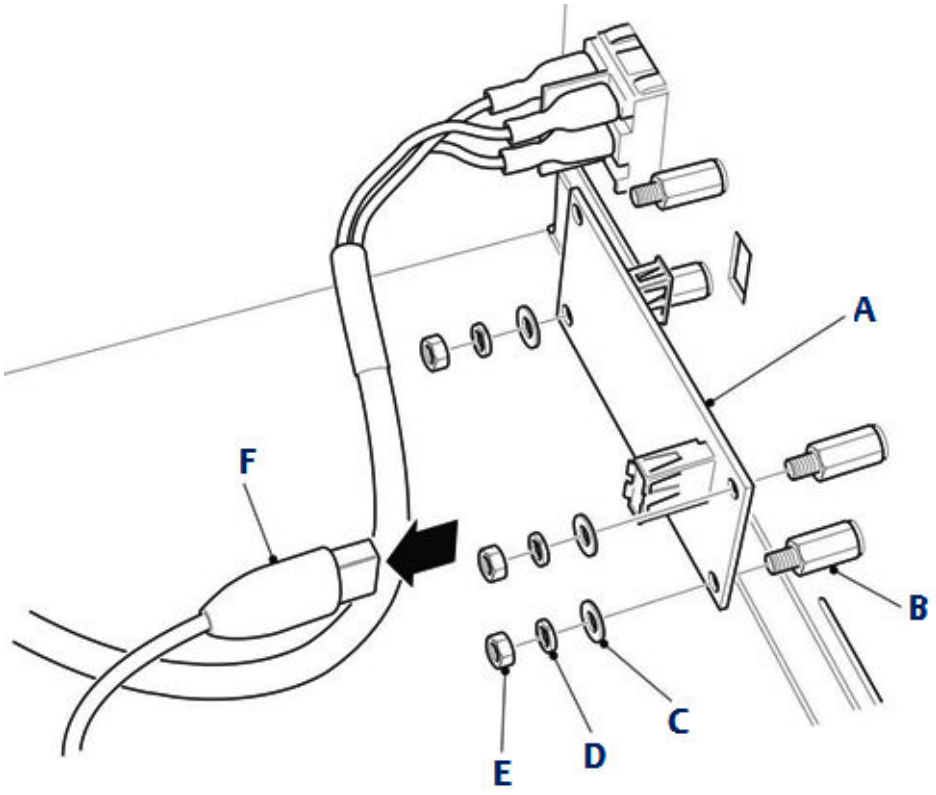
Figure 7-15: Earth Ground Connection



A. Earth lead
B. M4 nut
C. Tag connector
D. Threaded spacer (front panel part)
E. USB circuit board
F. M4 flat washer
G. M4 spring washer

5. Disconnect the USB cable (F) from the USB PCB (A).

Figure 7-16: Removing the USB PCB



A. USB PCB
B. Threaded spacer (part of front panel)
C. M4 flat washer
D. M4 spring washer
E. M4 nut
F. USB cable

6. Remove and retain the three nuts (E), spring washers (D), and flat washers (C).
7. Remove the USB PCB.
8. Use caution when unpackaging and handling the USB PCB. Examine the replacement USB PCB for physical damage and delamination.

⚠ CAUTION!

EQUIPMENT DAMAGE

Wear an ESD wrist strap or ground yourself to prevent damage to the USB PCB electronics.

9. Place the replacement USB PCB (A) on the four threaded spacers (B) that form part of the front panel.

10. Secure the USB PCB by fitting the three flat washers (C), spring washers (D) and nuts (E) retained in Step 4, in the locations shown in *Figure 12-7*.

    Do not fit securing hardware to the top left-hand threaded spacer at this stage.

11. Attach the USB cable (F) to the USB connector on the USB PCB.
12. Refer to *Figure 7-16*. Fit the tag connector (C) to the top left-hand threaded spacer (D). Secure the tag connector with the flat washer (F), spring washer (G), and nut (B) retained in Step 6.
13. Attach the spade connector at the free end of the Earth wire (A) to the tag connector (C).

7.11 Replacing the power socket fuses

The analyzer contains two external fuses that are located in the fused power socket on the rear panel.
Observe all safety precautions and allow the equipment to cool down before performing this procedure.

The same procedure is used to replace both external fuses; therefore, the replacement of only one is described.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Power down the analyzer using the *ON*/*OFF* switches on the front panel and back panel.
2. Disconnect the external power supply from the power socket.

Note
Do not remove the top cover. The external fuses are located on the back panel.

⚠ WARNING!

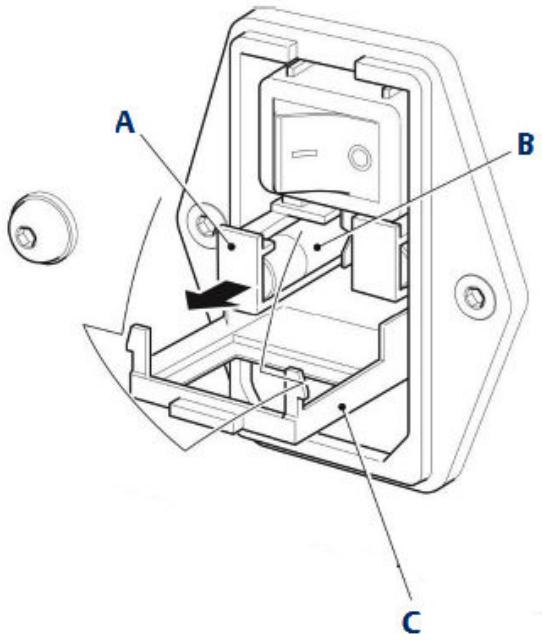
ELECTRIC SHOCK

Only replace fuses with fuses of the same type and rating (240 V, 50 Hz, 500 mA, fast-acting).

Failure to do so may result in personal injury.

3. Lower the fuse cover (C) by rotating downward.

Figure 7-17: Power Socket Fuses



A. Fuse holder
B. Fuse
C. Cover

4. Pull out the fuse holder (A).
5. Remove the fuse (B) from the holder (A) .
6. Fit a new fuse (B), type: 240 V, 50 Hz, 500 mA, fast-acting, into the fuse holder (A).
7. Fully push in the fuse holder (A).
8. Close the fuse cover (C).
9. Reconnect the external power supply to the power socket.
10. Start up the analyzer by turning the *ON*/*OFF* switches to the ON position.

7.12 Replacing the internal fuses

The analyzer contains a number of internal fuses. The same procedure is used to replace all of the internal fuses; therefore, the replacement of only one is described.

DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

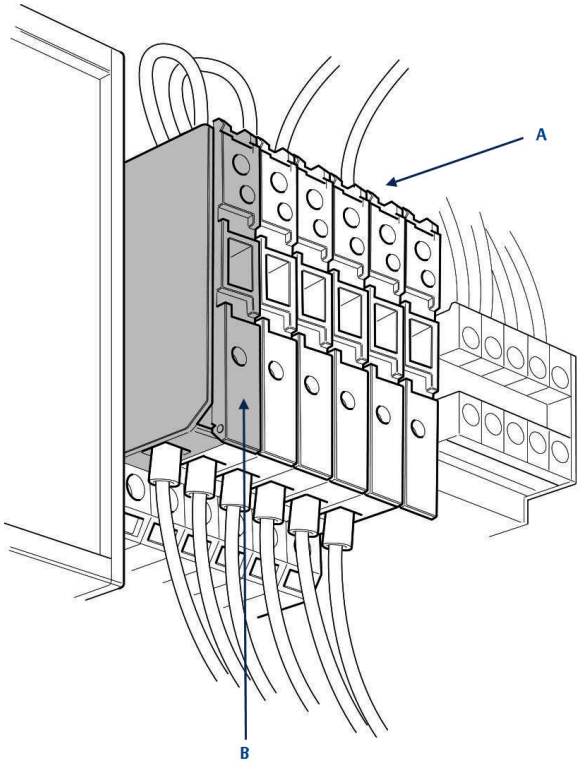
Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Shut down the analyzer as described in *Section 8.2*.
2. Remove power to the analyzer and disconnect the power cable.
3. Remove the analyzer from the rack using two people to lift and transport the analyzer to a stable surface.
4. Remove the top cover and set it aside.

   Each fuse is located inside a fuse box sub-assembly that is mounted on a DIN rail on one side of the core.

Figure 7-18: Fuse Block Sub-assembly (Fuse Holder Closed)



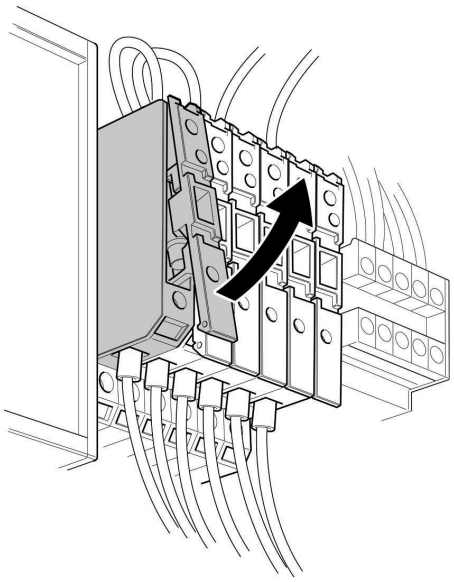
A. Internal fuse block sub-assembly
B. Grey-shaded fuse holder

Table 7-3: Internal fuse - specifications

Fuse number	Type	Protection
F1	6 A, 250 V, 5 x 20 mm, fast-acting	12 Vdc PSU
F2	6 A, 250 V, 5 x 20 mm, fast-acting	12 Vdc PSU
F3	1 A, 250 V, 5 x 20 mm, fast-acting	Line heater, number 1
F4	2 A, 250 V, 5 x 20 mm, fast-acting	Line heater, number 2
F5	2 A, 250 V, 5 x 20 mm, fast-acting	Cell heaters
F6	1 A, 250 V, 5 x 20 mm, fast-acting	Line heater controllers

5. No tools are required to remove the fuse. Place a finger on the catch at the top of fuse holder and lift up the upper part of the fuse holder.

Figure 7-19: Fuse block sub-assembly (fuse holder partially opened)



⚠ WARNING!

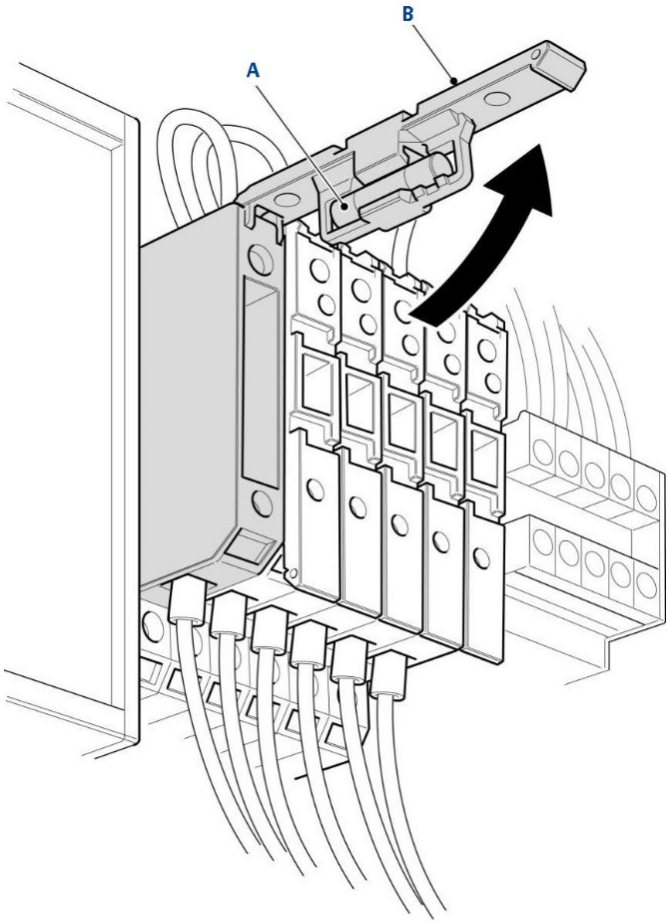
ELECTRIC SHOCK

Only replace fuses with fuses of the same type and rating.

Failure to do so may result in personal injury.

6. Refer to *Figure 7-20*. Fully raise the upper part of the fuse holder (B) and then push out the old fuse (A).

Figure 7-20: Fuse Block Sub-assembly (Fuse Holder Fully Opened)



A. Fuse holders
B. Fuse holder cover

⚠ WARNING!

ELECTRIC SHOCK

Only replace fuses with fuses of the same type and rating.

Failure to do so may result in personal injury.

7. Fit the replacement fuse (A) into the fuse holder (B).

   Refer to *Table 7-3* and make sure that the fuse is of the correct type and rating.
8. Lower the upper part of the fuse holder, ensure that it *clicks* into place when fully lowered.
9. Remove the *Lock-Out /Tag-out* tag .

10. Turn the *ON*/*OFF* switches on the front and back panel to the **ON** position to restart the analyzer.

7.13 Replacing the fans

The analyzer contains two identical fans. The replacement procedures for both fans are similar; therefore, the replacement procedure for only one is described.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Power down the analyzer and allow it to cool.
2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport it to the workbench.

3. Cut and remove the cable ties from the wiring harness.

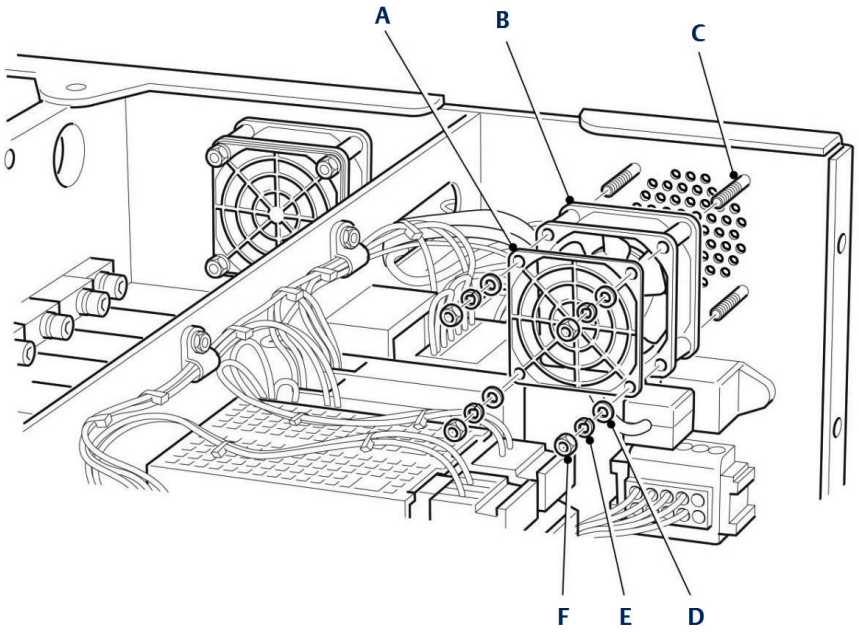
Important

Note the routing of the fan wiring harness and the location of the cable ties securing the fan wiring harness.

The wiring harness of one fan goes directly to the peripheral PCB. The wiring harness of the other fan goes to a two-way mini-fit terminal block.

4. Disconnect the fan wiring harness from the peripheral PCB or the two-way mini-fit terminal block, as applicable.
5. Remove and retain the four nuts (F) and associated spring washers (E) and flat washers (D).

Figure 7-21: Replacing the Analyzer Fan(s)



A. Fan finger guard
B. Fan
C. Threaded stud
D. M4 flat washer
E. M4 spring washer
F. M4 plain nut

6. Remove and retain the nuts, spring washers, and flat washers (D, E, and F).
7. Remove and retain the fan finger guard (A).
8. Remove and discard the unserviceable fan (B).
9. Examine the replacement fan for damage. If it is damaged, contact your local Emerson Customer Care representative.

10. Fit the replacement fan in position on the four threaded studs (C) and the finger guard (A).
11. Secure the fan (B) and finger guard (A) with the nuts, spring washers, and flat washers (D, E, and F).
12. Route the fan wiring harness as noted in Step 4 and connect the fan wiring harness to either the peripheral PCB or the two-way mini-fit terminal block, as applicable.
13. Secure the wiring harness with cable ties.
14. Refit the top cover and reinstall on the rack. Use two people to lift and transport the analyzer (see *Section 7.25*) .
15. Apply power to restart the analyzer.

7.14 Replacing the terminal electric cooler (TEC) board

Complete the following instructions to replace the terminal electric cooler (TEC) board. Observe all safety precautions before starting this procedure.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson recommends that the analyzer is only moved and lifted by a minimum of two people when lifting and transporting the equipment. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

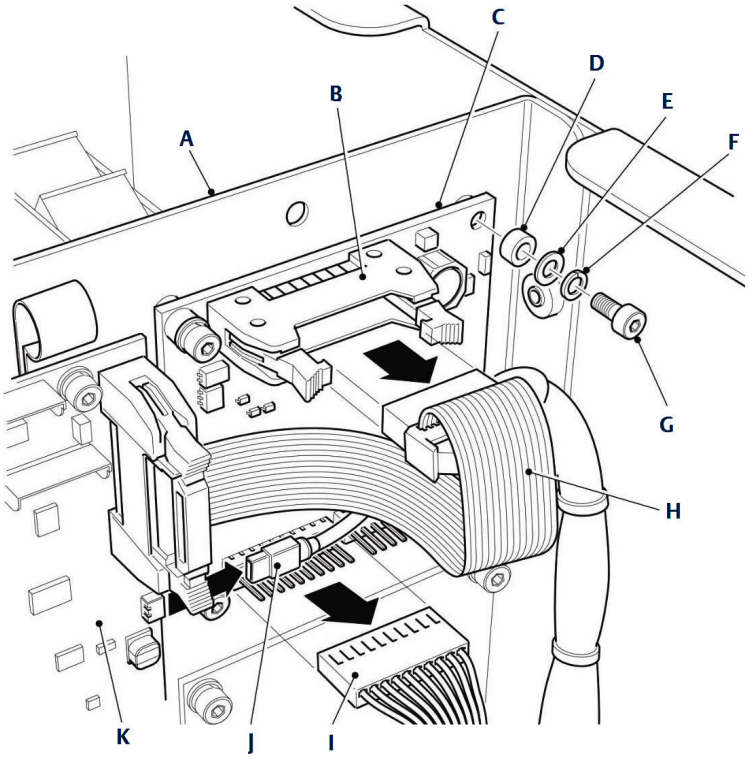
Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

To gain access to the electrical, pneumatic, and optical components, it is necessary to remove the top cover.

Procedure

1. Shut down the analyzer as described in *Section 8.2* and allow it to cool..
2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport to the workbench.
3. Remove and retain the four screws attaching the top cover to the chassis.
4. Open the locking arms of the ribbon cable connector (B) and disconnect the ribbon cable (H) from the TEC Board (C).

Figure 7-22: Replace the TEC Board



A. PCB mounting plate
B. Ribbon cable connector
C. TEC board
D. Spacer
E. M3 flat washer
F. M3 spring washer
G. M3 x 6 mm socket head cap screw
H. Ribbon cable to Motherboard
I. Wiring harness
J. Wiring harness to USB port
K. Motherboard

5. Disconnect the wiring harness (I) from the TEC Board (C). A wiring harness to the USB port (J) obstructs the removal of the TEC Board. Disconnect the wiring harness (J) from the motherboard (K).
6. Remove and retain the four screws (G) and associated spring washers (F), flat washers (E), and spacers (D) that secure the TEC Board to the mounting plate (A).
7. Remove the TEC Board (C) from the PCB Mounting Plate (A).
8. Discard the unserviceable TEC board observing all local and federal laws regarding disposal of electronics.

⚠ CAUTION!

ELECTROSTATIC DISCHARGE

Wear an ESD wrist strap or ground yourself to prevent damage to the USB PCB electronics.

9. Examine the replacement TEC Board for damage or delamination. If damaged, contact your local Customer Care representative.
10. Fit the TEC Board (C) in position on the PCB Mounting Plate (A). Secure the TEC Board by fitting the four screws (G) and associated spring washers (F), flat washers (E), and spacers (D) that were retained during the removal procedure. Torque tighten the screws to 0.5 Nm.
11. Connect the USB wiring harness (J) to the motherboard (K).
12. Connect the wiring harness (I) to the TEC board (C).
13. Connect the ribbon cable (H) to the ribbon cable connector (B) on the TEC board. Make sure that the ribbon cable securely clicks into place in the ribbon cable connector.
14. Remove Lock-Out Tag-Out labels.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

15. Apply power to restart the analyzer.

7.15 Replacing the peripheral PCA board

To replace the peripheral board, complete the following steps.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON/OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson recommends that the analyzer is only moved and lifted by a minimum of two people when lifting and transporting the equipment. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

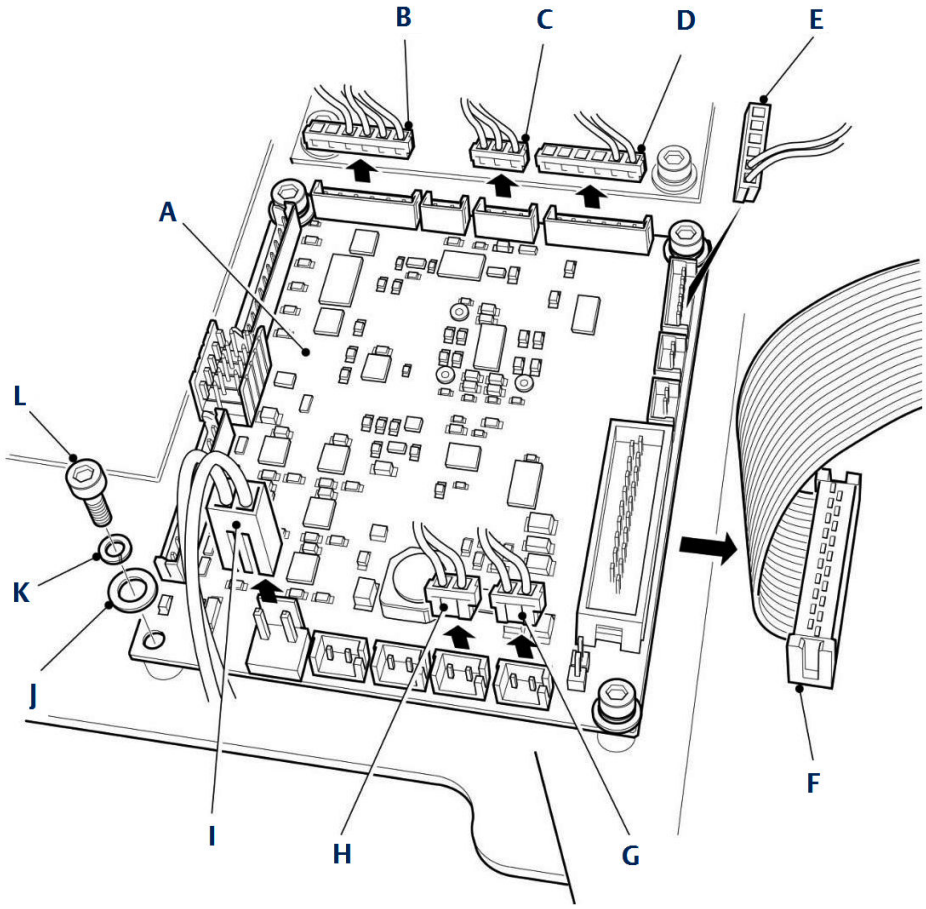
- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Shut down the analyzer as described in *Section 8.2* and allow it to cool..
2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport to the workbench.
3. Refer to *Figure 7-23*. Disconnect the 12 V power wiring harness (I) from the peripheral PCA board (A).

Figure 7-23: Peripheral PCA Board



A. Peripheral PCA board
B. Gas/cell temperature monitoring harness
C. Gas/cell temperature monitoring harness
D. Gas/cell temperature monitoring harness
E. Wiring harness to cell heater relay
F. Ribbon cable to motherboard
G. Wiring harness to fan A
H. Wiring harness to fan B
I. 12 V power wiring harness to J17 on motherboard
J. M3 flat washer
K. M3 spring washer
L. M3 x 6 socket head cap screw

4. Disconnect the ribbon cable (F) from the peripheral PCA board (A).
5. Disconnect the two fan wiring harnesses (G and H) from the peripheral PCA.
6. Disconnect the cell heater relay wiring harness (E)

7. Disconnect the three connectors (B, C, and D) of the gas/cell temperature monitoring harness.
8. Remove the four cap head screws (L), spring washers (K), and flat washers (J).
9. Remove the peripheral PCA board (A) from the analyzer.

⚠ CAUTION!

ELECTROSTATIC DISCHARGE

Wear an ESD wrist strap or ground yourself to prevent damage to the replacement peripheral PCA board.

10. Discard the unserviceable peripheral PCA board observing all local and federal laws regarding disposal of electronics.
11. Remove the replacement peripheral PCA board from the shipping package and inspect for damage. If damaged, contact your local Customer Care representative.
12. Place the peripheral PCA (A) in position on the PCB mounting plate. Secure the peripheral PCA by fitting the four cap head screws (L), spring washers (K), and flat washers (J) retained during the removal procedure.
13. Torque tighten the screws to 0.6 Nm.
14. Connect the three gas/cell temperature monitoring harness connectors (B, C, and D).
15. Connect the cell heater relay wiring harness (E) to connector J50 on the peripheral PCA.
16. Connect the two fan wiring harnesses (G and H) to connectors J4 and J18 on the peripheral PCA.

    It is not important which fan wiring harness is connected to which connector.
17. Connect the ribbon cable (F) to connector J2 on the peripheral PCA board (A).
18. Connect the 12 V power wiring harness (I) to connector J2 on the peripheral PCA board (A).
19. Refit the top cover as described in *Section 7.25*.
20. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport it to the rack.
21. Remove Lock-Out Tag-Out labels.
22. Apply power to restart the analyzer.

7.16 Replacing the motherboard

Complete the following steps to replace the motherboard.
Observe all safety precautions before starting this procedure.

DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

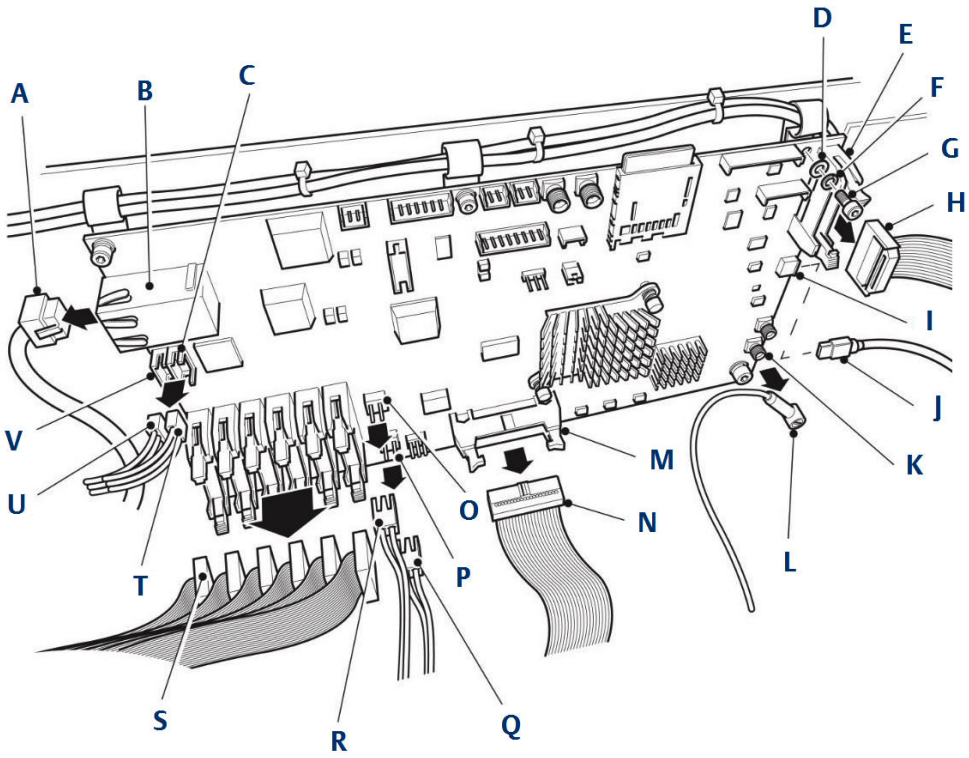
Death or personal injury may result if this is not observed.

To gain access to the electrical, pneumatic, and optical components it is necessary to remove the top cover.

Procedure

1. Shut down the analyzer as described in *Section 8.2*.
2. Power down the analyzer and allow it to cool.
3. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport to the workbench.
4. Tag or otherwise identify all wiring harnesses before disconnecting.

Figure 7-24: Replacing the Motherboard



A. Ethernet cable
B. Ethernet connector
C. Connector J23
D. M3 flat washer
E. Ribbon cable connector J12
F. M3 spring washer
G. M3 x 6 mm socket head cap screw
H. USB wiring harness
I. Ribbon cable to TEC board
J. USB ribbon cable connector J21
K. TRIGGER OUT connector J32
L. TRIGGER OUT wiring harness
M. Ribbon cable connector to J7
N. Ribbon cable connector to Peripheral PCA board
O. 12 V power out connector J17
P. 12 V power in connector J16
Q. 12 V power input wiring harness
R. 12 V power output wiring harness
S. Laser module ribbon cable
T. Serial port wiring harness
U. HMI display wiring harness
V. Connector J22

5. On the motherboard, disconnect the TEC board ribbon cable (I) from connector J12 (E).
6. Disconnect the USB wiring harness (H) from the USB connector J21 (J).
7. Disconnect the TRIGGER OUT wiring harness (L) from connector J32 (K).
8. Disconnect the laser module ribbon cables (S) from the motherboard.

   The number of laser module ribbon cables to be disconnected will vary depending upon the application for which the analyzer has been configured.
9. Disconnect the 12 V power input wiring harness (Q) from connector J16 (P).
10. Disconnect the 12 V power output wiring harness (R) from connector J17 (O).
11. Disconnect the peripheral PCA ribbon cable (N) from connector J7 (M).
12. Disconnect the Ethernet cable (A) from the Ethernet connector (B).
13. Disconnect the HMI display wiring harness (U) from connector J22 (V).
14. Disconnect the serial port wiring harness (T) from connector J23 (C).
15. Remove and retain the six screws, spring washers, and flat washers (G, F and D).
16. Remove the motherboard.
17. Discard the unserviceable motherboard observing all local and federal laws regarding disposal of electronics.

⚠ CAUTION!

ELECTROSTATIC DISCHARGE

Wear an ESD wrist strap or ground yourself to prevent damage to the motherboard electronics.

18. Inspect the replacement motherboard for signs of damage or delamination.
19. Place the motherboard in position on the PCB mounting plate and secure it by fitting the six screws (G) and the associated spring washers (F) and flat washers (D) retained during the removal procedure. Torque tighten the screws to 0.6 Nm.
20. Connect the serial port wiring harness (T) to connector J23 (C) on the motherboard.
21. Connect the HMI display wiring harness (U) to connector J22 (V).
22. Connect the Ethernet cable (A) to the Ethernet connector (B).
23. Connect the peripheral PCA ribbon cable (N) to connector J7 (M).
24. Connect the 12 V power output wiring harness (R) to connector J17 (O).
25. Connect the 12 V power input wiring harness (Q) to connector J16 (P).
26. Connect the laser module ribbon cables (S) to the motherboard. Make sure that the laser module ribbon cables are connected to the correct laser module connectors on the motherboard, as tagged or noted down during the removal procedure.
27. Connect the TRIGGER OUT wiring harness (L) to connector J32 (K).
28. Connect the USB wiring harness (H) to the USB connector J21 (J).
29. Connect the TEC board ribbon cable (I) to connector J12 (E).

30. Refit the top cover as described in *Section 7.25*.
31. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport it to the rack.
32. Remove Lock-Out Tag-Out labels.
33. Apply power to the analyzer.

7.17 Replacing the DIN Rail

Replacing the unserviceable active components on the DIN rail is complex and time consuming. For assistance contact your local Customer Care representative.

7.17.1 Replacing the analog input unit

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

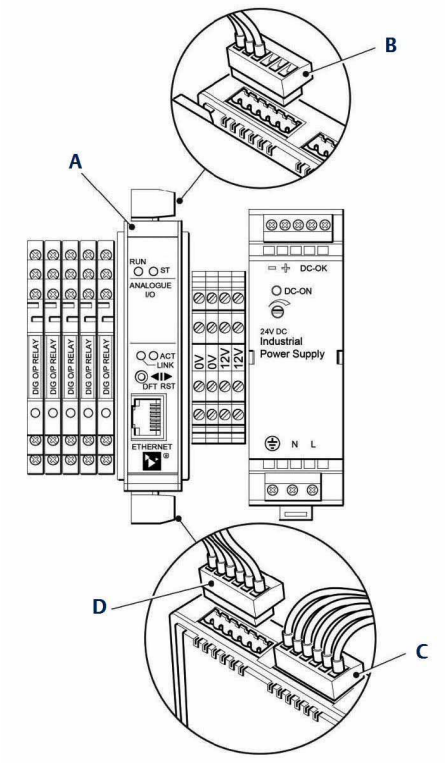
- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Shut down the analyzer by switching the *ON/OFF* switches on the front and rear panels to the **OFF** position and allow the analyzer to cool.
2. Remove the analyzer from the rack using two people to lift the analyzer and place it on a clean workbench.
3. Remove and retain the four screws attaching the top cover to the chassis.
4. Disconnect the analog I/O connector from the top of the analog IN/OUT unit.

Figure 7-25: Analog IN/OUT Unit



A. Analog I/O unit
B. Wiring harness connector (top)
C. Wiring harness connector (bottom)
D. Wiring harness connector (bottom)

5. Disconnect the two wiring harness connectors (C and D) from the bottom of the analog input unit.
6. Release the analog input unit from the DIN rail by pressing a small lever on the underside of the unit. While continuing to press the lever, remove the analog input unit from the DIN rail.
7. Discard the unserviceable analog input unit.
8. Inspect the replacement unit for damage. If damage has occurred, contact your local Emerson Customer Care Representative.
9. Insert the replacement analog input unit in its correct location on the DIN rail. Press the small lever on the underside of the unit and push the unit onto the DIN rail. Release the small lever and check that the unit is secure.
10. Connect the two wiring harness connectors (C and D) to the bottom of the unit.
11. Refit the top cover as described in *Section 7.25*.
12. Remove the protective masking tape from the flanges, seal,and flamepath.
13. Remove Lock-Out Tag-Out labels.
14. Apply power to the analyzer.

15. Reinstall the analyzer in the rack. This step requires two persons to properly lift and transport to the rack.

7.17.2 Replacing the DC power supply

Use this procedure to replace the DC power supply.

The two DC power supplies are identical; therefore, the replacement procedure for only one is described.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson recommends that the analyzer is only moved and lifted by a minimum of two people when lifting and transporting the equipment. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

1. Power down the analyzer by switching the *ON/OFF* switches on the front and rear panel to the OFF position and allow the core to cool for twelve hours.
2. Remove the analyzer from the rack using two people to lift the analyzer and place it on a clean workbench.
3. Remove the four screws and associated washers attaching the top cover to the chassis. Vertically lift the cover from the chassis and set aside.
4. Disconnect the wiring harness connector (B) from the top of the DC Power Supply (A).
5. Disconnect the wiring harness connector (C) from the bottom of the DC power supply (A).

6. Press the small lever (D) on the underside of the DC power supply (A) to release it from the DIN rail. While continuing to press the lever, remove the DC power supply from the DIN rail.
7. Tag and disconnect all cables and connections as appropriate.
8. Discard the unserviceable DC power supply.
9. Inspect the replacement DC power supply for damage. If damaged, contact your local Customer Care Representative.
10. Place the replacement DC power supply (A) in its correct location on the DIN rail. While pressing the small lever (D) on the underside of the DC power supply (A) to the down position, push the DC power supply onto the DIN rail. Release the small lever and check that the DC power supply is secure.
11. Connect the wiring harness connector (B) to the top of the DC power supply (A).
12. Refit the top cover as described in *Section 7.25*.
13. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport it to the rack.
14. Apply power to restart the analyzer.

7.17.3 Replacing the temperature controller

The two temperature controllers are identical; therefore, the replacement procedure for only one is described. Each temperature controller plugs into a base unit that is mounted on the DIN rail. The base unit has no active components and should not require replacement.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

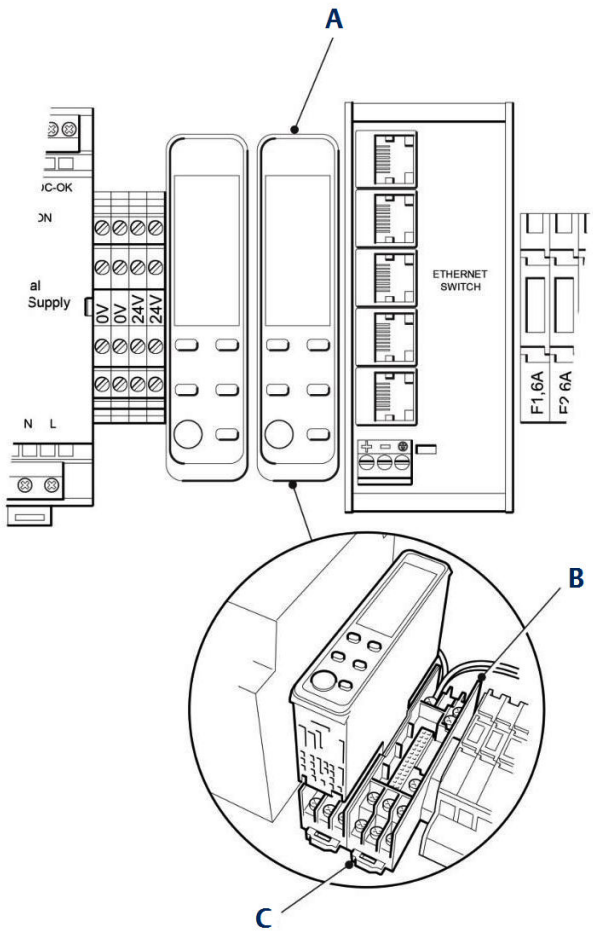
⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Figure 7-26: Replacing a temperature controller



A. Temperature controller
B. Temperature controller base
C. Lever

Procedure

1. Press the small lever (C). While holding the lever in the down position, unplug the temperature controller (A) from the base unit (B).

NOTICE

When replacing a temperature controller, the interconnecting wiring does not have to be disconnected from the base unit.

2. Discard the unserviceable temperature controller.
3. Inspect the replacement temperature controller for damage. If damage has occurred, contact your local Customer Care Representative.
4. Fit the replacement temperature controller (A) onto the base unit (B). Make sure the orientation of the temperature controller is correct. Press the small lever (C) on the base unit and, while holding the lever in the down position, push the temperature controller home into the base unit. Release the lever and check that the temperature controller is secure.
5. Attach the cables and wiring connections to the temperature controller.
6. Refit the top cover as described in *Section 7.25*.
7. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport it to the rack.
8. Remove the protective masking tape from the flanges, seal,and flamepath.

   Use care not to damage the flamepath. Any damage to the flamepath will invalidate certification.
9. Remove lock-out tag-out labels.
10. Apply power to the analyzer.

7.17.4 Replacing the Ethernet switch

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

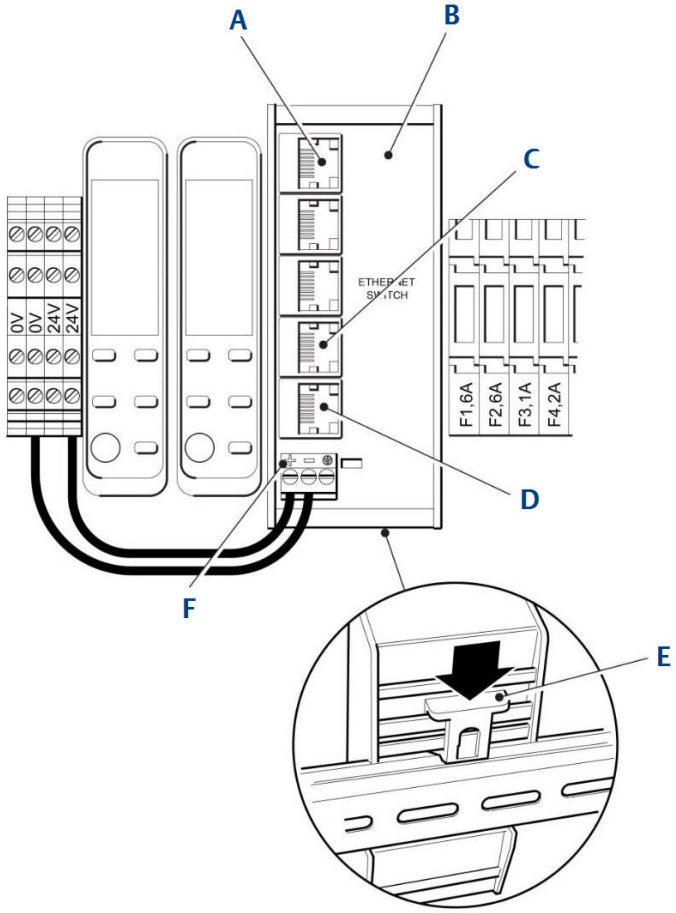
⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Figure 7-27: Replace an Ethernet switch



A. Ethernet connector (to analog input unit)
B. Ethernet switch
C. Ethernet connector (to Ethernet port)
D. Ethernet connector (to Motherboard)
E. Lever
F. Wiring harness

Procedure

1. Power down the analyzer by switching the *ON/OFF* switches on the front and rear panel to the OFF position and allow the core to cool for twelve hours.
2. Lock-out tag-out the power supply.
3. Remove the analyzer from the rack using two people to lift the analyzer and place it on a clean workbench.
4. On the Ethernet switch (B), disconnect the Ethernet cable that links the Ethernet switch to the analog input unit from Ethernet connector number 1 (A).

5. Disconnect the Ethernet cable that links the Ethernet switch to the external Ethernet port from Ethernet connector number 4 (C).
6. Disconnect the Ethernet cable that links the Ethernet switch to the motherboard from Ethernet connector number 5 (D).
7. Disconnect the wiring harness (E) from the Ethernet switch.
8. Press the small lever (F) on the underside of the Ethernet switch to release it from the DIN rail. While continuing to press the lever, remove the Ethernet switch from the DIN rail.
9. Inspect the replacement Ethernet connector for damage. If damaged, contact your local Customer Care Representative.
10. Discard the unserviceable Ethernet switch.
11. Place the replacement Ethernet switch (B) in its correct location on the DIN rail. While pressing the small lever (E) on the underside of the Ethernet switch to the down position, push the Ethernet switch onto the DIN rail. Release the small lever (E) and check that the Ethernet switch is secure.
12. Connect the wiring harness (F) to the Ethernet switch.
13. On the Ethernet switch, connect the Ethernet cable from the motherboard to Ethernet connector number 5 (D).
14. Connect the Ethernet cable from the external Ethernet Port to Ethernet connector number 4 (C).
15. Connect the Ethernet cable from the analog input unit to Ethernet connector number 1 (A).
16. Refit the top cover as described in *Section 7.25*.
17. Close the enclosure cover and secure with the twenty M16 bolts.
18. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport it to the rack.
19. Apply power to restart the analyzer.

7.17.5 Replacing the laser modules

The analyzer contains multiple laser modules; the precise number of laser modules is determined by the configuration of the analyzer.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

Prerequisites

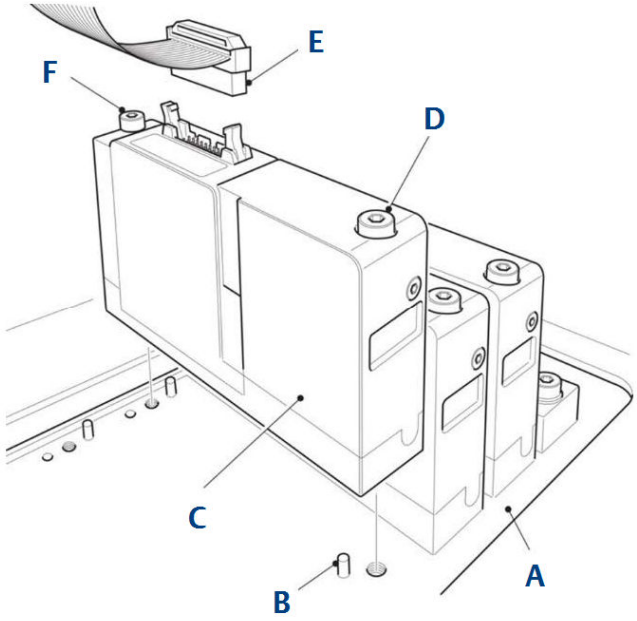
All the laser modules are physically identical, but are NOT interchangeable as they differ in internal settings. Each laser module is a sealed unit and can only be repaired by Emerson. Repair therefore consists of removing the unserviceable laser module and returning it to Emerson for repair.

Procedure

1. Power down the analyzer and allow to cool for two hours.
2. Lock-out tag-out the power circuit breaker.
3. Apply masking tape to the flanges, seal,and flamepath to protect them from scratches, chipping, and other forms of damage or deformation.
4. Remove the twenty M16 captive bolts securing the enclosure and carefully open the enclosure.
5. Unscrew the two 14 mm connections to the gas input and output lines (see *Section 7.21* and *Section 7.22*).
6. Remove the lower DIN rail as described in *Section 7.17.3*.

   Refer to *Figure 7-28* to complete this procedure.
7. Disconnect the ribbon cable (E) and the captive screws (D and F).

Figure 7-28: Removing a Laser Module



A. Base plate
B. Pin
C. Laser module
D. Captive screw
E. Ribbon cable
F. Captive screw

8. Inspect the replacement laser module for damage.
9. Fit the replacement laser module in position on the base plate (A). The laser module must mate with the two locating pins (B) on the Base Plate.
10. Secure the laser module by tightening the two captive screws (D and F).
11. Connect the ribbon cable (E) to the laser module (C).
12. Remove the protective masking tape from the flanges, seal,and flamepath.

    Use care not to damage the flamepath. Any damage to the flamepath will invalidate certification.
13. Remove lock-out tag-out labels.
14. Apply power to the analyzer.

7.18 Replacing the gas temperature sensor

DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

Procedure

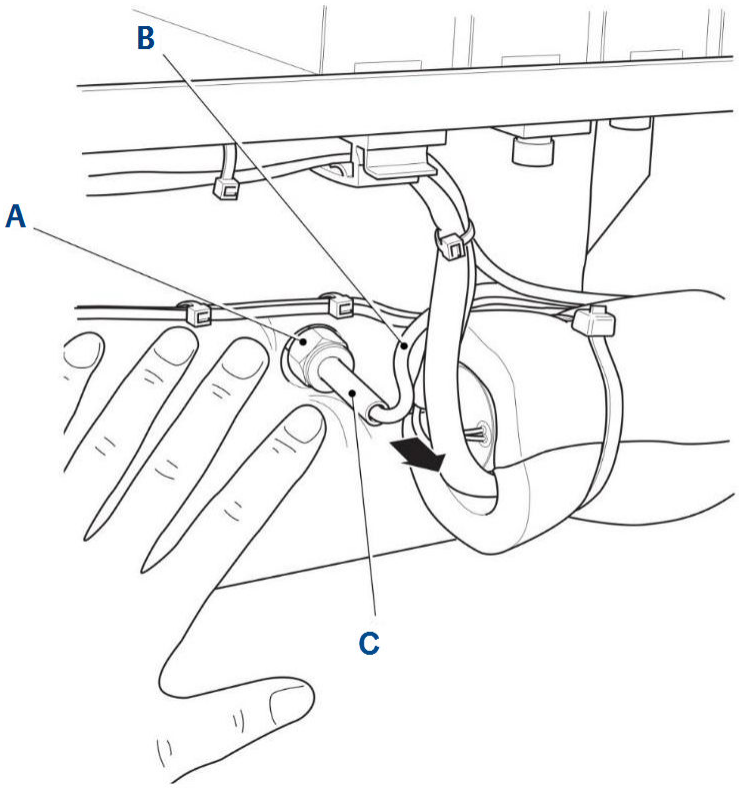
1. Power down the analyzer and allow it to cool.
2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport it to the workbench.
3. Remove the top cover as described in *Section 7.7*
4. Refer to *Figure 7-29*. Note the routing of the gas temperature sensor wiring harness (B) and the location of the cable ties that secure the wiring harness.

   NOTICE

   It is NOT necessary to open up the insulation around the analysis cell in order to replace the gas temperature sensor.

5. Carefully cut and remove any cable ties that secure the gas temperature sensor wiring harness.
6. Disconnect the gas temperature sensor wiring harness from (B) connector block X2 on the DIN rail.
7. As shown in *Figure 7-29*, use your fingers to push inwards the insulation around the analysis cell until the tube fitting (A) is exposed.
8. Release the tube fitting (A) and slide it up the gas temperature sensor thermocouple (C). Remove the thermocouple and tube fitting.

Figure 7-29: Replacing the gas temperature sensor



A. Stainless steel 316 male connector, Let-Lok tube fitting, 6 mm x male ISO tapered thread 1/4 in.

B. Gas temperature sensor wiring harness

C. Gas temperature sensor thermocouple

9. Inspect the replacement gas temperature sensor thermocouple (C) and associated tube fitting (A) for signs of damage.

10. As shown in *Figure 7-29*, use your fingers to push inwards the insulation around the analysis cell. Fit the gas temperature sensor thermocouple (C) and tube fitting (A) to the analysis cell. Apply a small quantity of Loctite 567 liquid PTFE compound to the threads of the tube fitting before it is fitted. Secure the thermocouple by tightening the tube fitting *spanner tight*.

NOTICE

The Swagelok recommendation for pipe fittings of this size is to tighten the nut finger tight and then tighten an additional one and a quarter (1-1/4) turns with a spanner.

11. Route the gas temperature sensor wiring harness (B) to connector block X2 on the DIN rail using the route noted in Step 4. Connect the gas temperature sensor wiring harness to connector block X2.

12. Secure the gas temperature sensor wiring harness with cable ties in the locations that were noted down in Step 4.
13. Refit the top cover as described in *Section 7.25*.
14. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport to the rack.
15. Apply power to restart the analyzer.

7.19 Replacing the pressure sensor

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

Procedure

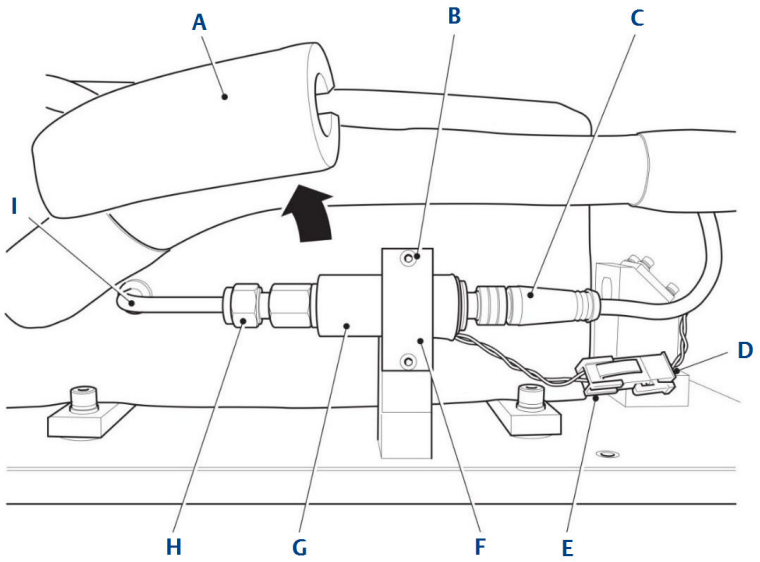
1. Power down the analyzer by switching the ON/OFF switches on the front and rear panels to the OFF position and allow the analyzer to cool.
2. Remove the analyzer from the rack using two people to lift the analyzer and place it on a clean workbench.
3. Remove and retain the four screws attaching the top cover to the chassis.

NOTICE

It is NOT necessary to open up the insulation around the analysis cell in order to replace the pressure sensor.

4. Refer to *Figure 7-30*. Carefully cut the two cable ties that secure the insulation (A) in position. Remove and retain the insulation.

Figure 7-30: Pressure sensor



A. Insulation
B. M3 x 6 mm countersunk socket head screw
C. Wiring harness
D. Wiring harness (to peripheral PCA)
E. 2-way mini-fit electrical connector
F. Retaining plate
G. Pressure sensor
H. 6 mm pipe to 1/8 BSPP adapter 766LGSSMMX1/8
I. Pressure sensor pipe

5. Disconnect power to the analyzer.
6. Allow the analyzer to cool for at least two hours.
7. Remove the twenty M16 bolts from the housing and carefully lower the front housing to the fully open position.
8. Carefully cut and remove any cable ties that secure the gas sensor wiring harness.
9. Disconnect the gas sensor wiring harness from connector block on the DIN rail.
10. Use a spanner on the sensor's 6 ¼ mm hex fitting and remove the sensor from the baseplate.
11. Discard the faulty sensor and Dowty washer.
12. Inspect the replacement sensor and washer for damage. If, damaged, contact you local Customer care Representative.
13. Insert the replacement Dowty washer on the base of the temperature sensor and insert into the baseplate.

14. Use a spanner to tighten the sensor fitting.

NOTICE

The Swagelok recommendation for pipe fittings of this size is to tighten the nut finger tight and then tighten an additional one and a quarter (1-1/4) turns with a spanner.

15. Reconnect the wiring harness and fit with cable ties.
16. Close the housing and secure with twenty M16 bolts.
17. Apply power to restart the analyzer.

7.20 Replacing the thermal cut-out

Complete the following steps to replace the thermal cut-out.
Observe all safety precautions before starting this procedure.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

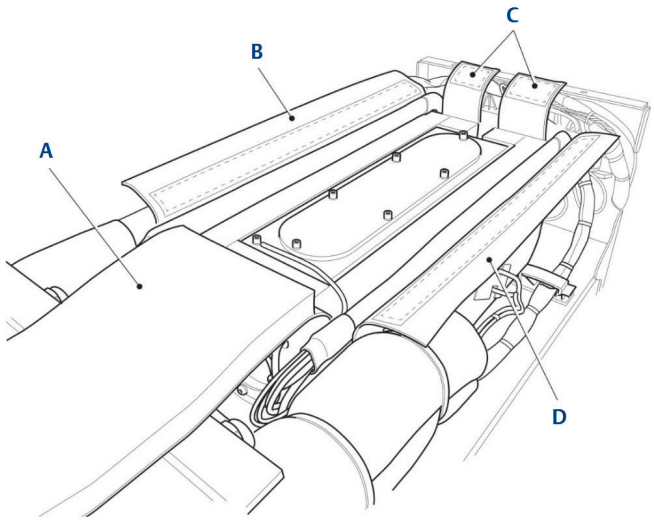
Death or personal injury may result if this is not observed.

To gain access to the electrical, pneumatic, and optical components, it is necessary to remove the top cover.

Procedure

1. Power down the analyzer and allow it to cool.
2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport it to the workbench.
3. Remove and retain the four screws attaching the top cover to the chassis.
4. Tag or otherwise identify all wiring harnesses before disconnecting.
5. Refer to *Figure 7-31*. Open up the insulation around the analysis cell. Pull open the two side flaps (B and D) and the two end flaps (C); then fold out the top insulation (A).

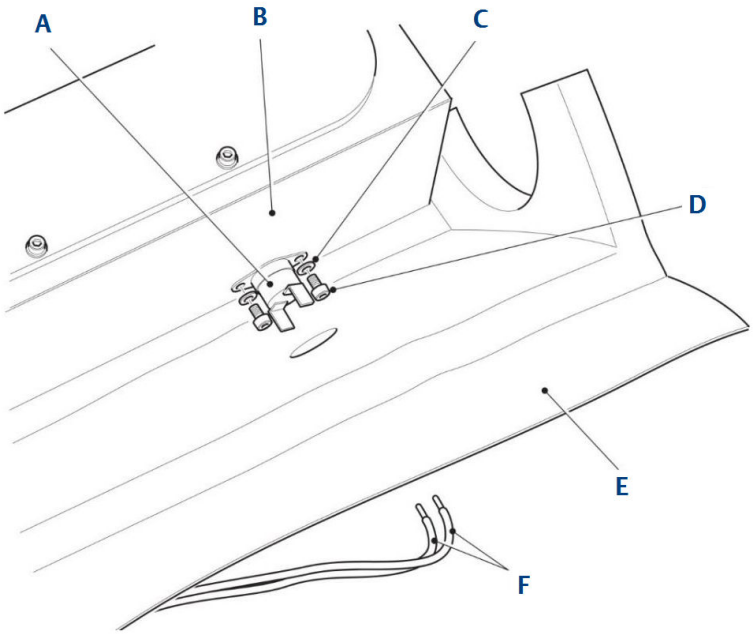
Figure 7-31: Opening the analysis cell insulation



A. Top insulation
B. Insulation side flap
C. Insulation end flaps
D. Insulation side flap

6. Refer to *Figure 7-32*. Pull the insulation (E) away from the side of the analysis cell (B).

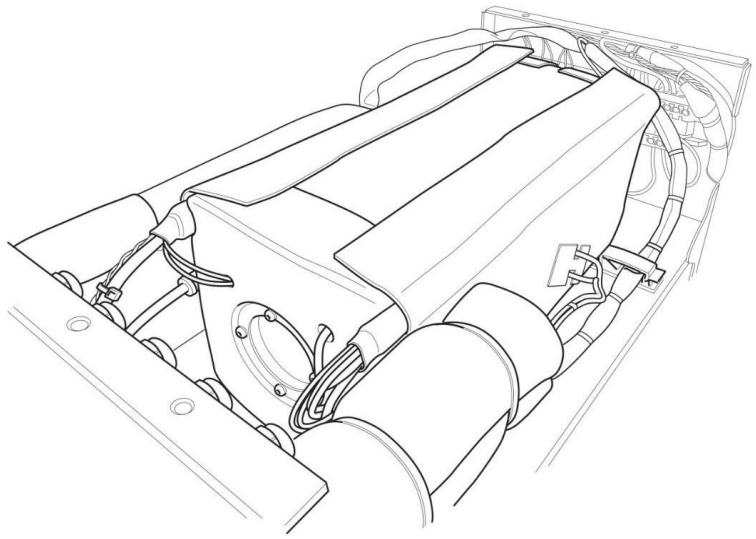
Figure 7-32: Removing the thermal cut-out



A. Thermal cut-out
B. Analysis cell
C. M3 flat washer
D. M3 x 8 mm socket head cap screw
E. Insulation
F. Wiring harness

7. Remove and retain the two screws (D) and associated washers (C).
8. Remove the thermal cut-out (A).
9. Disconnect the wiring harness (F) from the thermal cut-out by cutting the wiring harness close to the thermal cut-out. Discard the unserviceable thermal cut-out.
10. Inspect the replacement thermal cut-out for damage. If damage has occurred, contact your local Emerson Customer Care representative.
11. Route the wiring harness (F) through the hole in the side of the insulation (E). Using a soldering iron with a rating of 35 Watts or less, solder the wiring harness to the terminals of the thermal cut-out (A). Use high temperature solder and place a heat-shrink sleeve over each soldered terminal.
12. Fit the thermal cut-out to the analysis cell (B) and secure by fitting the screws (D) and washers (C) that were retained in step 6.
13. Return the insulation to its correct position against the side of the analysis cell.
14. Refer to *Figure 7-31*. Fold the top insulation (A) back into position on top of the analysis cell. Secure the top insulation by folding in the two side flaps (B and D) and the two end flaps (C). Make sure that the Velcro strips on the inside of the side flaps and end flaps mates with the Velcro strips on the exterior of the top insulation. *Figure 7-33* shows the insulation correctly fitted.

Figure 7-33: Insulated analysis cell



15. Refit the top cover as described in *Section 7.25*.
16. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport to the rack.
17. Apply power to restart the analyzer.

7.21 Replacing the gas input line

Replacing the gas input line.
Observe all safety precautions before starting this procedure.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON/OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

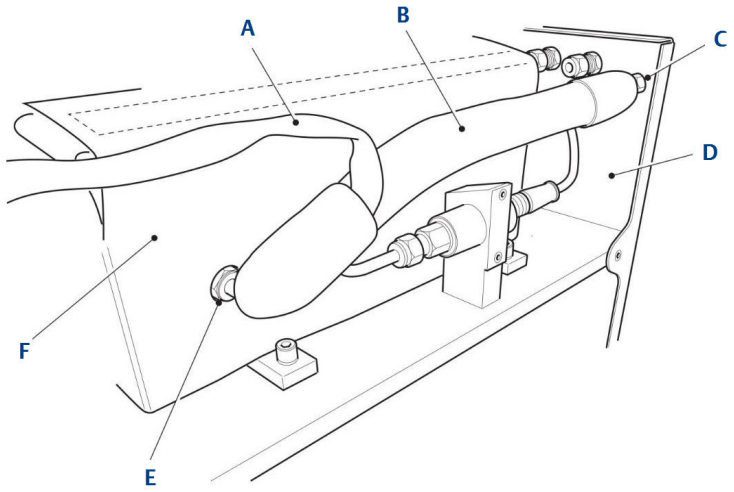
Death or personal injury may result if this is not observed.

To gain access to the electrical, pneumatic, and optical components it is necessary to remove the top cover.

Procedure

1. Turn power off at the circuit breaker and attach a Lock-out, Tag-out tag on the circuit breaker. Allow the analyzer to cool.
2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport it to the workbench.
3. Remove and retain the four screws attaching the top cover to the chassis.
4. Refer to *Figure 7-34*. Disconnect the wiring harness (A) from the connector block X1 on the DIN rail.
5. Release the pipe bulkhead (C) from the rear panel (D).
6. Use your fingers to push the analysis cell insulation (F) inwards until the tube adapter (E) is exposed. Release the tube adapter from the analysis cell. Then remove the gas input line.

Figure 7-34: Gas input line



A. Wiring harness
B. Gas Input Line
C. 6 mm pipe to 6 mm pipe bulkhead - 774L stainless steel 6 mm
D. Rear panel
E. Stainless steel 316 tube adapter, tube stub 6 mm x male ISO tapered thread 1/4 in. (gas in, gas out) SS-6-MTA-1-4RT
F. Analysis cell insulation

7. Inspect the gas input line for damage. If it is damaged, contact your local Customer Care representative.

8. Refer to *Figure 7-34*. Use your fingers to push the analysis cell insulation (F) inwards until the port for the gas input line is exposed. Fit the gas input line (B) to the analysis cell and secure and seal the joint with the tube adapter (E). Apply a small quantity of Loctite 567 liquid PTFE compound to the threads of the tube adapter before it is fitted. Tighten the tube adapter *spanner tight*.
9. Fit the gas input line (B) to the rear panel (D). Secure and seal the joint with the pipe bulkhead (C). Tighten the pipe bulkhead *spanner tight*.
10. Connect the wiring harness (A) to connector block X1 on the DIN rail.
11. Refit the top cover as described in *Section 7.25*.
12. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport it to the rack.
13. Apply power to restart the analyzer.

7.22 Replacing the gas output line

Complete the following steps to replace the gas output line.
Observe all safety precautions before starting this procedure.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

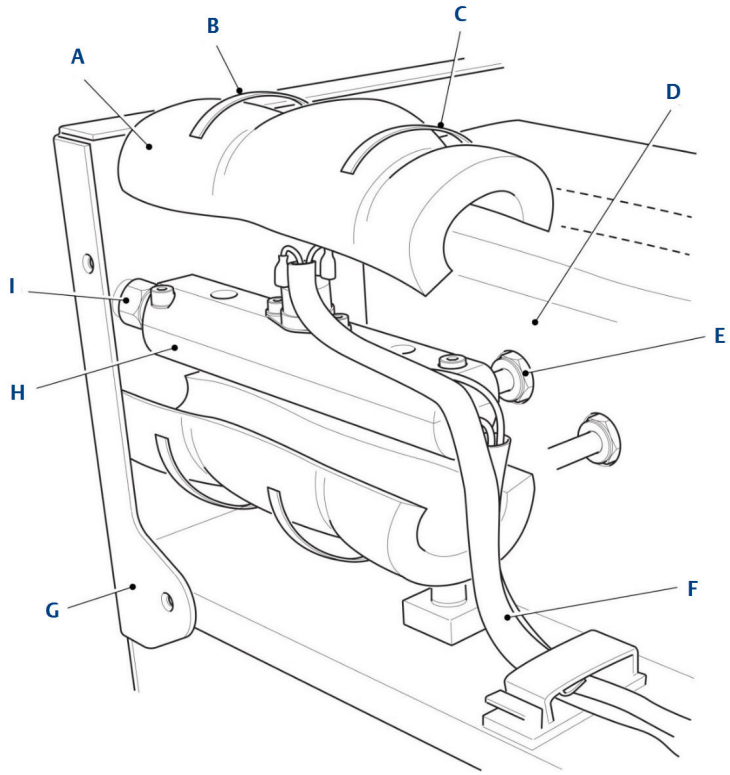
Death or personal injury may result if this is not observed.

To gain access to the electrical, pneumatic, and optical components, it is necessary to remove the top cover.

Procedure

1. Power down the analyzer and allow it to cool.
2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport it to the workbench.
3. Remove and retain the four screws attaching the top cover to the chassis.
4. Refer to *Figure 7-35*. Carefully cut the two cable ties (B and C).

Figure 7-35: Gas Output Line



A. Insulation (gas output line)
B. Cable tie
C. Cable tie
D. Insulation (analysis cell)
E. Stainless steel 316 tube adapter, tube stub 6 mm x male ISO tapered thread 1/4 in. (gas in/gas out) SS-6-MTA-1-4RT
F. Wiring harness
G. Rear panel
H. Gas output line
I. 6 mm pipe to 6 mm pipe bulkhead - 774L SS 6MM

5. Remove and retain the insulation (A).
6. Release the pipe bulkhead (I) from the rear panel (G).
7. Use your fingers to push the analysis cell insulation (D) inwards until the tube adapter (E) is exposed. Release the tube adapter from the analysis cell. Then remove the gas output line (H) from the analysis cell.

Note

It is only necessary to disconnect the wiring harness (F) from the gas output line if the gas output line is being replaced. If the gas output line is being removed to gain access to other components, do not disconnect the wiring harness.

8. If necessary, disconnect the wiring harness (F) from the gas output line.
9. Inspect the gas output line for damage.
10. Refer to *Figure 7-35*. If necessary, connect the wiring harness (F) to the gas output line (H).
11. Use your fingers to push the analysis cell insulation (D) inwards until the port to the gas output line is exposed. Fit the gas output line to the analysis cell port; then secure and seal the joint with the tube adapter (E). Apply a small quantity of Loctite 567 liquid PTFE compound to the threads of the tube adapter before it is fitted. Tighten the tube adapter *spanner tight*.

NOTICE

The Swagelok recommendation for pipe fittings of this size is to tighten the nut finger tight and then tighten an additional one and a quarter (1-1/4) turns with a spanner.

12. Fit the gas output line to the rear panel (G). Secure and seal the joint with the pipe bulkhead (I). Tighten the pipe bulkhead spanner tight.
13. Fit the insulation (A) to the gas output line and secure it with two cable ties (B and C).
14. Refit the top cover as described in *Section 7.25*.
15. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport it to the rack.
16. Apply power to restart the analyzer.

7.23 Replacing the analysis cell

Complete the following steps to replace the analysis cell.
Observe all safety precautions before starting this procedure.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

Death or personal injury may result if this is not observed.

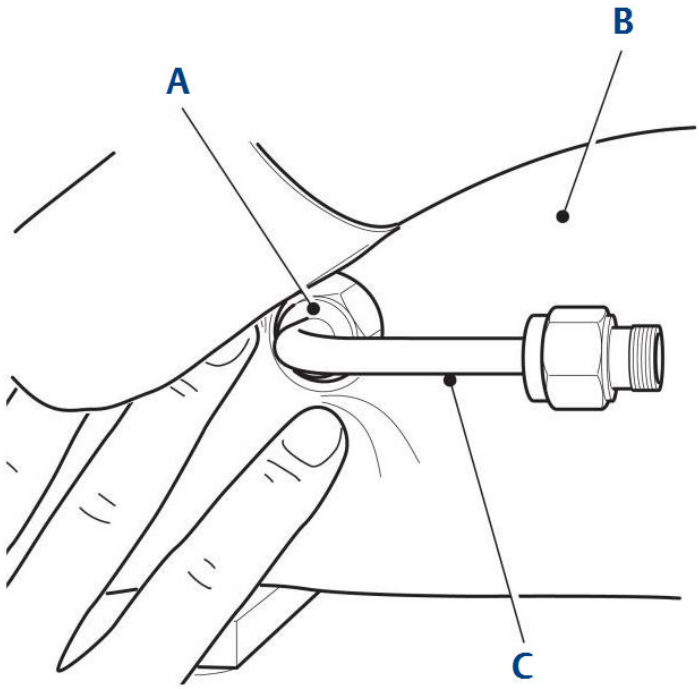
To gain access to the electrical, pneumatic, and optical components, it is necessary to remove the top cover.

Procedure

1. Power down the analyzer and allow it to cool.

2. Remove the analyzer from the rack and place it on a stable workbench. This step requires two people to properly lift and transport it to the workbench.
3. Remove and retain the four screws attaching the top cover to the chassis.
4. Remove the gas input and output lines as described in *Section 7.21* and *Section 7.22*.
5. Remove the pressure sensor as described in *Section 7.19*, steps 4 through 9.
6. As shown in *Figure 7-36*, use your fingers to push inwards the analysis cell insulation (B) until the tube fitting (A) is exposed.

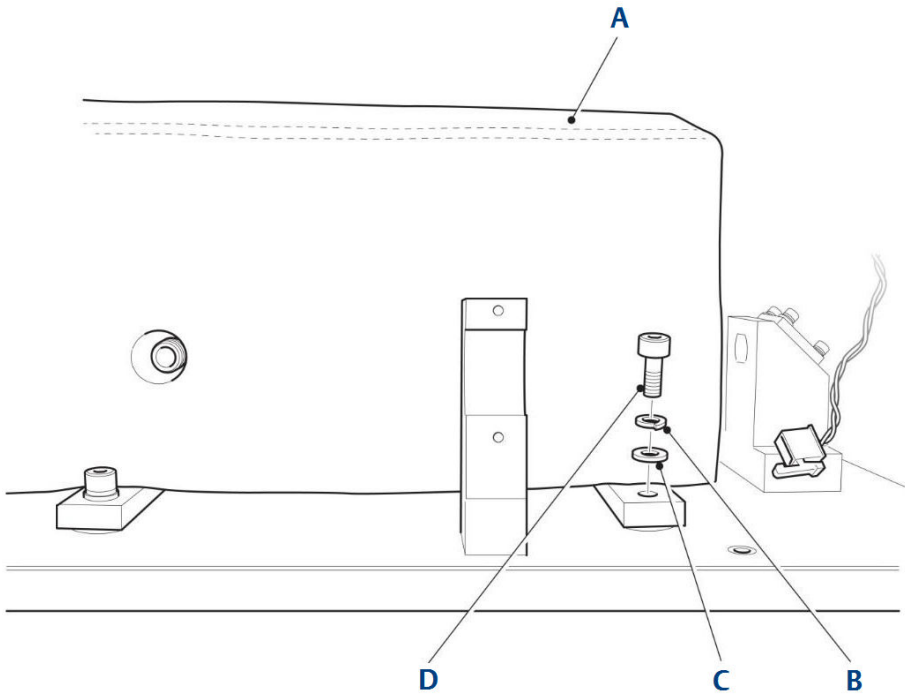
Figure 7-36: Pressure sensor pipe



A. Stainless steel 316 male connector, Let-Lok tube fitting 6 mm x male ISO tapered thread 1/4 in. (pressure connector)
B. Analysis cell insulation
C. Pipe

7. Release the tube fitting (A) and slide it up the pipe (C). Remove and retain the pipe, complete with tube fitting.
8. Remove the gas temperature sensor as described in *Section 7.18*.
9. Remove the thermal cut-out as described in *Section 7.20*.
10. Refer to *Figure 7-37*. Remove and retain the four M6 x 20 mm socket head cap screws (D) and associated M6 spring washers (B) and M6 flat washers (C). Lift the analysis cell (A) off the optical baseplate.

Figure 7-37: Removing the analysis cell



A. Analysis cell (in insulation)
B. M6 spring washer
C. M6 flat washer
D. M6 x 20 mm socket head cap screw

11. Inspect the replacement analysis cell for damage. If damaged, contact your local Customer Care representative.
12. Refer to *Figure 7-37*. Place the analysis cell (A) in position on the optical baseplate. Dowels ensure that the location and alignment of the analysis cell is correct.
13. Secure the analysis cell by fitting the four M6 x 20 mm socket head cap screws (D) and associated M6 spring washers (B) and M6 flat washers (C) that were retained during the removal procedure.
14. Fit the thermal cut-out as described in *Section 7.20*, steps 13 through 15.
15. Fit the gas temperature sensor as described in *Section 7.18*, steps 11 through 13.
16. Refer to *Figure 7-36*. Use your fingers to push the insulation (B) until the port for the pipe (C) is exposed.
17. Fit the pipe to the port in the analysis cell and secure it with the tube fitting (A). Apply a small quantity of Loctite 567 liquid PTFE compound to the threads of the tube fitting before it is fitted. Secure the pipe by tightening the tube fitting *spanner tight*.
18. Fit the pressure sensor as described in *Section 7.19*, steps 11 through 16.

19. Fit the gas output line as described in *Section 7.22*.
20. Fit the gas input line as described in *Section 7.21*.
21. Refit the top cover as described in *Section 7.25*.

7.24 Cleaning the analysis cell mirrors

Only clean the mirrors inside the analysis cell in a clean area.
It is possible that the mirrors inside the cell may become contaminated; for example, contaminants may be carried into the cell in water droplets in the gas being sampled. The mirrors may be cleaned to remove any contamination from them.

Prerequisites

Observe all safety precautions before starting this procedure.

⚠ DANGER!

ELECTRIC SHOCK

The analyzer operates using mains voltage that is dangerous to life. Make sure that the power *ON*/*OFF* switch at the rear of the panel is set to *OFF* and tagged off before removing the top cover.

The analyzer must be earthed.

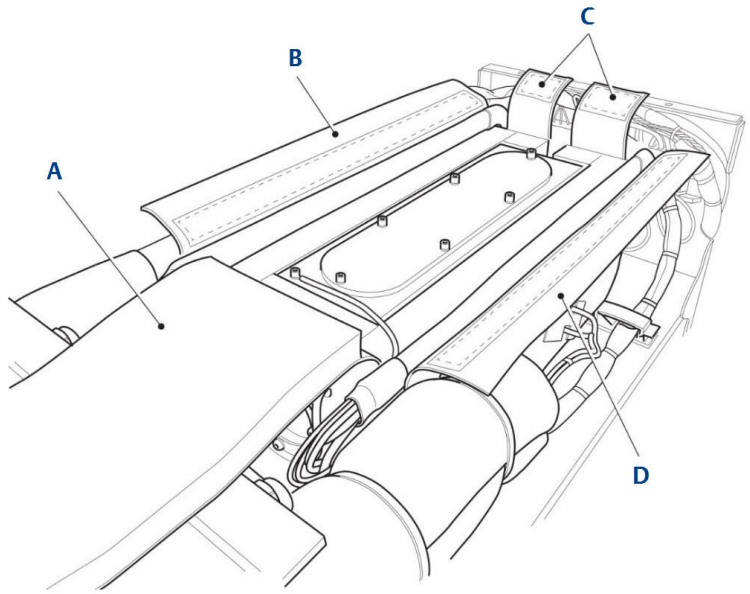
Death or personal injury may result if this is not observed.

To gain access to the electrical, pneumatic, and optical components, it is necessary to remove the top cover.

Procedure

1. Power down the analyzer and allow to cool.
2. Remove the analyzer from the rack and place to a stable workbench. This step requires two people to properly lift and transport it to the workbench.
3. Remove and retain the four screws attaching the top cover to the chassis.
4. Open the insulation around the analysis cell. Pull open the two side flaps (B and D) and the two end flaps (C) and then fold out the top insulation (A).

Figure 7-38: Opening the analysis cell insulation



A. Top insulation
B. Insulation side flap
C. Insulation end flaps
D. Insulation side flap

5. Using a 2.5 mm Allen wrench, remove and retain the six socket head cap screws and associated spring washers and flat washers that secure the lid on the cell; then remove the lid.

   It may be necessary to use a small flat blade screwdriver to lever the lid off.

NOTICE

The pressure inside the cell must be at atmospheric pressure in order to remove the lid.

   With the lid removed, the mirrors are exposed.

6. Clean the mirrors by applying a small quantity of methanol to a clean, dry, lens tissue and then gently wiping the mirrors with the lens tissue.

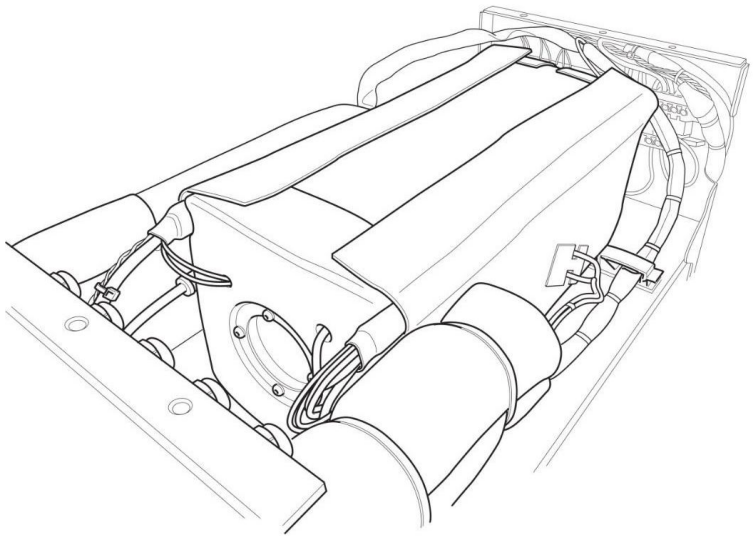
   If methanol is unavailable, IPA may be used instead; however, methanol is preferable.

NOTICE

The flow of gas through the cell means that any water droplets introduced into the system will travel through the cell to the front mirror; therefore, it is the front mirror that is more likely to be contaminated. The mirrors are coated with enhanced nickel and should be clean and reflective. Cleaning the mirrors with methanol may not visibly improve the mirror surface, but should improve reflectivity in the mid-infrared band used by the lasers.

7. Fit the lid onto the cell and, using a 2.5 mm Allen wrench, secure the lid with the six socket head cap screws and associated spring washers and flat washers retained in step 6.
8. Refer to *Figure 7-38*. Fold the top insulation (A) back into position on top of the analysis cell. Secure the top insulation by folding in the two side flaps (B and D) and the two end flaps (C). Make sure that the Velcro strips on the inside of the side flaps and end flaps mate with the Velcro strips on the exterior of the top insulation.

Figure 7-39: Insulated analysis cell



9. Refit the top cover as described in *Section 7.25*.
10. Reinstall the analyzer in the rack. This step requires two people to properly lift and transport it to the rack.
11. Apply power to restart the analyzer.

7.25 Installing the Top Cover

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

Procedure

1. Examine the top cover for signs of physical damage. If necessary, retouch minor damage to the paintwork.
2. Place the analyzer on a flat, stable surface capable of accommodating the weight.
3. Place the top cover on top of the chassis assembly.
4. Use the four screws and associated flash washers to attach the top cover to the chassis assembly.

7.26 Installing the bottom cover

⚠ WARNING!

HEAVY ITEM
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 31 kg (68 lb). Emerson™ recommends that the analyzer is only moved and lifted by a minimum of two people. Wear suitable protective gloves and protective footwear.

Failure to properly handle the analyzer may cause injury to personnel.

Procedure

1. Examine the bottom cover for signs of physical damage. If necessary, retouch minor damage to the paintwork.
2. Place the analyzer upside down on a flat, stable surface capable of accommodating the weight.
3. Place the bottom cover on top of the chassis assembly.
4. Use the four screws and associated flash washers to attach the bottom cover to the chassis assembly.

7.27 Downloading data for diagnostics and service

This section describes how to download data from the analyzer for servicing and fault diagnostic purposes.

The downloaded data comprises two logs:

- The first log records sensor events (start-up, connected, lasers started, etc.).
- The second log records gas concentrations and periodic batches of diagnostic data showing the spectral fit.

The events log is a text file, the log of measured gas concentrations and diagnostics data is a (hierarchical data format) HDF5 format log file. The data is not used by operators or maintainers of the analyzer. Send the data to Emerson; we can analyze the data to monitor the health of the analyzer and to debug any faults.

When to download the data

Only download the data following a failure of the analyzer. Then send the data to Emerson for analysis.

Methods of downloading the data

There are two methods of downloading the data from the analyzer:

- To a USB flash drive (stick)
- By trivial file transfer protocol (TFTP)

Note
Downloading the data to a USB flash drive is the most efficient and easiest method.

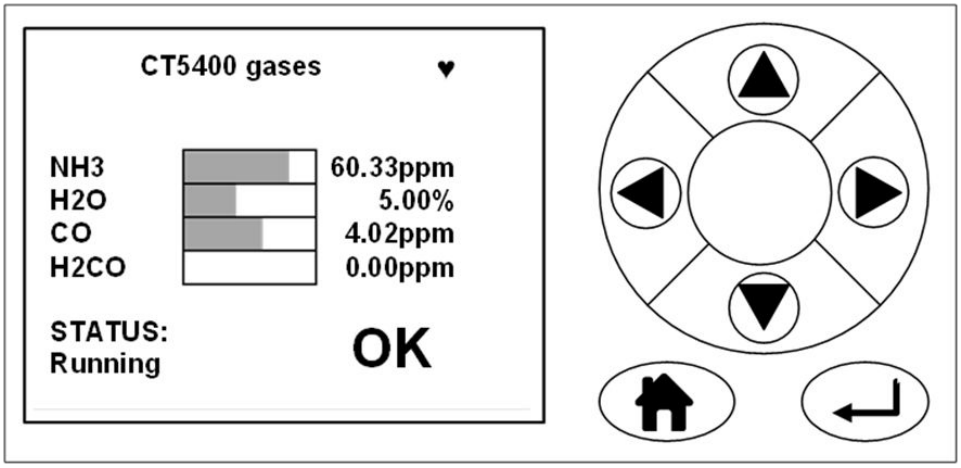
7.27.1 Downloading data to a USB flash drive

Use a USB flash drive to download analyzer fault and diagnostics data.

Prerequisites

The data download process is performed under the control of the analyzer software, using *download to USB Stick* routines built into the software. Refer to *Section 4.5* for the display controller functions.

Figure 7-40: Gas Sensor Main Screen



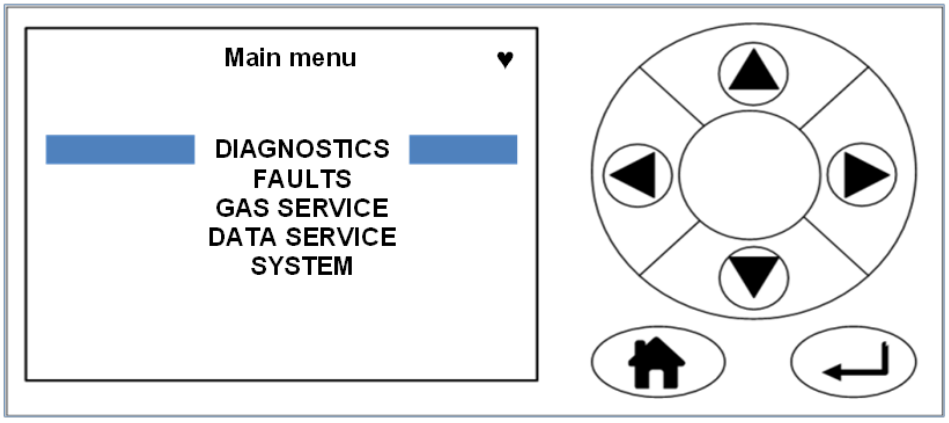
Note

The gas concentrations shown in the screenshots may be different from those shown on your particular analyzer. They indicate the functionality of the software, which is the same regardless of the gases or gas concentrations being measured.

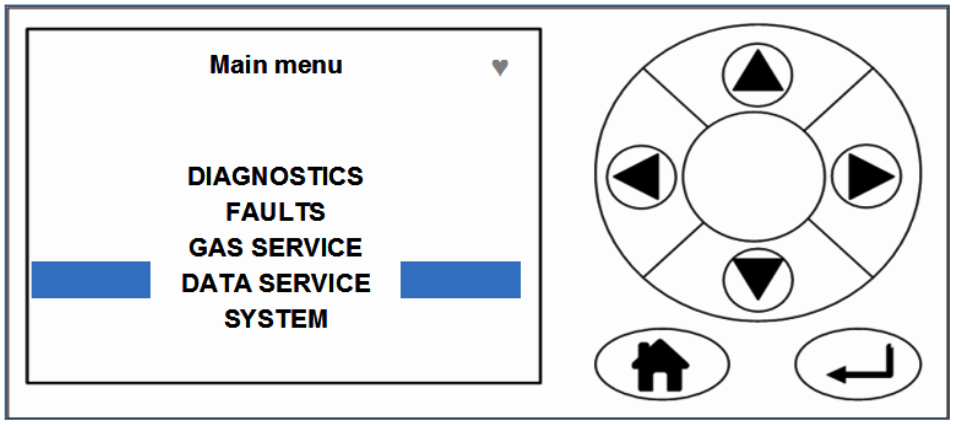
Procedure

1. From the *Gas Sensor Main* screen, press ▶ to go to the *Main menu*.

Figure 7-41: Main menu

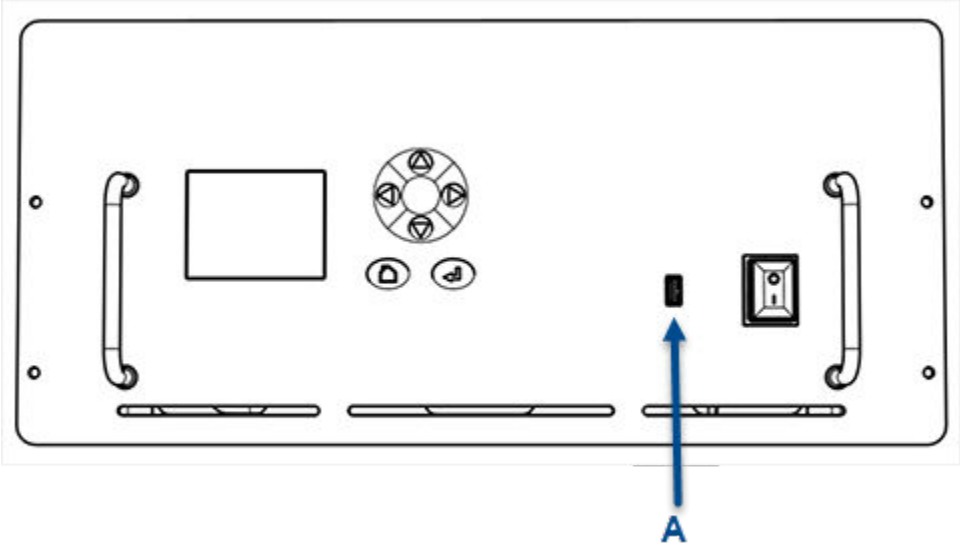


2. Use ▲ and ▼ to scroll to *DATA SERVICE*.



3. Insert a USB Flash Drive into the USB port on the analyzer's front panel.

Figure 7-42: USB Access Port

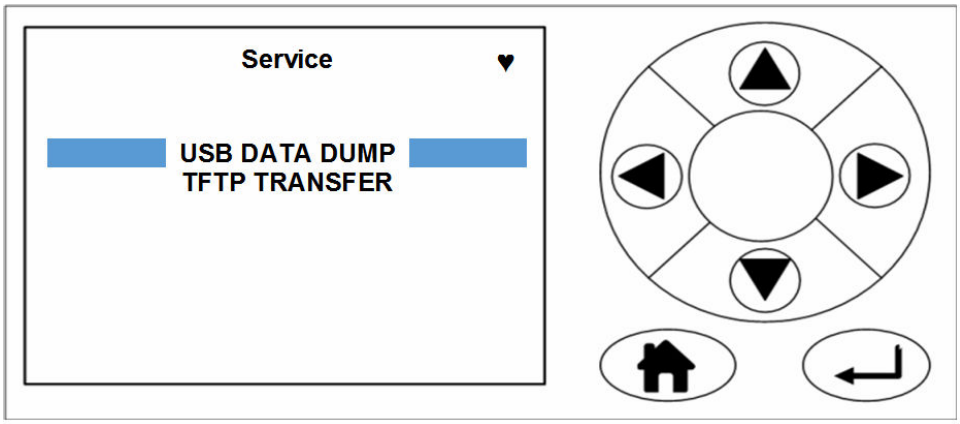


A. USB flash drive access port

4. Press ▶.

   The Service menu screen displays.

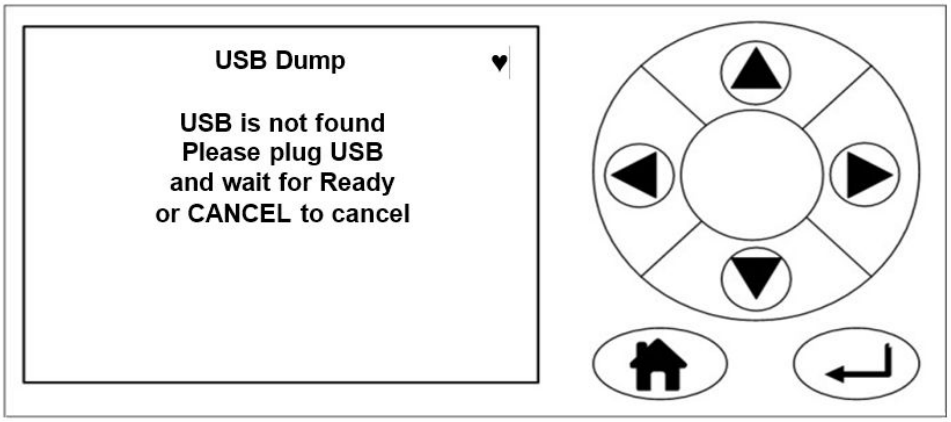
Figure 7-43: Service Menu Screen



5. Scroll to USB DATA DUMP using ▲ and ▼.

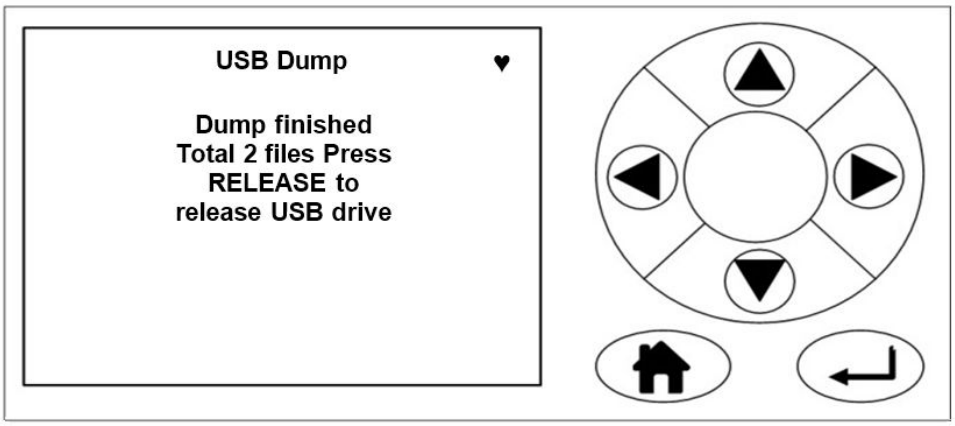
   The USB Dump routine checks that a USB Flash Drive is correctly fitted to the USB port on the on the front panel. If there is no USB Flash Drive in the USB port or the USB flash drive is not fitted correctly, an error message displays.

Figure 7-44: USB Dump Error



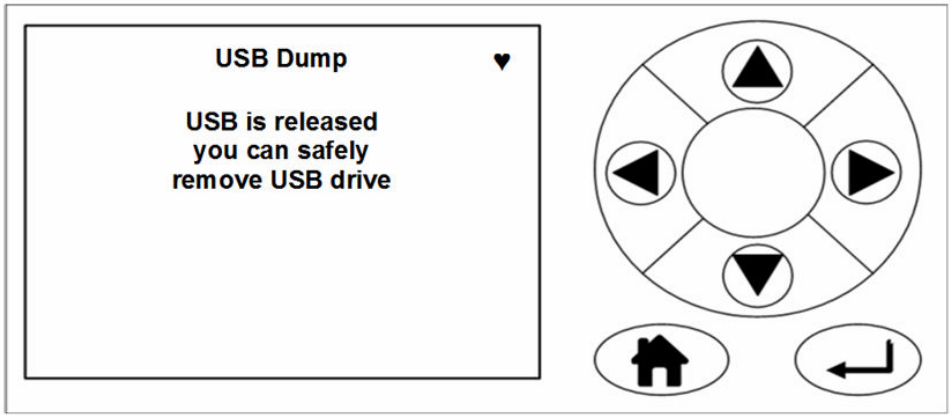
6. If the USB flash drive is correctly fitted to the USB port the data transfer automatically starts, and the *USB Dump* screen displays when the data transfer is completed.

Figure 7-45: USB Dump Finished Screen



7. Press ▶ to safely **release** (remove) the USB flash drive.

Figure 7-46: Release USB Flash Drive



If, for any reason it is necessary to repeat the data download, then press ▶ on either the **USB Dump - Dump finished** screen (see *Figure 7-45*) or **USB Dump - USB released** screen (see *Figure 7-46*).

7.27.2 Downloading data using TFTP

Trivial File Transfer Protocol (TFTP) data download is performed under the control of the analyzer software, using TFTP routines built into the software.

Prerequisites

To download the data by TFTP, you must have a laptop computer that has been set up to a suitable IP address and has the required software (PuTTY) and (TightVNC Viewer) installed.

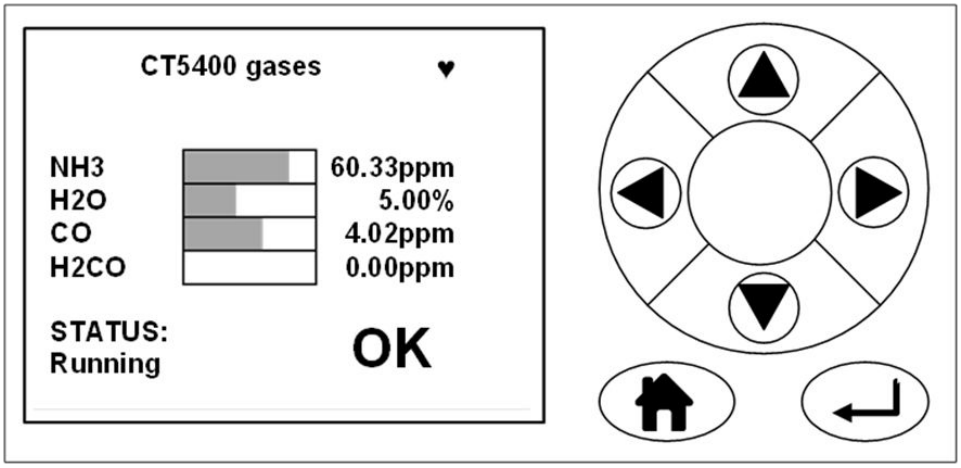
- Download PuTTY from: *http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html*
- Download TightVNC Viewer from: *http://www.tightvnc.com/download.php*

The data download process is performed under the control of the analyzer software, using TFTP routines built into the software. Refer to *Section 4.5* for the display controller functions.

Procedure

1. Establish an Ethernet connection to the analyzer from your laptop.
2. Switch on the analyzer and wait for the Gas Sensor Main screen to display.

Figure 7-47: Gas Sensor Main Screen

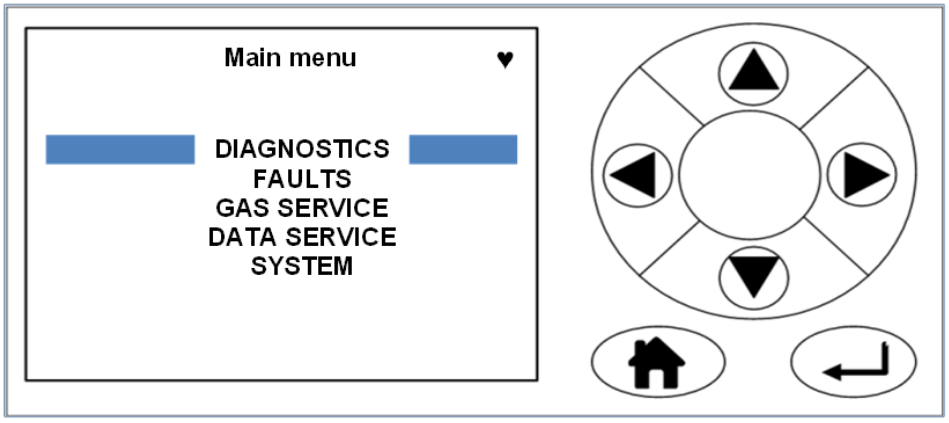


Note

The gas concentrations shown in the screenshots may be different from those shown on your particular analyzer. They indicate the functionality of the software, which is the same regardless of the gases or gas concentrations being measured. The data shown on the screens is for illustration purposes only.

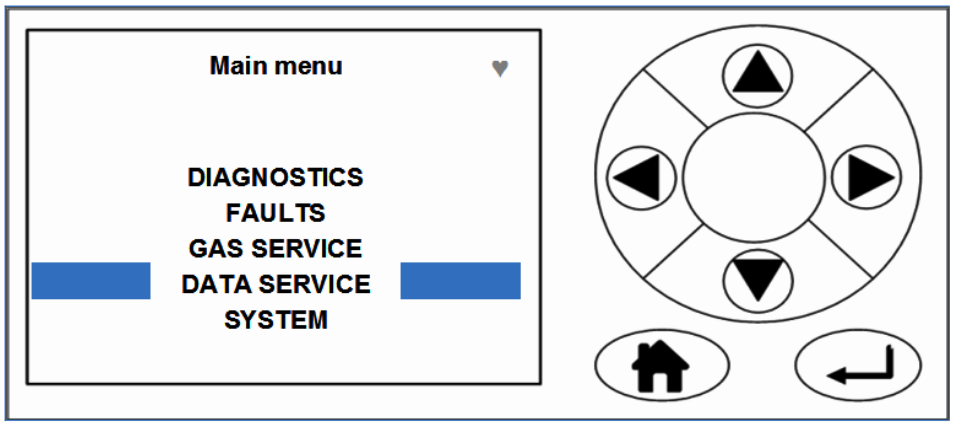
3. From the *Gas Sensor Main* screen, press ▶ to go to the Main menu.

Figure 7-48: Main menu



4. Use ▲ and ▼ to scroll to DATA SERVICE.

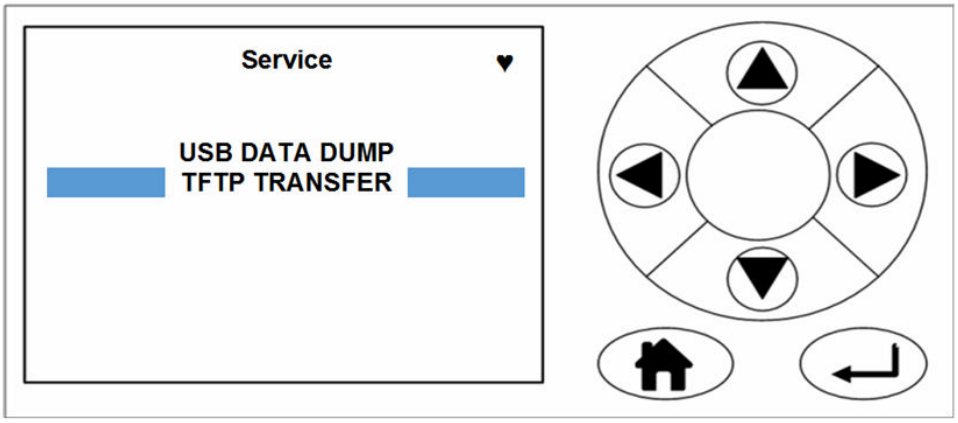
Figure 7-49: DATA SERVICE menu



5. Press ▶.

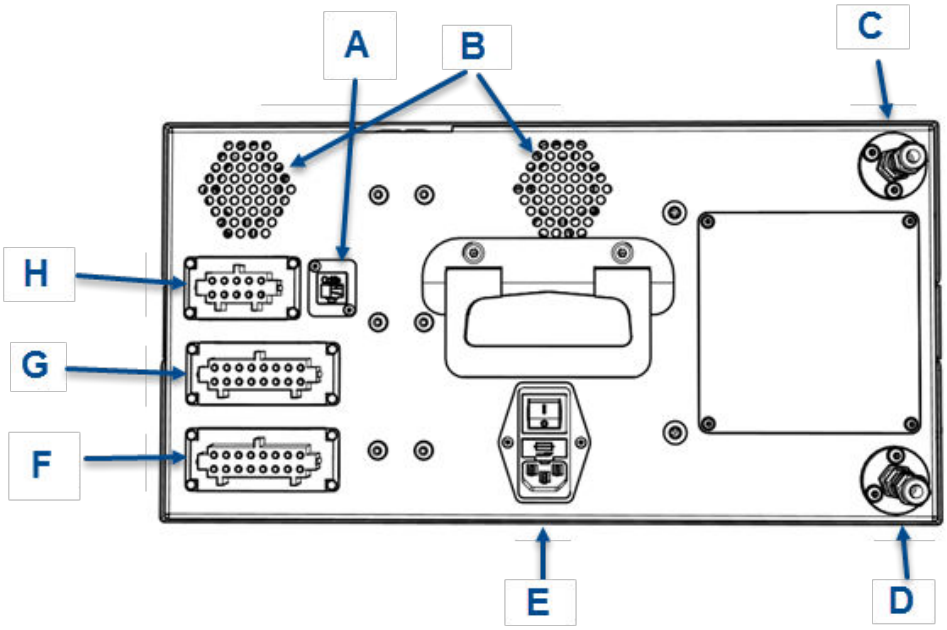
   The Service Menu screen displays.

Figure 7-50: Service Screen



6. Connect a laptop to the Ethernet port on the rear panel of the analyzer (A).

Figure 7-51: Electrical/Electronic Connectors



A. Ethernet connector
B. Ventilation holes
C. Sample supply (stainless steel tubing)
D. Sample return (stainless steel tubing)
E. Main power supply
F. Analog outputs (4-20 mA)
G. Digital outputs
H. Status output (10 way connector)

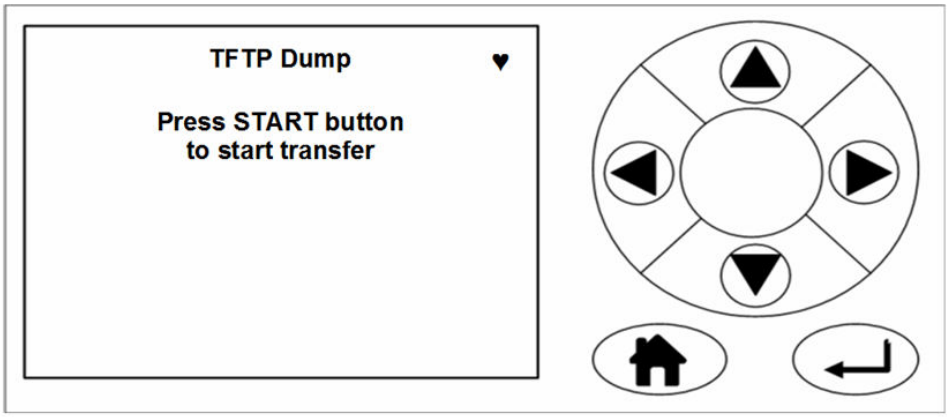
NOTICE

Communications can be made inside the analyzer via a network switch/MOXA connection.

7. Start the software needed to receive the TFTP data transfer.
8. From the *Service Menu* screen, use ▲ and ▼ to scroll to *TFTP TRANSFER*.
9. Press ▶

   The TFTP Dump screen displays.

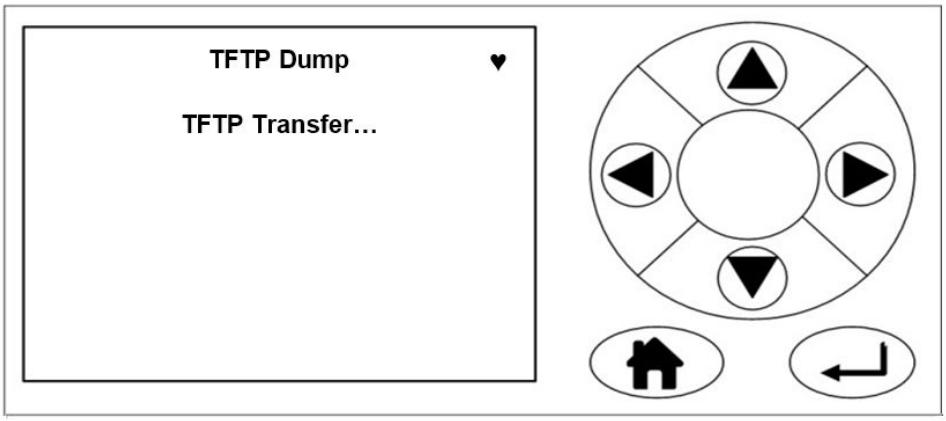
Figure 7-52: TFTP Dump Screen



10. Press ▶ to start the TFTP data transfer.

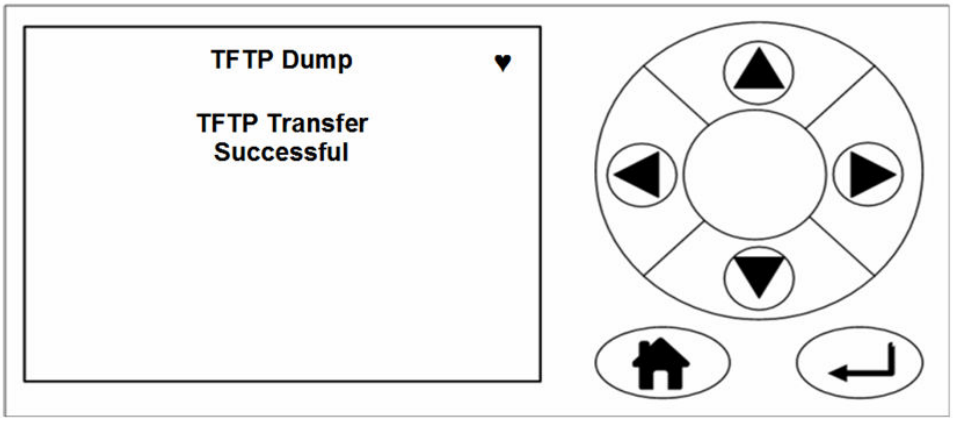
    The TFTP Dump Progress screen displays.

Figure 7-53: TFTP Transfer Progress Screen



11. When the data download completes, the TFTP Transfer Successful screen displays.

Figure 7-54: TFTP Transfer Successful Screen



8 Shutdown procedure

8.1 Shutdown procedure safety precautions

This chapter describes the analyzer's shutdown procedure.

⚠ CAUTION!

EQUIPMENT DAMAGE

Always follow this shutdown procedure. Damage to the analyzer may result from a failure to follow this procedure.

The analyzer normally operates continuously. It should only be necessary to shut down the instrument in the following circumstances:

- In order to perform repairs or maintenance on the analyzer
- When the analyzer has to be switched off as part of a plant shutdown or plant maintenance

Use the display controller to perform the shutdown procedure.

Operation of the analyzer is controlled through the display controller located on the front panel of the instrument. *Chapter 4* of this manual describes how to use the display controller.

NOTICE

The gas concentrations shown in the following screenshots may be different from those shown in your particular analyzer. The screenshots indicate the functionality of the software, which is the same regardless of the gases or gas concentrations being measured.

⚠ WARNING!

BURNS
Do not touch any part of the analyzer. Assume all parts of the analyzer are hot unless it has been switched off and allowed to cool down. Some parts of the analyzer may be heated to 190 °C (374 °F). Always wear proper protective equipment when handling the analyzer.

- **Switch off the analyzer and allow it to cool for at least two hours before fitting, removing, or performing any maintenance.**
- **The analysis cell is insulated against heat loss. Allow the analyzer to cool for at least twelve hours before performing any maintenance on, or in the vicinity of, the analysis cell.**

Failure to allow sufficient cooling may cause serious burn injury to personnel. If burns occur, seek immediate medical treatment.

8.2 Shutdown procedure

To shut down the analyzer, perform the following steps:

⚠ DANGER!

EXPLOSION HAZARD

Always lock-out the gas handling system when shutting down the analyzer. Unauthorized operation of the gas handling system when maintenance is being performed on the analyzer or its associated pipes/hoses may result in hazardous gas being released, causing fire or explosion. Failure to lock-out gas handling system may cause death.

Procedure

1. Shut down the gas handling system that conditions the sample gas and feeds it to the analyzer. Always lock-out the gas handling system to prevent its unauthorized operation during maintenance, which may cause an escape of gas.

   ⚠ DANGER!

   EXPLOSION HAZARD

   The sample gas in the system must be vented to prevent fire or explosion during maintenance and to prevent damage to the analyzer during shutdown.

   The sample gas in the pipes leading to the analyzer must be purged to prevent hazards to personnel during maintenance. Purging the sample gas must be done in accordance with the safe working procedures for the site.

   Allow the analyzer and system for returning the sample gas to run for five minutes to allow any sample gas in the instrument to be returned to the exhaust.

   Failure to vent sample gas may cause death.

2. Purge any sample gas in the pipe/hose from the gas handling system to the analyzer using factory air or nitrogen supply.
3. Allow the analyzer to run for five minutes with the purge gas connected, so that any sample gas in the instrument is vented to the exhaust. On the display controller, check that the gas concentrations read *0 ppm* before stopping the purge flow.

   ⚠ WARNING!

   HIGH PRESSURE GAS AND AIR
   The calibration gas supply and compressed air supply operate at a pressure that can cause injury, e.g., damage to eyes and skin punctures from debris blown by the high pressure gas or compressed air.

   Always lock out or tag off the calibration gas supply and compressed air supply when shutting down the analyzer.

4. Turn off the calibration gas supply to the analyzer. Lock-out and tag-out the compressed air supply.
5. Press ▶ on the display controller in either the Gas Sensor Main screen (*Figure 8-1*) or the Pressure and Temperature screen (*Figure 8-2*).

Figure 8-1: Gas Sensor Main Screen

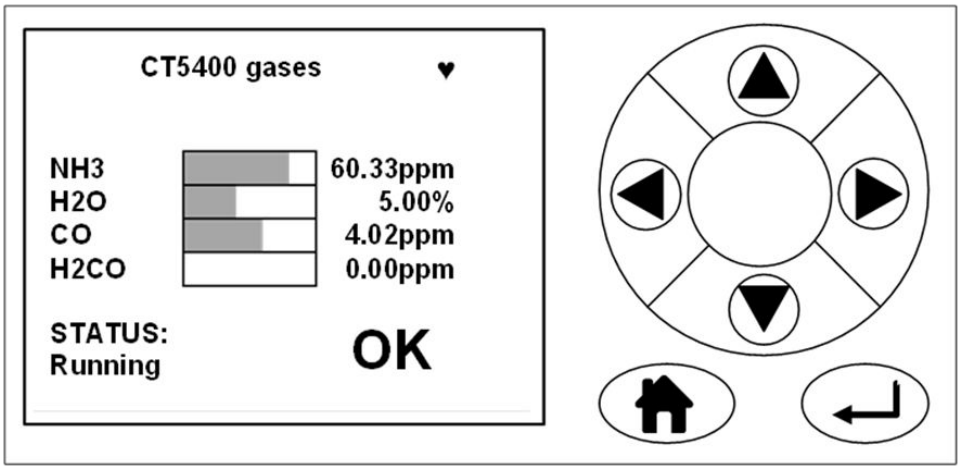
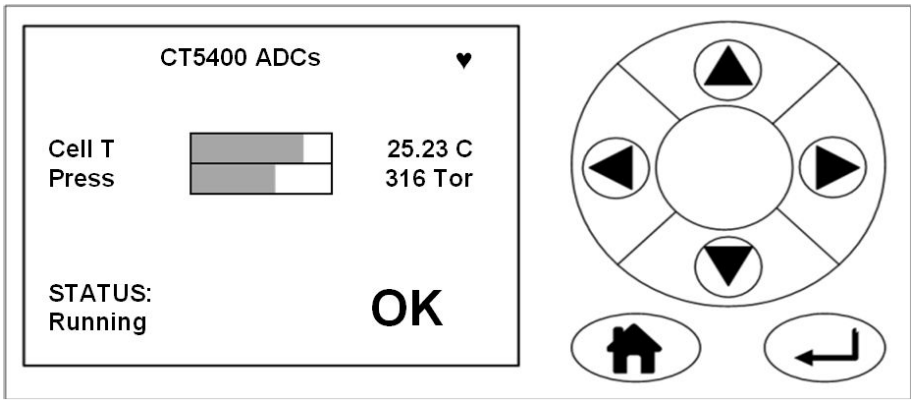
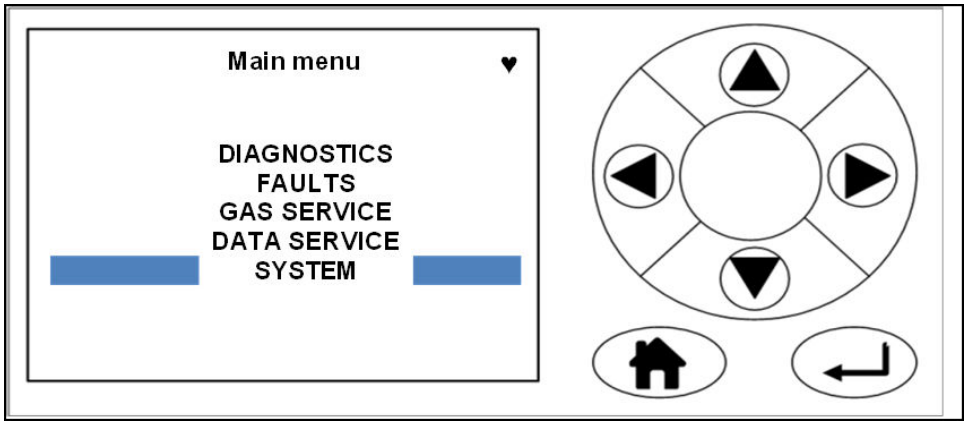


Figure 8-2: Pressure and Temperature Screen



The Main menu (*Figure 8-3*) opens.

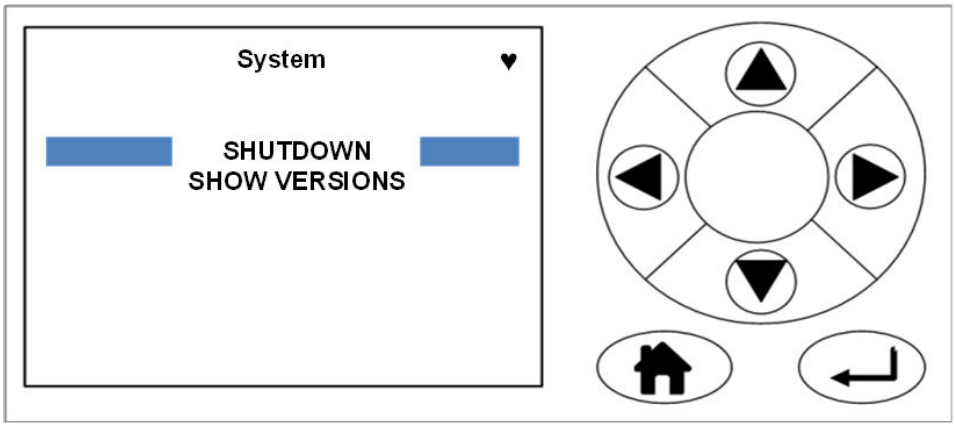
Figure 8-3: Main menu



6. On the display controller, use ▲ and ▼ to scroll down to select *SYSTEM* as shown in *Figure 8-3*. Then press ▶.

   The System screen (*Figure 8-4*) opens.

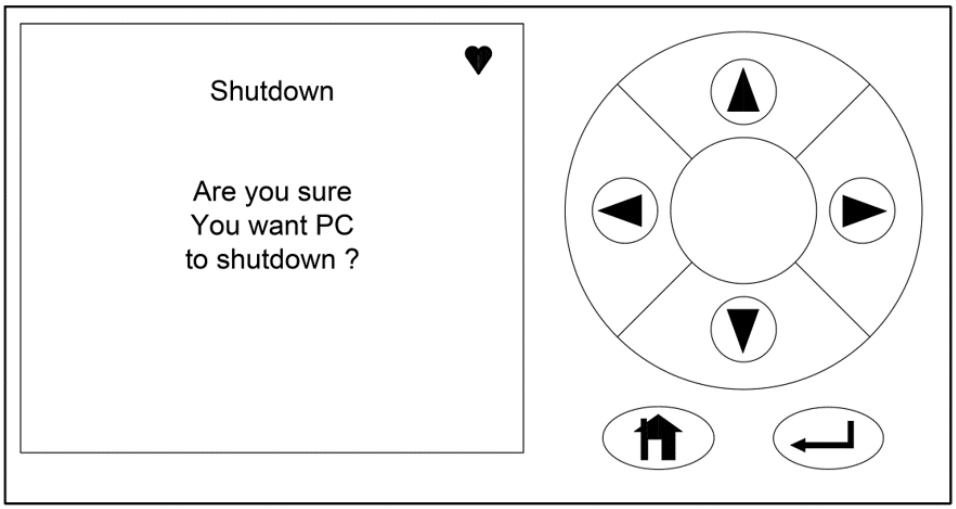
Figure 8-4: System Shutdown Screen



7. Use ▲ and ▼ to select *SHUTDOWN* as shown in *Figure 8-4*. Then press ▶.

   The Shutdown screen (*Figure 8-5*) displays.

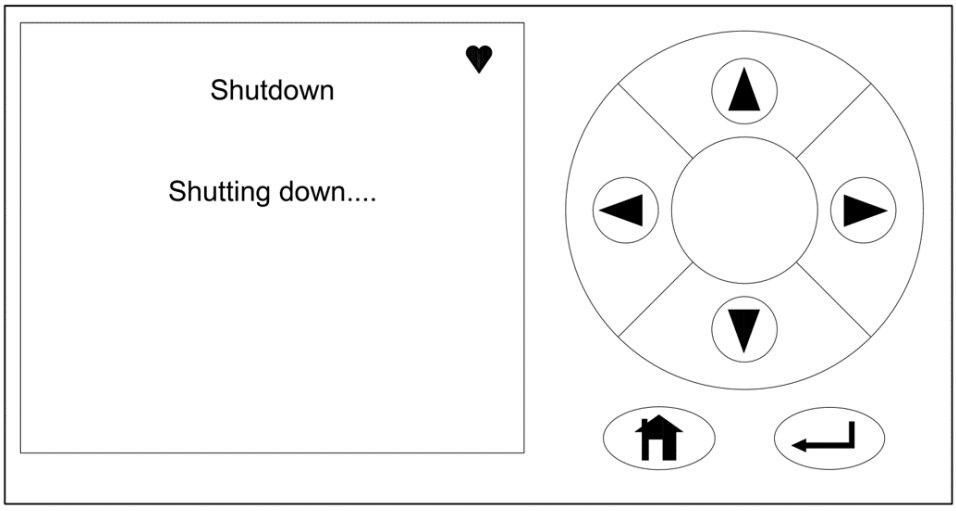
Figure 8-5: Shutdown Screen



8. Press ▶ to confirm.

   The analyzer displays the Shutdown screen (*Figure 8-6*) and then stops running.

Figure 8-6: Shutdown Screen



9. Once the heartbeat icon stops blinking, it is safe to power off the analyzer.

9 Preventative maintenance

9.1 Maintaining the analyzer

This section describes the preventative maintenance of the analyzer.

9.2 Scheduled maintenance

This schedule lists the tasks required by the analyzer and the recommended frequency. Variation in customer sites may require these activities to be performed more or less often than indicated. Details of the tasks to be performed are contained in *Table 9-1*.

Table 9-1: Scheduled checks

Frequency	Action
Monthly	1. Check the zero and span calibration. 2. Perform the calibration more or less frequently if necessary to meet quality control or plant operation requirements.

Appendix A
Theory of Operation

A.1 Overview

The Rosemount™ CT5400 is a gas sensor system that can be configured to measure the concentrations of multiple small molecules carried in the gas sample. The types of molecules that are measured depend on the system configuration.

The analyzer can be configured to detect and measure up to twelve gases, with ranges varying from volume to percent (%) volume levels. A detailed description of the system is given in Detailed System Specification of this manual.

A.2 Quantum Cascade Laser measurement principle

The analyzer uses six Quantum Cascade Lasers to detect and measure the gases. Each Quantum Cascade Laser (QCL) measures between one and three gases.

Inside the QCL, which is about the size of a pin head, electrons cascade down a series of quantum wells, producing a photon at each step. This cascade of electrons can produce between 20 and 100 photons per electron, giving QCLs higher output power than traditional semi-conductor lasers.

The lasing wavelength of a QCL is determined by adjusting the physical thickness of the semiconductor layers, giving access to high power lasers covering the mid-infrared spectral region. A QCL has no need for cryogenic cooling, has excellent spectral quality in chirped mode, and good tuneability.

A.3 Process analyzer - gas concentration measurements

In the analyzer, gas concentrations are measured using mid-infrared optical absorption spectroscopy. The light sources are QCLs, which are operated to produce wavelength sweeps that cover the absorption lines of the gases to be measured.

Sample gas, which may contain impurity gases that are to be detected and measured, is conditioned and drawn into the analyzer. Inside the analyzer, the sample gas is fed into an analysis cell, where the beams from the QCLs are passed through the gas. The analysis cell contains a set of mirrors that bounce the light back and forth many times, which lengthens the path of the lasers through the gas. On exiting the analysis cell, the light is detected by a receiver unit. The variation in the intensity of light in the vicinity of absorption lines for the gases being detected is measured, and the concentration is determined using a comprehensive spectral fitting routine.

Appendix B
Spare parts list

Part number	Description
P-5000-0953	Serial text (data) display, general purpose, panel mounting
M-3000-0754	5000 laser module right-angle output (Type A)
M-3000-1133	5000 laser module right-angle output (Type B)
M-3000-0914	CT5400 cell assembly
P-5000-1443	Schurter001.1009 fuse, fast-acting, ceramic, 5.1 A
M-1000-2468	CT5400 inlet pipe
E-4001-6302	Detector TEC
E-4001-6201	Peripheral board
E-4001-8001	Motherboard
P-5000-0310	Fan 60 mm (2.4 in.)
P-5000-0920	72 W switch mode DIN rail panel mount power supply, 12 Vdc 6 A
P-5000-0921	90 W switch mode DIN rail panel mount power supply, 24 Vdc 3.75 A
P-5000-0938	PID temperature controller, 110-240 Vac voltage output
P-5000-0415	Honeywell NC 10 A thermostat, solder tag termination, 0 to 260 °C (32 to 500 °F)
P-5000-0900	PT100 stainless steel dia: 6 mm (0.2 in.), length: 60 mm (2.4 in.), 400°C (752 °F) max, 2.5 m (98.4 in.) lead
P-5000-0366	RS PT100 200 °C (392 °F) max platinum resistance temp. sensor, 6 mm (0.2 in.) probe diameter
P-5000-0924	Interface relay module (DIN rail, SPST-NO, coil -12 V, contact 6 A 250 V)
P-5000-0566	Pressure sensor CTE8001AY7V 0-1bara, 0-5 V, G 1/8 in. (3.2 mm) FKM
P-5000-0941	Diameter: 6.5 mm (0.3 in.), length: 50 mm (2 in.), 240 V, 120 W heater rod
P-5000-1019	Detector assembly
P-5000-0264	Firerod cartridge heater, diameter: 1/4 in. (6.4 mm), length: 7-1/2 in. (190.5 mm), 240 V - 200 W

Table B-1: 2 year recommended spare parts list

Part number	Part description	Recommended quantity
M-1000-2468	Inlet pipe	1
P-5000-0941	Heater rod	1
P-5000-0920	12 V power supply	1
P-5000-0921	24 V power supply	1

Table B-1: 2 year recommended spare parts list *(continued)*

Part number	Part description	Recommended quantity
P-5000-0938	Temperature controller	1
P-5000-0415	Thermostat	2
P-5000-0900	Temperature sensor	2
P-5000-0366	Temperature sensor	2
P-5000-0924	Relay	2
P-5000-0310	Fan	2
P-5000-1443	Fuse 3.15 A	5
P-5000-0264	240 V cartridge heater	2

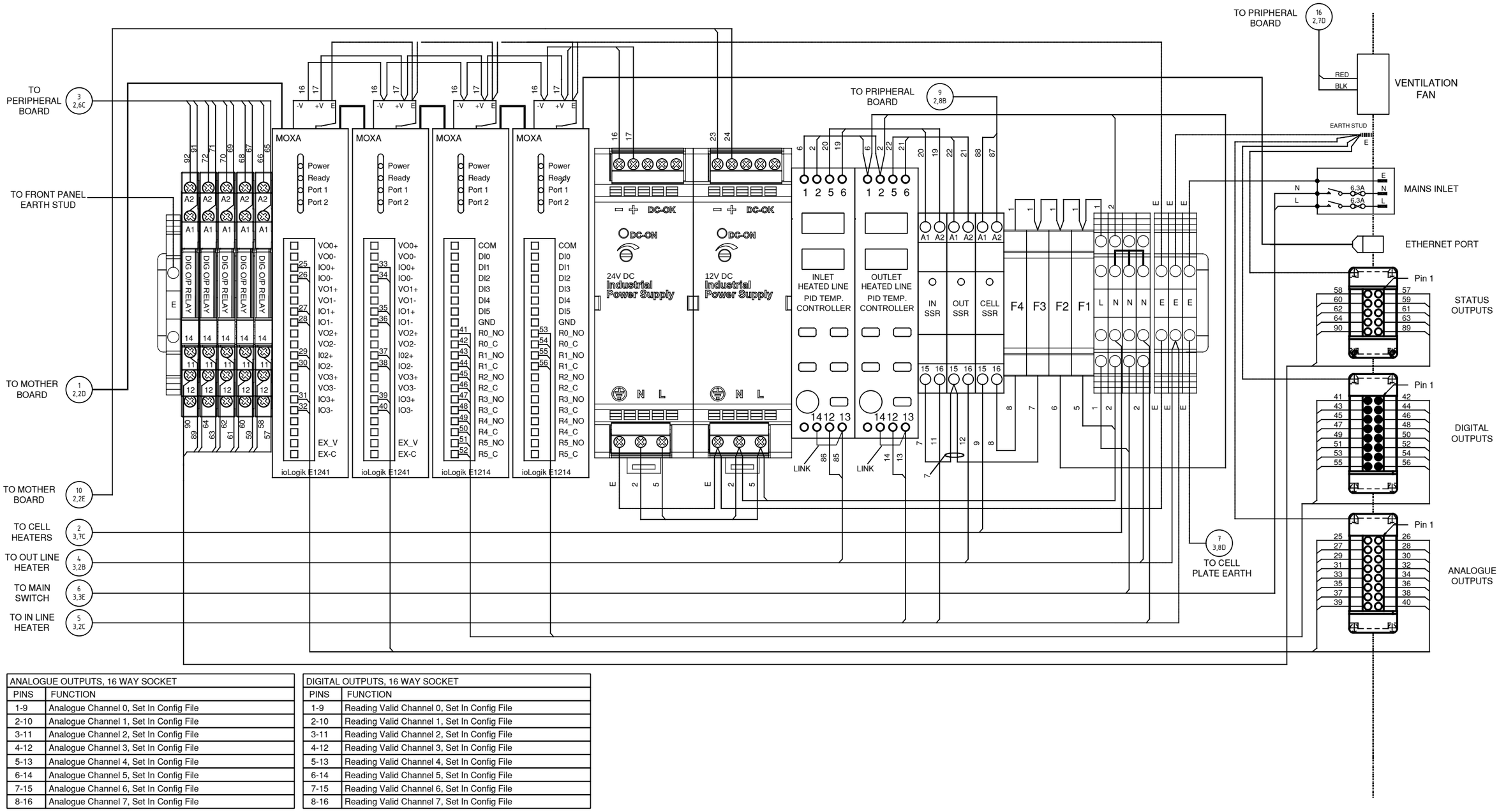
Appendix C
Engineering Drawings

Use the wiring diagrams for the Rosemount™ CT5400 analyzer to assist with troubleshooting faults. These diagrams may be used to locate the position of a wiring connector should it become disconnected.

C.1 Engineering drawings

Table C-1: Engineering drawings

Drawing number	Description
W-2000-0028 (Sheets 1-3)	Rosemount CT5400 wiring diagram for 19 in. rack mount unit



ANALOGUE OUTPUTS, 16 WAY SOCKET	
PINS	FUNCTION
1-9	Analogue Channel 0, Set In Config File
2-10	Analogue Channel 1, Set In Config File
3-11	Analogue Channel 2, Set In Config File
4-12	Analogue Channel 3, Set In Config File
5-13	Analogue Channel 4, Set In Config File
6-14	Analogue Channel 5, Set In Config File
7-15	Analogue Channel 6, Set In Config File
8-16	Analogue Channel 7, Set In Config File

DIGITAL OUTPUTS, 16 WAY SOCKET	
PINS	FUNCTION
1-9	Reading Valid Channel 0, Set In Config File
2-10	Reading Valid Channel 1, Set In Config File
3-11	Reading Valid Channel 2, Set In Config File
4-12	Reading Valid Channel 3, Set In Config File
5-13	Reading Valid Channel 4, Set In Config File
6-14	Reading Valid Channel 5, Set In Config File
7-15	Reading Valid Channel 6, Set In Config File
8-16	Reading Valid Channel 7, Set In Config File

STATUS OUTPUTS, 10 WAY SOCKET	
PINS	FUNCTION
1-6	Status Output 1(Check Function), Optional
2-7	Status Output 2(Maintenance required), Optional
3-8	Status Output 3(Out of Specification), Optional
4-9	Status Output 4(Failed), Optional
5-10	Status Output (System Healthy), Optional

FUSES		
FUSE	DUTY	RATING
F1	DC PSU PSUs	5A
F2	LINE HEATER CONTROL	1A
F3	LINE HEATER 1 & 2	5A
F4	CELL HEATER	5A

EMERSON. Process Management

ROSEMOUNT™

CASCADE TECHNOLOGIES LTD
GLENDEVON HOUSE-CASTLE BUSINESS PARK
STIRLING FK9 4TZ-UK

GENERAL DRAWING PRACTICE TO ISO14617, PNEUMATIC SYMBOLS DRAWN TO ISO1219-1, PIPING AND INSTRUMENTATION DIAGRAMS (P&ID) DRAWN TO ISO 10628, WIRING DRAWN TO IEC61346 & ICS 19-2002, WHERE APPLICABLE, CUSTOM SYMBOLS LISTED ON KEY PROVIDED, BLOCK DIAGRAMS CAN BE INSERTED TO CLARIFY FUNCTIONALITY.

A3

DO NOT SCALE
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DRAWING No: W-2000-0028

REV. E

DESCRIPTION: CT5400 19" RACK ANALYZER

DRAWN BY	JMC
CHECKED BY	??
ISSUE DATE	19/Jan/2017

SHEET 1 OF 3

1 B,2A — BALLOON I.D. NO. / DRAWING SHEET LOC. / DRAWING SHEET NO.

DRG No:W-2000-0028 REVISION:E
SAVED BY:JChalmers
DATE LAST SAVED:28-Nov-16 10:18
TEMPLATE: 7.3.3.00001-06

THERM No.	CONNECTOR	PIN OUTS	FUNCTION
THERM 1	J9	1 & 2	GAS TEMP.
THERM 2	J37	1 & 2	CELL TEMP.
THERM 3	J9	3 & 4	PRESS COMP.
THERM 4	J37	3 & 4	N/A
THERM 5	J9	5 & 6	INTERNAL AMB.

LASER MODULE
LASER MODULE
LASER MODULE
LASER MODULE
LASER MODULE
LASER MODULE

DETECTOR MODULE 1
DETECTOR MODULE 2 (optional)

TO DETECTOR MODULE 2 (if fitted) — 12 2,4B
TO TEC BOARD — 12 2,2B
TO M/BOARD — 13 2,6D

14Way Ribbon cable

TEC BOARD
J5
J6
J1
+12/-12V DC CONVERTER

TO MOXA MODULE — 1 1,1C
ETHERNET
J22
J23
Tx
GND
Rx

MOTHERBOARD
J2
J10
J26
J27
J34
J33
J32
J20 CARD READER
J701
J703
J12
J21 USB
J17
J16
J5
J6
J3
J4
J8
J9
J7
J32
J31

TO USB PORT — 14 3,3E
TO DETECTOR MODULE 2 (if fitted) — 13 2,5B

20Way Ribbon cable

TO 12V DC TERMINALS — 10 1,1C

INTERNAL PT100
RIBBON CABLE NOs.
RESISTOR TO BE SOLDERED IN LINE
4K7
+5V
GND
MISO
MOSI
CHIP SEL
CLOCK
TO HMI DISPLAY — 15 3,3E
TO STATUS OUTPUT RELAYS — 3 1,1A
TO GAS/CELL TEMP MONITORING — 11 3,8D
TO CELL HTR RELAY — 9 1,5A

PERIPHERAL BOARD
J1
J9
J7
J24
J37
J50
J8
J25
J51
J23
J2
J11
J6
J5
J18

2 WAY MINFIT
2 WAY MINFIT
VENTILATION FAN — 16 1,7A

RED
BLK

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DRG No:W-2000-0028 REVISION:E

DATE LAST SAVED:28-Nov-16 10:34 SAVED BY:JChalmers

TEMPLATE: 7.3.3.00001-06

*CT5400 Cell Assembly Part Number
M-1000-0178-B
M-1000-4077-A
P-6000-00108
P-6000-00236

H.M.I. DISPLAY
CHIP SET
MISO
CLOCK
MOSI
DSP3V3
+5V
GND

6 WAY MINFIT
TO LINE HEATER CTRL/ RELAYS

IN LINE HEATER

THERMOSTAT

PT 100 GAS TEMP

HEATER ROD 1

CELL TEMP PT 100

HEATER ROD 2

HEATED CELL

GAS PRESS PRESS SENSOR

PT 100

4 WAY MINFIT X4

3 WAY MINFIT X3

OUT LINE HEATER

2 WAY MINFIT X2

TO CELL HEATER CTRL/RELAY

TO PERIPHERAL BRD

EARTH STUD

USB 1

TO PERIPHERAL BOARD

TO MOTHERBOARD

ON/OFF SWITCH

TO MAINS TERMINALS

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SHEET 3 OF 3

BALLOON I.D. NO.
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Rev C
2018

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