Reference Manual
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April 2022

Rosemount™ CT5100(Ex)

Continuous Gas Analyzer

ROSEMOUNT™

EMERSON™

Preface

Published by Emerson.

All possible care has been taken in the preparation of this publication, but Emerson and its agents and distributors accept no liability for any inaccuracies that may be found. This manual reflects the state of the product at the issue date below, but further enhancements while in service may mean that the manual does not reflect your particular system.

Emerson reserves the right to make changes without notice both to this publication and the products which it describes.

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If you require additional technical assistance, request help from cascade.support@emerson.com or Emerson distribution partners.

Send general inquiries to cascade.support@emerson.com.

Rosemount CT5100(Ex) preliminary information

This section details important user information for the Rosemount CT5100(Ex) Continuous Gas Analyzer.

This article is in accordance with IEC 60079-0: 2011 Clause 30.

This article 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 documents shipped with the analyzer. The following document are available and/or referenced within this manual:

- Quick Start Guide

Save all instructions for future use. Contact your local service center or sales office when missing documents.

Authorized personnel

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 personnel of the operating company for hazardous areas and the manufacturer. It is the responsibility of the operating company to:

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

Operators must:

- Have been trained
- Have 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 analyzer before reading and understanding this reference manual and receiving appropriate training.

Important instructions

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 CT5100(Ex) 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 analyzer
  - 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 Reference 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.

Regulations and standards

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

Regulations / Standards	Description
2014/35/EU	The Low Voltage Directive
94/9/EC (until 19 April 2016)(1)	The ATEX Directive
2014/34/EU (from 20 April 2016) (2)	
2014/30/EU	The Electromagnetic Compatibility Directive
2012/19/EU	Waste Electrical and Electronic Equipment (WEEE) Directive
USA 21 CFR 1040.1	Laser products
NFPA 496	Standard for purged and pressurized enclosures for electrical equipment
NEC 505	National Electrical Code (issued by ANSI: American National Standards Institute and NFPA 70: National Fire Protection Association)
47CFR: 2011 Part 15, Sub Part B	Unintentional radiators; conducted and radiated emissions limits.
IEC 60079-10: 2002-06	Electrical apparatus for explosive gas atmospheres. Part 10: Classification of hazardous areas
IEC 60529:1992 + A2: 2013	Degrees of protection provided by enclosures (Ingress protection code)
BS EN 60825-1:2007	Safety of laser products. Equipment classification and requirements.
BS EN 61010-1 2010 IEC 61010-1 2010	Safety requirements for electrical equipment for measurements, control, and laboratory use. General requirements.
IEC 61241-10: 2004-06	Electrical apparatus for use in the presence of combustible dust. Part 10: Classification of areas where combustible dusts are or may be present.
BS EN 61326-1: 2013	Electrical equipment for measurement, control, and laboratory use. EMC requirements. General requirements
IEC 60079-0	Explosive atmospheres: General requirements
IEC 60079-2	Explosive atmospheres: Equipment protection by pressurized enclosure
IEC 60664-1	Pollution degree
FM3600 (2011)	Electrical equipment for use in hazardous (classified) locations – General requirements
FM3620 (2014)	Approval standard for purged andpressurized electrical equipment for hazardous (classified) locations
CAN/CSA-C22.2 No. 61010-1-12	Safety requirements for electrical equipment for measurement, control, and laboratory use, part 1: General requirements
UL Std.No. 61010-1 (3rd edition)	Safety requirements for electrical equipment for measurement, control, and laboratory use - part 1: General requirements

(1) May affect equipment tested prior to 20 April 2016 but shipped at a later date.
(2) All equipment tested from 20 April 2016 will be subject to this directive.

Regulations / Standards	Description
UK Statutory Instruments 2016 No. 1101	The Electrical Equipment (Safety) Regulations 2016
UK Statutory Instruments 2016 No. 1107	The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016
UK Statutory Instruments 2016 No. 1091	The Electromagnetic Compatibility Regulations 2016
UK Statutory Instruments 2013 No. 3113	The Waste Electrical and Electronic Equipment Regulations 2013

Associated publications

Quick Start Guide

Compliance approvals

This product complies with USA 21 CFR 1040.10.

This product is designed and manufactured under an approved quality management system to ISO 9001: 2015.

Emerson and the Rosemount CT5100(Ex) have satisfied the requirements for applying the CE and UKCA marking to the Rosemount CT5100(Ex) Gas Analyzer.

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

Explosive / hazardous area protection

Emerson has satisfied the requirements of and complies with IEC, ATEX, UKEx, and North American regulators for operation of electrical/electronic equipment in hazardous locations .

In accordance with IEC 60079-0: 2011 Clause 30.This statement must not be amended or changed.

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

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

⚠ 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 Precautions

Operators, maintenance personnel, and authorized users must observe the following safety precautions and warnings.

Safety precautions are in accordance with IEC 60079-0: 2011 Clause 30. The precautions in this manual MUST NOT be changed amended or removed. All authorized users, installation, operation and maintenance personnel, must observe the following safety precautions and warnings.

⚠ DANGER

ELECTRIC SHOCK

In accordance with IEC 60079-0: 2011 Clause 30.

The analyzer operates using mains voltage, which may cause death or serious injury to personnel. Confirm that the circuit breakers are set to *Off* and locked out and tagged out off before removing the top cover or opening the front cover. The analyzer must be earthed.

Death, personal injury, and/or damage to persons and/or property may result if this is not observed.

⚠ DANGER

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

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

The sample gas in the pipes leading to the analyzer must be purged for a minimum of 2 minutes 30 seconds at a minimum flow rate of 280 L/m at 1.5 ± 0.5 bar to prevent hazards to personnel during maintenance.

Purge the sample gas in accordance with the safe working procedures for this site.

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

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

⚠ DANGER

FLAMMABLE SUBSTANCES

Some parts of the analyzer may reach temperatures of 320 °F (160 °C) and may present an ignition source. Exercise care when using oil, paint, cleaning rags, or other flammable substances near the analyzer. A fire may result if this precaution is not observed. The interior of a analyzer is always hot unless it has been switched off and allowed to cool down.

⚠ WARNING

TRANSPORTATION HAZARD

Handle the analyzer with caution during unpacking, installation, maintenance, and transport to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 121 lb. (55 kg) and should always be lifted and moved using suitable lifting/moving equipment. Wear suitable protective gloves and protective footwear. When preparing the analyzer for transport by air, road, or rail, safeguard the analyzer against movement or break-away during transport by securely strapping it in place.

⚠ WARNING

FIRE AND EXPLOSION

In accordance with IEC 60079-0: 2011 Clause 30.

Do not open the analyzer's electrical compartment unless the atmosphere in the area is known to be below the ignitable concentration of combustible gases or materials, or unless all equipment within the protected enclosure is de-energized in accordance with NFPA 496 and ISO60079-1/2 and 28.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

FIRE, BURN, AND OPTICAL RADIATION EXPOSURE HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Operators and service personnel do not have access to the laser/electrics or upper cell compartments for general maintenance or service.

Electrical shock, thermal burns, or loss of vision may occur.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

COMBUSTIBLE GASES

In accordance with IEC 60079-0: 2011 Clause 30.

The protective gas supply valve must be kept open unless the atmosphere in the area is known to be below the ignitable concentration of combustible gases or materials, or unless all equipment within the protected enclosure is de-energized in accordance with NFPA 496.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Always lock out the gas handling system when shutting down the analyzer. Unauthorized performance on the analyzer or its associated pipes/hoses may result in highly flammable gas being released, causing fire or explosion. Failure to lock out gas handling system may cause death.

⚠ WARNING

BURNS

Some parts of the analyzer may be heated to 320 °F (160 °C). To prevent burns, do not touch any of the hot parts. All parts of a analyzer are always hot unless it has been switched off and allowed to cool down.

Before fitting, removing, or performing any maintenance on the analyzer, ensure that it has been switched off and allowed to cool for at least two hours. Before performing any maintenance on, or in the vicinity of, the analysis cell, allow the analyzer to cool for at least 12 hours as the analysis cell is insulated against heat loss.

When handling the analyzer, always wear suitable protective gloves.

Personal injury and/or damage to property may result if these precautions are not observed. These precautions are particularly important when working at heights. If you receive a burn, seek medical treatment immediately.

⚠ WARNING

LASER

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.

⚠ WARNING

HAZARDOUS SUBSTANCES

The analyzer may contain hazardous substances. Always handle the analyzer assemblies and components with extreme caution. Wear personal protective equipment (PPE) when handling the equipment.

Gas handling components within the analyzer 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 in accordance with applicable local, national, or international health and safety regulations and pollution regulations.

Failure to observe this warning could cause a potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

OPTICAL RADIATION EXPOSURE HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

There are three types of laser that may be included in the Rosemount CT5100(Ex) : Quantum Cascade Lasers (QCLs), Interband Cascade Lasers (ICLs), and diode lasers. The lasers within the analyzer are Class 1. The characteristics of the lasers contained within the analyzer are given in the table below.

Parameter	QCL	ICL	Diode	Comment
Operation mode	Pulsed	Pulsed	Pulsed	N/A
Lasers per system	1 - 6	1 - 6	1 - 6	Maximum of 6 lasers per system
Wavelength	4 - 10 µm	2 - 5 µm	Approximately 760 nm	N/A
Power	< 5 mW	< 5 mW	< 5 mW	Combined power of QCL at first accessible aperture: < 9.62 mW
Pulse duration	< 1 µs	< 1 µs	< 5 µs	N/A
Pulse repetition frequency	< 100 kHz	< 100 kHz	< 100 kHz	N/A
Duty cycle	< 5%	< 5%	< 25%	N/A

The combined power of the QCL, ICL, and diode lasers at the first accessible aperture is < 9.62 mW.

The analyzer has warning labels in appropriate positions according to USA 21 CFR 1040.10. The location of laser safety labels on the analyzer is specified in Safety and system labels and annotation.

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

⚠ WARNING

HAZARDOUS GAS

In accordance with IEC 60079-0: 2011 Clause 30.

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 or punctures from debris blown by the high pressure gas or compressed air. Always lock off or tag out the calibration gas supply and compressed air supply when shutting down the analyzer.

⚠ WARNING

HEAVY ITEM

In accordance with IEC 60079-0: 2011 Clause 30.

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

Ensure the wall the analyzer is mounted on is solid, stable, and of suitable material to hold the weight of the analyzer.
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.
The analyzer weighs 121 lb. (55 kg).
Emerson recommends that a minimum of two people move and lift the analyzer.
Wear suitable protective gloves and protective footwear.

⚠ WARNING

EXPLOSION HAZARD / ELECTRIC SHOCK HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Only trained, qualified personnel may install and connect power and signal cables. The installation/connection must be in accordance with all legislative requirements and applicable standards.

Failure to follow may cause warranty invalidation, property damage, and/or personal injury or death.

Only qualified personnel, familiar with potential risks, should install the analyzer.

Analyzers providing screw terminals for electrical connections may require working near live parts. Failure to observe this warning and or follow safety instruction could cause an explosion or potentially hazardous situation, which if not avoided, could result in death or serious injury.

⚠ WARNING

HIGH PRESSURE HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

The maximum inlet purge gas pressure at the inlet valve must not exceed 690 kPa (6.9 bar). Higher pressure may damage the analyzer enclosure in case of failure of the inlet valve.

Failure to observe this warning could cause a potentially hazardous situation which if not avoided, could result in death or serious injury.

⚠ WARNING

EXPLOSIONS HAZARD DUE TO ELECTROSTATIC DISCHARGE

In accordance with IEC 60079-0: 2011 Clause 30.

In the event of a sudden discharge from electrostatically charged devices or individuals, there is a risk of an explosion. Take suitable measures to ensure that no electrostatic discharge can build up in the explosions risk area.

Clean the device surface by gently wiping it with a damp or antistatic cloth only.

Failure to observe this warning and or follow safety instruction could cause an explosion or potentially hazardous situation, which if not avoided, could result in death or serious injury.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

After opening the enclosure, do not restore power until the enclosure has been purged for a minimum of 2 minutes 30 seconds at a minimum flow rate of 280 L/m at 1.5 ± 0.5 bar.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

POSSIBLE EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

DO NOT operate the analyzer with doors or covers open.

Refer to local regulations as this may require a competent hot work supervisor to issue a hot work permit.

Failure to observe this warning and or follow safety instruction could cause an explosion or potentially hazardous situation, which if not avoided, could result in death or serious injury.

⚠ WARNING

HAZARD BY WRONG INPUT VOLTAGE

In accordance with IEC 60079-0: 2011 Clause 30.

Applying a rated voltage other than specified on the analyzer´s nameplate label may cause an explosion, injury, or damage to the installation.

Pressurized analyzers for hazardous locations DO NOT provide wide range power supplies.

This type of analyzer is always setup for a specific rated input voltage; see nameplate label.

Ensure the voltage at site of installation meets the rated analyzer input voltage.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

When the analyzer is out of order or if the pressurization unit shuts off due to a failure, all inputs and outputs connected to external equipment MUST be shut off.

This will ensure that no hazardous voltages are present within the analyzer enclosure when not pressurized.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Only properly trained personnel who understand the contents of all applicable manuals and related instructions should start up the analyzer.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

During the pre-purge phase, all inputs and outputs connected to external equipment MUST be shut off.

This will ensure that no hazardous voltages are present within the analyzer enclosure when not pressurized.

The internal backup battery is still connected and associated circuitry remains powered.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Do not open while an explosive atmosphere may be present.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Do not keep operating the analyzer if the enclosure shows permanent deformations after performing the overpressure test.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Use only replacement parts and components authorized by Emerson.

All replacement parts and components must be certified and approved for use in hazardous areas.

Failure to comply will void certification and may cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

EXPLOSION HAZARD BY BATTERY

In accordance with IEC 60079-0: 2011 Clause 30.

The analyzer contains a battery for data backup purposes.

Under normal operating conditions, there is no need to replace the battery during the analyzer life time. Battery replacement **MUST** only be conducted by Rosemount Customer Care personnel. It is NOT a customer serviceable item.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

⚠ WARNING

LOOSE ITEMS

Do not place any loose items on top of the system or inside the compartments when doors / covers are open.

Confirm that all loose items, tools, and equipment are removed from compartments before closing doors and covers.

Failure to observe this warning could cause a potentially hazardous situation, which if not avoided, could result in death or serious injury.

⚠ WARNING

MAINTENANCE/MODIFICATIONS

In accordance with IEC 60079-0: 2011 Clause 30.

On completion of any maintenance and or modifications verify:

- All tools and equipment are removed.
- No contamination (water/dust) is in the compartments.
- Analyzer is wiped clean.
- Vents are clear and not obstructed.
- Verify that system is in a safe state for operation.

Failure to observe this warning could cause a potentially hazardous situation, which if not avoided, could result in death or serious injury.

⚠ WARNING

TRANSPORTATION HAZARD

Use safety approved lifting equipment. Ensure that the equipment is tested, meets the lifting ratings for the weight of the equipment, and is in good operational condition.

Failure to verify equipment meets the lifting ratings and is in good operational condition may cause injury to personnel or damage the analyzer.

⚠ WARNING

PHYSICAL ACCESS

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

⚠ 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 starting up the analyzer, ensure that electrical power, sample gas handling facilities, and any calibration gases that are required are available to the analyzer.

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

⚠ CAUTION

EQUIPMENT DAMAGE

Always follow the start-up procedure. Damage to the analyzer may result from a failure to follow this procedure.

⚠ 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 screen does not display measurements similar to those shown in Figure 6-6 and Figure 6-8, refer to Troubleshooting and diagnostics.

⚠ CAUTION

EMC

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

⚠ CAUTION

EMC

As a general principle, if any optical component other than the cell assembly, the laser modules, and the detectors is unserviceable, the analyzer must be repaired by Emerson. This is because the repair, replacement, and alignment of the optical components requires the use of special optical test/calibration equipment and procedures.

Some faults can only be repaired by Emerson. Where an item is unserviceable, and no replacement procedure is given in this manual, then the fault must be repaired by Emerson.

Contents

1 Introduction

1.1 Description

The Rosemount™ CT5100(Ex) Continuous Gas Analyzer, referred to hereafter as the Rosemount CT5100(Ex) Continuous Gas Analyzer or Rosemount CT5100(Ex), 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 10 different types of gas at concentrations ranging from parts per million (ppm) to percentage levels in the process gas stream.

The analyzer meets all current requirements for operation in potentially explosive environments.

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

1.2 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.

For information regarding installation, consult Install and the Quick Start Guide.

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, this document reflects the supplied analyzer 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 (cascade.support@emerson.com) or Emerson distribution partners. Further contact details for Emerson can be found on the back page of this manual.

1.3 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 analyzer 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 analyzer has warning labels at appropriate positions in accordance with USA 21 CFR 1040.10.

Conditions for safe use (Europe)

- The maximum sample gas temperature that the analyzer can operate with is 320 °F (160 °C).
- The purge controller keypad mounted on the front of the equipment shall not be exposed to direct UV light sources or direct sunlight. Example methods of protection include, but are not limited to, indoor applications away from UV sources and outdoor locations under shading. As part of regular inspections, if damage to or deterioration of the membrane keypad is detected, take the unit out of service for repair or replacement.
- The purge controller bypass function shall only be enabled during setup or maintenance and only when the area is known to be non-hazardous.
- The equipment shall be installed in an area of not more than pollution degree 2 as defined in IEC 60664-1.
- The equipment shall be installed and operated only in an environment of overvoltage category II or better according to IEC 60664-1
- The cable glands used in the equipment are only suitable for use in areas with a low risk of mechanical damage and must be suitably protected.
- The purge controller automatically monitors the internal pressure of the enclosure and will output any fault conditions onto contact K2. It is the end user's responsibility to connect this contact to a suitable facility such as an alarm or an automatic shutdown system.
- For correct operation, the on-site pressurizing air supply must be capable of providing at least 25 L/min for leakage compensation.
- When using the analyzer variant fitted with the Elmess gas cell heater certified as BVS 14ATEXE155U and IECEx BVS 14.0106U, the equipment top compartment should be cooled with a source of compressed air at a minimum flow rate of 280 L/min.
- The Elmess gas cell heater, certified as BVS 14ATEXE155U and IECEx BVS 14.0106U, may only be used in combination with the ESI Technology gas cell pressure transducer, certified as TRAC12ATEX0060X and IECEx TRC 12.0025X.

Conditions for safe use (North America)

- The maximum sample gas temperature that the analyzer can operate with is 176 °F (80 °C).
- The purge controller keypad mounted on the front of the equipment shall not be exposed to direct UV light sources or direct sunlight. Example methods of protection include, but are not limited to, indoor applications away from UV sources and outdoor locations under shading. As part of regular inspections, if damage to or deterioration of the membrane keypad is detected, take the unit out of service for repair or replacement.
- The purge controller bypass function shall only be enabled during setup or maintenance and only when the area is known to be non-hazardous.
- The cable glands used in the equipment are only suitable for use in areas with a low risk of mechanical damage and must be suitably protected.

- The purge controller provided with this equipment provides alarm signals at various contacts as described in the equipment instructions. The alarms relate to low-flow and loss of purged air supply, and must be connected to the end-user's remote, monitored alarm system.
- For correct operation, the on-site pressurizing air supply must be capable of providing at least 25 L/min for leakage compensation.
- 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 the protective earth wire.
- 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, the local requirements always take precedence.
- Equipment is not to be used with flammable liquids.
- The relief valve sealing cap must be fitted to maintain IP66 when the unit is in a non-operational state.
- Equipment is subject to acceptance of the local inspection authorities having jurisdiction.
- The equipment is intended for use only with air of instrument quality; all piping up to and including the shut-off valve adjacent to the equipment must be protected against mechanical damage.
- The protective gas supply to the equipment must be marked with the warning as detailed in NFPA496 Clause 4.12.5.
- When installing conduit for power and data connections, the end-user must select suitably certified conduit.

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 analyzers).
- 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.

1.4 Qualified personnel

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 personnel of the operating company for hazardous areas 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 analyzer before reading and understanding this reference manual and receiving appropriate training.

1.5 Software version

The analyzer includes software that is used to control the operation of the analyzer. This manual describes the software version as: 5.7.13 .

1.6 Glossary and abbreviations

Table 1-1: Abbreviations

Abbreviation	Description
©	Copyright
%	Percent
<	Less than
°	Degree
AC	Alternating current
ATEX	Explosive atmospheres
Barg	Pressure, in units of bars, above or below atmospheric pressure
BS	British Standard
C	Celsius
CDA	Compressed dry air
CE	European Conformity
CFR	Code of Federal Regulations

Table 1-1: Abbreviations *(continued)*

Abbreviation	Description
CGA	Continuous Gas Analyzer
CH_4	Methane
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
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

Table 1-1: Abbreviations *(continued)*

Abbreviation	Description
mg	Milligram
mg/m^3	Milligram/cubic meter
Mid IR	Mid Infrared
min	Minute
mm	Millimeter
N_2	Nitrogen
NEC®	National Electrical Code
NFPA	National Fire Protection Association
nm	Nanometer
NH_3	Ammonia
NO	Nitric oxide
NO_2	Nitrogen dioxide
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
WEEE	Waste electrical and electronic equipment
µm	Micro-meter

2 Theory of operation

2.1 Overview

The Rosemount™ CT5100(Ex) 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 10 gases, with ranges varying from volume to percent (%) volume levels. A detailed description of the system is given in Detailed system specifications .

2.2 Laser measurement principle

The Rosemount CT5100(Ex) can use up to six lasers to detect and measure gases. Each laser can measure between one and three gases. Inside the laser, 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 the lasers a higher output power than traditional semi-conductor lasers.

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

2.3 Gas concentration measurements

In the Rosemount CT5100(Ex), gas concentrations are measured using optical absorption spectroscopy. The laser light sources 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 laser 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.

3 Description

3.1 Equipment purpose and role

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

Figure 3-1: Rosemount™ CT5100(Ex) Continuous Gas Analyzer

The analyzer can be configured to detect and measure up to 10 different gases, depending on the combination of laser modules fitted.

3.2 System overview

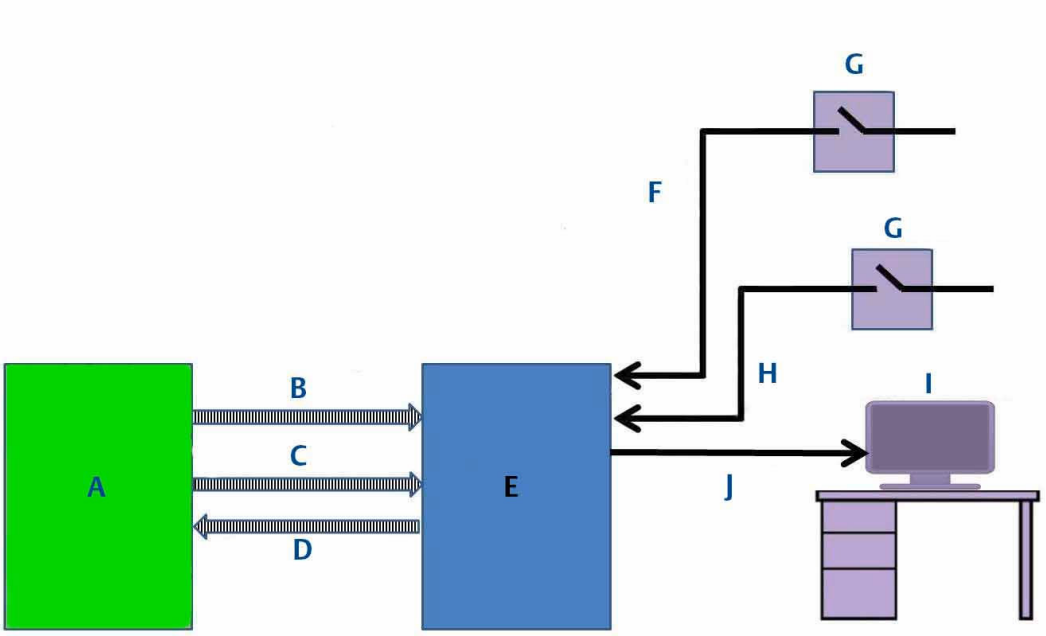
A complete Rosemount CT5100(Ex) system consists of a gas handling system, the analyzer, and the associated interconnecting wiring and gas piping.

The Rosemount CT5100(Ex) is supplied by Emerson. The gas handling system may be provided by either you or Emerson, depending upon the specific installation. The circuit breakers used to control the application of electrical power to the analyzer, the interconnecting wires, and gas piping are provided by you.

In Figure 3-2, the items supplied by Emerson are colored blue; the items supplied by you are colored purple. The green gas handling system may be provided by Emerson or you.

Table 3-1 lists the main items of the system.

Figure 3-2: Complete Rosemount CT5100(Ex) Installation



A. Gas handling system
B. Instrument air
C. Sample supply line
D. Sample return (exhaust) line
E. Rosemount CT5100(Ex)
F. Electrical power
G. Two pole main isolator
H. Purge power
I. Control center
J. Measurement data

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 110 to 230 Vac 5050/60 Hz supply.

The analyzer uses mid-infrared optical absorption spectroscopy to measure gas concentrations. The light sources are lasers, 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 Detailed system specifications before entering the analyzer. Detailed characteristics of the analyzer are also given in Table 4-1.

Table 3-1: Main Items of the Rosemount CT5100(Ex) Installation

Item	Name or description	Supplied by	Part number	Quantity	Notes
1	Rosemount CT5100(Ex)	Emerson	Rosemount CT5100(Ex)	1	
2	Rosemount CT5100(Ex) software package, version 5.7.13	Emerson	N/A.Software is embedded in the system.	1	Version described in manual
3	Gas handling system	Customer (optionally by Emerson)	Customer Choice or Emerson	1	
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	1	Required for calibration
9	Excess flow line	Customer	Customer choice	1	Required for calibration
10	Power cables to Rosemount CT5100(Ex)	Customer	Customer choice	1	
11	Cables from Rosemount CT5100(Ex) to control center	Customer	Customer choice	1	
12	Main circuit breaker	Customer	Customer choice		

Table 3-1: Main Items of the Rosemount CT5100(Ex) Installation *(continued)*

Item	Name or description	Supplied by	Part number	Quantity	Notes
13	Secondary circuit breaker	Customer	Customer choice		

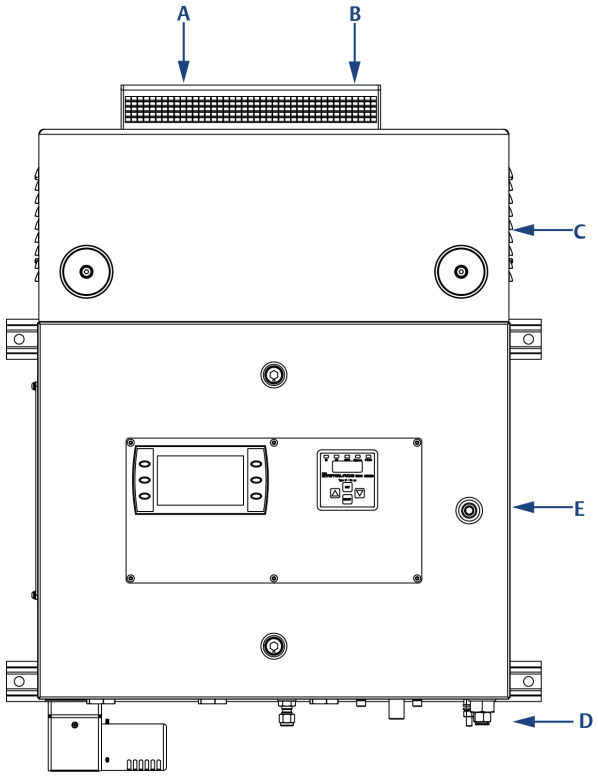
3.2.1 Explosive safety

To prevent explosive vapors from entering the analyzer, the electrical compartment is held at a positive pressure above the surrounding air pressure.

3.3 Gas flow through analyzer

The analyzer has two gas inputs and one gas output. See Figure 3-3.

Figure 3-3: Gas Inlet and Outlet Connectors



A. Sample gas return port
B. Sample gas input port
C. Top cover of Rosemount CT5100(Ex) (cell compartment)
D. Purge air supply
E. Laser/electrical compartment

Procedure

1. The gas sample that is to be measured for impurities enters the analyzer through the sample gas input port located on top of the analyzer (see Figure 3-3, Items A and B).
2. Once the gas sample has been examined for impurities, it is expelled from the analyzer through the sample gas return port (A).
3. A compressed air supply enters the analyzer through a port (D) on the underside of the unit.

   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

AIR SUPPLY

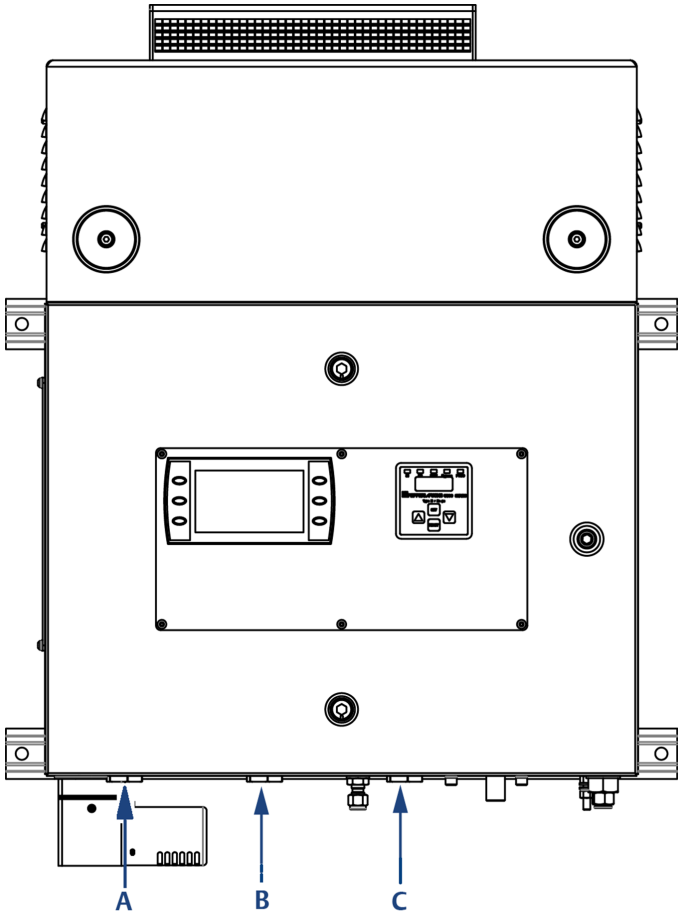
The air supply must be clean, filtered, and free from moisture.

3.4 Connecting the electrical/electronic inputs and outputs

⚠ CAUTION

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

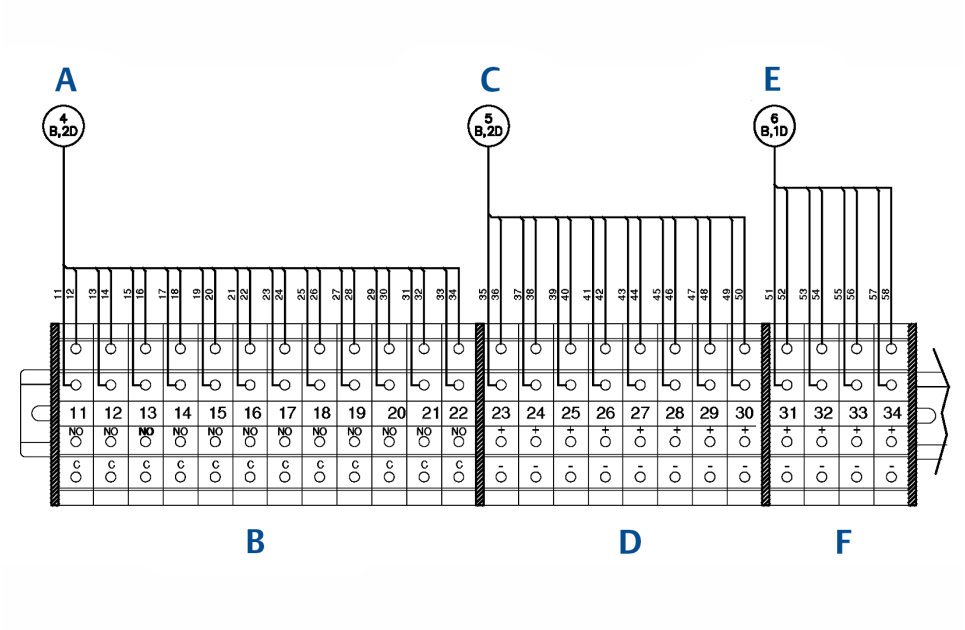
Figure 3-4: Electrical / Electronic Connectors



A. *Purge power and alarm entry point*
B. *Power entry point*
C. *Analog/digital entry point*

Electrical/electronic signal connections to the analyzer are made through three electrical entry points located on the underside of the analyzer, as shown in Figure 3-4. Use the wiring diagram to make the electrical connections as shown in Engineering drawings and Figure 3-5.

Figure 3-5: Signal Cable Outputs



A. To digital modules
B. Digital output terminals
C. To analog modules
D. Analog output terminals
E. To status relays
F. Status output terminals

Note
Purge solenoid fitted can be either for 5500-MAN-EX01 for ATEX/IEC applications or 5500-MAN-CD01 for North American applications.

Note
Maximum number of user terminals shown. These may be reduced depending on number and type of analog/digital outputs required.

Two sources of electrical power are applied to the analyzer through power entry points (see Figure 3-4 Items A and B).

1. A purge electrical supply that is used to power the overpressure facility in the electrical compartment of the analyzer entry point (A).
2. An instrumentation electrical supply that is used to power all other functions of the analyzer entry point (C).

Both power supplies are 110 to 230 Vac, 50/60 Hz ± 10%. AC to DC power converters inside the analyzer automatically adjust in response to the input voltage level and ensure that the correct DC voltage is available inside the unit. The analyzer is electrically protected by an internal 5 A, 250 VA fast acting fuse on the instrumentation electrical supply line and an internal 2 A, 250 VA fuse on the purge electrical supply line.

The wiring diagram (Figure 3-6) for the purge electrical supply is in accordance the with the latest Pepperl+Fuchs 5500 Series Installation Manual Purge and Pressurization System documentation (www.Pepperl-fuchs.com). It is recommended that these instructions are verified from the Pepperl+Fuchs website to ensure the latest wiring instructions for the purge controller have been followed during installation. The complete wiring diagram used during the manufacture of the Rosemount CT5100(Ex) is included for reference in Engineering drawings.

Figure 3-6: Pepperl +Fuchs Wiring Diagram (External Mount)

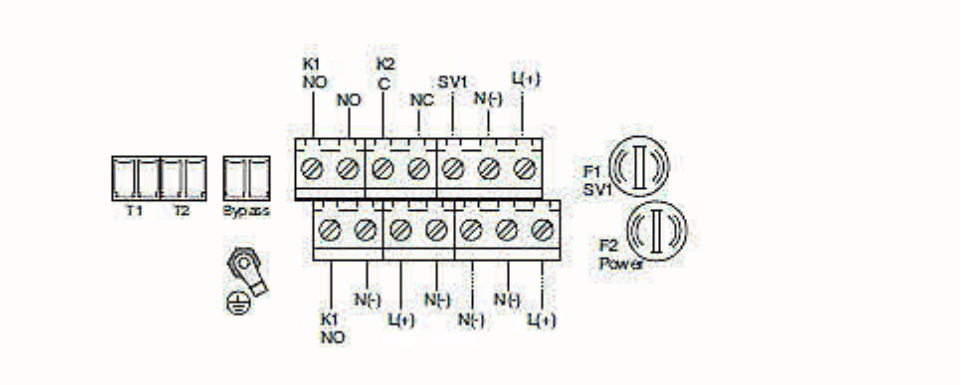


Figure 3-7: Pepperl +Fuchs Wiring Diagram (Internal Mount)

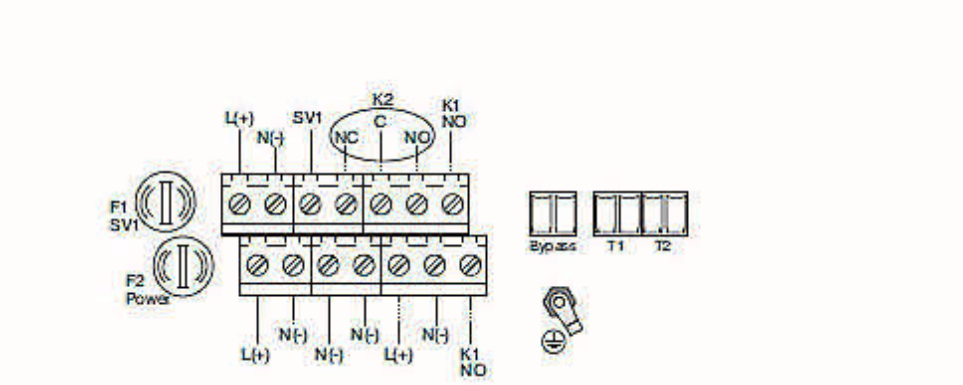
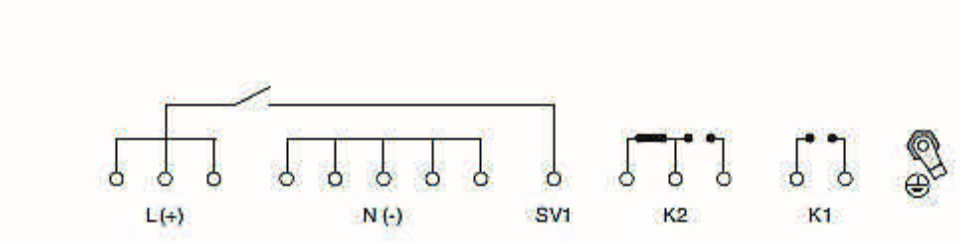


Figure 3-8: Pepperl +Fuchs Wiring Diagram (Terminal Block Connections)



General wiring instructions for the Pepperl+Fuchs 5500 series purge control power connection are as follows:

- All applicable local and national wiring codes **MUST** be followed when wiring the system. Also see IEC60079-14.
- The power supply to this device shall have a separate customer installed external disconnect. If placed in the hazardous area, it shall be rated for the area it is being installed in. Placing the disconnect into the purged enclosure is not an option as power needs to be applied to the control unit before the purge cycle is complete.
- PE ground wire to be same size as largest wire used to bring power into the enclosure. Terminate using ring lug properly crimped at grounding stud in bottom of enclosure.
- All wire shall be copper only, rated 176 °F (80 °C) minimum.
- The minimum wire strand in a stranded wire shall have a diameter of 0.004-in. (0.1 mm) or greater.
- Wire strip length into fixed terminal block is 0.315 in. (8 mm).
- Terminal torque is 0.5 Nm to 0.6 Nm.
- There shall be only one wire per terminal.
- It is recommended to leave a bit of extra wire loop in housing to allow for any re-termination.

3.5 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 0.7 ft. (0.2 m) and 49.2 ft. (15 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.

3.5.1 Explosion protection

The process gas stream being analyzed is **highly flammable and explosive**, as are other gases that could, in the event of a gas escape, be present around the analyzer. To prevent fires or explosion in the event of a gas escape, the analyzer has been designed to meet industry standard requirements for explosion protection.

A zonal approach to explosion protection has been adopted. A sample of the process gas stream passes through the analysis cell, and therefore the analysis cell is a sealed unit. The optical compartment is not airtight, and, in the event of a gas escape, flammable and explosive gases could enter the optical compartment. To prevent electrical ignition of a gas escape, all electrical components in the optical compartment (the pressure sensor, temperature sensor, and block heater) have been certified as safe for use in explosive

atmospheres. The components in the optical compartment are mounted on a metal baseplate that is sealed to prevent gases from entering the electrical compartment.

The electrical compartment contains a PC and numerous electrical/electronic components that are not certified for use in hazardous atmospheres. To prevent explosive gases from entering the electrical compartment, it is sealed and held at a positive air pressure - above the surrounding air pressure - when the analyzer is switched on.

4 Specifications

4.1 Gas detection

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

4.2 Detailed system specifications

Table 4-1 gives the physical characteristics for the analyzer while Table 4-2 gives the general characteristics. Schematic diagrams of the analyzer are shown in Figure 4-1, Figure 4-2, and Figure 4-3.

Table 4-1: Physical Characteristics

Rosemount CT5100(Ex)	Value	Comment
External dimensions	22.68 x 11.7 x 30.94 in. 575 x 298 x 786 mm	Length x width x height Nominal dimensions
Weight	121 lb. 55 kg	Approximate weight

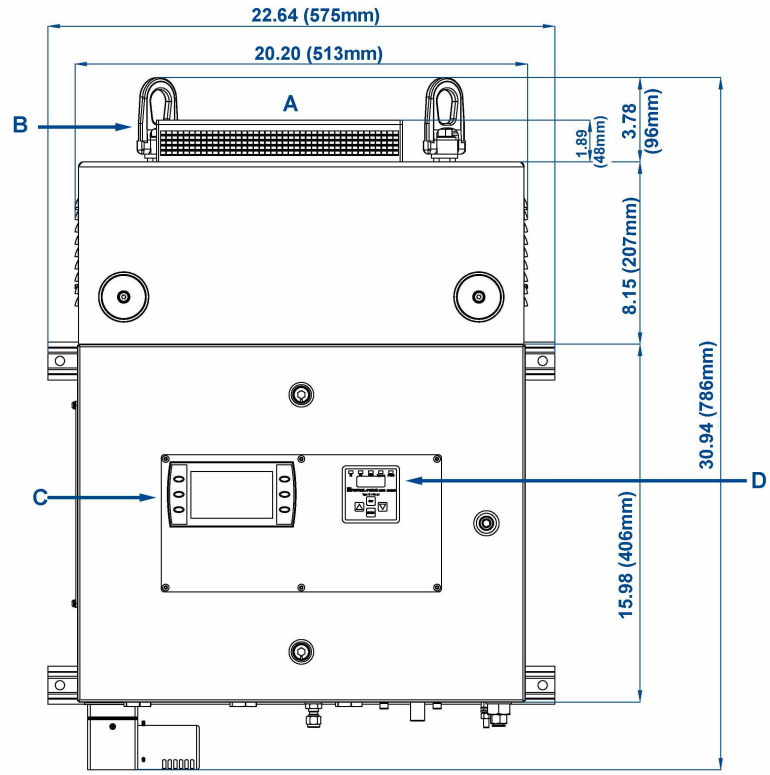
Table 4-2: General Characteristics

Rosemount™ CT5100(Ex)	Value	Units	Comment
Instrumentation supply voltage	110 or 230	Vac	50/60 HZ ±10%
Purge supply voltage	110 or 230	Vac	50/60 Hz ±10%
Peak power consumption	500	W	Max consumption per gas analyzer
Continuous steady-state power consumption	300	W	Once the gas analyzer has stabilized and the analysis cell has reached the temperature set point
Electrical compartment enclosure	N/A	N/A	Stainless steel
Optical compartment enclosure	N/A	N/A	Stainless steel
Measurement technique	N/A	N/A	Mid IR absorption spectroscopy
Operating conditions			
Mid IR source	N/A	N/A	Quantum Cascade Laser
Near IR source	N/A	N/A	Interband Cascade Laser Diode Laser
Laser classification	Class 1	N/A	BS EN 60825-1: 2007 safety of laser products. Equipment classification and requirements (identical to IEC 60825-1 2007)
Inlet gas port connector	¼ 6	in. mm	Swagelok® type, factory-configured, specify on order

Table 4-2: General Characteristics *(continued)*

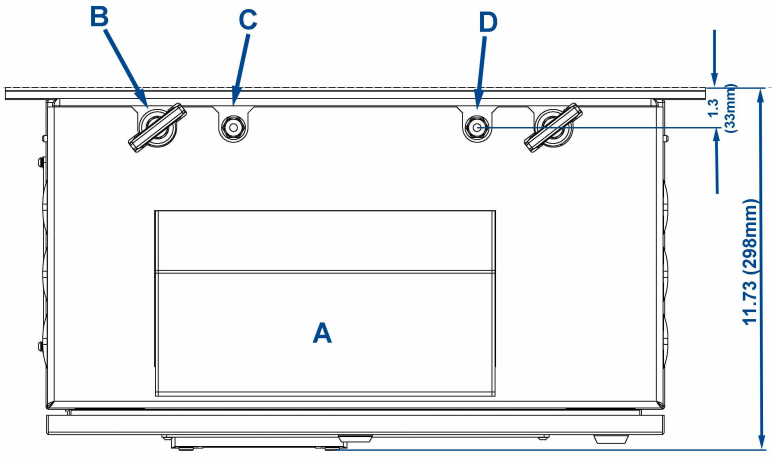
Rosemount™ CT5100(Ex)	Value	Units	Comment
Outlet (exhaust) gas port connector	¼ 6	in. mm	Swagelok type, factory-configured, specify on order
Purge connector	⅜ 10	in. mm	Purge inlet (certified system only)
Purge air pressure	2	Barg	
Measurement result signals	4 to 20	mA	4 or 8 channel outputs, specify on order
Communication	10/100	Mbps	Ethernet
Warm-up time	90	minutes	

Figure 4-1: Rosemount CT5100(Ex) Dimensions - Front View



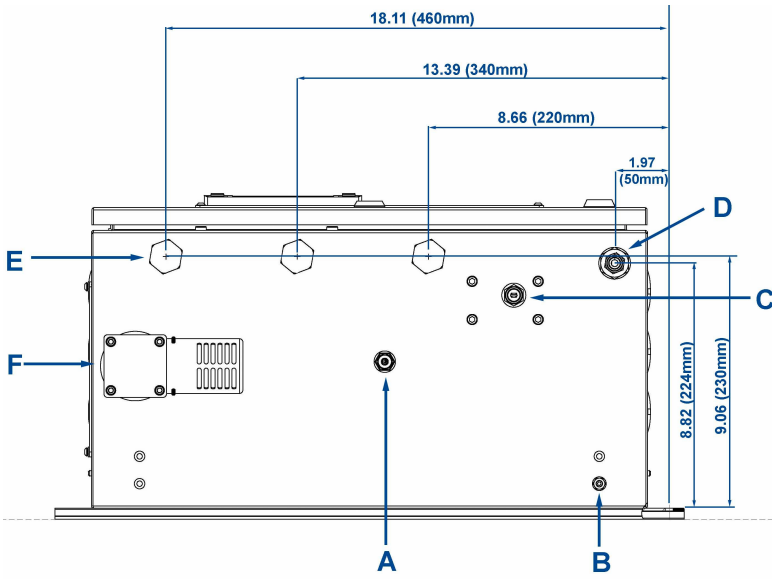
A. Ventilation
B. Lifting eyelet
C. User interface
D. Purge control panel

Figure 4-2: Rosemount CT5100(Ex) Dimensions - Top View



A. Ventilation
B. Lifting eyelet
C. Sample return
D. Sample inlet

Figure 4-3: Rosemount CT5100(Ex) Dimensions - Bottom View



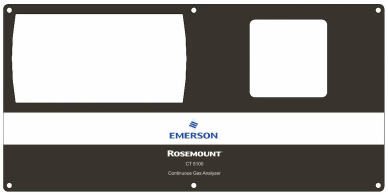
A. Atmospheric pressure refer plug
B. Earth point
C. Purge pressure Set
D. Air supply
E. Cable glands
F. Purge vent

Table 4-3: Environmental Characteristics

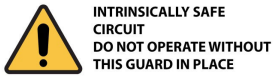
Environmental characteristic	Value	Units	Comment
Operating temperature range	-4 to 131 -20 to 55	°F °C	Ambient temperature
Sample gas temperature range (Condition for safe use Europe)	122 to 329 50 to 160	°F °C	Factory set, specify on order
Sample gas temperature range (Condition for safe use North America)	122 to 176 50 to 80	°F °C	Factory set, specify on order
Sample gas moisture content	20	%	Maximum
Sample gas particulate density	5	mg/m^3	Maximum
Sample gas particulate size	10	µm	Maximum
IP code	66	N/A	IP to IEC 60529
Sensor humidity range	10 to 95	%	Relative humidity (non-condensing) at 113 °F (45 °C)

4.3 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 and model number		Front panel
Fuse identification label		1. Back plate 2. Top right inside of door

Label type	Example	Location
IECEx and ATEX ratings label		Enclosure side panel
North America / Canada ratings label		Enclosure side panel

Label type	Example	Location
Universal Ratings Label		Enclosure side panel
Laser radiation CAUTION label		Baseplate
Laser module identification label		On each laser module housing
Intrinsically safe label		1. HMI 2. Intrinsically safe sensor barrier

Label type	Example	Location
Terminal label (typical layout)	USER CONNECTIONS TERMINAL / FUNCTION 1 SENSOR SYSTEM SUPPLY (L) 2 SENSOR SYSTEM SUPPLY (N) 3 EARTH 4 PURGE FAILURE ALARM CONTACTS 5 PURGE SYSTEM SUPPLY (L) 6 PURGE SYSTEM SUPPLY (N) 7 EARTH 8 PURGE SOLENOID (L) 9 PURGE SOLENOID (N) 10 EARTH 11 DGITAL OUTPUT 1 12 DGITAL OUTPUT 2 13 DGITAL OUTPUT 3 14 DGITAL OUTPUT 4 15 DGITAL OUTPUT 5 16 DGITAL OUTPUT 6 17 DGITAL OUTPUT 7 18 DGITAL OUTPUT 8 19 DGITAL OUTPUT 9 20 DGITAL OUTPUT 10 21 DGITAL OUTPUT 11 22 DGITAL OUTPUT 12 23 ANALOGUE OUTPUT 1 24 ANALOGUE OUTPUT 2 25 ANALOGUE OUTPUT 3 26 ANALOGUE OUTPUT 4 27 ANALOGUE OUTPUT 5 28 ANALOGUE OUTPUT 6 29 ANALOGUE OUTPUT 7 30 ANALOGUE OUTPUT 8 31 STATUS OUTPUT 1 (Check Function) 32 STATUS OUTPUT 2 (Maintenance Required) 33 STATUS OUTPUT 3 Out Of Specification) 34 STATUS OUTPUT 4 (Failed) 01 ANALOGUE OR DIGITAL OUTPUT 02 ANALOGUE OR DIGITAL OUTPUT 03 ANALOGUE OR DIGITAL OUTPUT 04 ANALOGUE OR DIGITAL OUTPUT 05 ANALOGUE OR DIGITAL OUTPUT 06 ANALOGUE OR DIGITAL OUTPUT	Top left inside of door
Earth identification label		Back plate
Manufacturer's label	INTERTEC SL BLOCKTHERM DKA T4 BI II2G Ex d IIC T4 110-265V II2D Ex tD A21 IP65 T135oC IECEx PTB 07 0055 X 50W PTB 02 ATEX 1116 X No. 34241/14 0102 INTERTEC Hess GmbH D-93333 Neustadt/Do.	On analysis cell heater block
Electrical safety label		On inside of electrical compartment door
AC Power Supply Danger label		1. On outside of electrical compartment door 2. On manifold block of air overpressure system

5 Install

5.1 Site selection

The Rosemount™ CT5100(Ex) has a T3 temperature classification. The user must ensure that no combustible gas concentrations will be present, whether on a continual or occasional basis, which have an ignition temperature below the T3 rating of the analyzer.

⚠ DANGER

FIRE AND EXPLOSION

The analyzer's electrical compartment must not be opened unless the atmosphere in the area is known to be below the ignitable concentration of combustible gases or materials, or unless all equipment within the protected enclosure is de-energized in accordance with NFPA496.

Death, personal injury, and/or damage to persons and/or property may result if this is not observed.

⚠ DANGER

ELECTRIC SHOCK

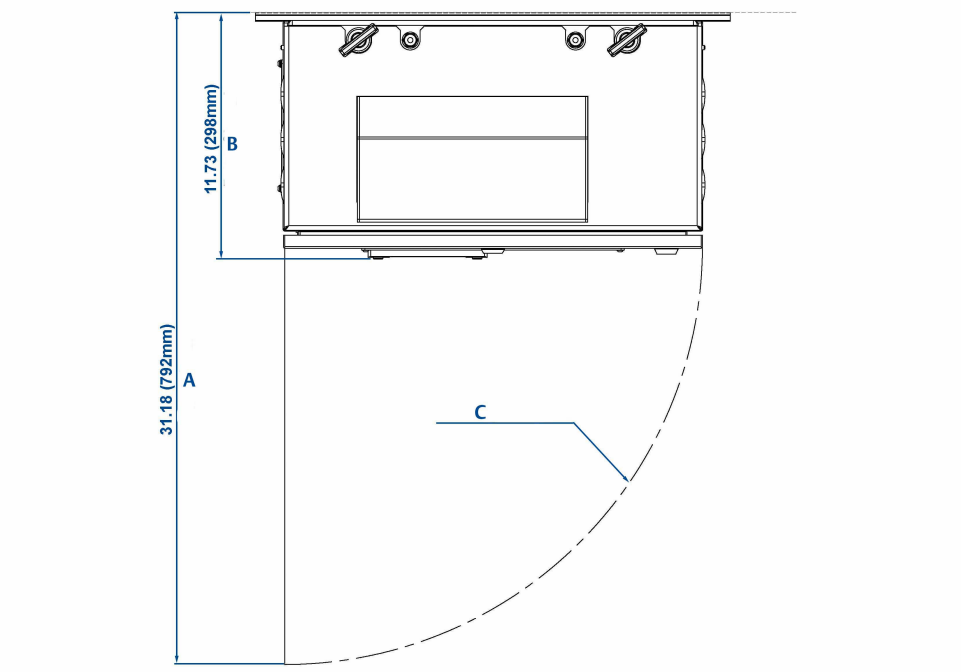
The analyzer operates using mains voltage, which may cause death or serious injury to personnel. Ensure that the circuit breakers are set to Off and locked out and tagged out off before removing the top cover or opening the front cover.

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

The analyzer is intended to be installed in a suitable Division 2 shelter to protect it from the elements.

Provide sufficient space around the analyzer to allow the maintenance and servicing of the unit.

Figure 5-1: Clearance with Door Open



A. Door open
B. Door closed
C. Door opening arc

5.2 Unpacking

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

⚠ WARNING

HEAVY INSTRUMENT - LIFTING HAZARD

Handle the analyzer with caution during unpacking, installation, maintenance, and transport to prevent crushing of hands, feet, or other body parts.

The analyzer weighs 121 lb. (55 kg) and should always be lifted and moved using suitable lifting/moving equipment. Emerson recommends that a minimum of two people using suitable tools for transportation and lifting are employed.

Wear suitable protective gloves and protective footwear.

⚠ CAUTION

EQUIPMENT DAMAGE

When preparing the analyzer for transport by air, road, or rail, safeguard the analyzer against movement or break-away during transport by securely strapping it in place.

Failure to observe may cause damage to the equipment.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Installing and wiring the analyzer must comply with all relevant national legislative requirements and regulations.

Consider all safety instructions within this manual and all associated analyzer instruction manuals.

⚠ WARNING

EXPLOSION HAZARD

In accordance with IEC 60079-0: 2011 Clause 30.

Installing the analyzer requires opening the enclosure and working at the open unit. This is permitted only when both the analyzer and connected external circuitry are de-energized.

Depending on the local regulation, this may require a competent hot work supervisor to issue a hot work permit.

⚠ WARNING

HEAVY ITEM

In accordance with IEC 60079-0: 2011 Clause 30.

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

Ensure the wall the analyzer is mounted on is solid, stable, and of suitable material to hold the weight of the analyzer.
Handle the analyzer with caution during unpacking, installing, maintaining, and transporting to prevent crushing of hands, feet, or other body parts.
The analyzer weighs 121 lb. (55 kg).
Emerson recommends that a minimum of two people move and lift the analyzer.
Wear suitable protective gloves and protective footwear.

⚠ CAUTION

SHOCK AND VIBRATION

The analyzer contains sensitive electronic equipment. It MUST NOT be subjected to any shock and or vibration.

Damage to the analyzer may result from a failure to follow this caution.

Procedure

1. On receipt of goods, look for any visible damage to the analyzer and verify that all items noted to be shipped were received. Record on the goods receipt note any damage or missing items, noting both the item(s) and quantity missing.
2. Visually inspect the exterior of the analyzer for signs of damage, corrosion, gas leaks, or signs of previously overheating.
3. Report anything found to the maintenance organization.
4. Attach suitably rated and tested lifting slings to the safety engineered lifting eye bolts mounted on top of the analyzer.
5. One person should carefully guide the equipment from the horizontal to vertical position while the other person lifts the equipment.
6. Use safety approved and tested lifting equipment to remove the analyzer from the shipping container and place it on a solid, level surface.
7. Ensure that the analyzer is stored in its protective plastic cover until installation.

5.3 Mounting the analyzer

This procedure requires two people to safely move and mount the Rosemount CT5100(Ex).

Procedure

1. Ensure that there is free space around the analyzer to allow ventilation of the upper part of the analyzer.

⚠ WARNING

HEAVY ITEM

In accordance with IEC 60079-0: 2011 Clause 30.

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

Ensure the wall the analyzer is mounted on is solid, stable, and of suitable material to hold the weight of the analyzer.

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

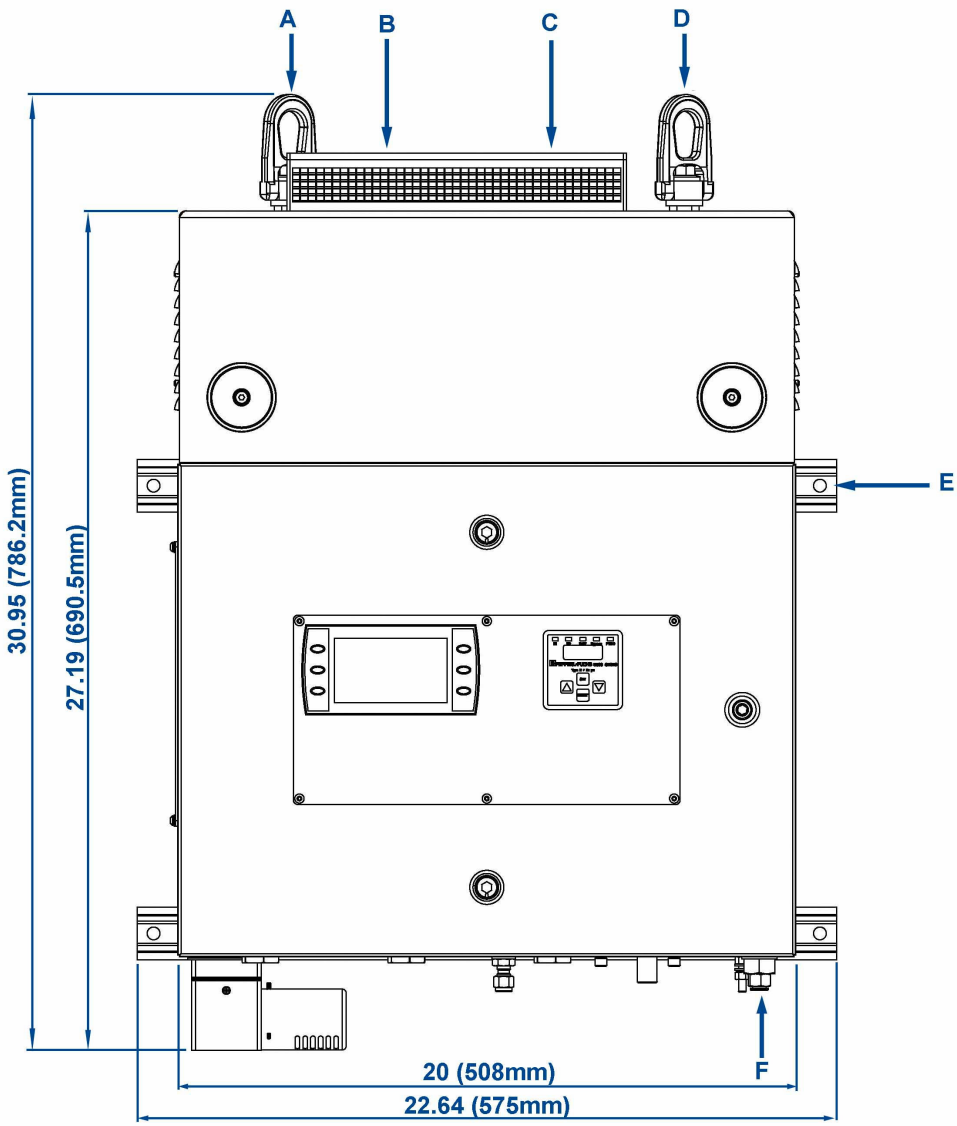
The analyzer weighs 121 lb. (55 kg).

Emerson recommends that a minimum of two people move and lift the analyzer.

Wear suitable protective gloves and protective footwear.

2. Attach suitably rated and tested lifting slings to the safety engineered lifting eye bolts (see Figure 5-2, items A and D) mounted on top of the analyzer.

Figure 5-2: Front View Dimensions



A. Lifting eye bolt
B. Sample gas input port
C. Sample gas return port
D. Lifting eye bolt
E. 0.413-in. (10.5 mm) diameter mounting points
F. Purge compressed air supply port

3. One person should carefully guide the equipment while the other person operates the lifting equipment.
4. Use safety approved and tested lifting equipment to lift the analyzer from the stable platform.

5. Mount the analyzer using four M8 (⅜-in.) fasteners to attach the wall mount brackets.

   The bolts must be positioned in such a way to allow maximum use of all thread length.

   The installer must ensure that the fasteners used are suitable for the load and surface that the analyzer is mounted on.

   In case you need to thread lock the fittings for extra security, only do this with compounds compatible with the zone classification of the installation location.

   The four wall fixing points must be 0.413-in. (10.5 mm) diameter mounting holes.

   Ensure that the wall fixing points are capable of supporting a load of 242 lb. (110 kg) each; this includes a x 2 factor of safety. Figure 5-4 shows the locations of the mounting points on the analyzer. All mounting points are 0.413-in. (10.5 mm) diameter holes.

   Confirm the bolts are secure. Do not over tighten the fasteners.

   The analyzer must be mounted using the four off factory fitted and pre-drilled holes on the brace bars. Refer to Figure 5-2.

6. Remove the lifting eyes and retain them for future use.

   Threads must be protected with a suitable grease and plastic grommets.

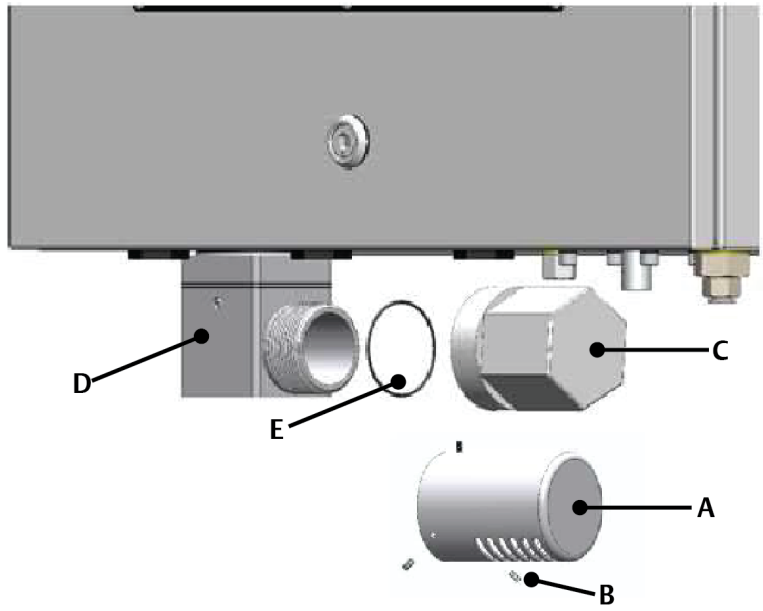
   After mounting, do not place any additional load on the analyzer.

   Do not place or leave loose items on flat surfaces.

   For transportation, the purge vent (D) located on the base of the analyzer is fitted with a temporary protector cap (C). This protector cap **MUST** remain in place until the analyzer is commissioned. Refer to Figure 5-3.

   The vent cap (A), O-ring (E) and grub screws (B) are shipped loose in the crate. Refer to Figure 5-3.

Figure 5-3: Connecting the Purge Vent Cap



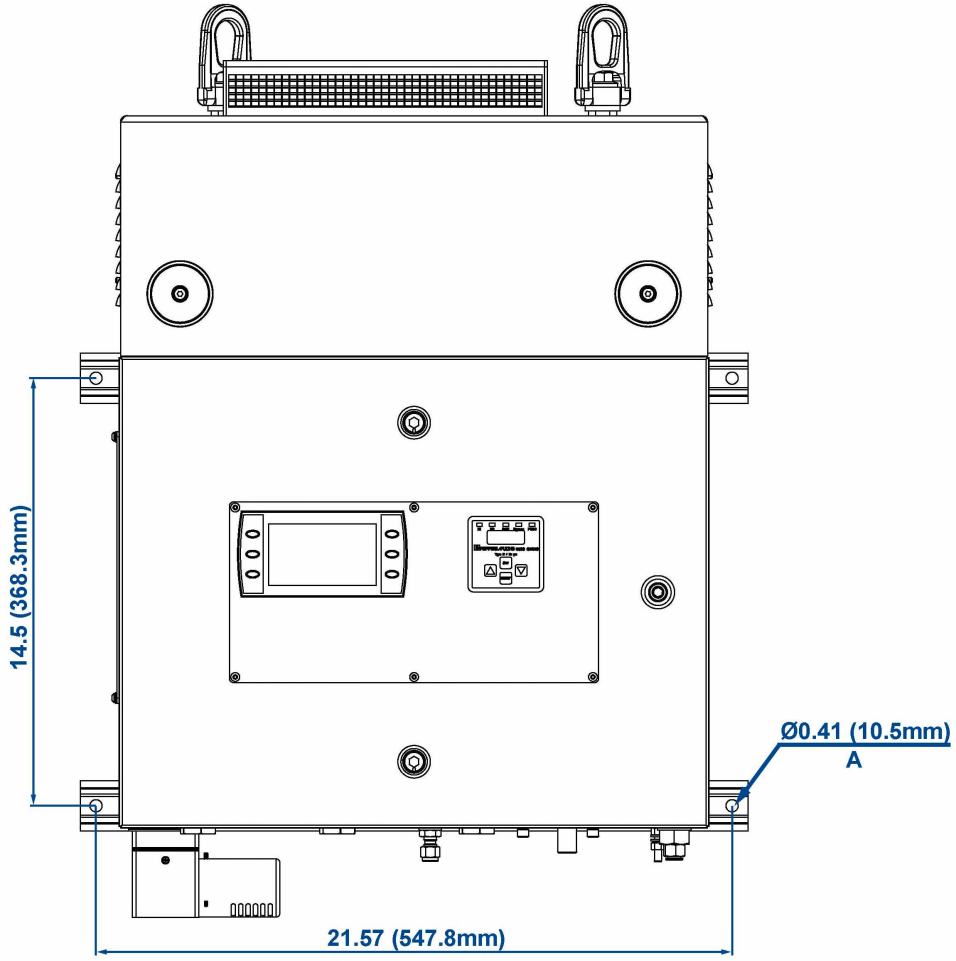
A. Vent cap
B. 3/32-in. socket grub screws
C. Protector cap
D. Purge vent
E. O-ring

7. To complete the installation, remove the protector cap from the purge vent and the O-ring (E). Install the vent cap, locking it in position with the grub screws.

   Refer to Figure 5-2. An Allen key is provided for the grub screws.

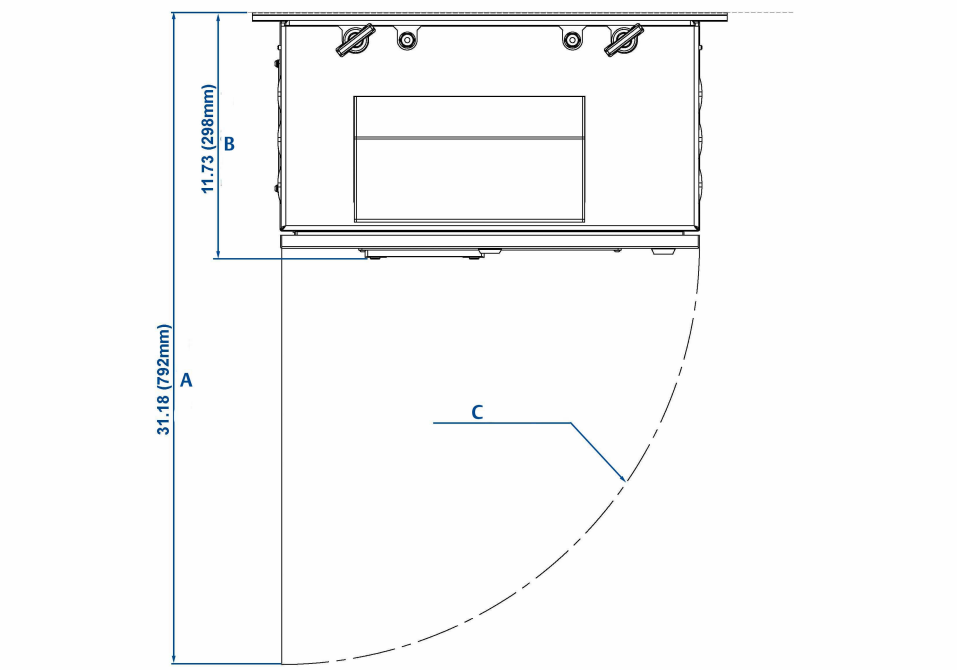
   The protector cap (C) must be retained as it will need to be refitted whenever the analyzer is being shutdown for a prolonged period to seal the purge vent from fluid ingress.

Figure 5-4: Mounting Details



A. Mounting points

Figure 5-5: Clearance with Door Open



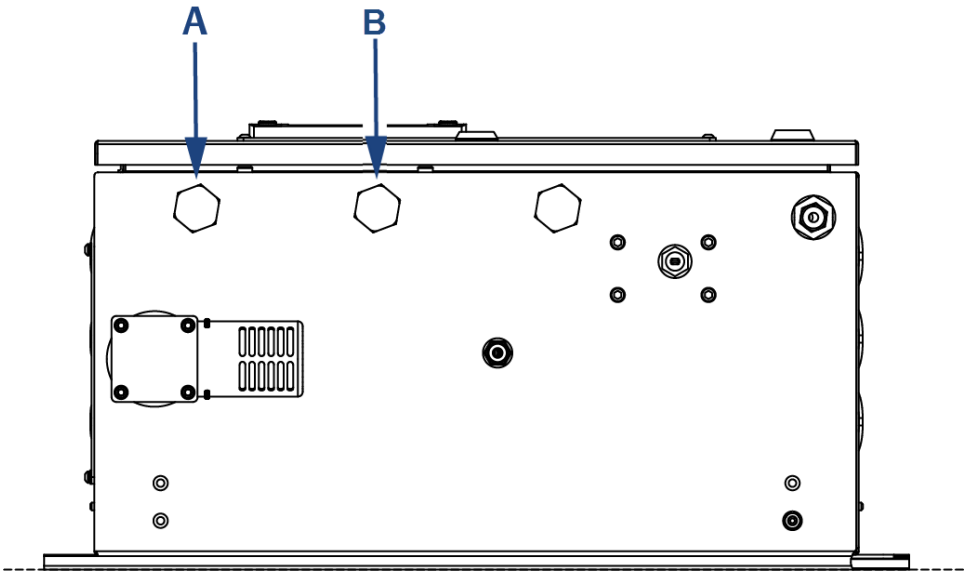
A. Door open
B. Door closed
C. Door opening arc

5.4 Connecting the electrical/electronic inputs and outputs

5.4.1 AC power

Power is connected to the analyzer instrumentation through the power entry point (B) and the purge controller through the purge power and alarm entry point (A) fitted to the base of the analyzer. Refer to Figure 5-6.

Figure 5-6: Power Gland



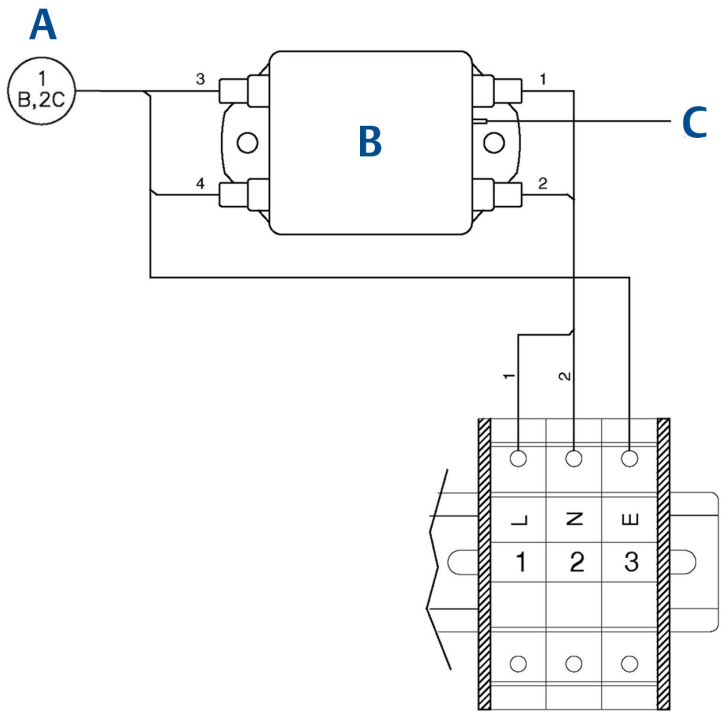
A. Purge power and alarm entry point
B. Power entry point

Two sources of electrical power are applied to the analyzer:

- A purge electrical and alarm supply that is used to power the overpressure facility in the electrical compartment of the analyzer. Refer to Figure 5-6 (Item A).
- An instrumentation electrical supply that is used to power all other functions of the analyzer. See Figure 5-6 (Item B).

The customer supplied circuit breakers **must** be in accordance with ATEX / IECEx / North American protection concepts. The main power isolator controls the application of electrical power to the purge controller with the secondary power isolator controlling the application of electrical power to the remaining analyzer functions.

Figure 5-7: Power Entry Point Connections

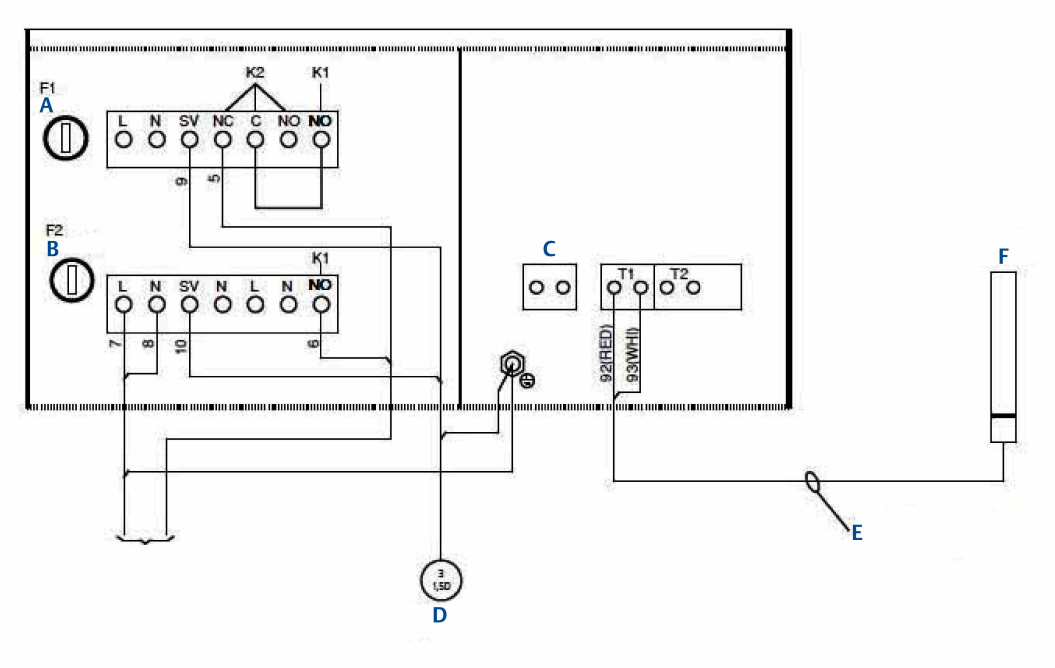


A. To mains input fuses
B. Mains input filter
C. To enclosure earth stud

Table 5-1: Mains Input Terminal

Terminal	Function
1	Sensor system supply (L)
2	Sensor system supply (N)
3	Earth

Figure 5-8: Purge Power and Alarm Entry Point Connections



A. SV1
B. Power
C. Bypass
D. To purge solenoid
E. To be run separately from other cables looms
F. To PT100 sensor

Note
Purge control system power and alarm contact to be directly wired into purge control unit by end user. The cables must use cable glands suitable for the zone of application of the analyzer for entry into the analyzer enclosure and the purge control unit.

Terminal	Function
L	Purge control supply (live)
N	Purge control supply (neutral)
K1 (normally open)	Alarm contract
K2 (normally closed)	Alarm contract

Electrical protection for the instrumentation circuitry of the analyzer is provided by fuses F1 and F2 located inside the analyzer. Refer to Figure 5-9.

The customer supplied power cable for the analyzer instrumentation will be connected to terminals 1 - 3.

Table 5-2: Electrical Power Requirements

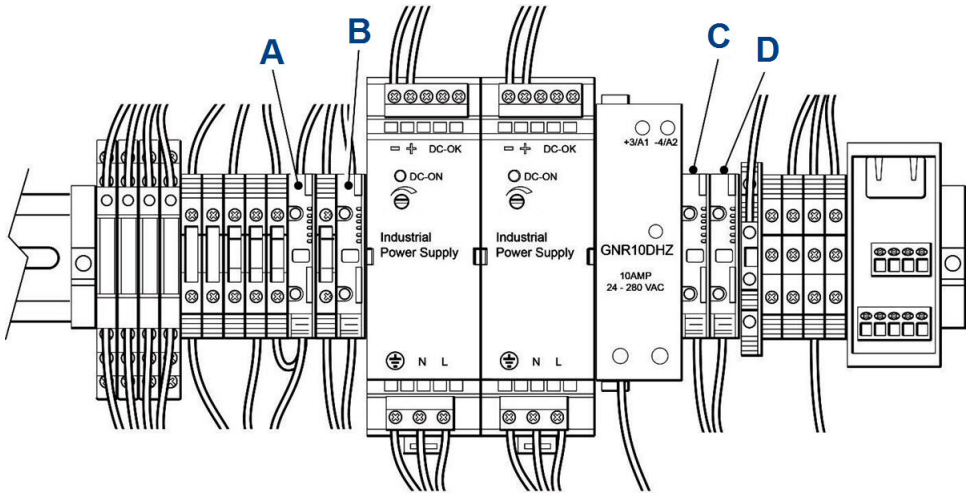
Electrical supply	Power consumption	Voltage	Fuse
Instrumentation supply voltage	400 W	100 to 230 Vac, 50/60 Hz ±10%	3.15 A internal fuses F1 and F2
Purge supply voltage	100 to 230 Vac, 2.3 VA (without digital valve)	100 to 240 Vac, 48/62 Hz ± 10%, single phase Overvoltage category 2	AC: 2.0A

For the electrical power wiring use 16 AWG stranded, three conductor copper or tin-plated copper power wire, rated for at least 250 Vac, of the required length. Cables must be terminated in the power entry points in accordance with local electrical codes. The full electrical wiring diagram is provided in Engineering drawings.

5.4.2 Fuses

Figure 5-9 shows the location of the fuses.

Figure 5-9: Fuses



A. Fuse F4 (24 Vdc supply)
B. Fuse F3 (12 Vdc supply)
C. Fuse F1 (mains supply – live)
D. Fuse F2 (mains supply – neutral)

Table 5-3: Fuse Requirements

Fuse	Function	Rating	Schurter part number
1	Live line 110/230 Vac (following mains filter)	3.15 A, 250 V, fast acting ceramic	0001.1009

Table 5-3: Fuse Requirements *(continued)*

Fuse	Function	Rating	Schurter part number
2	Neutral line 110/230 Vac (following mains filter)	3.15 A, 250 V, fast acting ceramic	0001.1009
3	Analyzer 12 Vdc supply rail	5 A, 250 V, fast acting ceramic	0001.1011
4	Analyzer 24 Vdc supply rail	3.15 A, 250 V, fast acting ceramic	0001.9011

5.4.3 Connecting the sample supply and return line

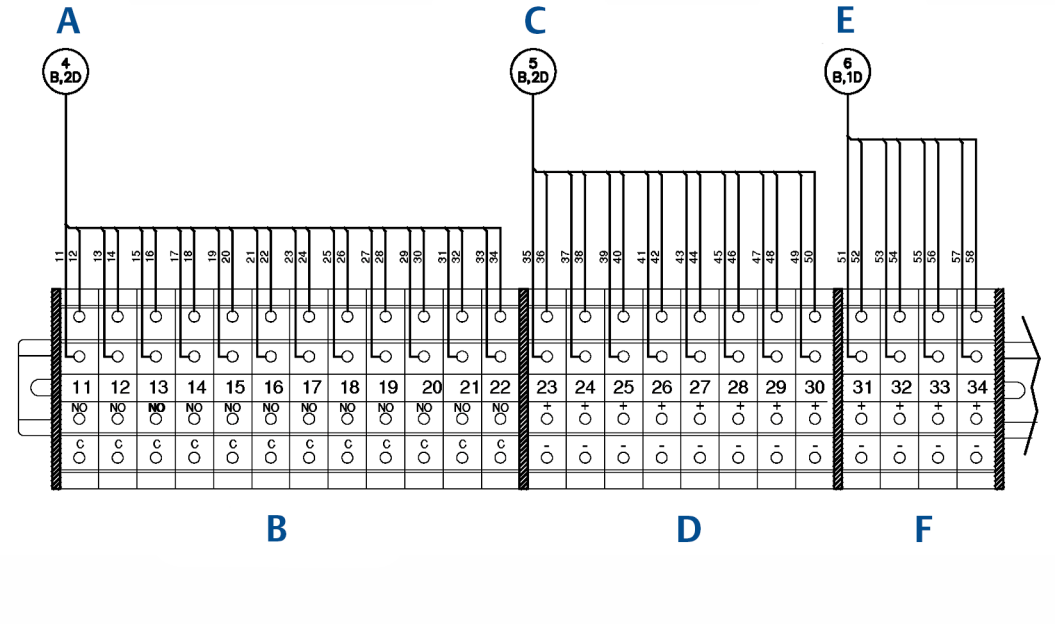
Sample gas supply and sample return connections are ¼-in. (6 mm) ”Hamlet” compression tube fittings. To avoid the risk of gas leaks, confirm that these connections are made correctly and tightly. Both the sample gas supply pipe and the sample return pipe should be thermal insulated.

The maximum sample gas supply pressure is 2 BarG.

5.4.4 Connecting the signal cables

The signal cables are connected to the system through an entry point outlet C, as shown in Figure 3-4. All signal cables are to be minimum 20 AWG tri-rated switchgear cable. Customer supplied conduit and cables are to be terminated in the entry point provided in accordance with local electrical codes.

Figure 5-10: Signal Cable Outputs



A. To digital modules
B. Digital output terminals
C. To analog modules
D. Analog output terminals
E. To status relays
F. Status output terminals

Table 5-4: User Connections

Terminal	Function
11	Digital output 1
12	Digital output 2
13	Digital output 3
14	Digital output 4
15	Digital output 5
16	Digital output 6
17	Digital output 7
18	Digital output 8
19	Digital output 9
20	Digital output 10
21	Digital output 11

Table 5-4: User Connections *(continued)*

Terminal	Function
22	Digital output 12
23	Analog output 1
24	Analog output 2
25	Analog output 3
26	Analog output 4
27	Analog output 5
28	Analog output 6
29	Analog output 7
30	Analog output 8
31	Status output 1 (check function)
32	Status output 2 (maintenance required)
33	Status output 3 (out of specification)
34	Status output 4 (failed)

5.4.5 Power input cables and circuit breakers

⚠ WARNING

FLAMMABLE/EXPLOSIVE GASES

The purge / pressurization cycle expels any flammable or explosive gases from the electrical compartment and **MUST** be completed before applying electrical power to the rest of the analyzer.

Failure to observe this warning could cause an explosion or potentially hazardous situation, which if not avoided, may cause death, personal injury, and/or damage to persons and/or property.

The power input cable / purge power cable circuit breakers can be tested as follows:

- Set the Purge circuit breaker to **ON**. The purge / pressurization process will start **ONLY** when the K1 LED on the purge control panel comes on indicating the purge process is complete can you proceed to the next step. Refer to Figure 6-4.
- The main power input circuit breaker can now be set to **ON**.
- Check that the display controller lights up. The analyzer will then begin to power-up.

5.4.6 Temperature sensor and cell heater

The sample cell is controlled to operate at a pre-set temperature. This involves a heater and a temperature sensor. To test these, check that a temperature reading is displayed against temperature on the display controller as described in Pressure and Temperature screen.

Leave the analyzer operating and confirm that the temperature rises until the analysis cell reaches the pre-set operating temperature around 122 °F (50 °C). This will take approximately 90 minutes.

5.4.7 Pressure sensor

The pressure sensor monitors the pressure in the analysis cell. To test that it is functioning, check that a pressure reading is displayed under pressure on the Beka Display Controller as described in Pressure and Temperature screen.

The reading will be approximately 760 Torr at atmospheric pressure. If desired, cap off the gas inlet and use an external pump to evacuate the cell. Verify that the pressure drops as expected.

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.

5.4.8 Analog output cables

In order to generate a 4-20 mA output, the analyzer must be left for 90 minutes to warm up, and the analysis cell must be at the correct pressure.

The 4-20 mA outputs will operate when the analysis cell temperature and pressure are within the required test range. It is not essential to flow sample gas through the system; nitrogen or atmospheric air will be adequate for this test.

With the analyzer at operating temperature and pressure, ensure that a current between 4 mA and 20 mA is generated on each 4-20 mA output. This can either be measured as a current with a multimeter, or as a gas concentration through the control station.

5.4.9 Ethernet

To test the Ethernet connection, connect a remote laptop to the Ethernet port and attempt to connect to the internal PC as described in the separate connection procedure. It is not necessary to run the gas sensor on the laptop; once connected, enter the command exit to disconnect again.

⚠ DANGER

FIRE AND EXPLOSION

The electrical compartment of the analyzer must not be opened unless the atmosphere in the area is known to be below the ignitable concentration of combustible gases or materials, or unless all equipment within the protected enclosure is de-energized in accordance with NFPA 496.

Death, personal injury and/or damage to persons and/or property may result if this is not observed.

5.4.10 Seal glands

Where poured seal glands are a local industry requirement for cable termination, they should be made in accordance with the manufacturer's instructions once acceptance tests have been made on the system to ensure that the analyzer does not need to be removed.

5.4.11 Commissioning

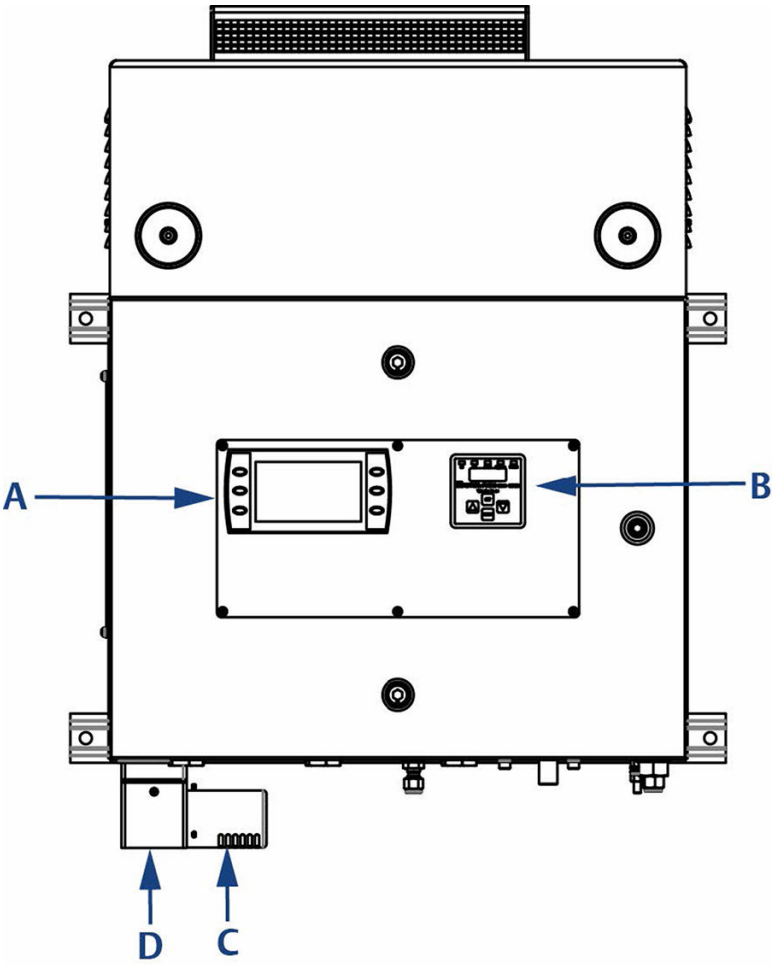
Once the sensor is fully installed as described above, it should be commissioned in accordance with the commissioning plan agreed between Emerson and the customer.

6 Controls and display controller

6.1 Front panel controls and indicators

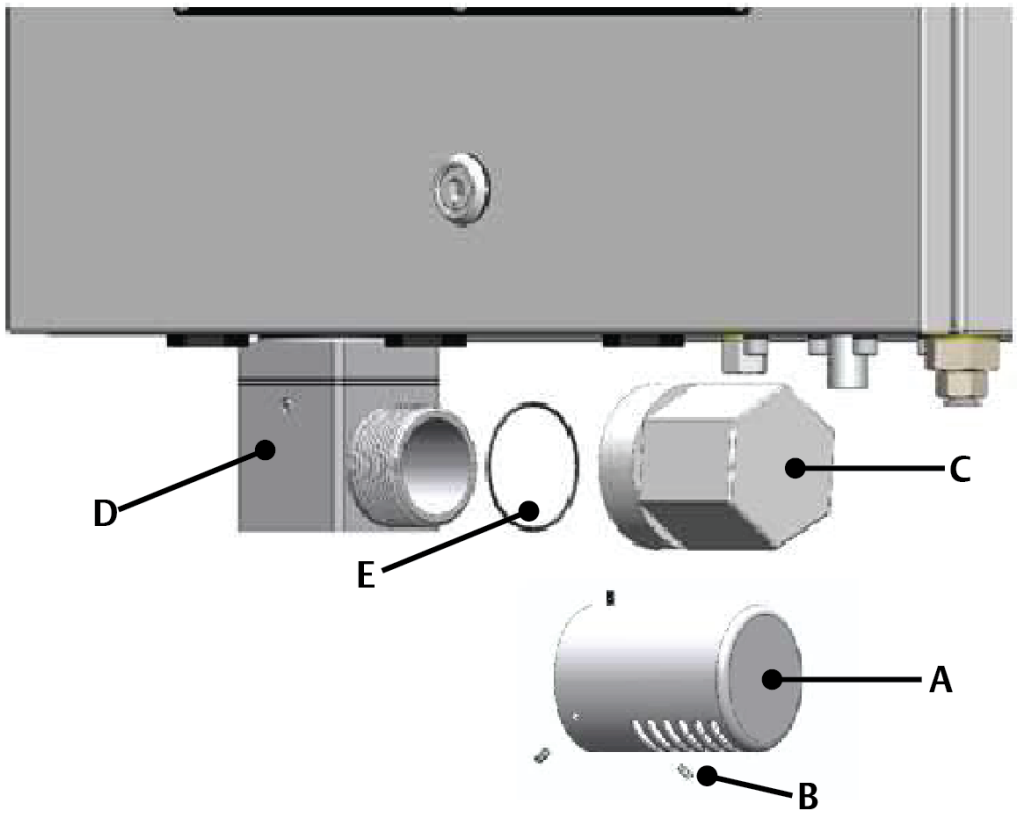
The Rosemount™ CT5100(Ex) is configured from the two control displays located on the front panel. Refer to Figure 6-1.

Figure 6-1: Front Panel



A. *Display controller*
B. *Purge control panel*
C. *Protector cap*
D. *Purge vent*

Figure 6-2: Exploded View



A. Vent cap
B. 3/32-in. socket grub screws
C. Protector cap
D. Purge vent
E. O-ring

The protector cap (Figure 6-2, C) must be removed from the purge vent (D) and replaced with the vented cap (A) supplied with the unit.

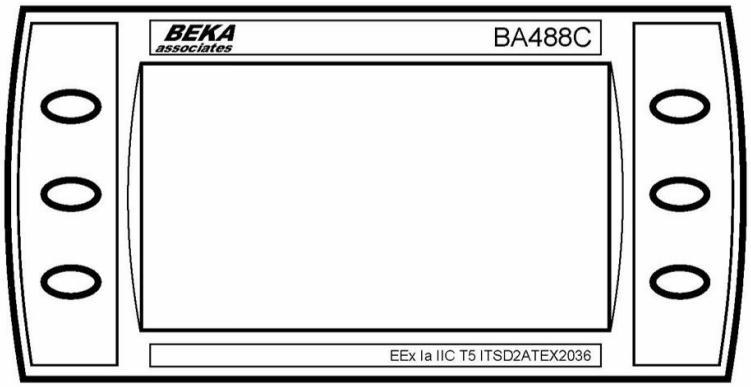
NOTICE

On/Off circuit breakers
There are no **On/Off** switches on the analyzer. The application of electrical power to the analyzer is controlled through two external circuit breakers.

Both external circuit breakers are simple two-pole on/off circuit breakers. Both must be set to On to permit the safe operation of the analyzer.

Operation of the analyzer is controlled primarily through the display controller.
Refer to Figure 6-3.

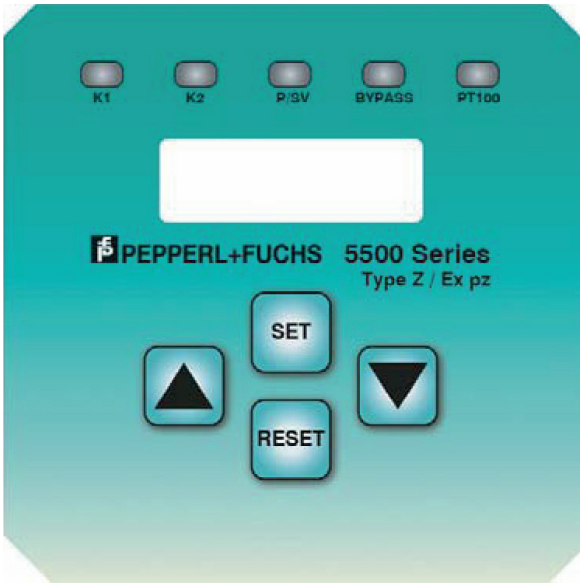
Figure 6-3: Display Controller



The purge control panel (Figure 6-4) is used to program the operation of the overpressure air system that prevents flammable and explosive gases from entering the analyzer's electrical compartment. Adjustment of the overpressure air system **must only** be performed by maintenance personnel.

Five LEDs, identified as K1, K2, PSV, Bypass, and PT100, are located on the upper part of the purge control panel. These five LEDs indicate the status of the overpressure air system.

Figure 6-4: Purge Control Panel



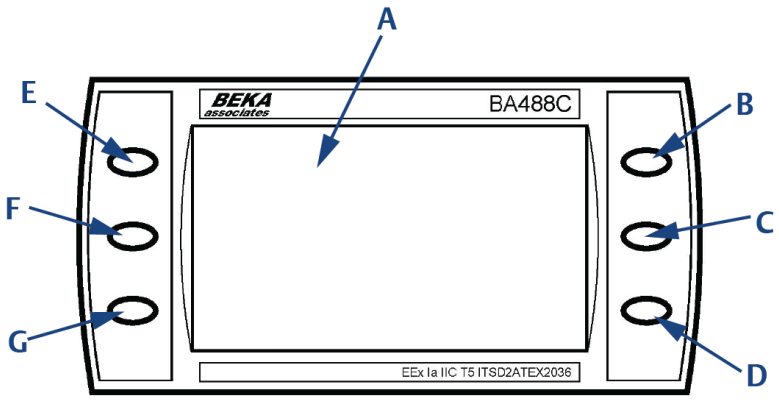
6.2 Display controller

Operation of the Rosemount CT5100(Ex) is controlled through the six buttons on the display controller: Figure 6-5.

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

- Gas concentration measurements obtained
- Operating temperature and pressure
- Help screens
- Step-by-step calibration
- Diagnostics

Figure 6-5: Display Controller Buttons



A. LCD display
B. Configurable button
C. Scroll button
D. Configurable button
E. Configurable button
F. Scroll button
G. Configurable button

The two scroll buttons (C and F) are used to scroll through the information on the LCD display. The right-hand scroll button (C) is used to scroll up, and the left-hand scroll button (F) is used to scroll down.

The other four buttons (B, D, E, and G) are configured to perform different functions according to which software screen is shown on the LCD display.

6.3 Gas Sensor Main screen

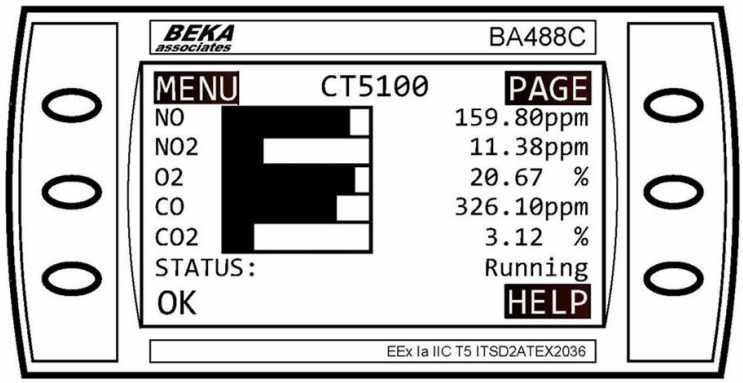
When the analyzer is switched on at the end of the start-up procedure, the ***Gas Sensor Main*** screen (Figure 6-6) appears appears.

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 6-6: Gas Sensor Main Screen



The ***Gas Sensor Main*** screen displays the gas concentration measurements obtained by the analyzer. In the example shown in Figure 6-6 the gases nitric oxide (NO), nitrogen dioxide (NO_2), oxygen (O_2), carbon monoxide (CO), and carbon dioxide (CO_2) are being measured, and for each gas, the concentration detected is in parts per million (ppm) or percentage as applicable.

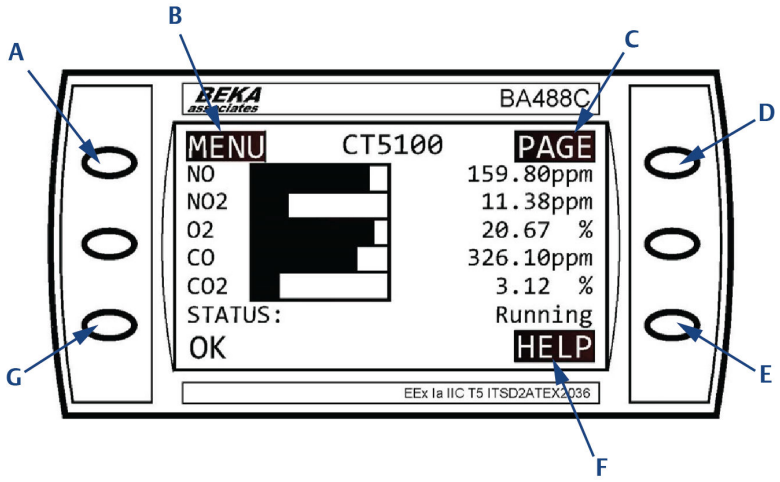
The NO_x reading is the total nitrogen oxide reading, a combination of nitric oxide (NO) and nitrogen dioxide (NO_2).

At the end of the start-up procedure, the gas measurements initially appear as `0.00 ppm` 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 6-7, the analyzer is *Running* and *OK* (i.e., no faults have been identified). This area of the display shows any errors detected by the software.

On the software screens, highlighted items are links to other screens in the software. To access a screen, press the button next to the highlighted item.

Figure 6-7: Gas Sensor Main Screen Buttons



A. MENU button
B. MENU text
C. PAGE text
D. PAGE button
E. HELP button
F. HELP text
G. STATUS button

PAGE (C) is a link between the ***Gas Sensor Main*** screen and the ***Pressure and Temperature*** screen (described in Pressure and Temperature screen). Press the **PAGE** button (D) to toggle between these two screens.

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

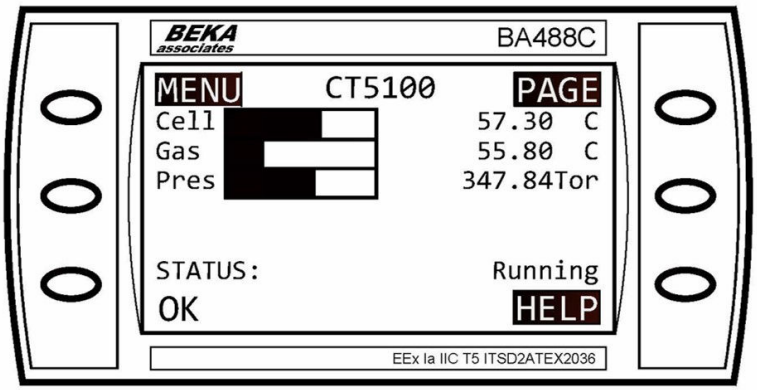
MENU (B) is a link to the ***Main Menu*** of the software. Press the **MENU** button (A) to go to the ***MAIN MENU*** screen (described in Main menu).

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

6.4 Pressure and Temperature screen

The ***Pressure and Temperature*** screen (Figure 6-8) shows pressure and temperature measurements taken inside the analyzer.

Figure 6-8: Pressure and Temperature Screen



The `Gas Te` reading is the temperature, in °C, of the gas within the analysis cell.

The `Pres` 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.

6.5 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.

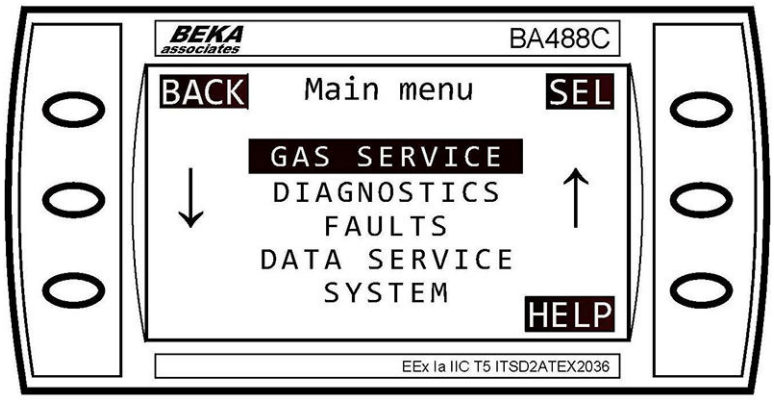
The help system contains a number of different ***Help*** screens, each conveying a different message. As the help system is context-sensitive, the ***Help*** screen that appears is the one that is most appropriate to the software function engaged when was pressed. Figure 6-9 shows an example of a ***Help*** screen.

Figure 6-9: Example of a Help Screen

6.6 Main menu

To access the ***Main menu*** (Figure 6-10), press the **MENU** button on either side of the ***Gas Sensor Main*** screen (Figure 6-6). or the ***Pressure and Temperature*** screen (Figure 6-8). The ***Main menu*** is used for calibration, diagnostics, fault finding, downloading data, and shutting down the analyzer.

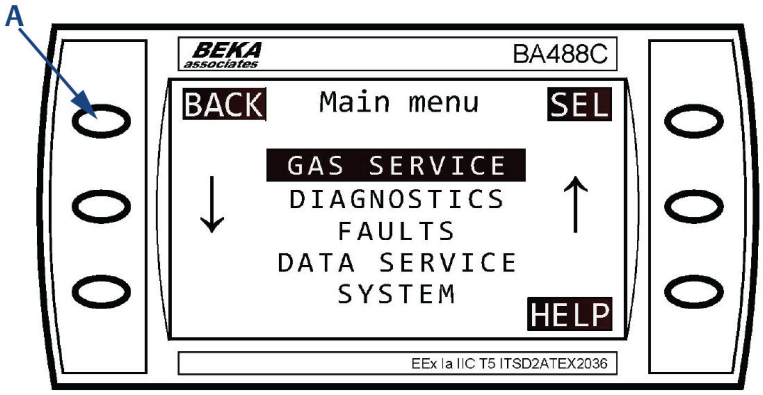
Figure 6-10: Main Menu



6.7 BACK button

On most of the software screens, the top left-hand button (Figure 6-11) is configured as a **BACK** button. Press **BACK (A)** to return to the previous screen.

Figure 6-11: BACK Button



A. BACK button

7 Start-up procedure

7.1 Introduction

⚠ CAUTION

EQUIPMENT DAMAGE

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

Always follow the start-up procedure.

The analyzer normally operates continuously. It should only be necessary to start up the analyzer under the following circumstances:

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

7.2 Preparation for use

The Rosemount™ CT5100(Ex) must be installed and fully commissioned prior to start-up.

⚠ 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, ensure that electrical power, sample gas handling facilities, and any calibration gases that are required are available to the analyzer. Failure to perform pre-system start-up checks may cause damage to equipment.

⚠ WARNING

BURN HAZARD

Some parts of the analyzer may be heated up to 320 °F (160 °C). To prevent burns, do not touch any of the hot parts. All components of the analyzer are hot unless it has been switched off and allowed to cool down.

Before fitting, removing, or performing any maintenance on the analyzer, ensure that it has been switched off and allowed to cool for at least two hours. Before performing any maintenance on or, in the vicinity of the analysis cell, allow the analyzer to cool for at least twelve hours, as the analysis cell is insulated against heat loss.

When handling the analyzer, always use suitable protective gloves.

Personal injury and/or damage to property may result if these safety precautions are not observed. These precautions are especially important when working at heights. If you receive a burn, seek medical treatment immediately.

7.3 Start-up

Note
The gases shown in the screenshots and the measurements thereof may be different from those shown in your particular Rosemount CT5100(Ex). They indicate the functionality of the software, which is the same regardless of the gases being measured.

Note
To stop the start-up procedure at any time, set the main circuit breaker to **Off**.

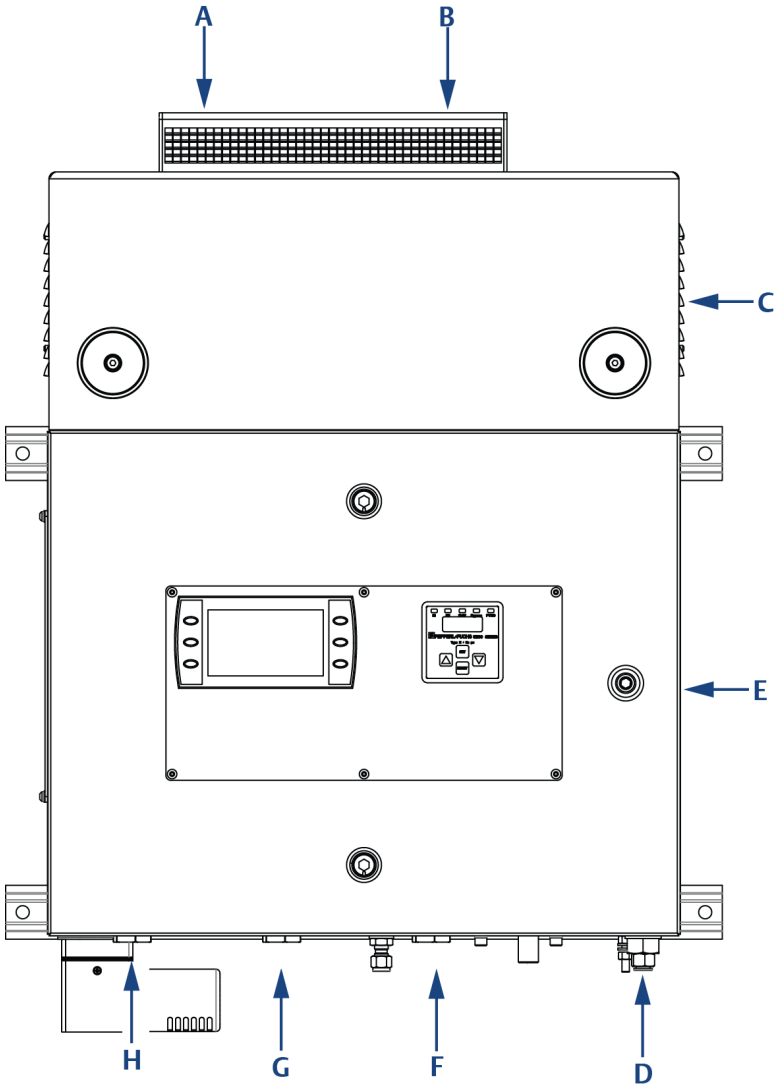
To start up the analyzer,

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. Verify that the analyzer has been correctly installed as described in Install.
3. Ensure that the top cover is fitted to the analyzer. If it is not, report it to the maintenance organization and do not proceed further until the top cover has been fitted.
4. Confirm that the door to the electrical compartment is closed and locked. If the door cannot be closed and locked, report it to the maintenance organization and do not proceed further until the door has been repaired.
5. Ensure that the gas handling system is turned off.
6. Verify that the external main and secondary circuit breakers are set to **Off**.
7. Visually examine the three gas ports.

   If necessary, refer to Figure 7-1 to ensure that the sample supply line, the sample return line, and the compressed air line are correctly attached.

Figure 7-1: Rosemount CT5100(Ex) Gas Inlet and Outlet and Electrical Connections



A. Sample gas return port
B. Sample gas input port
C. Top cover of analyzer (cell compartment)
D. Purge air supply
E. Laser/electrical compartment
F. Analog/digital power entry point
G. Power entry point
H. Purge power and alarm entry point

8. Visually check that the electrical connections have been made to the three power entry points, Figure 7-1, at the base of the analyzer.
9. Visually check that the vent cap is fitted to the purge vent (Figure 5-3).

UNDER NO CIRCUMSTANCES must the analyzer be started with the protector cap fitted as this will prevent the analyzer from venting during the purge process.

⚠ WARNING

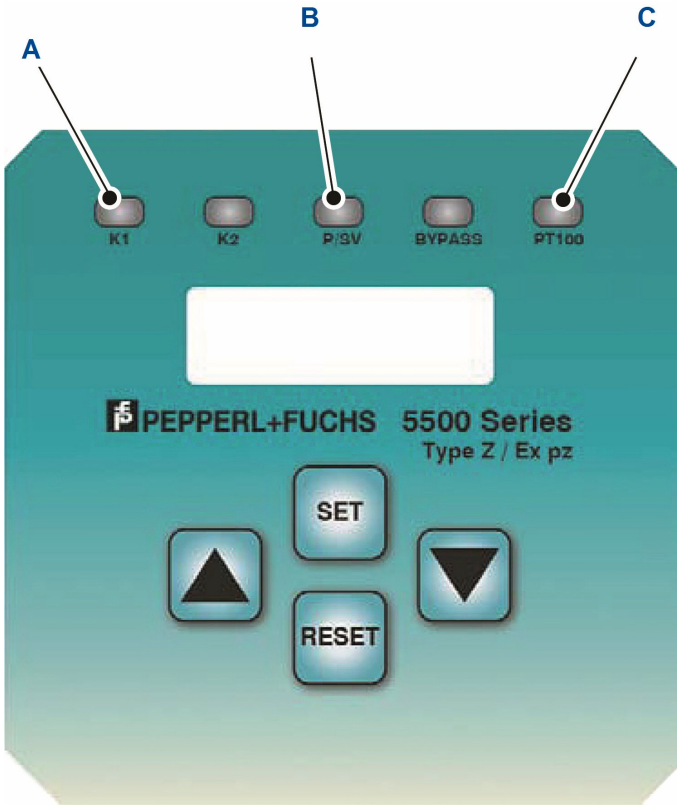
FLAMMABLE/EXPLOSIVE GASES

The purge/pressurization cycle expels any flammable or explosive gases from the analyzer's electrical compartment. The analyzer must be purged for a minimum of 2 minutes 30 seconds at a minimum flow rate of 280 L/m at 1.5 ± 0.5 bar to prevent hazards to personnel during the startup process.

Only after the purge/pressurization cycle has been completed can electrical power be applied to the rest of the analyzer.

10. Turn on the compressed air supply to the analyzer.
11. Set the main circuit breaker to *On*. The air pressurization will begin its automatic start-up and begin to purge the air inside the analyzer.

Figure 7-2: Purge Control Panel



A. K1 LED
B. P/SV LED
C. PT100 LED

12. Observe the PT100 LED on the purge control panel (Figure 7-2).

If the PT100 LED (C) illuminates red, the air pressurization system is unserviceable, and the start-up procedure must be halted immediately. To halt the start-up procedure, set the external main circuit breaker to **Off**. Lock off or tag off the main circuit breaker, turn off the compressed air supply, and report the fault to the maintenance organization.

13. Observe the P/SV LED (B) on the purge control panel.

    When the pre-set internal overpressure has been reached, the P/SV LED (B) illuminates orange. If the P/SV LED (B) does not illuminate blue, the pressurization system is unserviceable, and the start-up procedure must be halted immediately. To halt the start-up procedure, set the external main circuit breaker to **Off**, lock off or tag off the main circuit breaker, turn off the compressed air supply, and report the fault to the maintenance organization.

⚠ WARNING

FLAMMABLE/EXPLOSIVE GASES

The purge/pressurization cycle expels any flammable or explosive gases from the analyzer's electrical compartment. The analyzer must be purged for a minimum of 2 minutes 30 seconds at a minimum flow rate of 280 L/m at 1.5 ± 0.5 bar to prevent hazards to personnel during the startup process.

Only after the purge/pressurization cycle has been completed can electrical power be applied to the rest of the analyzer.

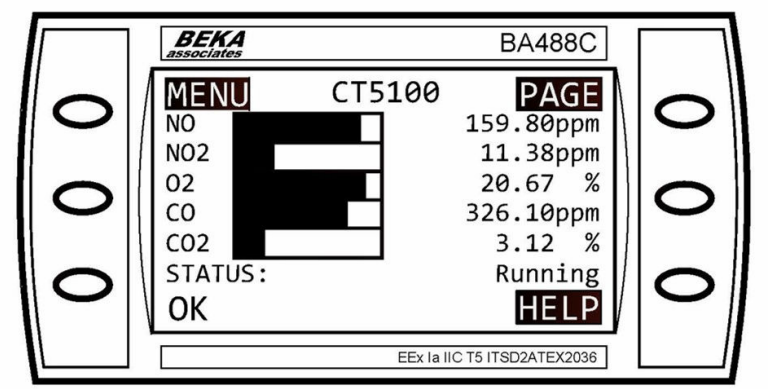
14. Wait until the purge cycle is performed.

    Do not switch on the secondary circuit breaker until the purge cycle is complete. Observe the K1 LED (A) on the purge control panel, which will illuminate green when the purge cycle is complete.

15. When the purge/pressurization cycle is complete, set the secondary circuit breaker to **On**, which applies electrical power to the rest of the analyzer.
    The analyzer begins its automatic start-up. The control PC that forms part of the analyzer is configured to automatically load the necessary gas sensor software and configuration files. The start-up sequence commences automatically under software control.

    After a few seconds, the ***Gas Sensor main*** screen (Figure 7-3) appears on the display controller. If it does not, report the fault to the maintenance organization.

Figure 7-3: Gas Sensor Main Screen



16. Start up the system for returning sample gas.
17. Start up the gas handling system that conditions the sample gas before it is fed into the analyzer.

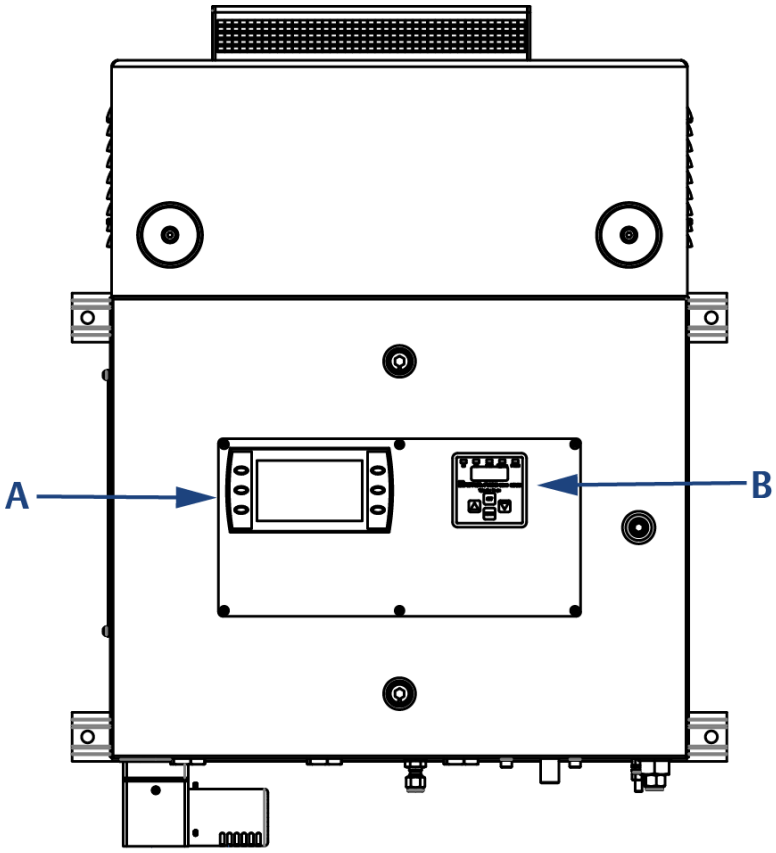
At the end of the start-up procedure, the gas measurements initially appear as 0.00 ppm until the first readings are taken. After a few seconds, the initial gas concentrations are displayed.

The start-up procedure is now complete.

7.4 Front panel controls and indicators

The Rosemount CT5100(Ex) is configured from the control display located on the front panel (Figure 7-4).

Figure 7-4: Front Panel



A. Display controller
B. Purge control panel

NOTICE

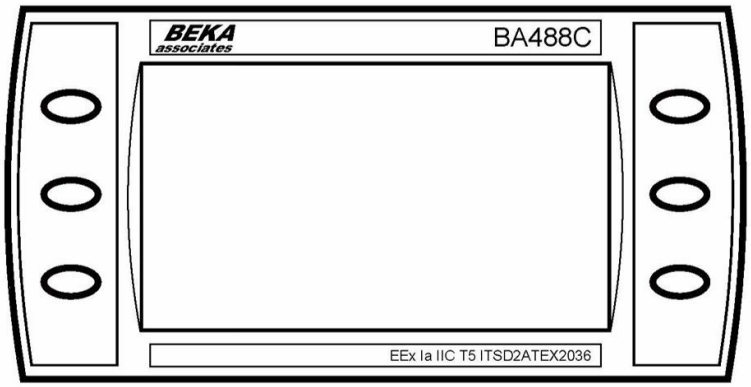
On/Off circuit breakers

There are no **On/Off** switches on the analyzer. The application of electrical power to the analyzer is controlled through a customer provided external circuit breaker.

The circuit breaker is a simple two-pole on/off circuit breaker that must be set to *On* to permit the safe operation of the analyzer.

Operation of the analyzer is controlled primarily through the display controller (Figure 7-5).

Figure 7-5: Display Controller



⚠ CAUTION

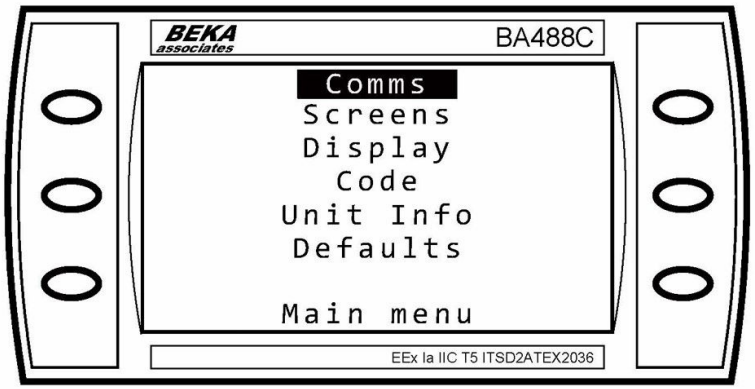
DO NOT, under any circumstances, press the top two buttons on the display controller simultaneously. This will override the system code supplied with the analyzer and display the default program screen for the controller.

This will lock the software controlling the analyzer requiring the analyzer to shut down externally and restarted risking a possible corruption of the software and loss of the analyzer operation during the shutdown and restart process.

It is essential that only trained, qualified personnel operate the controls on the analyzer.

Failure to follow these instructions may cause warranty invalidation, property damage and/or personal injury or death.

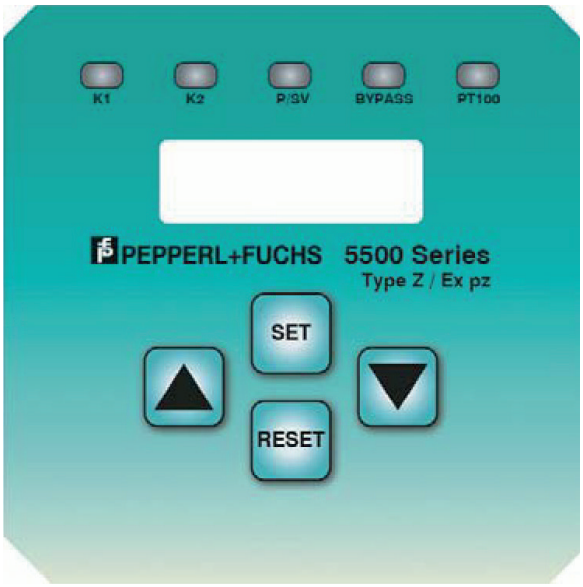
Figure 7-6: Default Program Screen



The purge control panel (Figure 7-7) is used to program the operation of the overpressure air system that prevents flammable and explosive gases from entering the electrical compartment of the analyzer. Adjustment of the overpressure air system must only be performed by maintenance personnel.

Five LEDs, identified as K1, K2, PSV, Bypass, and PT100 are located on the upper part of the purge control panel. These five LEDs indicate the status of the overpressure air system.

Figure 7-7: Purge Control Panel (if Applicable)



8 Operating the analyzer

8.1 Introduction

This section describes the normal operation 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.

⚠ WARNING

BURN HAZARD

Some parts of the analyzer may be heated to 320 °F (160 °C). To prevent burns, do not touch any of the hot parts. All components of the analyzer are hot unless it has been switched off and allowed to cool down.

Before fitting, removing, or performing any maintenance on the analyzer, ensure that it has been switched off and allowed to cool for at least two hours. Before performing any maintenance on or in the vicinity of the analysis cell, allow the analyzer to cool for at least twelve hours, as the analysis cell is insulated against heat loss.

When handling the analyzer, always use suitable protective gloves.

Personal injury and/or damage to property may result if these safety precautions are not observed. These precautions are especially important when working at heights. If you receive a burn, seek medical treatment immediately.

8.2 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.

During normal operation, either the ***Gas Sensor Main*** screen (Figure 8-1) or the ***Pressure and Temperature*** screen (Figure 8-2) is shown on the display controller. To toggle between these two screens, press **PAGE**.

Figure 8-1: Gas Sensor Main Screen

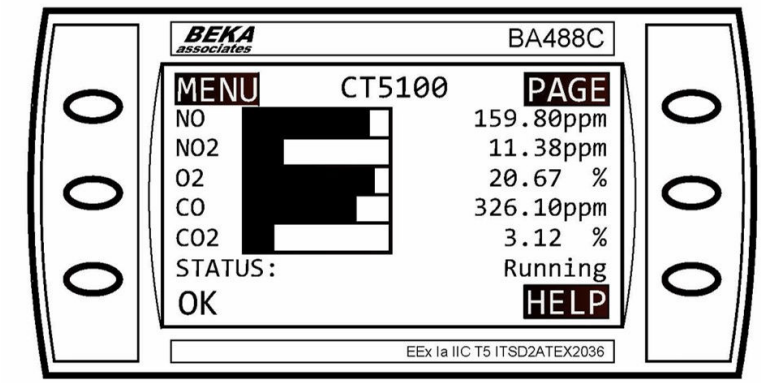
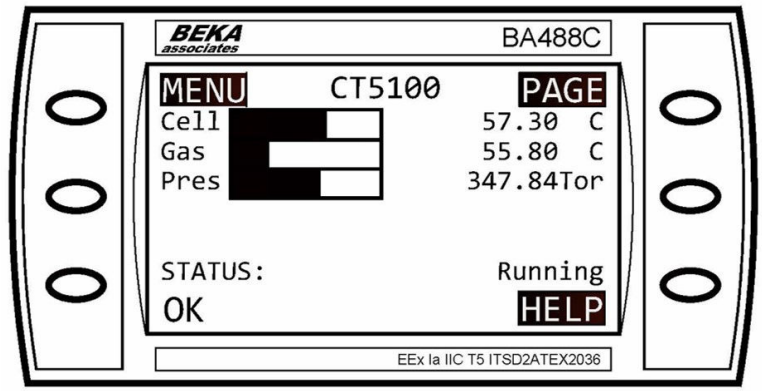


Figure 8-2: Pressure and Temperature Screen



9 Shutdown procedure

9.1 Shutdown procedure safety precautions

⚠ CAUTION

EQUIPMENT DAMAGE

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

Always follow the shutdown procedure.

The analyzer normally operates continuously. It should only be necessary to shut down the analyzer 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.
- When the analyzer is switched off for re-calibration.

Use the display controller to perform the shutdown procedure. Refer to Display controller for the display controller navigation instructions.

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

BURN HAZARD

Some parts of the analyzer may be heated up to 320 °F (160 °C). To prevent burns, do not touch any of the hot parts. All parts of the analyzer are hot unless it has been switched off and allowed to cool down.

Before fitting, removing, or performing any maintenance on the analyzer, ensure that it has been switched off and allowed to cool for at least two hours. Before performing any maintenance on, or in the vicinity of, the analysis cell, allow the analyzer to cool for at least twelve hours, as the analysis cell is insulated against heat loss.

When handling the analyzer, always use suitable protective gloves.

Personal injury and/or damage to property may result if these safety precautions are not observed. These precautions are particularly important when working at heights. If you receive a burn, seek medical treatment immediately.

9.2 Shutdown procedure

To shut down the analyzer:

⚠ DANGER

EXPLOSION HAZARD

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

Always lock lock out the gas handling system when shutting down the analyzer.

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

   Failure to vent sample gas may cause death.

   Vent the sample gas in the system to prevent fire or explosion during maintenance and to prevent damage to the analyzer during shutdown.
   Purge the sample gas in the pipes leading to the analyzer to prevent hazards to personnel during maintenance.
   Purge the sample gas in accordance with 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 analyzer to be returned to the exhaust.

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 analyzer 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).

4. Turn off the calibration gas supply to the analyzer. Lock out and tag out the compressed air supply.

5. Press **MENU** on the display controller in either the ***Gas Sensor Main*** screen (Figure 9-1) or the ***Pressure and Temperature*** screen (Figure 9-2).

Figure 9-1: Gas Sensor Main Screen

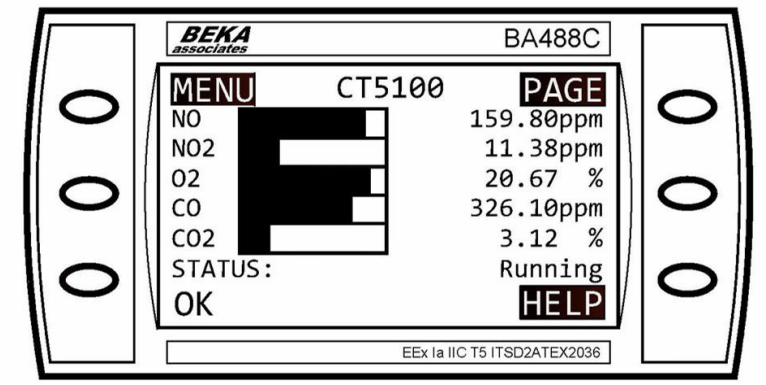
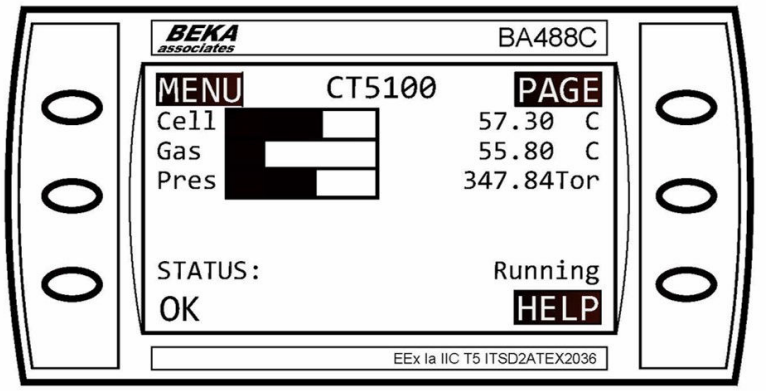
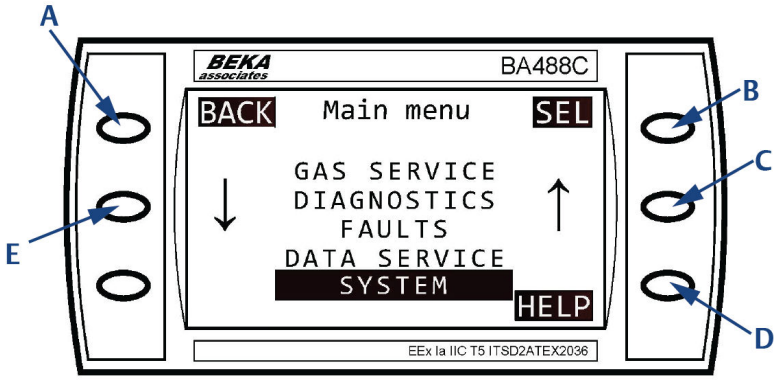


Figure 9-2: Pressure and Temperature Screen



The ***Main menu*** (Figure 9-3) opens.

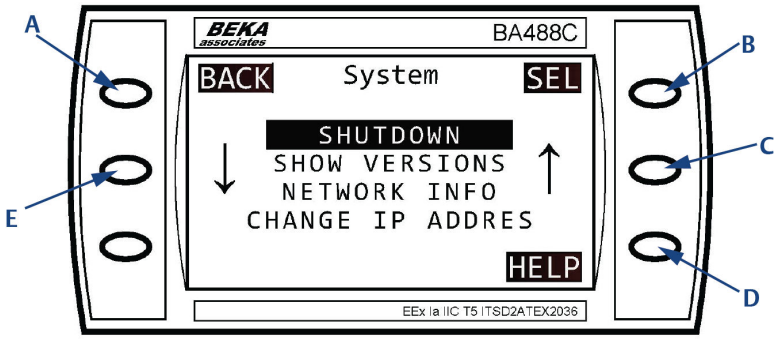
Figure 9-3: Main Menu



*A. **BACK** button*
*B. **SELECT** button*
*C. **Scroll up** button*
*D. **HELP** button*
*E. **Scroll down** button*

6. On the *Display Controller*, select **System** as shown in Figure 9-4 (B).
7. Press **SEL** (select) (B).
   The ***System*** screen opens. Refer to Figure 9-4.

Figure 9-4: System Screen



A. BACK button
B. SELECT button
C. Scroll up button
D. HELP button
E. Scroll down button

8. Use scroll up (C) and scroll down (E) to select `SHUTDOWN` as shown in Figure 9-4 (B).
   Then press **SEL** (select) (B).
   The ***Shutdown*** screen (Figure 9-5) opens.

Figure 9-5: Shutdown Screen

9. Press **YES**.
   The analyzer shuts down.
10. Set the external secondary circuit breaker to **Off**. Lock-out and tag-out the secondary circuit breaker.
11. Set the external main circuit breaker to **Off**. Lock-out and tag-out the main circuit breaker.
12. Remove the vent cap and O-ring fitted to the purge vent (see Figure 5-3) and fit the protector cap that was supplied with the analyzer to prevent moisture ingress during a prolonged shutdown.

10 Gas calibration

10.1 Required tools

The gas concentrations measured by the analyzer can be validated against a known sample gas or calibrated to match it by using the following gas calibration procedure.

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, for which 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 you need to calibrate (e.g., for legal requirements), you can use a water vapor generator to supply a known concentration of water vapor.

The validation procedure is essentially the same as the calibration procedure, except that it does not adjust the analyzer measurements to match the calibration standard.

⚠ CAUTION

EQUIPMENT DAMAGE

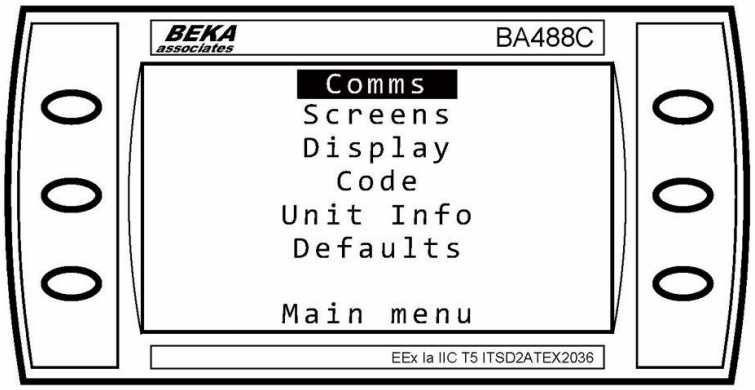
DO NOT, under any circumstances, press the top two buttons on the display controller simultaneously. This will override the system code supplied with the analyzer and display the default program screen for the controller.

This will lock the software controlling the analyzer requiring the analyzer to shut down externally and restart, risking a possible corruption of the software and loss of the analyzer operation during the shutdown and restart process.

It is essential that only trained, qualified personnel operate the controls on the analyzer.

Failure to follow may cause warranty invalidation, property damage, and/or personal injury or death.

Figure 10-1: Default Program Screen



10.2 Main menu calibration routines

Calibration is performed under the control of the analyzer software, using calibration routines built in to the software. The calibration functions are accessed through the ***Main menu*** (Figure 10-4).

Procedure

1. To get the ***Main menu***, press the **MENU** button on the ***Gas Sensor Main*** screen (Figure 10-2) or ***Pressure and Temperature*** screen Figure 10-3.

NOTICE

Pressing the **BACK** button cancels the procedure and returns you to the previous screen.

Figure 10-2: Gas Sensor Main Screen

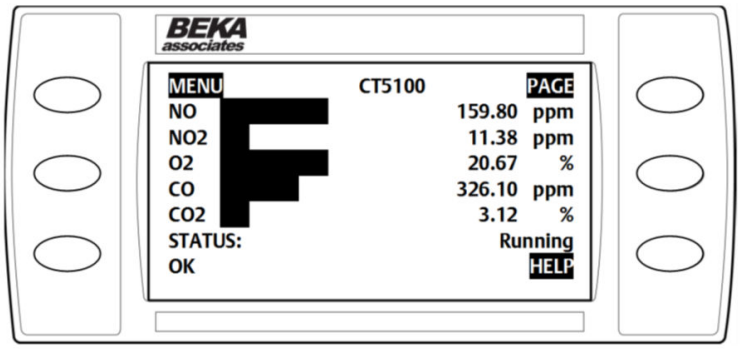
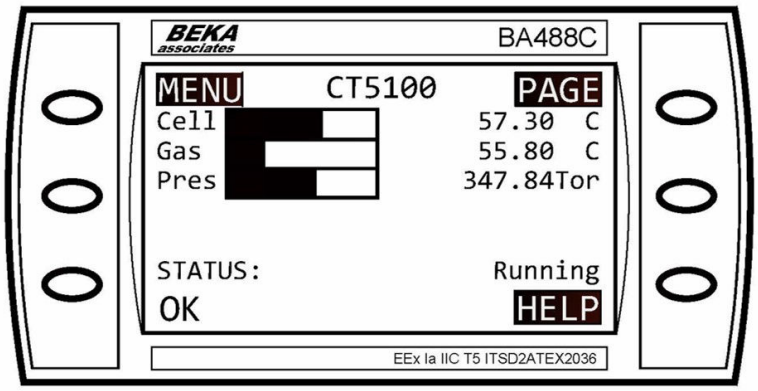
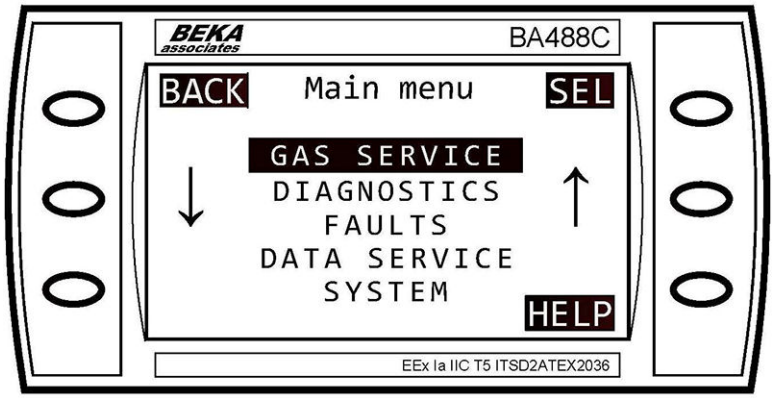


Figure 10-3: Pressure and Temperature Screen



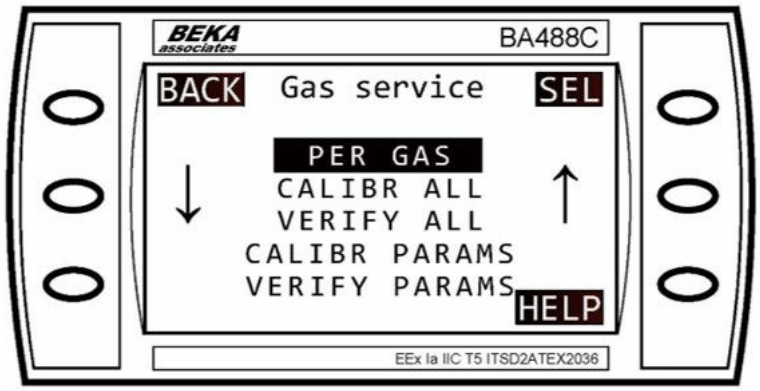
2. The ***Main menu*** (Figure 10-4) is used to access the software routines and screens that are used throughout the process.

Figure 10-4: Main Menu



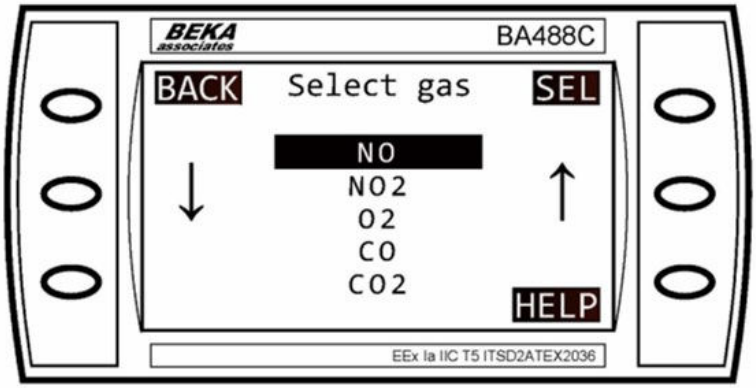
3. Use the middle buttons (↓ and ↑) to scroll up or down to select **GAS SERVICE**.
4. Press the **SEL** button.

Figure 10-5: Gas Service (PER GAS)



5. Use the middle buttons (↓ and ↑) to scroll up or down to select **PER GAS.**
6. Press the **SEL** button.

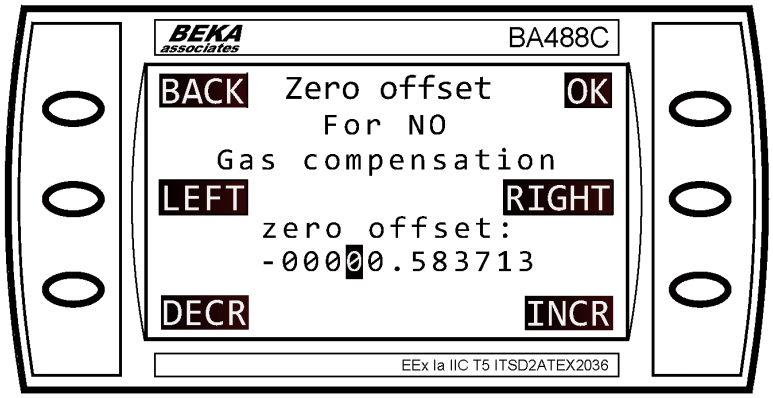
Figure 10-6: Select Gas (NO)



7. Use the middle buttons (↓ and ↑) to scroll up or down to select the desired gas (e.g., NO).
8. Press the **SEL** button.
9. To check or change the current offset value, select **ZERO OFFSET** and press **CAL** to view.

Figure 10-7: Action

Figure 10-8: Calibration



10. Use the **LEFT, RIGHT, INCR** (increase), and **DECR** (decrease) buttons to enter the desired offset (in the example above, -0.06ppm).
11. Press **OK** to confirm.

    The factory default offset is zero, and under normal circumstances, the offset should never be a positive number.

    If it is shown as positive, press **LEFT** until the space to the left of the number is highlighted, then select **INCR** to change it to a minus (**–**) sign.

12. To check or change the current span value, select **SPAN FACTOR** and press **CAL** to view.

Figure 10-9: Input Type

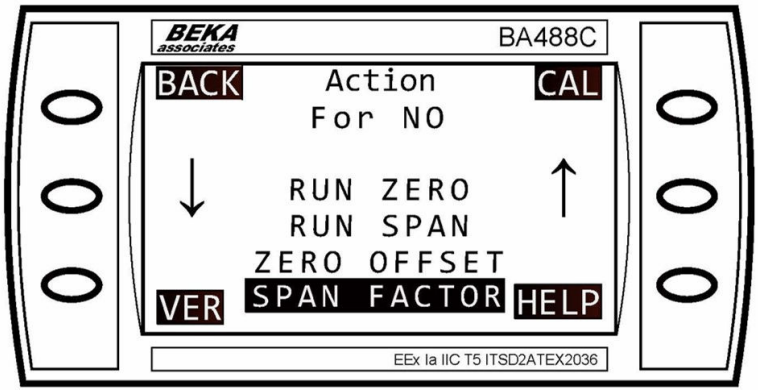
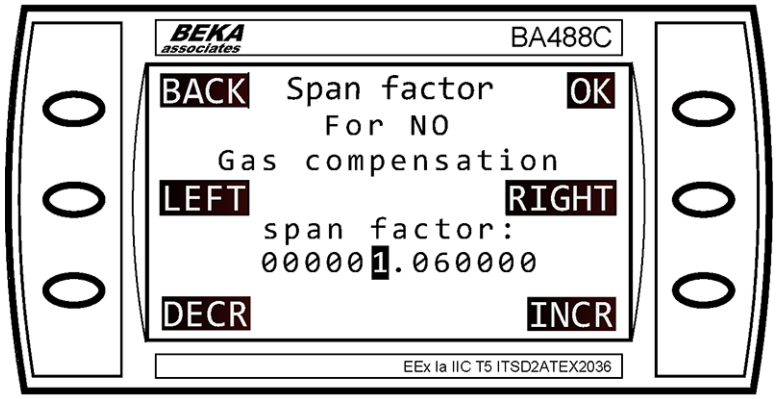


Figure 10-10: Calibration



13. Use the **LEFT, RIGHT, INCR** (increase), and **DECR** (decrease) buttons to enter the desired offset (in the example above, 1.06 ppm).
14. Press **OK** to confirm.

    The factory default span factor is one, and under normal circumstances, the offset should be between 0.8 and 1.2.

10.2.1 Zero calibrate an individual gas

Procedure

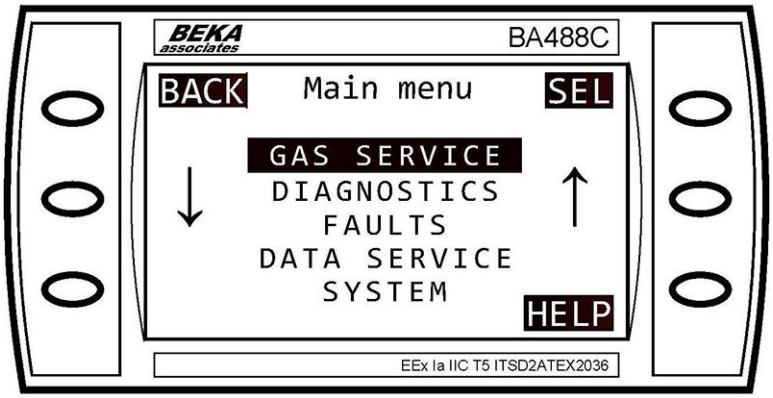
1. To get the ***Main menu***, press the **MENU** button on the ***Gas Sensor Main*** screen (Figure 10-2) or ***Pressure and Temperature*** screen (Figure 10-3).

NOTICE

Pressing the **BACK** button will cancel the procedure and return the user to the previous screen.

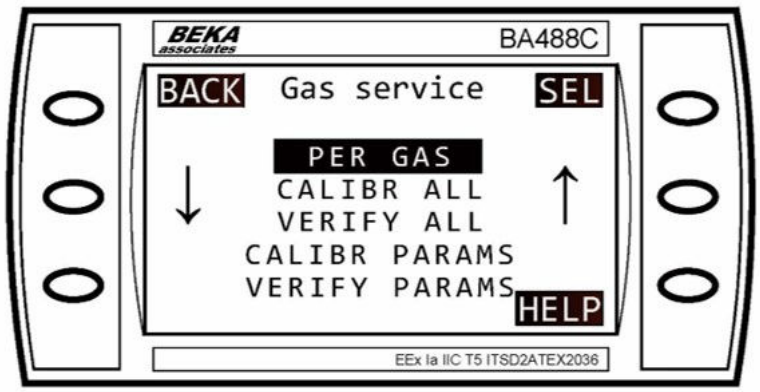
2. Use the middle buttons (↓ and ↑) to scroll up or down to select **GAS SERVICE**. Press the **SEL** button.

Figure 10-11: Main Menu (GAS SERVICE)



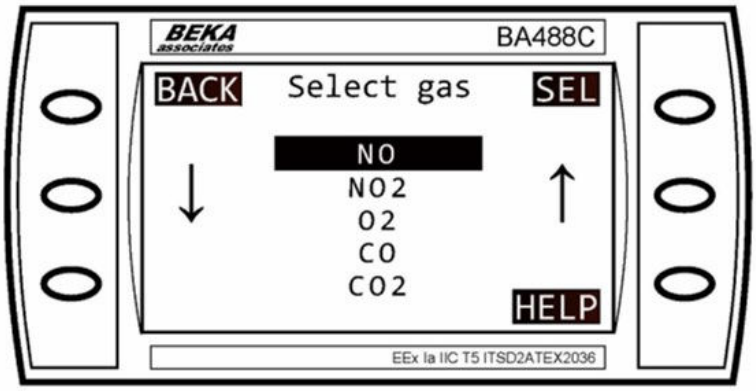
3. Use the middle buttons (↓ and ↑) to scroll up or down to select **PER GAS**. Press the **SEL** button.

Figure 10-12: Gas Service Menu (PER GAS)



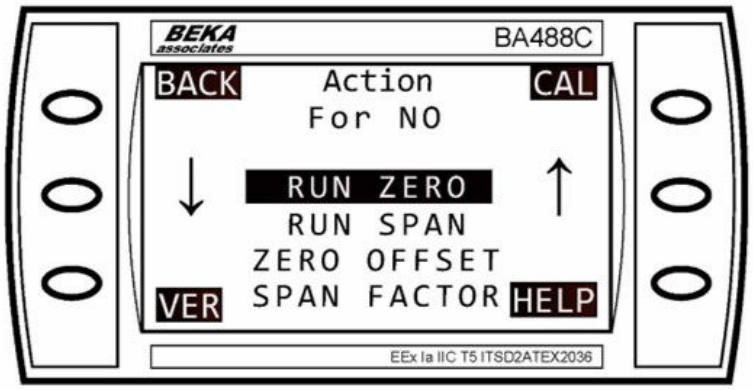
4. Use the middle buttons (↓and ↑) to scroll up or down to select the desired gas (e.g., **NO**). Press the **SEL** button.

Figure 10-13: Select Gas (NO)



5. Use the middle buttons (↓ and ↑) to scroll up or down to select **RUN ZERO**.

Figure 10-14: Action Screen for NO (RUN ZERO)



6. Press the **CAL** button to calibrate, or the **VER** button to verify.
   Figure 10-15 displays as the calibration progresses.

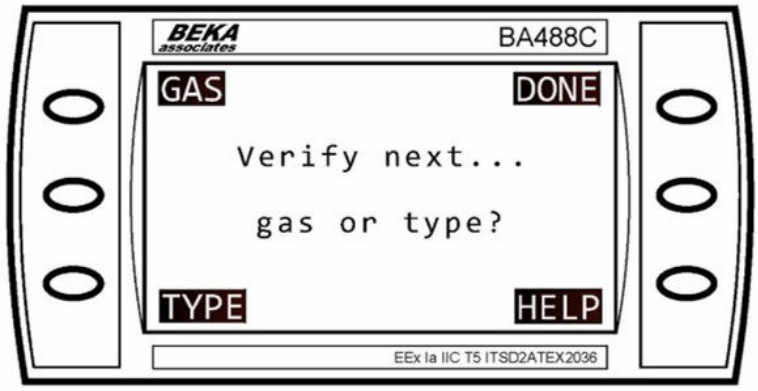
Figure 10-15: Calibration

Once complete, the program will automatically open the ***Result*** screen (Figure 10-16).

Figure 10-16: Result Screen

7. Press **OK**.
   The ***Verify next*** screen displays.

Figure 10-17: Verify Next Step Screen



8. Press **DONE** to finish.
   - To calibrate additional gases, select **GAS** and repeat Step 1 through Step 7.
   - To change types select **TYPE**.

   This completes the process and the display will return to the ***Main menu***.

10.2.2 Span calibrate an individual gas

Procedure

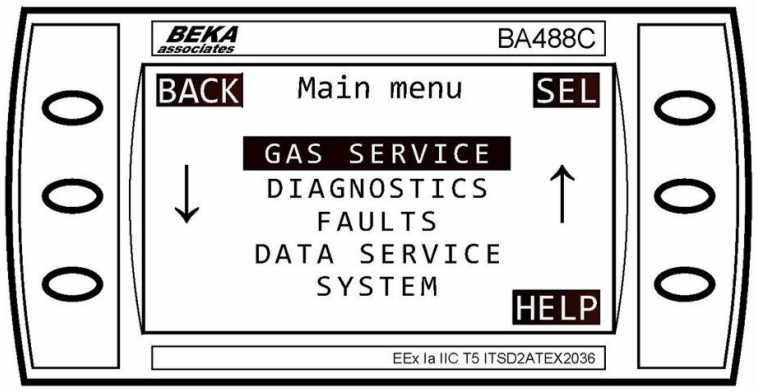
1. To get to the ***Main menu***, press the **MENU** button on the ***Gas Sensor Main*** screen (Figure 10-2) or ***Pressure and Temperature*** screen (Figure 10-3).

   NOTICE

   Pressing the **BACK** button will cancel the procedure and return the user to the previous screen.

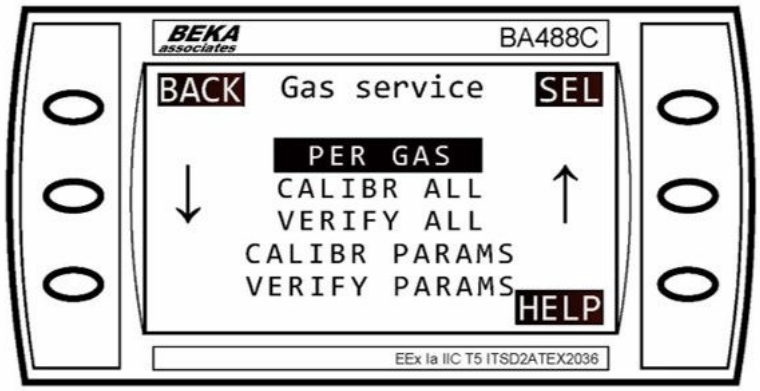
2. Use the middle buttons (↓ and ↑) to scroll up or down to select **GAS SERVICE**. Press the **SEL** button.

Figure 10-18: Main Menu (GAS SERVICE)



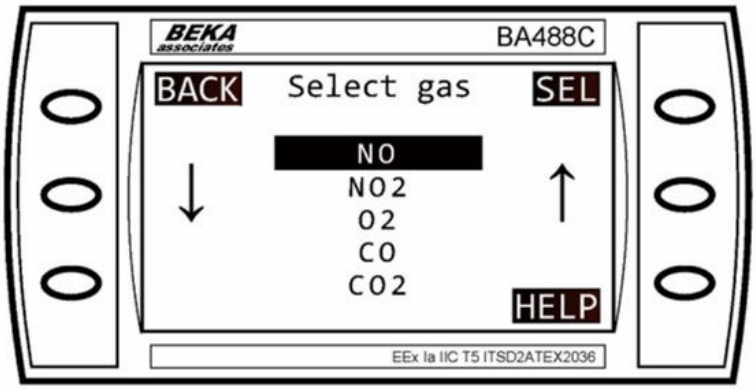
3. Use the middle buttons (↓ and ↑) to scroll up or down to select **PER GAS**. Press the **SEL** button.

Figure 10-19: Gas Service (PER GAS)



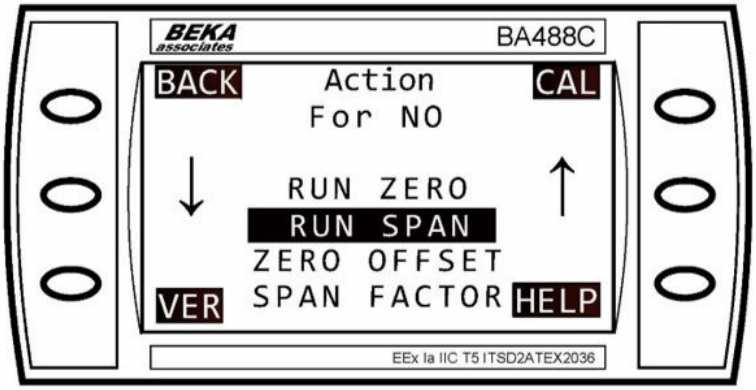
4. Use the middle buttons (↓ and ↑) to scroll up or down to select the desired gas (e.g. *NO*). Press the **SEL** button.

Figure 10-20: Select Gas (NO)



5. Use the middle buttons (↓ and ↑) to scroll up or down. Select **RUN SPAN**. Press the **CAL** button to calibrate, or the **VER** button to verify.

Figure 10-21: Action (SPAN)



6. Using the **LEFT, RIGHT, INCR** (increase), and **DECR** (decrease) buttons, enter the cylinder concentration (e.g., 20 ppm).

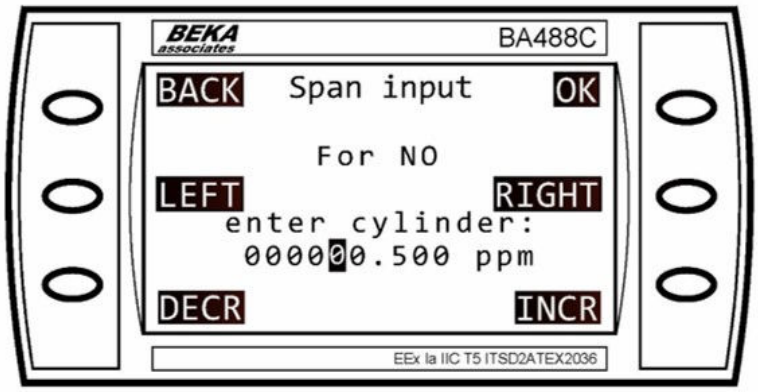
Figure 10-22: Calibration

Figure 10-22 displays the screen as the calibration progresses.

7. Press **OK** to confirm.

   Once complete, the program will automatically open *Span Factor For NO* (Figure 10-23).

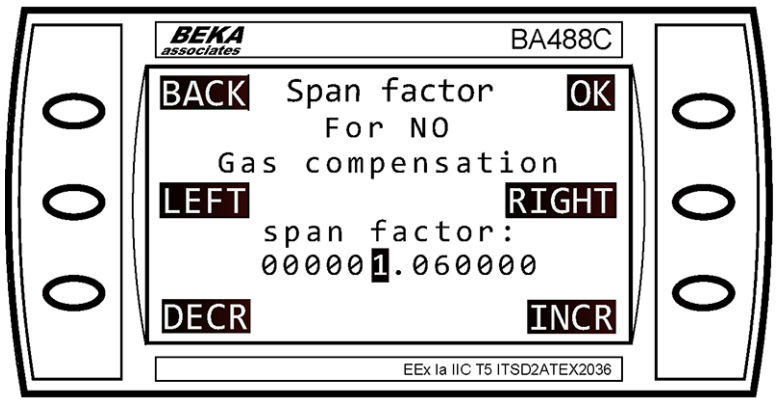
Figure 10-23: Span Input



Note that if an excessively high or low span factor is calculated (<0.7 or > 1.3 for example,) and if the calibration gas is a different concentration from that set above, it will be rejected and the previous span factor will be displayed and will continue to be used.

8. Press **OK**.

Figure 10-24: Result

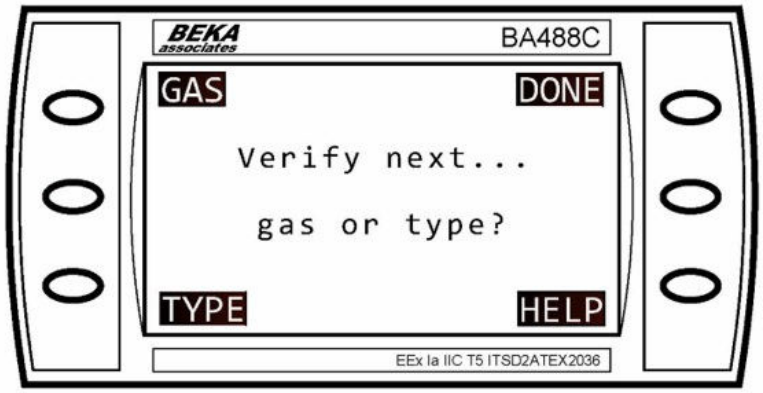


The ***Result*** screen (Figure 10-24) displays.

9. Press **DONE** to finish.

   Refer to Figure 10-25.

Figure 10-25: Calibration Complete



This completes the process, and the display will return to the ***Main menu***.

10.2.3 Calibrate all gases (zero and span)

On systems with valve control, it is possible to run a calibration on all gases. The valves will sequentially switch through each of the span and zero gases. This option is not practical to use on systems which require manual valve switching.

In order to set the cylinder concentration when a new span gas cylinder is to be used, it is necessary to perform a single gas calibration as described earlier. This concentration will then be stored for future calibrations.

Procedure

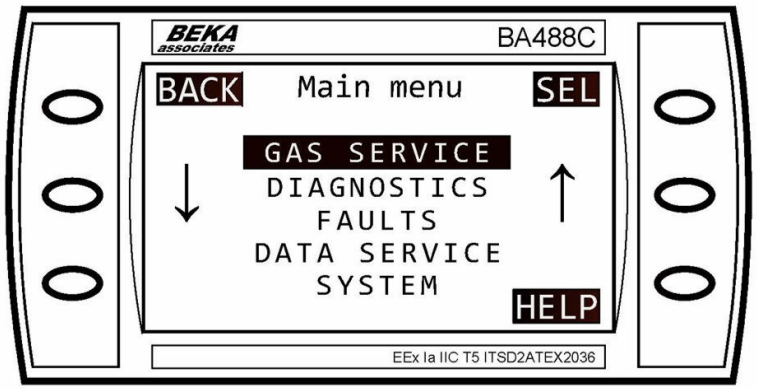
1. To get to the ***Main menu***, press the **MENU** button on the ***Gas Sensor Main*** screen (Figure 10-2) or ***Pressure and Temperature*** screen (Figure 10-3).

NOTICE

Pressing the **BACK** button will cancel the procedure and return the user to the previous screen.

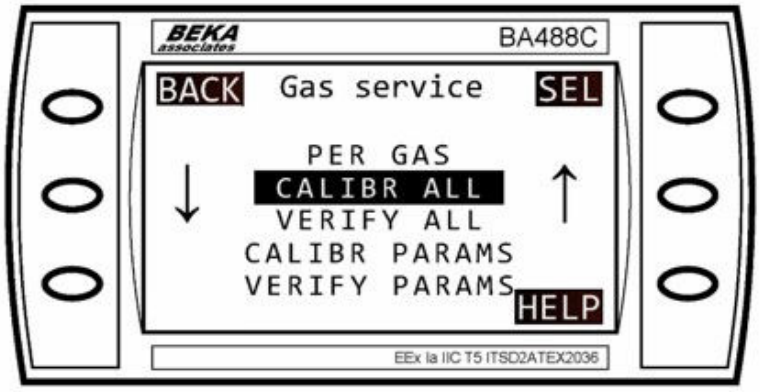
2. Use the middle buttons (↓ and ↑) to scroll up or down to select **GAS SERVICE**. Press the **SEL** button.

Figure 10-26: Main Menu (GAS SERVICE)



3. Use the middle buttons (↓ and ↑) to scroll up or down to select **CALIBR ALL**. Press the **SEL** button.

Figure 10-27: Gas Service (CALIBR ALL)



4. The system will work through the *ZERO* and *SPAN* calibration process for all readings.

   The **Please wait** screen will be displayed. This takes approximately one minute per gas depending on the purge time.

Figure 10-28: Calibration

The ***Finished*** screen displays when the Zero and Span calibrations process completes.

Figure 10-29: Calibration (Finished)

5. Press **BACK**.

   This completes the process, and the display returns to the ***Main menu***.

10.2.4 Change the automatic calibration settings

Procedure

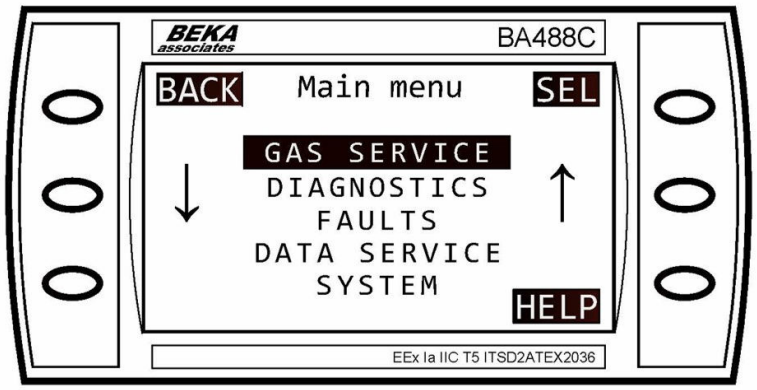
1. To get to the ***Main menu***, press the **MENU** button on the ***Gas Sensor Main*** screen (Figure 10-2) or the ***Pressure and Temperature*** screen (Figure 10-3).

NOTICE

Pressing the **BACK** button will cancel the procedure and return the you the previous screen.

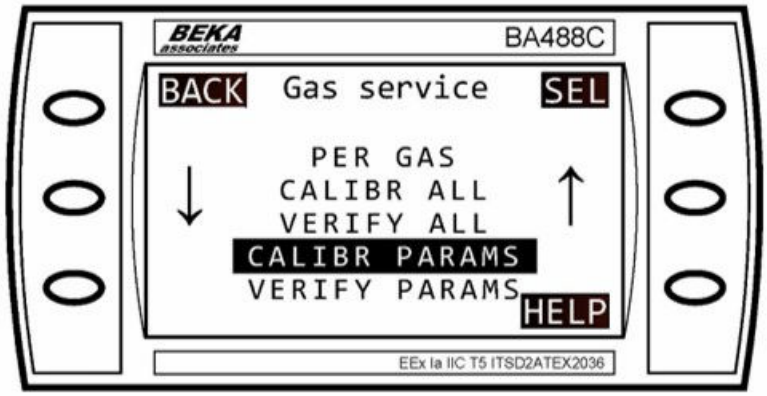
2. Use the middle buttons (↓ and ↑) to scroll up or down to select **GAS SERVICE**. Press the **SEL** button.

Figure 10-30: Main Menu (GAS SERVICE)



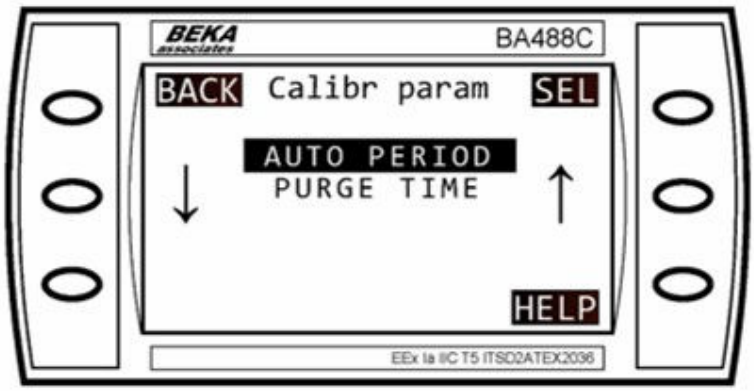
3. Use the middle buttons (↓ and ↑) to scroll up or down to select **CALIBR PARAMS** or **VERIFY PARAMS** for validation settings). Press the **SEL** button.

Figure 10-31: Gas Service (CALIBR PARAMS)



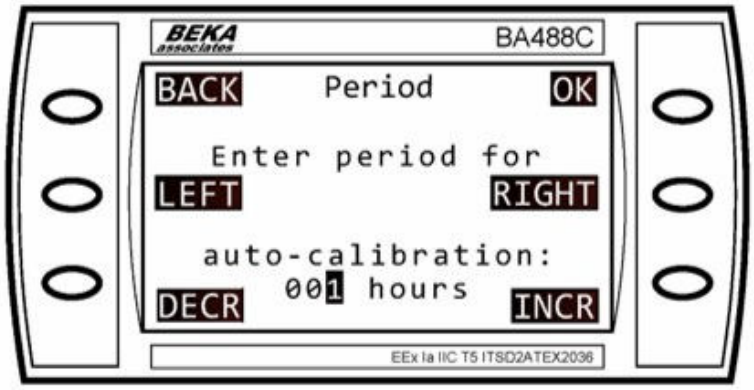
4. This section applies to systems configured to perform automatic calibration at timed intervals only.
5. To adjust the frequency of automatic calibration: Use the middle buttons (↓ and ↑) to scroll up or down
6. Select **AUTO PERIOD**.
7. Press the **SEL** button.

Figure 10-32: Calibr param (AUTO PERIOD)



8. To change the time and the units (days, hours, min and sec) between calibrations: Use the **LEFT, RIGHT, INCR** (increase), and **DECR** (decrease) buttons to set the number and time interval.

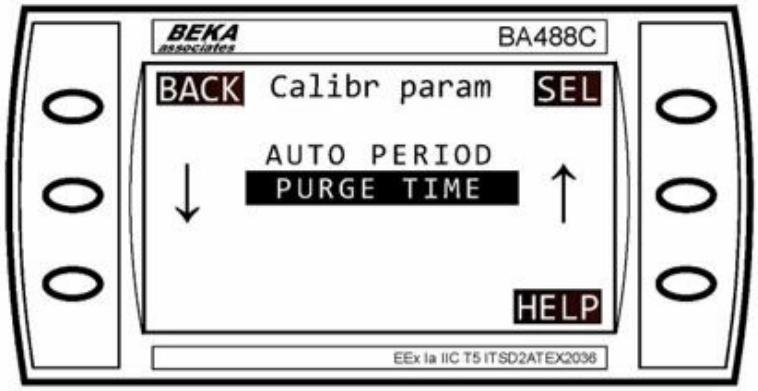
Figure 10-33: (Calibration) Period



9. Press the **OK** button.

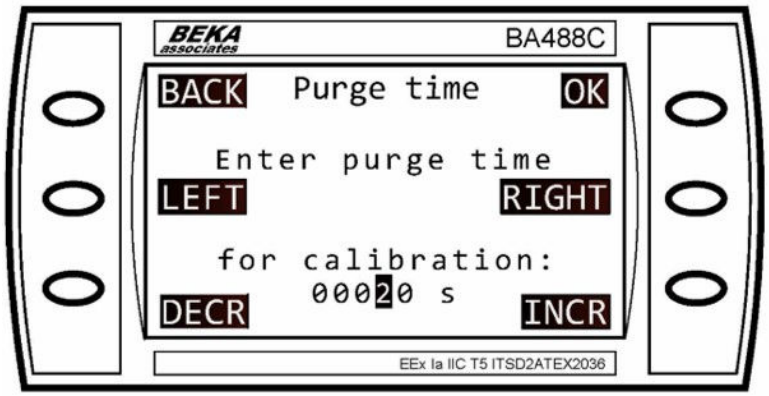
10. To adjust the length of time for the span gas to flush the cell: Use the middle buttons (↓ and ↑) to scroll up or down select **PURGE TIME**.

Figure 10-34: Calibr param (PURGE TIME)



11. Press the **SEL** button.
12. To change the time between opening the valve and performing the calibration:

Figure 10-35: Purge Time



13. Use the **LEFT, RIGHT, INCR** (increase), and **DECR** (decrease) buttons to set the number and time interval.
14. Press the **OK** button.

11 Troubleshooting and diagnostics

11.1 Using the Built-in-Self-Test (BIST) fault diagnostics

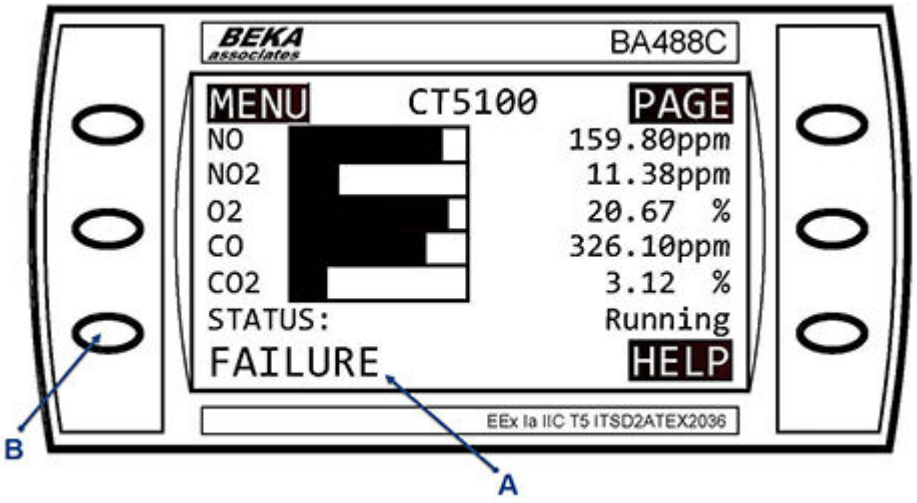
The analyzer has a Built-In-Self-Test (BIST) function that can be used to perform failure diagnosis of some functions in situations where there is a fault other than a complete failure of the equipment. The BIST is accessed and controlled through the display controller mounted on the door of the electrical compartment.

The BIST runs in the background when the analyzer is operating and continuously monitors the analyzer for faults.

Procedure

1. If the BIST detects a fault, the *STATUS* display in the bottom left-hand corner of the ***Gas Sensor Main*** screen (Figure 11-1, Item A) will change from **OK** to flashing the word **FAILURE**.

Figure 11-1: Gas Sensor Main Screen

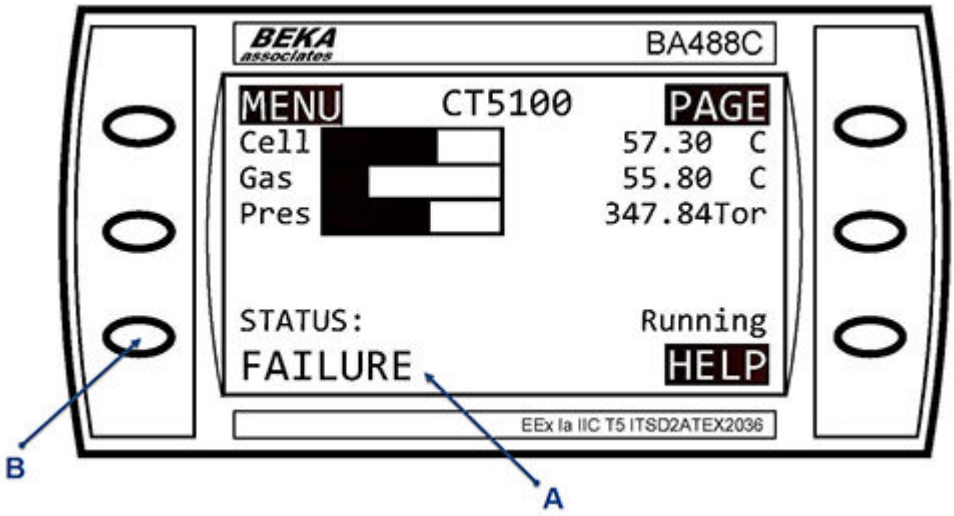


A. FAILURE message
B. FAILURE button

2. Similarly, if a fault is detected and the ***Pressure and Temperature*** screen (Figure 11-2) is being displayed, the *STATUS* display in the bottom left-hand corner of the screen (A) will change from **OK** to flashing the word **FAILURE**.
3. On either the ***Gas Sensor Main*** screen (Figure 11-1) or the ***Pressure and Temperature*** screen (Figure 11-2), pressing the **FAILURE** button (B) will take you to the ***Faults menu*** screen (Figure 11-5).

Details of how to use the controls on the display controller and functions of the **BACK** and **HELP** buttons are given in Controls and display controller.

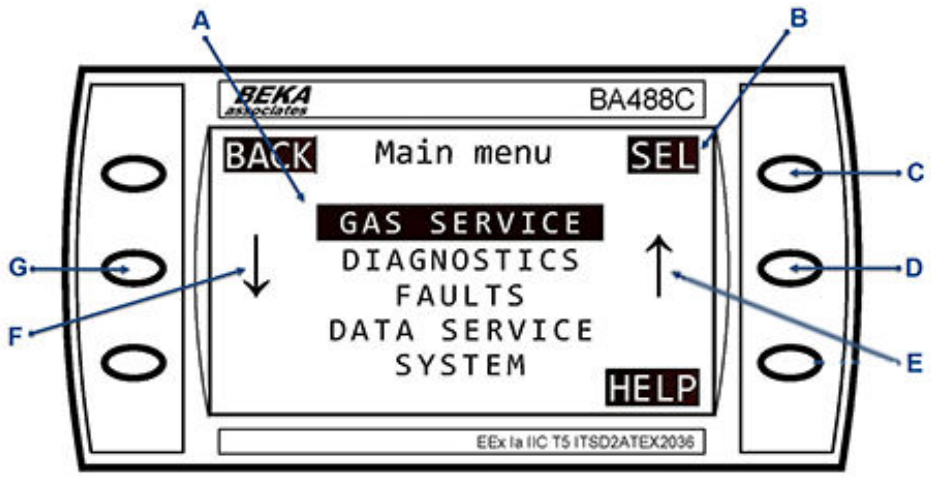
Figure 11-2: Pressure and Temperature Screen



A. FAILURE message
B. FAILURE button

4. The ***FAULTS*** menu can also be accessed through the ***Main Menu*** (Figure 11-4) as follows:
5. In the ***Gas Sensor Main*** screen, Figure 11-1, press the **MENU** button.
6. Alternatively, press the **MENU** button on the ***Pressure and Temperature*** screen (Figure 11-2). The ***Main Menu*** screen (Figure 11-3) opens.

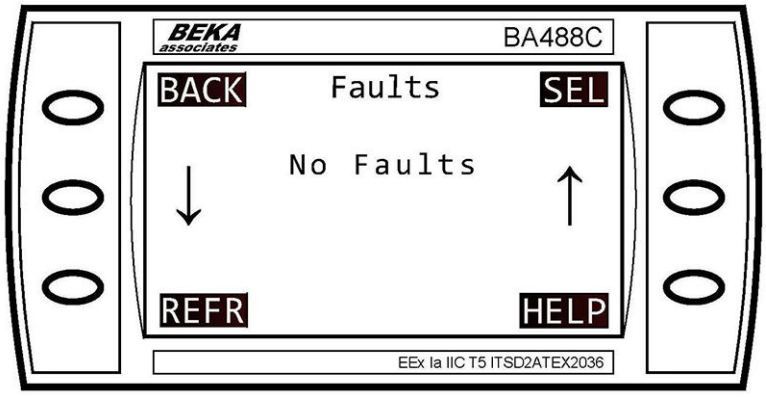
Figure 11-3: Main Menu Screen



A. Calibration and maintenance options
B. SEL text
C. SEL button
D. Scroll Up button
E. Scroll Up arrow
F. Scroll Down arrow
G. Scroll Down button

7. Using the **Scroll Up** button (D) and **Scroll Down** button (G), select **FAULTS**.
   Refer to Figure 11-3.
8. Press the **SEL** button (C).
   The ***Faults*** menu will then open.

Figure 11-4: Faults Menu - No Faults Indicated

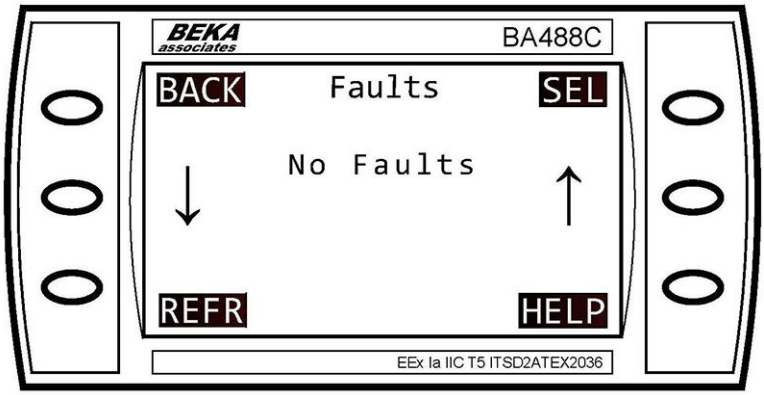


11.2 Faults menu

The ***Faults*** menu displays a list of faults affecting the analyzer that have been identified by the BIST.

If no faults have been identified by the BIST the central area of the ***Faults*** menu will display *No FAULTS* (see Figure 11-5).

Figure 11-5: Faults Menu - No Faults Indicated



Procedure

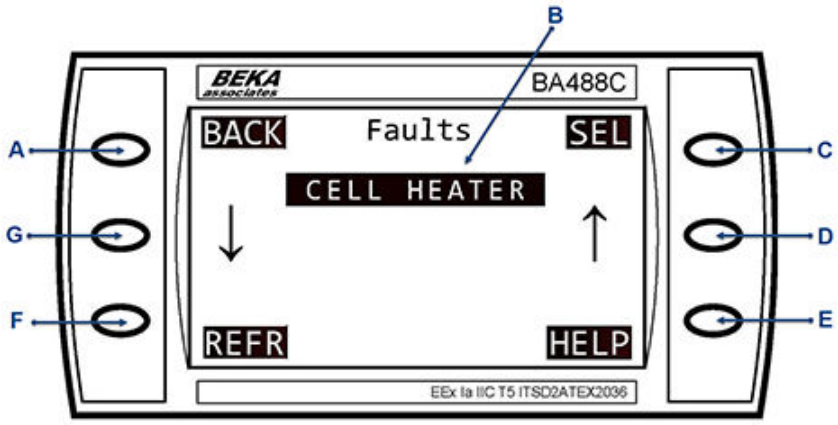
1. Press the **REFR** button to refresh the fault list (B).

   Refer to Figure 11-6.

2. Use the **Scroll Up** (D) and **Scroll Down** (G) buttons to highlight a fault for further investigation by the BIT system.
3. Once the fault that you wish to diagnose has been highlighted, press the **SEL** button to select that fault.
   The ***Fault Display*** screen for the component that is reporting an error will then open.

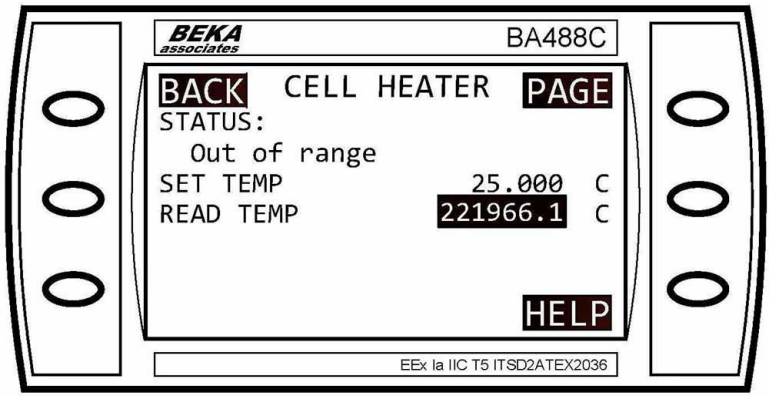
   The ***Fault Display*** screen will display the parameters of the suspect component. Figure 11-7 shows an example of a Fault Display; the precise data that will be displayed will vary depending upon where the fault has occurred.

Figure 11-6: Faults Menu



A. BACK button
B. Fault list
C. SEL button
D. Scroll Up button
E. HELP button
F. REFR button
G. Scroll Down button

Figure 11-7: Fault Display Screen



Examine the data shown on the ***Fault Display*** 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 Cascade Technologies Ltd for advice and assistance.

If there are more parameters than can be displayed on the available screen space, a *PAGE* message will appear in the top right-hand corner of the screen, and the top right-hand button will become the associated **PAGE** button. Pressing the **PAGE** button will display the next page of parameters.

11.3 Failure diagnosis principles

Failure diagnosis of the analyzer comprises interpretation of system fault messages shown on the LCD display, visual examination, and functional failure diagnosis.

The normal start point should be to use the Built-In-Self-Test (BIST) facility to attempt to identify any faults. If that fails to identify the fault, if the analyzer fails to start correctly, or if the display controller is not working, perform the functional failure diagnosis.

Electrical power to operate the analyzer is provided through the host equipment supplied by the customer.

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

The failure diagnosis procedures described in this section assume that any host equipment provided by the customer is fully functional. Always confirm that the host equipment is fully serviceable before performing failure diagnosis on the analyzer.

The host equipment includes:

- A two-pole main isolator (circuit breaker) that controls the application of electrical power to the analyzer.
- Power cables and interconnecting wiring that connect to the analyzer.
- Pneumatic pipes/hoses and associated T-pieces, pneumatic connectors and fittings, etc., that route the gas sample to and from the analyzer.
- Any gas conditioning equipment necessary to condition the gas sample before it is routed to the analyzer.

11.4 Repairable faults

The repair and servicing procedures given in this manual describe all repairs and servicing that can be undertaken by the customer maintenance personnel. In all cases, the repair is by direct replacement of the faulty item with a known serviceable item.

All other items must be repaired or replaced by Emerson.

NOTICE

In general, if any optical component other than the cell assembly, laser module, and the detector are deemed unserviceable, the analyzer must be repaired by Emerson personnel. The repair, replacement, and alignment of the optical components requires the use of specialized optical test/calibration equipment and procedures to ensure the correct operation of the unit.

11.5 Tools and test equipment

All tools required when performing failure diagnosis are standard hand tools.

The only test equipment required when performing failure diagnosis is a multi-meter that may be used to perform continuity checks on electrical wiring during an inspection.

11.6 General troubleshooting and diagnostics information

The Rosemount™ CT5100(Ex) is specifically designed to run unattended indefinitely, 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 section fail to return the analyzer to normal operation or do not identify a fault, notify your service agent for further assistance.

11.7 Diagnostics menu

Selecting **DIAGNOSTICS** on the ***Main Menu*** will open the ***Diagnostics Menu*** (Figure 11-8). The ***Diagnostics Menu*** lists those main components of the Rosemount CT5100(Ex) where problems can be diagnosed using the BIST system. The ***Diagnostics Menu*** also enables you to check on the status and, where appropriate, the values of, any of the listed components.

Press the **REFR** button (F) to refresh the fault list.

Use the **Scroll Up** (C) and **Scroll Down** (G) buttons to highlight a component for further investigation by the BIST system.

Once you have highlighted the component you wish to diagnose, press the **SEL** button (B) to select that fault. The ***Diagnostics*** screen for that component will then open.

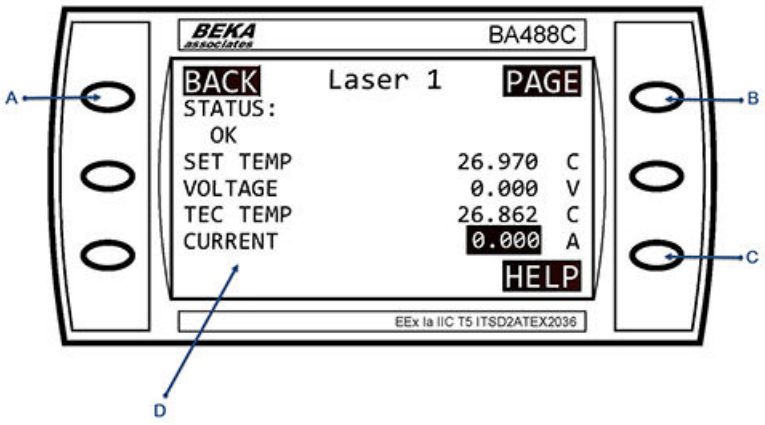
Figure 11-8: Diagnostics Menu

A. BACK button
B. SEL button
C. Scroll Up button
D. HELP button
E. List of components
F. REFR button
G. Scroll down button

In the example shown in Figure 11-8, LASER 1 has been highlighted.

Pressing the **SEL** button (B) to select the *LASER 1* component will open up the Laser 1 diagnostics menu shown in Figure 11-9.

Figure 11-9: Laser 1 Diagnostics Menu (Page 1)



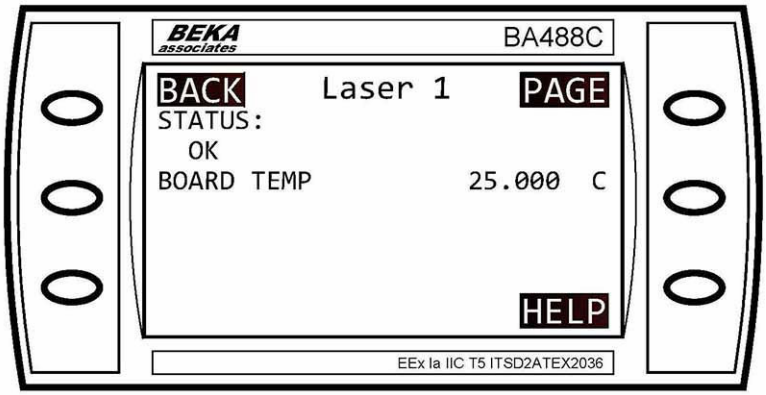
A. BACK button
B. PAGE button
C. HELP button
D. Parameters

The component diagnostic screen will show the parameters of the component that was selected on the ***Diagnostics*** menu. In the example shown in Figure 11-9, the parameters of Laser 1 are shown. The parameters data that will be displayed will vary depending upon which component was selected for diagnosis.

By examining the parameters shown on the display, it is possible 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 Emerson for advice and assistance.

If there are more parameters than can be displayed on the available screen space, a *PAGE* message will appear in the top right-hand corner of the screen as shown in Figure 11-9, and the top right-hand button will become the associated **PAGE** button. Pressing the **PAGE** button will display the next page of parameters. In the example shown in Figure 11-9 pressing the **PAGE** button will display the second page of parameter data for Laser 1, which is shown in Figure 11-10.

Figure 11-10: Laser 1 Diagnostics Menu (Page 2)



11.8 Visual examination

If the BIST fails to identify the problem, the next step is a visual examination of the Rosemount CT5100(Ex).

Procedure

1. Open the door of the electrical compartment and remove the top cover.
   Refer to Removing the top cover.
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.
   Refer to Figure 3-5.
4. If any loose connections are found in the electrical compartment, refer to the wiring diagrams (Engineering drawings) to identify and repair the connection.
5. Refit the top cover and close the electrical compartment door.

11.9 Functional failure diagnostics

If the Built-in-Self Test and the visual examination fail to identify the fault, perform the failure diagnostics and recommended actions.

11.9.1 No illuminated LEDs on Power supply unit (PSU) when analyzer switched ON.

Recommended actions

1. Check mains power is available.
2. If OK, replace PSUs.

11.9.2 Nothing powers up when connected to mains

Recommended actions

1. Check AC fuses (number 1 and number 2)
2. Replace if necessary.

11.9.3 Only MOXA and BEKA powers up

Condition

The startup screen displays BEKA; all other electronic modules remain unpowered.

Recommended actions

1. Check the 12 V PSU is working (LED illuminated).
2. If the 12 V PSU is not working, replace it.

3. If PSU is OK, check 12 Vdc fuse (number 3) and replace if necessary.

11.9.4 BEKA and MOXAs do not start up (LEDs not illuminated)

Condition

All electronics modules are powered up with various on board LEDs.

Recommended actions

1. Check that the 24 V PSU is working (LED illuminated).
2. If the PSU is not working, replace it.
3. If the PSU is OK, check 24 Vdc fuse (number 4) and replace if necessary.

11.9.5 No display at all on BEKA but MOXA (if available) is ON

Recommended actions

1. Check 24 Vdc fuse (number 4); replace if necessary.
2. Check connections from BEKA panel to 24 Vdc power supply and BEKA barrier (if applicable).
3. If interconnecting cable OK, replace BEKA display panel.

11.9.6 NAMUR relay LED is OFF and no FAILURE reported on BEKA

Recommended actions

1. Check power connections from peripheral board to relay.
2. If the interconnecting cable is, replace NAMUR relay.

11.9.7 BEKA shows low/noisy gas readings with FAILURE status

Condition

Faults page may display MISALIGNMENT on Gas Sensor 3, weak or no pulses from the affected laser with "Misalignment of laser" under Paths in the monitoring tab, and possibly "Pulse too noisy" message.

Recommended actions

1. Check laser module power connection is intact.
2. Check laser is enabled on Gas Sensor 3.
3. Check current, TEC, and volt readings on Gas Sensor 3.
4. If these are different from expected values or out of range, replace laser module.

11.9.8 BEKA shows low/noisy O_2 gas readings with FAILURE status

Condition

Faults page may display MISALIGNMENT on Gas Sensor 3, weak or no pulses from O_2 laser with "Misalignment of laser" under Paths in the monitoring tab, and possibly "Pulse too noisy" message.

Recommended actions

1. Ensure power supply to O_2 detector (LED ON) is present.
2. Check detector output cables are intact.
3. Ensure O_2 laser module is working properly (check laser current, volt and TEC readings on Gas Sensor 3).
4. If the power supply and output cables are working, but the O_2 laser module is not, replace O_2 detector

11.9.9 BEKA shows low/noisy gas readings for all gases (except O_2) with FAILURE status

Condition

Faults page may display MISALIGNMENT. On Gas Sensor 3, weak or no pulses from all lasers (except O_2) with "Misalignment of laser" under Paths in the monitoring tab and possibly "Pulse too noisy" message.

Recommended actions

1. Ensure laser modules are working properly (check laser current, voltage, and TEC readings on Gas Sensor 3); replace if necessary.
2. Check the cable between motherboard and detector TEC PCB (14- way ribbon cable); replace if necessary.
3. Check 10 way cable from detector TEC PCB to VIGO; replace if necessary.
4. Check detector output cable is intact, replace if necessary.
5. If items 1 – 4 are all OK, replace VIGO detector.

11.9.10 BEKA shows low/noisy gas readings for all gases with FAILURE status

Condition

Faults page may display MISALIGNMENT. On Gas Sensor 3, weak or no pulses from all lasers with "Misalignment of laser" under Paths in the monitoring tab and possibly "Pulse too noisy" message.

Recommended actions

1. Visually check all external optics for dust or damage and clean if necessary.

2. Ensure cables to detectors are intact.
3. Check all power rails (±12 V and -5 V) are OK and VIGO temp control is working.
4. If not, check power supply ribbon cable from motherboard.
5. If all above are OK, then replace detector TEC board.
6. Clean external optics.
7. If damaged, replace external optics.
8. If not external optics, visually check cell mirrors for dust and clean if necessary.
9. If cell mirrors are damaged or corroded, replace the cell assembly.
10. Replace power supply ribbon cable
11. Replace detector TEC board.

11.9.11 BEKA shows incorrect pressure reading

Condition

If out of range, readings display format will change to white on black.

Recommended actions

1. Check connection cable between pressure sensor and peripheral board and/or barrier if applicable.
2. If interconnecting cable OK, replace pressure sensor

11.9.12 BEKA display shows FAILURE status

Condition

The faults page shows CELL HEATER fault due to temperature being out of range with cell temperature reading either a constant value (short circuit) or a high value of 21000 and above.

Recommended actions

1. Check connection cable between cell temperature PT100 sensor and peripheral board.
2. If interconnecting cable is OK, replace cell temperature PT100 RTD.

11.9.13 BEKA display shows FAILURE status, and the faults page shows CELL HEATER fault due to temperature being out of range

Recommended actions

1. Ensure all connections to peripheral board are intact.
2. Check cell temperature PT100 sensor is working properly.
3. Check heater relay is working (LED ON). If it is not, check relay power supply.
4. If all are OK, replace cell assembly heater block.

11.9.14 BEKA display shows wrong gas temperature reading

Condition

The gas temperature reading is either a constant value (short circuit) or a high value of 21000 and above (open circuit) with gas readings being possibly affected.

Recommended actions

1. Check connection cable between gas temperature PT100 sensor and peripheral board.
2. If interconnecting cable OK, replace gas temperature PT100 RTD.

11.9.15 BEKA does not display any temp and pressure values and NAMUR relays not working

Recommended actions

1. Check power supply to peripheral board.
2. Check 20-way ribbon cable from motherboard to peripheral board.
3. Check connections to sensors and relays.
4. If all are OK, replace peripheral board.

11.9.16 BEKA display won't show any information or only displays start-up screen

Recommended actions

1. Check SD Card is connected; if SD card is not working, replace it.
2. Ensure the 12 V PSU and 12 Vdc fuse are OK; if 12 Vdc fuse is not working, replace it.
3. Ensure connection to BEKA from motherboard is intact; if is not, replace it.
4. Check other outputs (digital and analog) are OK (if available).
5. If all interconnecting cables are OK, replace the motherboard PCB.

12 Repair and replacement

12.1 Repair policy

Repair and maintenance of the Rosemount™ CT5100(Ex) must only be performed by qualified personnel.

The analyzer has a number of parts that can be repaired and/or replaced with spare parts supplied by Emerson.

In all cases the repair must be by direct replacement of the faulty item with a known serviceable item purchased from Emerson.

NOTICE

Some faults can only be repaired by Emerson. Where an item is unserviceable, and no replacement procedure is given in this manual, then the fault must be repaired by Emerson.

12.2 Opening the electrical compartment door

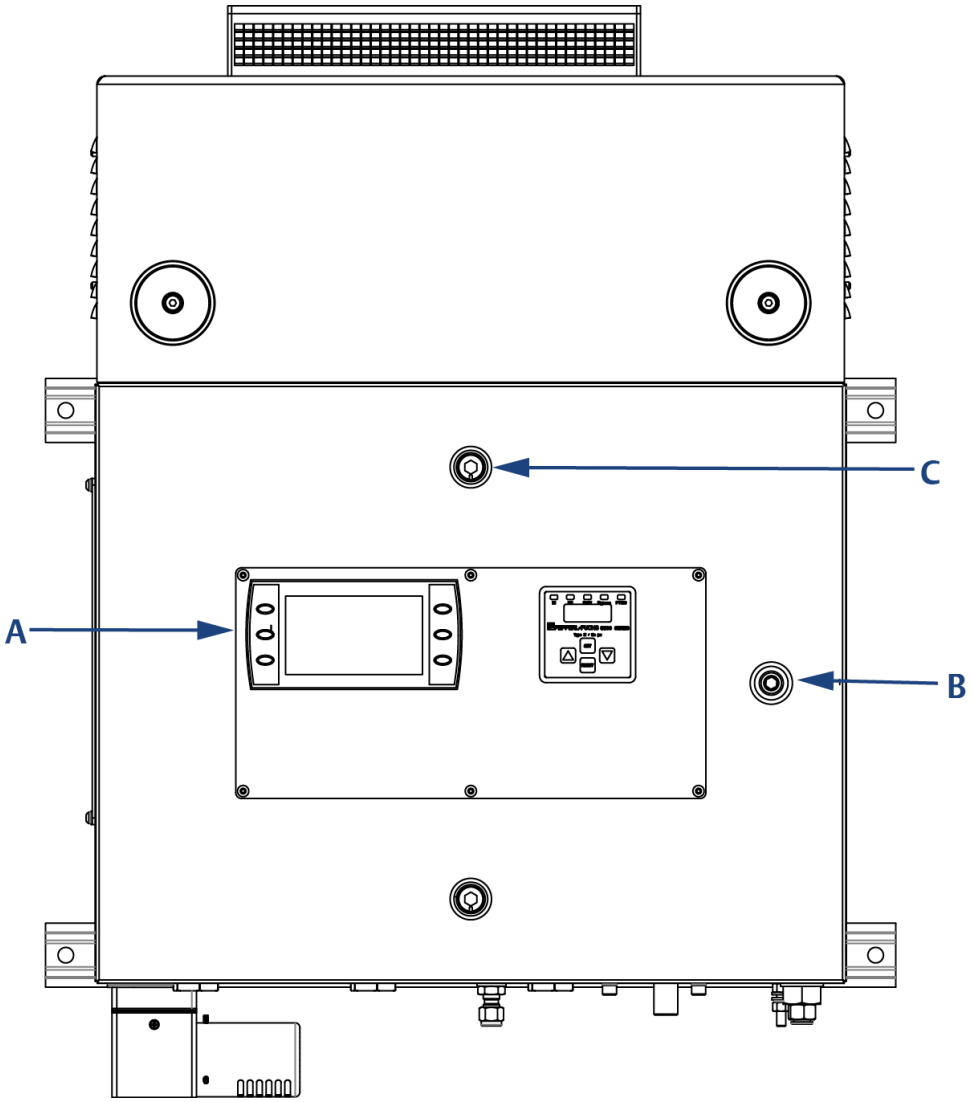
To gain access to the electrical compartment and the components mounted on the inside of the door, open the door on the front of the Rosemount CT5100(Ex) as follows:

Procedure

Using an 8 mm Allen key, loosen the compression screw (B) and cam latch screws (C) to unlock the door (A), then open the door.

See (Figure 12-1).

Figure 12-1: Electrical Compartment Door



A. Electrical compartment door
B. 1 off compression latch
C. 2 off cam latches

12.3 Closing the electrical compartment door

The procedure for closing and locking the door to the electrical compartment is the reverse of the opening procedure.

⚠ CAUTION

EQUIPMENT DAMAGE

Do not start up or try to operate the Rosemount CT5100(Ex) 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 .

Failure to perform pre-system start-up checks may cause damage to the equipment.

⚠ CAUTION

EQUIPMENT DAMAGE

Always follow the start-up procedure. Damage to the analyzer may result from a failure to follow the start-up procedure.

Procedure

1. Close the electrical compartment door.
2. Using an 8 mm Allen key, tighten the compression screw (B) and cam latch screws (C) to lock the door (A).
   See Figure 12-1.
3. Restart the analyzer.
   Refer to Start-up procedure for the start-up procedure.

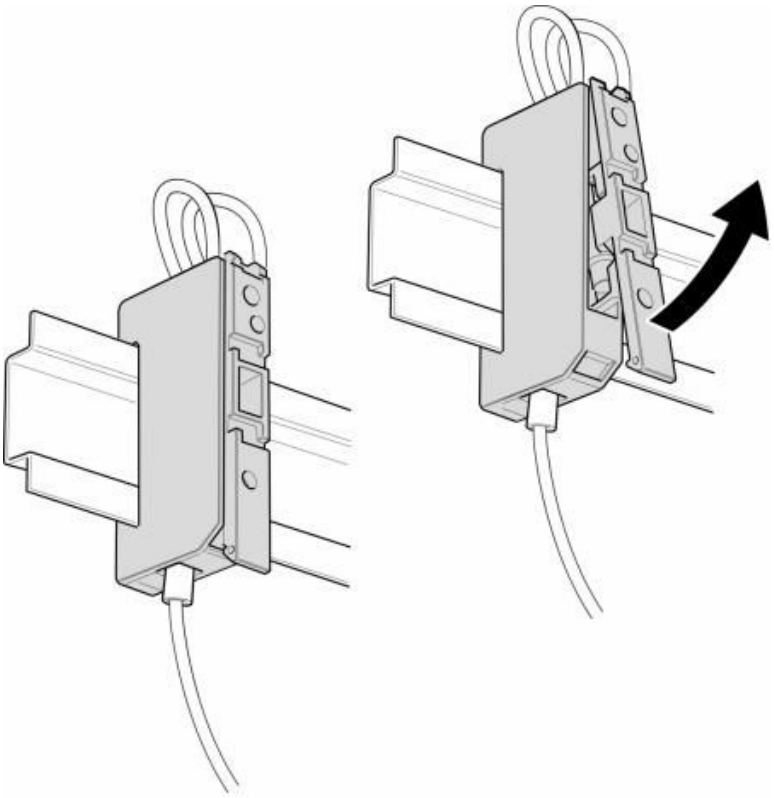
12.4 Replacing the fuses

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

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.

Figure 12-2: Fuse Holder

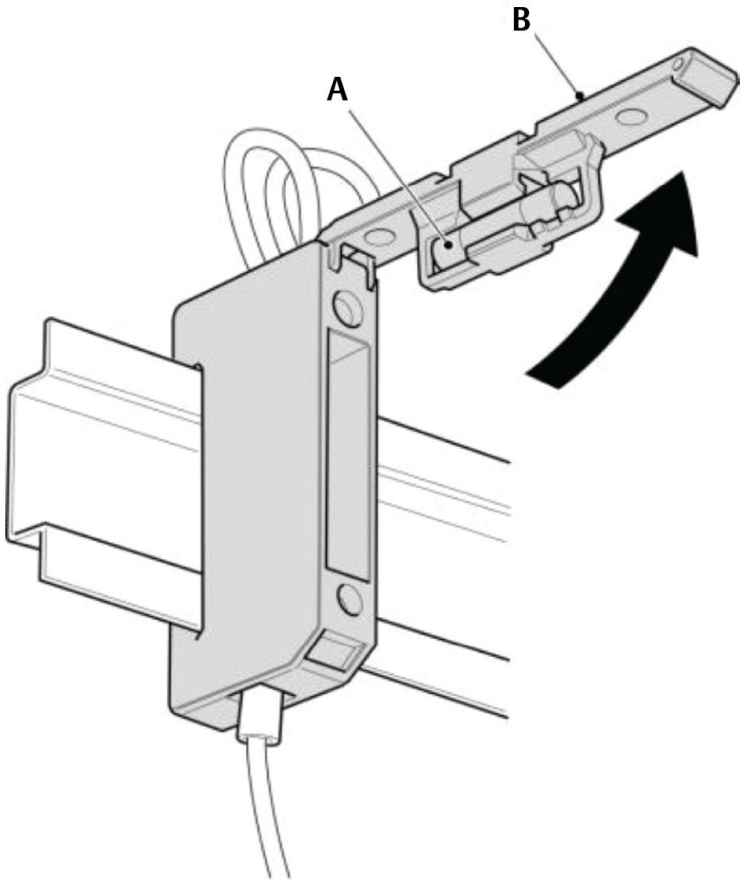


As shown in Figure 12-3 each fuse is located inside a fuse holder that is mounted on the lower DIN Rail. For clarity, Figure 12-3 only shows one of the fuse holders, which is shown in both the closed and partially open positions.

3. No tools are required to remove the fuse. Place a finger on the catch on the upper part of the fuse holder and lift up the upper part of the fuse holder as shown in Figure 12-3.

4. Fully raise the upper part of the fuse holder (B) as shown in Figure 12-4 and then push out the old fuse (A).

Figure 12-3: Replacing the Fuse



A. Fuse
B. Fuse holder

⚠ WARNING

CORRECT FUSES

Fuses must only be replaced with fuses of the same type and rating. Failure to do so may result in personal injury or death and/or damage to persons and/or property.

5. Fit the replacement fuse into the fuse holder.
   Refer to Table 12-1 and verify that the fuse is of the correct type and rating.
   When lowering the upper part of the fuse holder, ensure that it "clicks" into place when fully lowered.
6. Close the door of the electrical compartment and restart the analyzer.

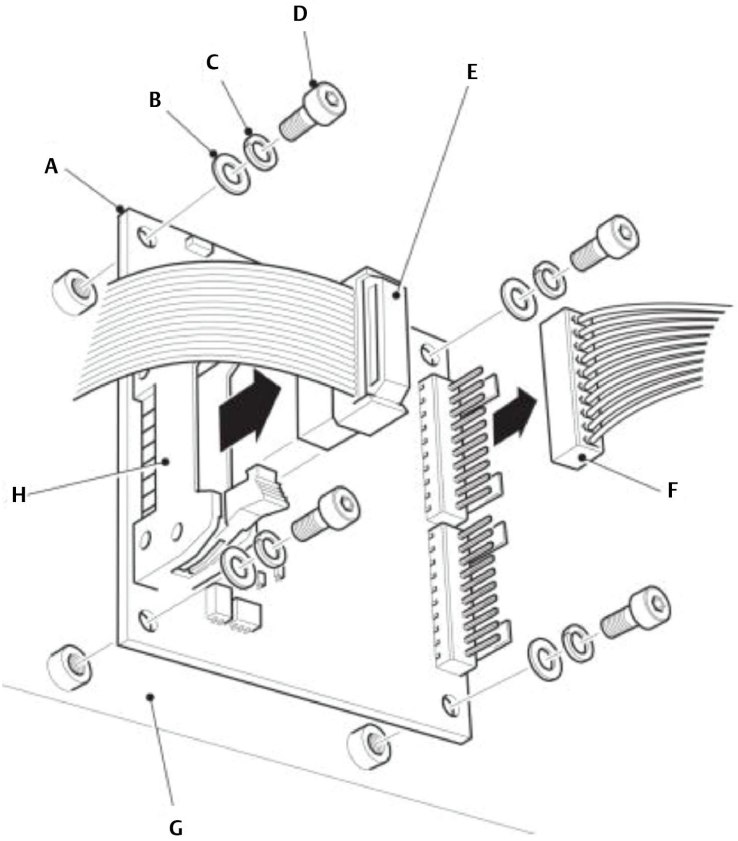
Table 12-1: Fuse Requirements

Fuse	Function	Rating	Schurter part number
1	Live line 110/230 Vac (following mains filter)	3.15 A, 250 V, fast acting ceramic	0001.1011
2	Neutral line 110/230 Vac (following mains filter)	3.15 A, 250 V, fast acting ceramic	0001.1011
3	Analyzer 12 Vdc supply rail	5 A, 250 V, fast acting ceramic	0001.1011
4	Analyzer 24 Vdc supply rail	3.15 A, 250 V, fast acting ceramic	0001.1011

12.5 Replacing the TEC board

To replace the TEC board, refer to Figure 12-4 and complete the following steps.

Figure 12-4: Replacing the TEC Board



A. TEC board
B. M3 flat washer
C. M3 spring washer
D. M3 x 6 mm socket head cap screw
E. Ribbon cable (to motherboard)
F. Wiring harness (to detector module)
G. Backplate
H. Connector for ribbon cable

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Tag or otherwise identify all wiring harnesses before disconnecting.

4. Open the locking arms of the connector (H) for the ribbon cable and disconnect the ribbon cable (E) from the TEC board (A).
5. Disconnect the wiring harness (F) from the TEC board.
6. Remove and retain the four off M3 x 6 mm hex cap screws (D) and associated spring washers (C) and flat washers (B) that secure the TEC board to the back plate.
7. Remove the TEC board from the backplate (G).
8. Discard the unserviceable TEC board.
9. Examine the replacement TEC board for damage during shipping or storage.
10. Fit the TEC board (A) in position on the backplate (G) in the same orientation.

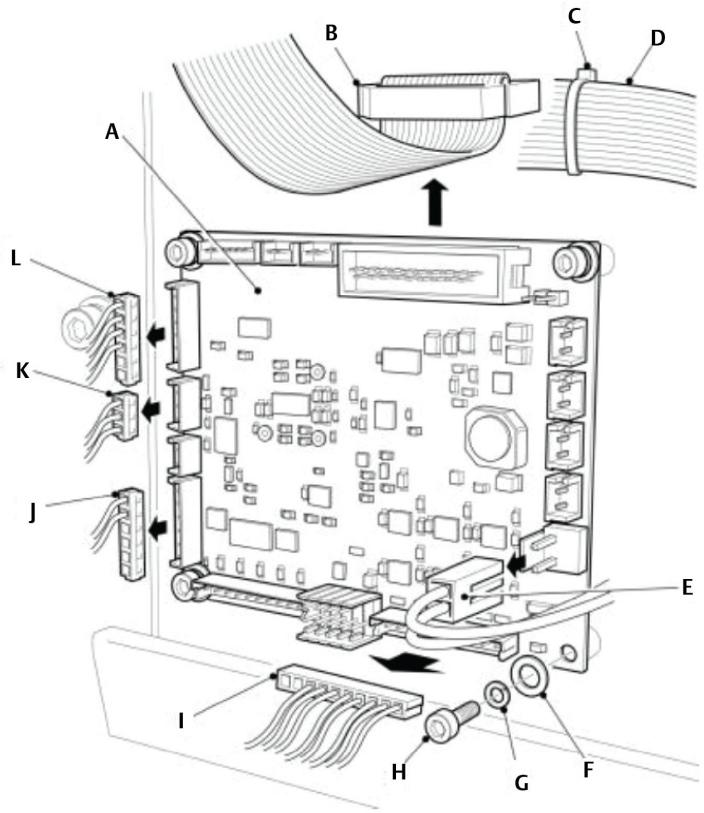
    Using the packaging from the replacement TEC board, send the unserviceable TEC board to Emerson for evaluation.
11. Secure the TEC board by fitting the four screws (D) and associated spring washers (C) and flat washers (B) that were retained during the removal procedure.
12. Apply Loctite® 222 to the four off M3 screws and torque tighten the screws to 0.75 Nm.
13. Connect the wiring harness (F) to the TEC board.
14. Connect the ribbon cable (E) to the connector (H) for the ribbon cable on the TEC board.

    Confirm that the ribbon cable securely fits to the connector.
15. Close the door of the electrical compartment and restart the analyzer.

12.6 Replacing the peripheral board

To replace the peripheral board, refer to Figure 12-5 and complete the following steps.

Figure 12-5: Replacing the Peripheral Board



A. Peripheral board
B. Ribbon cable (to motherboard)
C. Cable tie
D. TEC board ribbon cable
E. 12 V power wiring harness
F. M3 flat washer
G. M3 spring washer
H. M3 x 6 mm socket head cap screw
I. Relay wiring harness
J. Gas/cell temperature monitoring harness
K. Gas/cell temperature monitoring harness
L. Gas/cell temperature monitoring harness

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.

2. Open the door of the electrical compartment.
3. Tag or otherwise identify all wiring harnesses before disconnecting.
4. Disconnect the 12 V power wiring harness (E) from the peripheral board (A).

NOTICE

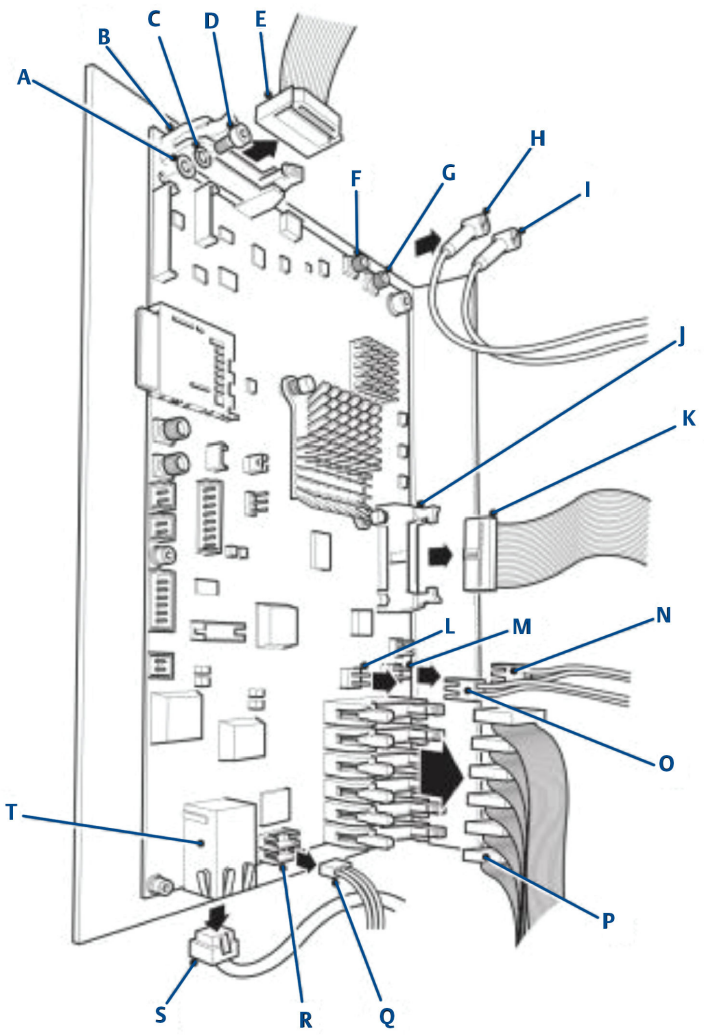
The other end of the 12 V power wiring harness (H) is connected to connector J11 on the motherboard.
A ribbon cable (E) that connects the TEC board to the motherboard runs across the top of the peripheral board and is secured with a cable tie (C) to the connector of the ribbon cable (B) that plugs into the peripheral board.

5. Cut the cable tie (C) that secures the TEC board ribbon cable (E) to the connector of the peripheral board ribbon cable (B). Carefully move the TEC board ribbon cable clear of the peripheral board.
6. Disconnect the peripheral board ribbon cable (B) from the peripheral board.
7. Disconnect the relay wiring harness (I) from the peripheral board.
8. Disconnect the three connectors (J, K, and L) of the gas/cell temperature monitoring harness from the peripheral board.
9. Remove and retain the four screws (H) and associated spring washers (G) and flat washers (F).
10. Remove and discard the peripheral board.
11. Place the peripheral board (A) in position on the backplate.
12. Secure the peripheral board by fitting the four screws (H) and the associated spring washers (G) and flat washers (F) retained during the removal procedure.
13. Torque tighten the screws to 0.6 Nm.
14. Connect the three connectors (J, K, and L) of the gas/cell temperature monitoring harness to, respectively, connectors J9, J24, and J37 on the peripheral printed circuit card (PCC).
15. Connect the relay wiring harness (I) to the peripheral board.
16. Connect the peripheral board ribbon cable (B) to the peripheral board.
17. Secure the TEC board ribbon cable (D) to the connector of the peripheral board ribbon cable (B) with a cable tie (C).
18. Connect the 12 V power wiring harness (E) to the peripheral board (A).
19. Close the door of the electrical compartment and restart the analyzer.

12.7 Replacing the motherboard

To replace the motherboard, refer to Figure 12-6 and complete the following steps.

Figure 12-6: Replacing the Motherboard



A. M3 flat washer
B. Ribbon cable connector J12
C. M3 spring washer
D. M3 x 6 mm socket head cap screw
E. TEC board ribbon cable
F. Signal Out connector J32
G. Signal Out connector J31
H. Signal Out wiring harness
I. Signal Out wiring harness
J. Ribbon cable connector J7

K. Ribbon cable (to peripheral PCB)
L. 12 V power out connector J17
M. 12 V power in connector J16
N. 12 V power input wiring harness
O. 12 V power output wiring harness
P. Laser module ribbon cable
Q. HMI Display wiring harness
R. Connector J22
S. Ethernet cable
T. Ethernet connector

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Tag or otherwise identify all wiring harnesses before disconnecting.
4. On the motherboard, disconnect the TEC board ribbon cable (E) from connector J12 (B).
   Refer to Figure 12-6.
5. Disconnect the Detector Module 1 Signal Out wiring harness (I) from connector J31 (G).

   NOTICE

   The Detector Module 2 Signal Out wiring harness (H) is an optional item that only forms part of those analyzers that are fitted with an O_2 detector.

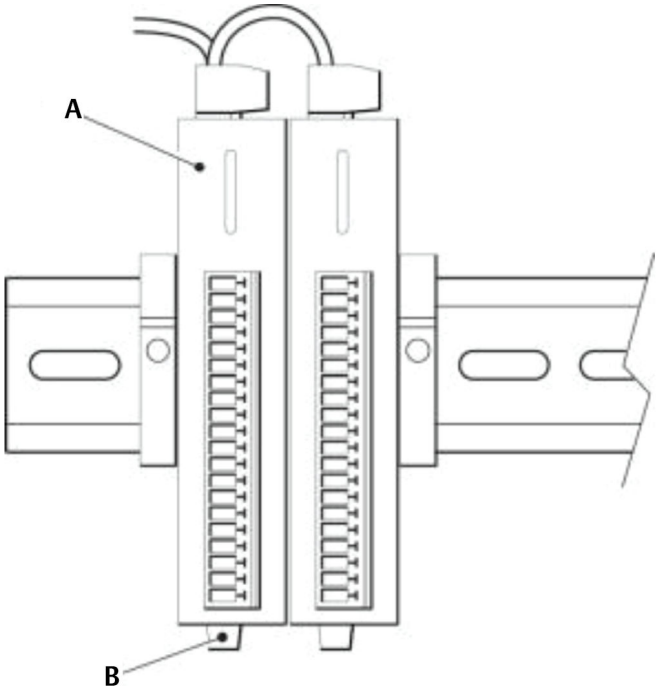
6. Disconnect the Detector Module 2 Signal Out wiring harness (H) from connector J32 (F).
7. Disconnect the Laser Module ribbon cables (P) from the motherboard.
   The number of Laser Module ribbon cables to be disconnected will vary depending upon the application that the analyzer has been configured for.
8. Disconnect the 12 V power output wiring harness (O) from connector J17 (L).
9. Disconnect the 12 V power input wiring harness (N) from connector J16 (M).
10. Disconnect the peripheral PCB ribbon cable (K) from connector J7 (J).
11. Disconnect the Ethernet cable (S) from the Ethernet connector (T).
12. Disconnect the HMI display wiring harness (Q) from connector J22 (R).
13. Remove and retain the six screws (D) and associated spring washers (C) and flat washers (A).
14. Remove and discard the unserviceable motherboard.
15. Inspect the replacement motherboard for signs of damage or delamination.
16. Place the motherboard in position on the backplate and secure by fitting the six screws (D) and the associated spring washers (C) and flat washers (A) retained in Step 13. Torque tighten the screws to 0.6 Nm.

17. Connect the HMI display wiring harness (Q) to connector J22 (R).
18. Connect the Ethernet cable (S) to the Ethernet connector (T).
19. Connect the peripheral PCB ribbon cable (K) to connector J7 (J).
20. Connect the 12 V power input wiring harness (N) to connector J16 (M).
21. Connect the 12 V power output wiring harness (O) to connector J17 (L).
22. Connect the Laser Module ribbon cables (P) to the motherboard. Ensure 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.
23. Connect the Detector Module 1 Signal Out wiring harness (I) to connector J31 (G).
24. If applicable, connect the Detector Module 2 Signal Out wiring harness (H) to connector J32 (F).
25. Connect the TEC board ribbon cable (E) to connector J12 (B).
26. Close the door of the electrical compartment and restart the analyzer.

12.8 Replacing the Ethernet in/out relay modules

The Ethernet in/out relay modules (to match section title) are located on the right-hand side of the lower DIN rail. Note that the number of Ethernet in/out relay modules may vary depending upon the application of the analyzer. To replace the Ethernet in/out relay modules, refer to Figure 12-7 and complete the following steps.

Figure 12-7: Lower DIN Rail – Right-hand Side



A. Ethernet in/out relay module
B. Lever

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Disconnect the wiring harnesses from the top and the output connectors from the front of the Ethernet in/out relay module (A).
4. Release the Ethernet in/out relay module from the DIN rail by pressing a small lever (B) on the underside of the Ethernet in/out relay module.
   While continuing to press the lever, remove the Ethernet in/out relay module from the DIN rail.
5. Discard the unserviceable Ethernet in/out relay module.
6. Inspect the replacement Ethernet in/out relay module for damage.
7. Place the replacement Ethernet in/out relay module (A) in its correct location on the DIN rail.
8. Press the small lever (B) on the underside of the Ethernet in/out relay module and push the module onto the DIN rail.
9. Release the small lever and check that the Ethernet in/out relay module is secure.
10. Connect the wiring harnesses to the Ethernet in/out relay module.
11. Close the door of the electrical compartment and restart the analyzer.

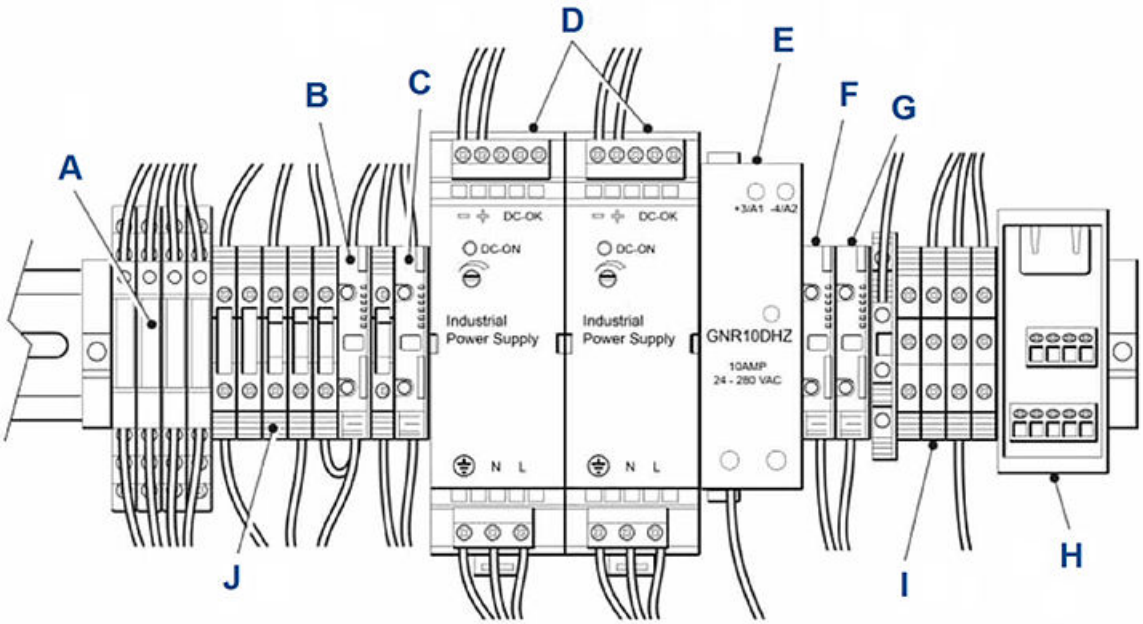
12.9 Lower (main) DIN rail electronic components

Figure 12-8 shows the electronic components located on the lower DIN rail.

See Replacing the fuses to replace a fuse.

The terminal blocks (I and J) and low-power status relays (A) should not require replacement during the expected life of the equipment.

Figure 12-8: Lower DIN Rail



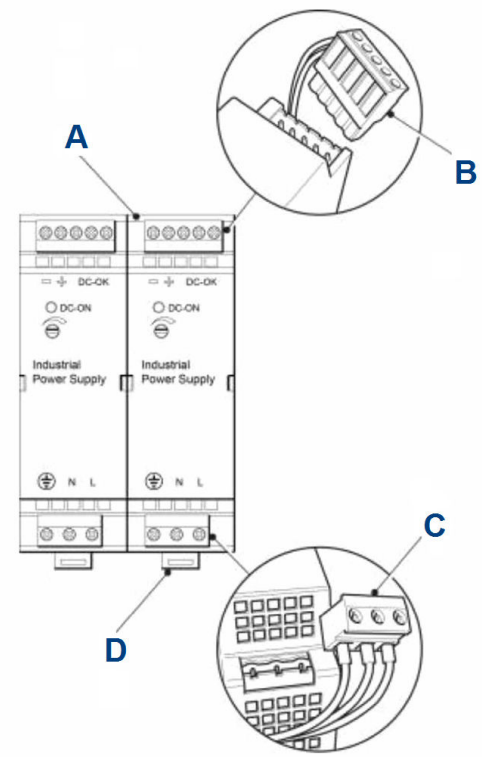
A. Status relays
B. Fuse holder for fuse F4
C. Fuse holder for fuse F3
D. Power supplies
E. 10 Amp solid state relay
F. Fuse holder for fuse F1
G. Fuse holder for fuse F2
H. Ethernet connector
I. Terminal blocks
J. Terminal blocks

12.10 Replacing a DC power supply

Use this procedure and the wiring diagrams in Engineering drawings to replace a DC power supply.

The two DC power supplies are 12V and 24V . To replace a DC power supply from the DIN rail, refer to Figure 12-9 and complete the following steps.

Figure 12-9: Replacing a DC Power Supply



A. DC power supply
B. Wiring harness connector (top)
C. Wiring harness connector (bottom)
D. Lever

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Disconnect the wiring harness connector (B) from the top of the DC power supply (A).
4. Disconnect the wiring harness connector (C) from the bottom of the DC power supply.
5. Press the small lever (D) on the underside of the DC power supply to release it from the DIN rail.
   While continuing to press the lever, remove the DC power supply from the DIN rail.
6. Discard the unserviceable DC power supply.
7. Inspect the replacement DC power supply for damage.
8. Place the replacement DC power supply (A) in its correct location on the DIN rail.

9. While pressing the small lever (D) on the underside of the DC power supply to the down position, push the DC power supply onto the DIN rail.
10. Release the small lever and check that the DC power supply is secure.
11. Connect the wiring harness connector (C) to the bottom of the DC power supply.
12. Connect the wiring harness connector (B) to the top of the DC power supply.
13. Close the door of the electrical compartment and restart the analyzer as described in Start-up procedure.

12.11 Replace the 10 Amp solid state relay

To replace the 10 Amp solid start relay, refer to Figure 12-8, item E and complete the following steps.

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Disconnect the wiring connectors from the 10 Amp solid state relay (E).
4. Remove and discard the unserviceable 10 Amp relay.
5. Inspect the replacement relay for damage.
6. Place the replacement 10 Amp relay (E) in its correct location on the DIN rail.
7. Make the wiring connections (E) to the relay.
8. Close the door of the electrical compartment and restart the analyzer as described in Start-up procedure.

12.12 Replacing the Ethernet connector

The Ethernet connector is clipped onto the DIN rail.

Procedure

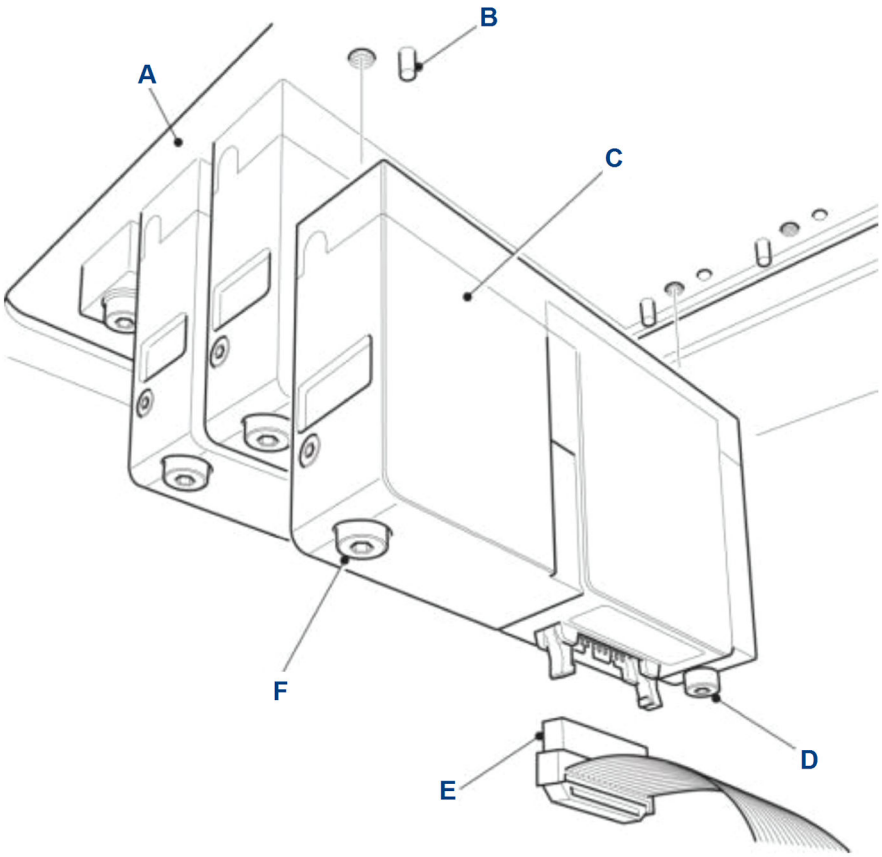
1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Disconnect the wiring harnesses from the ethernet connector (H).
   Refer to Figure 12-8.
4. Unclip the Ethernet connector (H) from the DIN rail.
   Refer to Figure 12-8.
5. Inspect the replacement Ethernet connector for damage.
6. Clip the replacement Ethernet connector into its correct location on the DIN rail.
   Check that the DC power supply is secure.
7. Connect the wiring harnesses to the Ethernet connector.

8. Close the door of the electrical compartment and restart the analyzer as described in Start-up

12.13 Replacing the laser module

The number of laser modules may vary depending upon the application of the analyzer. The laser modules are located on the underside of the optical compartment base plate.

Figure 12-10: Replacing the Laser Module



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

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.

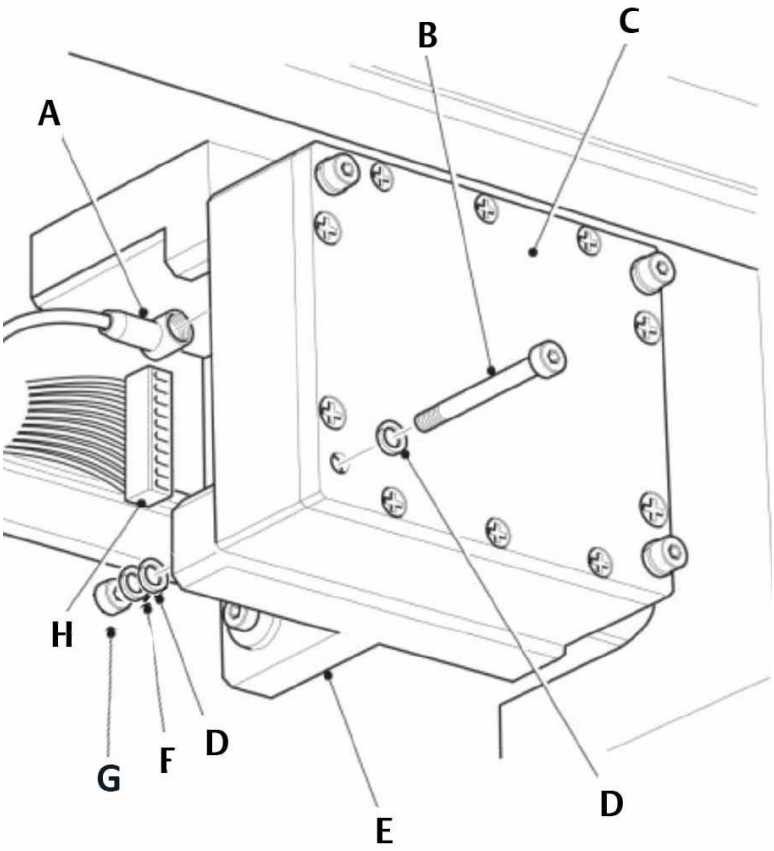
Refer to Figure 12-10.

3. Disconnect the ribbon cable (E).
4. Release the two captive screws (D and F).
5. Remove and discard the unserviceable laser module (C).
6. Inspect the new laser module for any damage.
7. Fit the new laser module in position on the base plate (A).
   The laser module must mate with the two locating pins (B) on the base plate.
8. Secure the laser module by tightening the two captive screws (D and F).
9. Connect the ribbon cable (E) to the laser module.
10. Close the door of the electrical compartment and restart the analyzer.

12.14 Replacing the detector module

The detector module is located on the underside of the optical compartment base plate.

Figure 12-11: Replacing a Detector Module



A. *Trigger OUT harness*
B. *M3 x 35 mm socket head cap screw*
C. *Detector module*
D. *M3 plain washer*
E. *Detector bracket*
F. *M3 spring washer*
G. *M3 nut*
H. *Wiring harness*

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Disconnect the trigger OUT harness (A).
   Refer to Figure 12-11.

4. Disconnect the wiring harness (H).
5. Remove and retain the four screws (B) nuts (G), plain washers (D) and spring washers (F).
6. Remove and discard the unserviceable detector module (C).
7. Inspect the new detector module for damage.
8. Fit the new detector module in position on the detector bracket (E). Secure the detector module with the four screws, nuts and washers retained in Step 5 (B, D, F & G).
9. Connect the wiring harness (H) to the detector module (C).
10. Connect the trigger OUT harness (A) to the detector module (C).
11. Close the door of the electrical compartment and restart the analyzer.

12.15 Replacing the O_2 detector

The O_2 detector is located on the underside of the optical compartment base plate. First determine which detector type is fitted: 1 or 2. Replace the O_2 detector identified using the following steps.

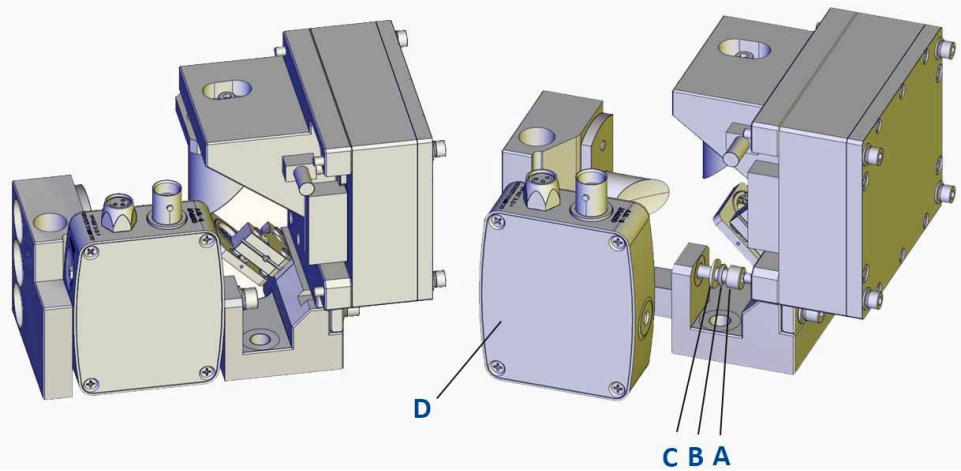
12.15.1 Replacing O_2 detector (type 1)

Procedure

1. Shut down the analyzer. Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Disconnect the Bayonet Neill–Concelman (BNC) cable and the Power cable from the O_2 detector (D).

   Refer to Figure 12-12.

Figure 12-12: Replace O_2 Detector (Type 1)



A. M4 socket head cap screw
B. M4 spring washer
C. M4 plain washer
D. O_2 detector sub-assembly

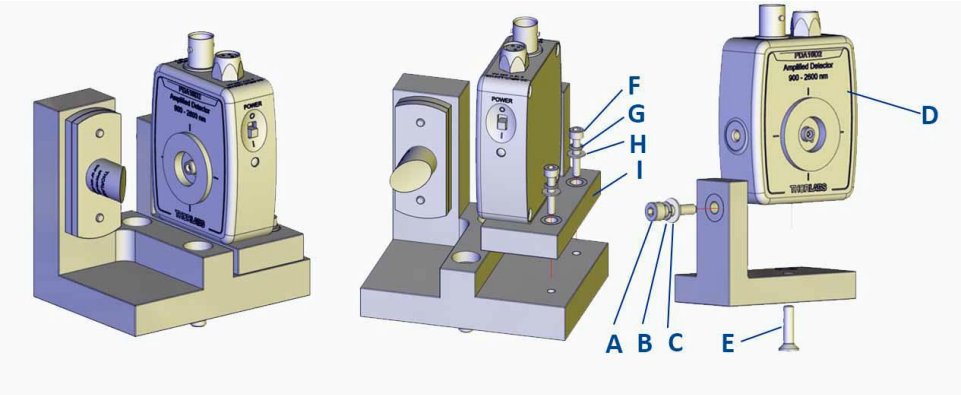
4. Remove and retain the M4 socket head cap screw (A), spring washer (B) and plain washer (C) used to secure the O_2 detector.
5. Remove the O_2 detector.
6. Inspect the replacement O_2 detector for damage.
7. Fit the replacement O_2 detector (D) in position using the M4 socket head cap screw (A), spring washer (B) and plain washer (C) removed previously secure the O_2 detector to the base.
8. Connect the power cable by screwing it onto the mating connector on the O_2 detector.
9. Connect the BNC cable to the O_2 detector.
10. Close the door of the electrical compartment and restart the analyzer.

12.15.2 Replacing O_2 detector (type 2)

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Open the door of the electrical compartment.
3. Disconnect the Bayonet Neill–Concelman (BNC) cable and the Power cable from the O_2 detector (D).
   Refer to Figure 12-13.

Figure 12-13: Replace O_2 Detector (Type 2)



A. M4 socket head cap screw
B. M4 spring washer
C. M4 plain washer
D. O_2 detector sub-assembly
E. M4 countersunk screw
F. M3 socket head cap screw
G. M3 spring washer
H. M3 plain washer
I. Bracket

4. Remove and retain the two M3 socket head cap screws (F), spring washers (G), and plain washers (H) used to secure the O_2 detector bracket (I) to the base.
5. Remove and retain the M4 socket head cap screw (A), spring washer (B), plain washer (C), and the M4 counter sunk screw (E) used to secure the O_2 detector to the bracket.
6. Remove the O_2 detector.
7. Inspect the replacement O_2 detector for damage.
8. Fit the replacement O_2 detector (D) in position. Using the M4 socket head cap screw (A), spring washer (B), plain washer (C), and the M4 counter sunk screw (E), secure the O_2 detector to the bracket.
9. Use the two M3 socket head cap screws (F), spring washers (G) and plain washers (H) to connect the O_2 detector and bracket (I) to the base.
10. Connect the power cable by screwing it onto the mating connector on the O_2 detector.
11. Connect the BNC cable to the O_2 detector.
12. Close the door of the electrical compartment and restart the analyzer.

12.16 Replacing the main terminal board

Procedure

1. Shut down the analyzer.

Refer to Shutdown procedure.

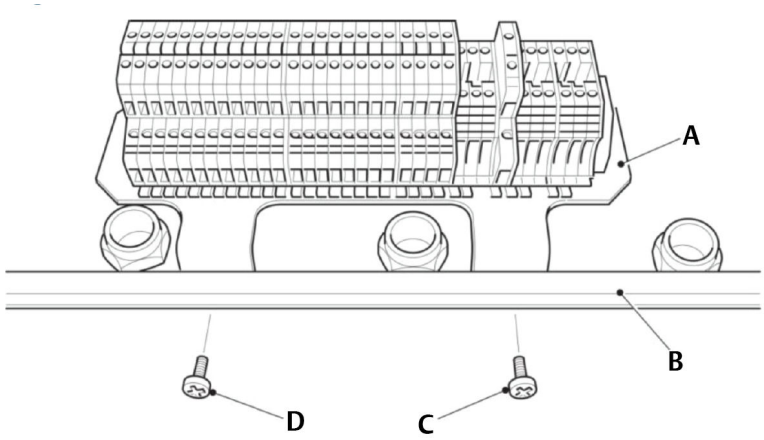
2. Open the door of the electrical compartment.
3. Tag or otherwise identify all wiring harnesses before disconnecting.

NOTICE

It is possible to replace individual terminal blocks in the main terminal board without removing the complete main terminal block.

4. Disconnect the wiring harnesses from the main terminal board (Figure 12-14, A).

Figure 12-14: Replace the Main Terminal Board



A. Main terminal board
B. Carcass
C. M5 x 12 mm self-sealing cross pan head screw
D. M5 x 12 mm self-sealing cross pan head screw

5. Remove and discard the two self-sealing screws (C and D).
6. Remove the main terminal board.
7. Inspect the replacement main terminal board for damage.
8. Fit the main terminal board (A) in position at the front of the carcass (B).
9. Secure the main terminal board by fitting the two self-sealing screws (C and D). New self-sealing screws must be used.
10. Connect the wiring harnesses to the main terminal board.
11. Close the door of the electrical compartment and restart the analyzer.

12.17 Replacing the mains power filter

The mains power filter is located on the underside of the main terminal board. Its purpose is to protect the analyzer against spikes and surges in the mains power.

Procedure

1. Remove the main terminal board.
2. Turn the main power terminal board upside down.
3. Disconnect the wiring harnesses from the mains power filter.
4. Remove and retain the two nuts that secure the mains power filter to the underside of the main terminal board.
5. Remove and discard the mains power filter.
6. Inspect the replacement mains power filter for damage.
7. Fit the mains power filter to the main terminal board and secure with the two nuts retained in Replacing the mains power filter.
8. Connect the wiring harnesses to the mains power filter.
9. Fit the main terminal board.

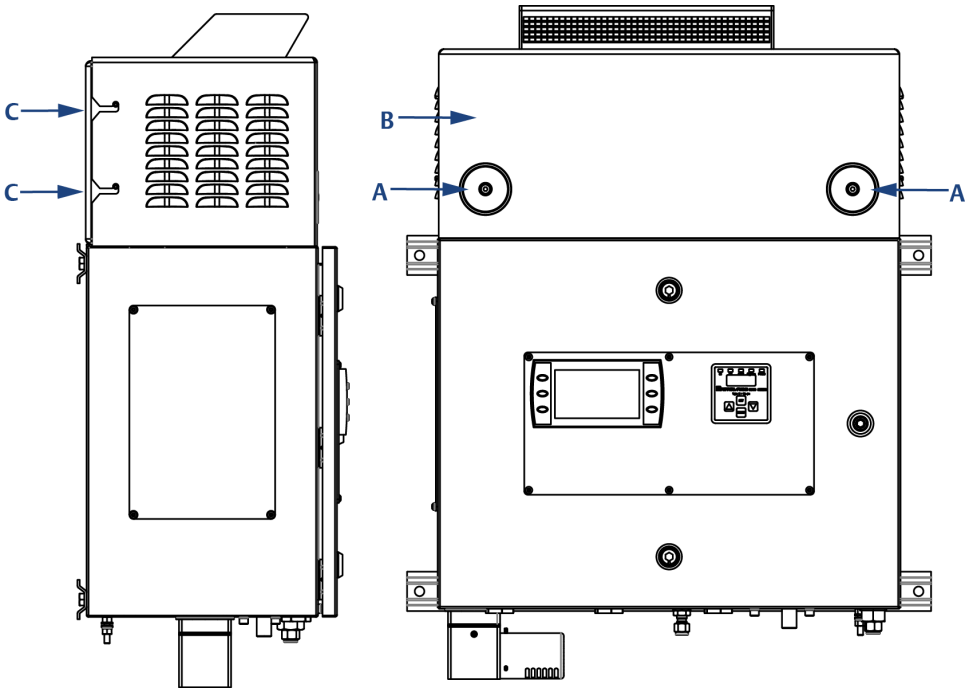
12.18 Removing the top cover

To gain access to the pneumatic compartment, it is necessary to remove the top cover.

Procedure

1. Refer to Figure 12-15. Rotate the two locking mechanisms (A) counterclockwise to release the front of the top cover (B).

Figure 12-15: Removing the Top Cover



A. Locking mechanism
B. Top cover
C. Notches

2. Lift the top cover a short distance upwards and then forwards to disengage the right-angled notches (C) on the top cover from the mating lugs on the chassis beneath.
3. Lift the top cover clear of the analyzer.
4. Examine the top cover for signs of physical damage.
5. Inspect all wiring positions/cables runs to ensure nothing can get trapped/nipped when the cover is refitted; use cable ties if required.
6. Carefully lift the top cover into position.
7. Re-engage the right-angled notches (C) on the top cover from the mating lugs on the chassis beneath.
8. Refer to Figure 12-15. Rotate the two locking mechanisms (A) clockwise to lock the front of the top cover (B) in position.

12.19 Replacing the PT100 gas temperature sensor

Note
Approval for the PT100 temperature sensor as a simple device:

To permit connection of a suitable temperature sensor, the following intrinsically safe (IS) parameters have been declared for the connections emerging from the purged enclosure.

Parameter	IS
Voltage U_o	12.4 V
Current I_o	17.4 mA
Power P_o	54 mW
Capacitance C_i	0
Inductance L_i	0

The capacitance and either the inductance or L/R of the load connected to hazardous area terminals of the apparatus must not exceed the following values for Group IIC:

Capacitance	Inductance	L/R ratio
1.24 µF	117 mH	597 µH/ohm

The above parameters apply when one of the two conditions below is given:

- The total L_i of the external circuit (excluding the cable) is < 1 percent of the L_o value **or**
- The total C_i of the external circuit (excluding the cable) is < 1 percent of the C_o value.

The above parameters are reduced to 50 percent when both of the two conditions below are given:

- The total L_i of the external circuit (excluding the cable) is ≥ 1 percent of the L_o value **or**
- The total C_i of the external circuit (excluding the cable) is ≥ 1 percent of the C_o value.

Note
The reduced capacitance of the external circuit (including cable) shall not be greater than 600 nF for Group IIC.

Procedure

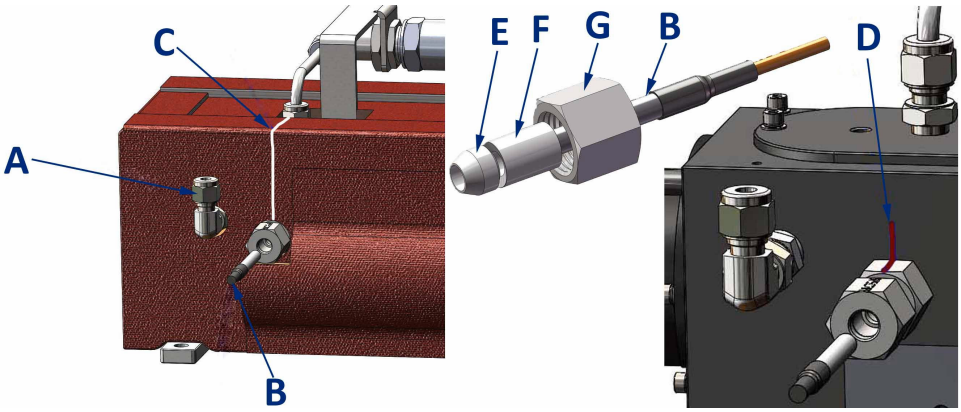
1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Remove the top cover.
3. Tag or otherwise identify all wiring harnesses before disconnecting.

   NOTICE

   It WILL be necessary to open the insulation around the analysis cell in order to replace the PT100 gas temperature sensor.

4. Note the routing of the PT100 gas temperature sensor wiring harness and the location of cable ties that secure the wiring harness.

Figure 12-16: Replacing the PT100 Gas Temperature Sensor



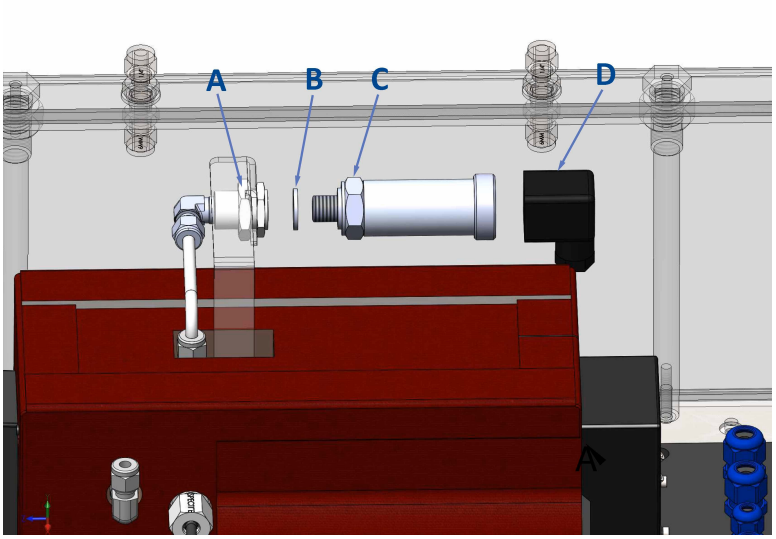
A. Cell Insulation
B. PT100 gas temperature sensor thermocouple
C. Cut line
D. Witness mark
E. Seal
F. Follower
G. Cap

5. Carefully cut and remove any cable ties and release any cable clips used to secure the PT100 gas temperature sensor wiring.
6. Disconnect the PT100 gas temperature sensor wiring harness from the respective intrinsically safe barrier.
7. Using a sharp knife cut the cell insulation (C) as indicated in Figure 12-16, to allow access to the thermocouple fitting.
8. While holding the cell insulation open, apply a witness mark (D) from the thermoucouple fitting onto the cell main body to show rotational alignment.
9. Using one spanner, hold the main body of the temperature sensor to prevent it turning while using the second spanner to loosen cap (G). Remove the PT100 gas temperature sensor assembly B, E, F and G.
10. Discard the faulty PT100 gas temperature sensor (B), retaining the cap (G), follower (F), and seal (E).
11. Inspect the replacement PT100 gas temperature sensor (B) for damage. If damaged contact your local customer care representative.
12. In this order, slide the cap (G), follower (F), and seal (E) onto the PT100 gas temperature sensor (B) and insert the assembly into the main body. Adjust the insertion length of the PT100 gas temperature sensor (B) in the main body and tighten the cap (G) by hand to lock in position.
13. Use one spanner to hold the main body to prevent it turning while using a torque wrench with crow foot attachment to tighten cap (G).
14. Route the gas temperature sensor wiring harness (B), as noted down in Step 3, to the intrinsically safe barrier.

15. Secure the gas temperature sensor wiring harness with cable ties and cable clips in the locations that were noted down in Step 3.
16. Fit the top cover and restart the analyzer.

12.20 Replacing the pressure sensor

Figure 12-17: Replacing the Pressure Sensor



A. Bulkhead adaptor
B. Dowty washer
C. Pressure sensor
D. Pressure sensor electrical connector

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Remove the analyzer top cover.
   Refer to Removing the top cover.
3. Disconnect the pressure sensor electrical connector (D).
4. While holding the bulkhead adaptor (A) steady unscrew the pressure sensor (C).
5. Discard the unserviceable pressure sensor.
6. Inspect the new pressure sensor for damage.
7. Install the replacement pressure sensor (C) and dowty washer (B) onto the bulkhead adaptor (A). Hold the bulkhead adaptor steady while tightening the pressure sensor.
8. Reconnect the pressure sensor electrical connector (D) to the pressure sensor.

12.21 Cleaning the cell mirrors

This procedure should be used during service intervention and only attempted if there has been a decrease in the laser pulse amplitudes which is likely to have been caused by contamination of the cell.

⚠ CAUTION

Anti-static precautions in the form of a static dissipative mat and anti-static wrist strap must be used at all times when handling electronic components and assemblies.

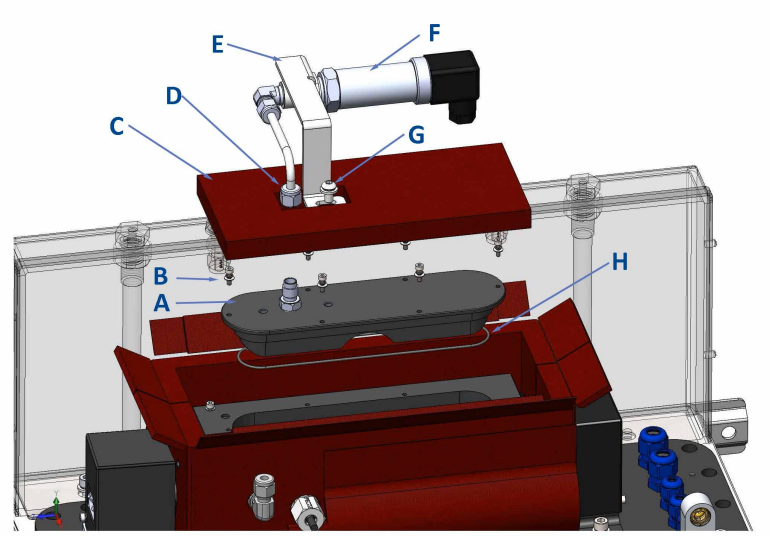
12.21.1 Equipment materials

The following equipment and materials are required when cleaning the cell mirrors:

- Spectroscopic grade methanol or ethanol
- Optical grade lens tissue
- Invertible air duster
- Hex head keys, sizes 1.5 mm to 4 mm

12.21.2 Removing the cell lid

Figure 12-18: Removing Analysis Cell Lid



A. *Cell lid*
B. *Cell lid fasteners*
C. *Cell lid insulation*
D. *Tube fitting nut*
E. *Bracket*
F. *Pressure sensor*
G. *Bracket fastener*
H. *O-ring*

Procedure

1. Shut down the analyzer.
   Refer to Shutdown procedure.
2. Remove the analyzer top cover.
   Refer to Removing the top cover.
3. Tag or otherwise identify all wiring harnesses before disconnecting.
4. The cell Insulation is closed using Velcro® flaps. Open the flaps and lift the cell lid insulation (C) to access the cell lid.
5. Disconnect the tube fitting nut (D).
6. Remove and retain the bracket fastener (G) to disconnect the bracket (E) and pressure sensor (F) from the cell lid (A). Place to one side.
7. Remove and retain the six cell lid fasteners (B).
8. Remove the cell lid, taking care not to damage the O-ring seal (H).

12.21.3 Cleaning the cell mirrors with air duster

Emerson recommends initially cleaning the cell mirrors with an invertible air duster to remove any particulates or dust that may have contaminated the surface. Following cleaning with the air duster, check the pulses to see if any improvement has been made.

Procedure

1. Before using the aerosol, test it away from the mirrors a few times to remove any moisture in the aerosol.

   Do not touch the mirrors.

2. Use only short bursts of around one second of air on each mirror. Apply three or four short bursts to each mirror.
3. Re-assemble the analysis cell.
4. Plug in the electrical connectors and start up the sensor.

Postrequisites

Allow the cell temperature to stabilize and check the pulses in the gas sensor software. If pulses have returned to a usable signal size, proceed to operate the analyzer. Otherwise, take a note of the signal sizes and go to next step Cleaning the mirrors with lens tissue and spectroscopic grade methanol.

12.21.4 Cleaning the mirrors with lens tissue and spectroscopic grade methanol

If cleaning with an invertible air duster does not recover the pulses to a useable level, the next step is cleaning with spectroscopic grade methanol and optical grade lens tissue.

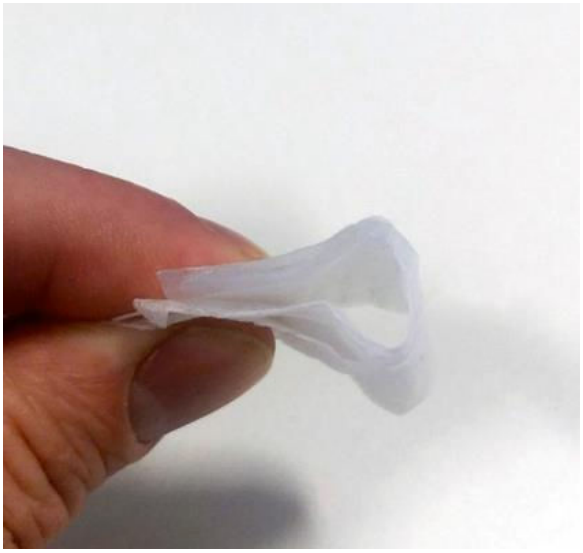
⚠ CAUTION

This should be done with care as the mirrors have highly polished surfaces, which may be damaged by contact cleaning.

Procedure

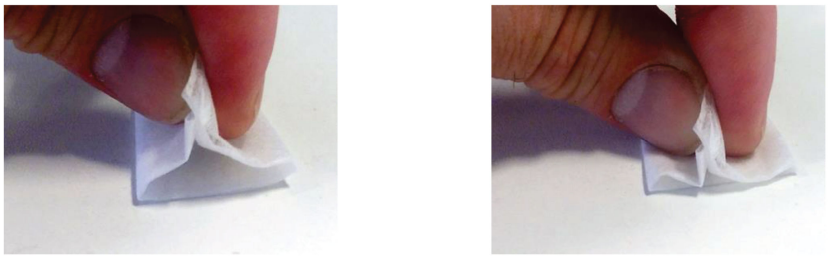
1. Fold a piece of lens tissue several times and fold it to produce a soft loop of tissue as shown in Figure 12-19.

Figure 12-19: Optical Grade Lens Tissue



2. Apply a small amount (one or two drops) of spectroscopic grade methanol to the front of the tissue loop.
3. To prevent scratching the mirrors do not apply any direct pressure to the mirrors (Figure 12-20).

Figure 12-20: Correct Cleaning Technique

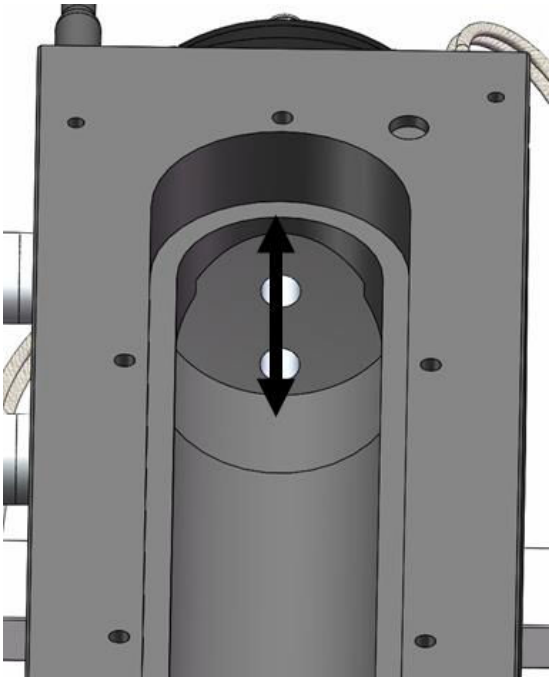


A. Correct
B. Incorrect

4. Clean the mirrors using the lens tissue in the direction shown in Figure 12-21.

   Be careful to wipe across the mirror surface to prevent any residue marks appearing on the mirror surface where the solvent has evaporated.

Figure 12-21: Cleaning the Mirrors

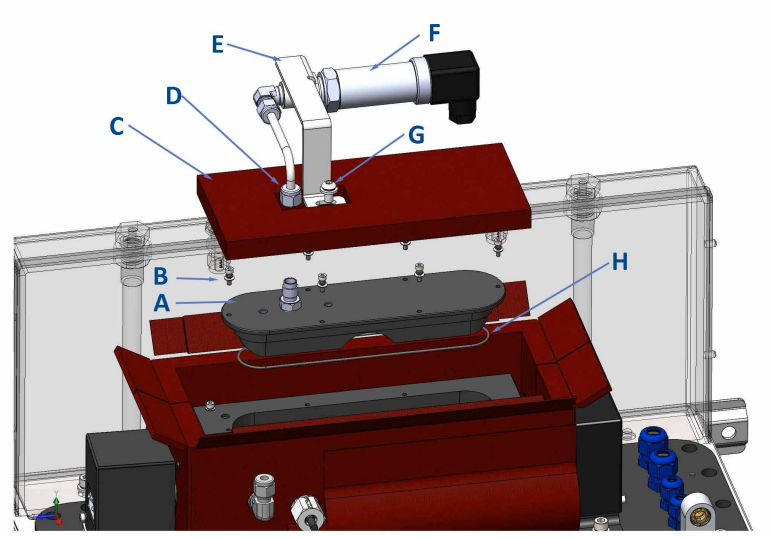


5. Reassemble the analysis cell (see Assembling analysis cell).
6. Plug in the electrical connectors and start up the sensor.
7. Allow the cell temperature to stabilize and check the pulses in the gas sensor software. If the pulses have returned to a usable signal size proceed to operate the analyzer.

Note
If pulses have not returned to a usable signal size, contact Emerson for assistance.

12.21.5 Assembling analysis cell

Figure 12-22: Assembling Analysis Cell



A. *Cell lid*
B. *Cell lid fasteners*
C. *Cell lid insulation*
D. *Tube fitting nut*
E. *Bracket*
F. *Pressure sensor*
G. *Bracket fastener*
H. *O-ring*

Procedure

1. Fit the O-ring (H) to the cell lid (A).
2. Fit the cell lid (A) to the analysis cell using the cell lid fasteners (B).
3. Pass the cell lid insulation (C) over the bracket before attaching the bracket (E) to the cell lid using the bracket fastener (G).
4. Reattach the tube fitting nut (D) to the pipe adaptor.
5. Fit the cell lid Insulation into position and secure using the Velcro flaps.

12.22 Spare parts list

Table 12-2: Spare Parts List

Item	Part No.	Description	Picture
240 V heater cartridge	P-6000-00321	240 V Watlow cartridge ¼ in. OD x190 mm x 200 W	
Relay, Crouzet	P-6001-00045	Solid state relay, 10 A, 280 Vac	
Temperature sensor	P-6000-00718	PT100 stainless steel 0.24 in. (6 mm) 752 °F (400 °C)	
Analog output module	P-6001-00025	Remote Ethernet I/O	
Digital output module	P-5000-1034	Remote Ethernet I/O	
Screen, display, BEKA BA488C, certified	P-6001-00011	Panel mount IS display module	
Heater 230 V, certified	P-6001-00014	Ex cart heater	
Heater 120 V, certified	P-6001-00015	SL Blocktherm DKA 80 W heater block	
Power supply 12 V	P-6001-00017	72 W switch mode DIN rail panel mount power	
Power supply 24 V	P-6001-00018	90 W switch mode DIN rail panel mount power	

13 Preventative maintenance

13.1 Maintaining the analyzer

⚠ WARNING

MAINTENANCE / MODIFICATIONS

On completion of any maintenance and/or modifications, verify:

- All tools and equipment are removed.
- No contamination (water or dust) is in the compartments.
- The analyzer is wiped clean.
- Vents are clear and not obstructed.
- The system is in a safe state for operation.

13.2 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 13-1.

Table 13-1: Scheduled Checks

Frequency	Action
Monthly	1. Check the zero and span calibration. Perform the calibration more or less frequently if necessary to meet quality control or plant operation requirements. 2. Clean outside of system. Ensure all vents are clean and unobstructed.
Every three months (quarterly)	1. Perform the monthly check detailed in the previous row. 2. Purge the long path cell mirrors. 3. Check the X-Shift calibration of the lasers. Contact your local service representative for guidance.
Annually	1. Perform the three-monthly check detailed in the previous row. 2. Perform a laser wavelength calibration. Contact your local service representative for guidance.

⚠ WARNING

SAFE OPERATING STATE

On completion of any maintenance, ensure that the Rosemount™ CT5100(Ex) is in a safe and correct operating state.

14 ATEX/IECEX/UKEx assessment report summary

14.1 Certification overview

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

This report covers the assessment of the Rosemount™ CT5100(Ex) Continuous Gas Analyzer to the standards listed in Assessment standards, in order to support the issue of prime ATEX and IECEx certification.

14.2 Applicant's name and address

Emerson Process Management Limited
2 Hunt Hill
Cumbernauld
Glasgow
G68 9LF

14.3 Manufacturer's name and address

As applicant.

14.4 Trademark

EMERSON

14.5 Product name/model number

Rosemount CT5100(Ex) Continuous Gas Analyzer

14.6 Rating

110 V to 120 V, 60 Hz

220 V to 240 V, 50 Hz

1100 W

14.7 Assessment standards

Table 14-1: Europe

IECEx	ATEX/UKEx
IEC 60079-0:2011 Ed 6	EN IEC 60079-0:2018
IEC 60079-1:2007-04, Ed 6	EN 60079-1:2014
IEC 60079-11:2011, Ed 6	EN 60079-11:2012
IEC 60079-2:2014 Ed 6	EN 60079-2:2014
IEC 60079-2:2014-07, Ed 6	EN 60079-2:2014
IEC 60079-28:2015 Ed 2	EN 60079-28:2015

(The requirements of the equivalent ATEX and IECEx standards are similar; therefore, any references in the following report can be regarded as referring to either format unless stated otherwise.)

This report may be issued against standards that do not appear on the UKAS Scope of Accreditation, but have been added through Sira's flexible scope of accreditation. Sira's flexible scope is available on request.

14.8 Markings

Table 14-2: IECEx and ATEX Markings

Detail	IECEx	ATEX
Certificate number	IECEx SIR 16.0050X	Sira 16ATEX1158X / CSAE 22UKEX1086X
Certification code	EX ia d [ia Ga] op is pzc IIC T3 Gc Tamb -20 to +55 °C	Ex db ia op is pzc [ia Ga] IIC T3 Gc -20 to +55°C
Other marking	N/A	CE UKCA  II 3 (1) G

Table 14-3: North American Markings

Detail	CSA North American Marking
Certificate number	70044220
Marking class	CLASS– 2258-02
Certification code	Class I, Division 2, Groups A, B, C, D; T3. Tamb-20 °C to +55 °C
Marking class	CLASS– 2258-82
Certification code	Class I, Division 2, Groups A, B, C, D; T3. Tamb-20 °C to +55 °C

Table 14-4: Common Markings

Details	
Model number	Rosemount CT5100(Ex) Continuous Gas Analyzer
Manufacturer's name	Emerson Process Management Limited
Manufacturer's address	2 Hunt Hill Cumbernauld Glasgow G68 9LF
Ambient range	-4 to 131 °F -20 to 55 °C
Serial number	As applicable
Year of manufacture	As applicable

Table 14-4: Common Markings *(continued)*

Details	
Warnings (English / French)	WARNING Pressurized enclosure AVERTISSEMENT Envelope à suppression interne WARNING Do not open when an explosive atmosphere is present. AVERTISSEMENT Ne pas ouvrir si une atmosphère explosive est présente. WARNING Power shall not be restored after an enclosure has been opened until enclosure has been purged for a minimum of two minutes 30 seconds at a minimum flow rate of 280 L/m at 1.5 ± 0.5 bar to prevent hazards to personnel during maintenance. AVERTISSEMENT À la suite d'une ouverture, la mise sous tension ne doit pas etre effectué avant que l'enveloppe n'ait été balayée pendant 2½ minutes sous un débit de 280 L/min. WARNING This enclosure contains inert gas and may be an asphyxiation hazard. AVERTISSEMENT Cette enveloppe contient un gaz inerte et peut constituer un danger d'asphyxie. WARNING Batteries are located inside this enclosure. Do not open when an explosive atmosphere is present. AVERTISSEMENT Présence de batteries à l'intérieur de cette enveloppe. Ne pas ouvrir si une atmosphère explosive est présente. WARNING This pressurized enclosure contains a battery which remains connected after the external power has been isolated. Consideration should be given to the removal of the battery if the enclosure is to remain unprotected by Ex for a significant time. AVERTISSEMENT Cette enveloppe à surpression interne contient une batterie qui reste connecté après que l'alimentation externe a été isolée. Il convient de retirer la batterie s'il faut que l'enveloppe reste sans protection ex pendant une durée prolongée.
Type of protective gas	Instrument quality air or inert gas
Minimum overpressure	0.5 mbar
Maximum overpressure	10 mbar

Table 14-4: Common Markings *(continued)*

Details	
Minimum purge flow rate	280 L/min
Leakage rate	25 L/min
Minimum purge supply pressure	1 Bar
Maximum purge supply pressure	2 Bar
Minimum purge time	2 minutes 30 seconds
Minimum supply pressure	1 Bar
Maximum supply pressure	2 Bar

14.9 Conditions of certification/special conditions for safe use

Europe

- The purge controller keypad mounted on the front of the equipment shall not be exposed to direct UV light sources or direct sunlight. Example methods of protection include, but are not limited to, indoor applications away from UV sources and outdoor locations under shading. As part of regular inspections, if damage to or deterioration of the membrane keypad is detected, the unit is to be taken out of service for repair or replacement.
- The purge controller bypass function shall only be enabled during setup or maintenance and only when the area is known to be non-hazardous.
- The equipment shall be installed in an area of not more than pollution degree 2 as defined in IEC 60664-1.
- The equipment shall be installed and operated only in an environment of overvoltage category II or better according to IEC 60664-1
- Rosemount CT5100(Ex) purge controller automatically monitors the internal pressure of the enclosure and will output any fault conditions onto contact K2. It is the responsibility of the end user to connect this contact to a suitable facility, such as an alarm or an automatic shutdown system.
- For correct operation the on-site pressurizing air supply must be capable of providing at least 25 L/min for leakage compensation.

North America

- The purge controller keypad mounted on the front of the equipment shall not be exposed to direct UV light sources or direct sunlight. Example methods of protection include, but are not limited to, indoor applications away from UV sources and outdoor locations under shading. As part of regular inspections, if damage to or deterioration of the membrane keypad is detected, the unit is to be taken out of service for repair or replacement.
- The purge controller bypass function shall only be enabled during setup or maintenance and only when the area is known to be non-hazardous.
- The cable glands used in the equipment are only suitable for use in areas with a low risk of mechanical damage and must be suitably protected.
- The purge controller provided with this equipment provides alarm signals at various contacts as described in the equipment instructions. The alarms relate to low-flow and loss of purged air supply and must be connected to the end-users remote, monitored, alarm system.
- For correct operation the on-site pressurizing air supply must be capable of providing at least 25 L/min for leakage compensation.
- 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 the protective earth wire.
- Equipment is only to be installed by manufacturer trained personnel.
- If at anytime there is a conflict between the system safety provisions and any relevant local (national or regional) requirements, the local requirements always take precedence.
- Equipment is not to be used with flammable liquids.
- The relief valve sealing cap must be fitted to maintain IP66 when the unit is in a non-operational state.
- Equipment is subject to acceptance of the local inspection authorities having jurisdiction.
- The equipment is intended for use only with air of instrument quality; all piping up to and including the shut-off valve adjacent to the equipment must be protected against mechanical damage.
- The protective gas supply to the equipment must be marked with the warning as detailed in NFPA496 Clause 4.12.5.
- When installing conduit for power and data connections the end-user must select suitably certified conduit.

14.10 Conditions of certification for the replacement of simple devices

Approval for the PT100 temperature sensor as a simple device.

- To permit connection of a suitable temperature sensor, the following intrinsically safe (IS) parameters have been declared.
- For the connections emerging from the purged enclosure:

Parameter	IS
Voltage U_o	12.4 V
Current I_o	17.4 mA
Power P_o	54 mW
Capacitance C_i	0
Inductance L_i	0

- The capacitance and either the inductance or L/R of the load connected to hazardous area terminals of the apparatus must not exceed the following values for Group IIC:

Capacitance	Inductance	L/R ratio
1.24 µF	117 mH	597 µH/ohm

The above parameters apply when one of the two conditions below is given:

- The total L_i of the external circuit (excluding the cable) is < 1 percent of the L_o value **or**
- The total C_i of the external circuit (excluding the cable) is < 1 percent of the C_o value.

The above parameters are reduced to 50 % when both of the two conditions below are given:

- The total L_i of the external circuit (excluding the cable) is ≥ 1 percent of the L_o value **or**
- The total C_i of the external circuit (excluding the cable) is ≥ 1 percent of the C_o value.

Note
The reduced capacitance of the external circuit (including cable) shall not be greater than 600 nF for Group IIC.

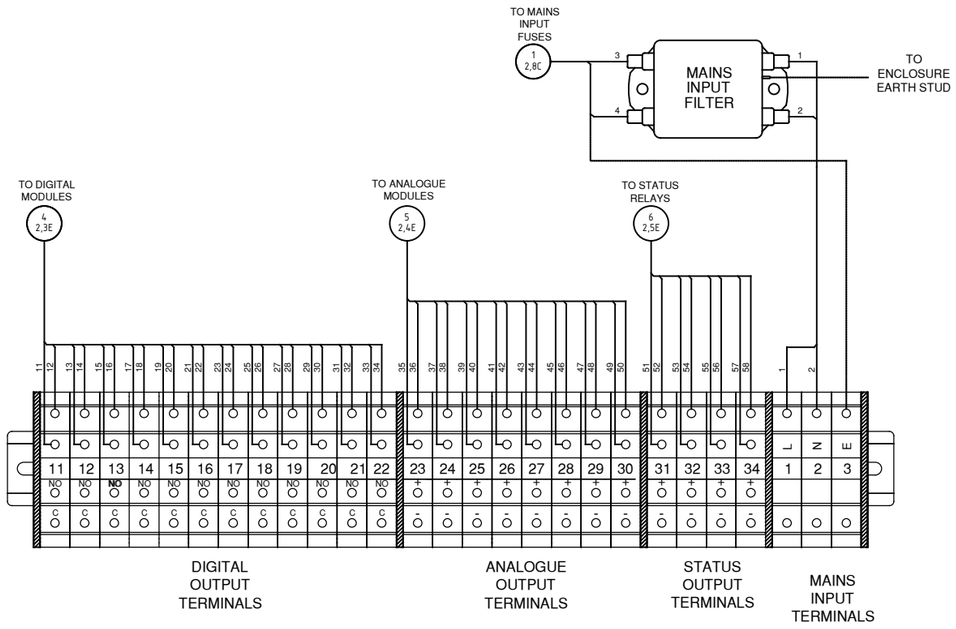
A Engineering drawings

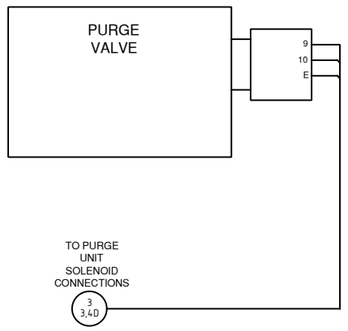
Use the wiring diagrams for the Rosemount™ CT5100(Ex) analyzer to assist with troubleshooting faults. These diagrams may be used to locate the position of a wiring connector should it become disconnected.

Table A-1: List of Engineering Drawings

Drawing number	Description
W-2000-0034 (Sheets 1-5)	Rosemount CT5100(Ex) heated

USER CONNECTIONS	
TERMINAL	FUNCTION
1	SENSOR SYSTEM SUPPLY (L)
2	SENSOR SYSTEM SUPPLY (N)
3	EARTH
11	DGITAL OUTPUT 1
12	DGITAL OUTPUT 2
13	DGITAL OUTPUT 3
14	DGITAL OUTPUT 4
15	DGITAL OUTPUT 5
16	DGITAL OUTPUT 6
17	DGITAL OUTPUT 7
18	DGITAL OUTPUT 8
19	DGITAL OUTPUT 9
20	DGITAL OUTPUT 10
21	DGITAL OUTPUT 11
22	DGITAL OUTPUT 12
23	ANALOGUE OUTPUT 1
24	ANALOGUE OUTPUT 2
25	ANALOGUE OUTPUT 3
26	ANALOGUE OUTPUT 4
27	ANALOGUE OUTPUT 5
28	ANALOGUE OUTPUT 6
29	ANALOGUE OUTPUT 7
30	ANALOGUE OUTPUT 8
31	STATUS OUTPUT 1 (Check Function)
32	STATUS OUTPUT 2 (Maintenance Required)
33	STATUS OUTPUT 3 Out Of Specification)
34	STATUS OUTPUT 4 (Failed)





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A3

DO NOT SCALE
DO NOT ALTER MANUALLY

DRAWING No: W-2000-0034

REV. D

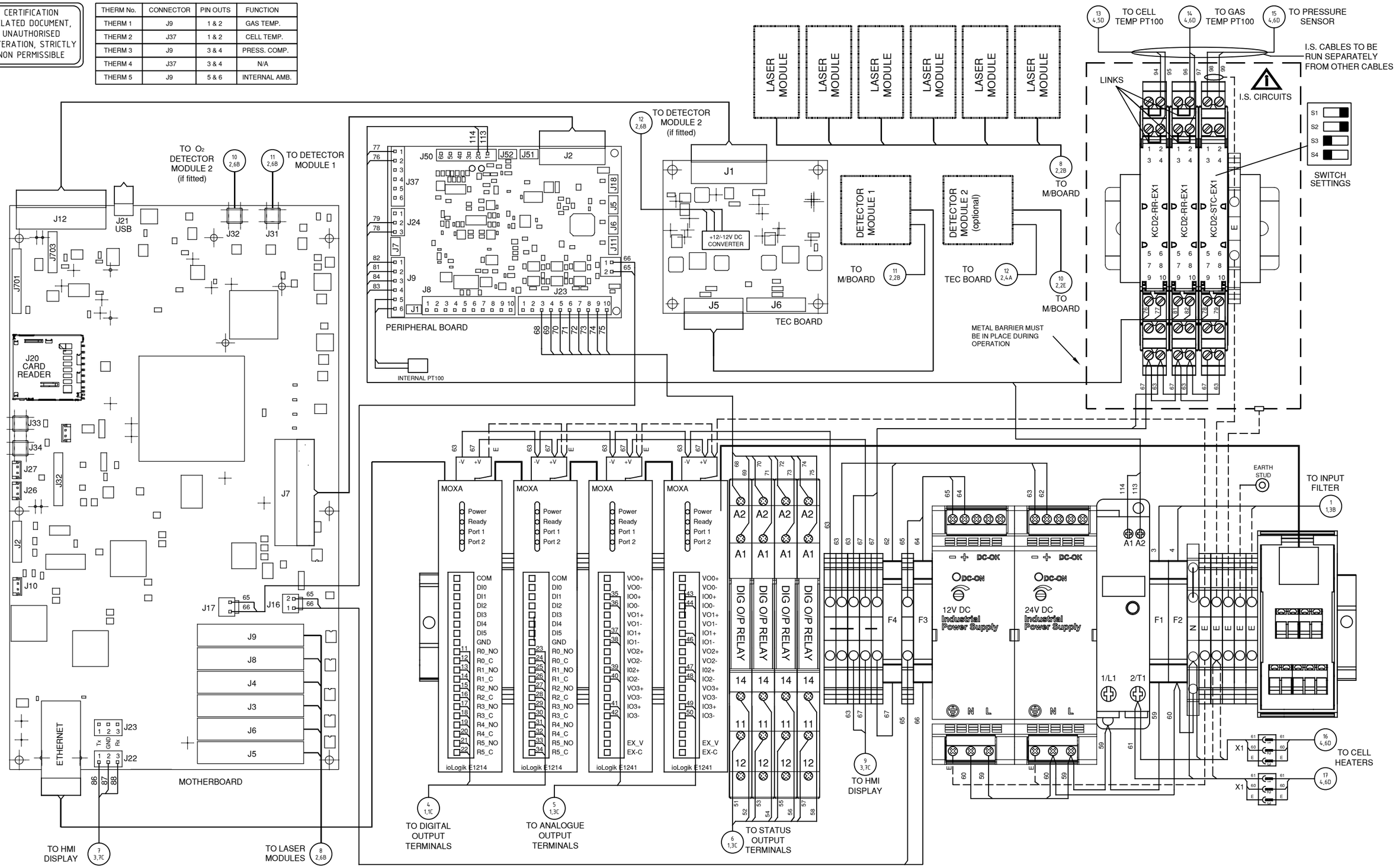
DESCRIPTION: CT5100 EX HEATED

DRAWN BY	JMC
CHECKED BY	??
ISSUE DATE	23/MAR/2016

SHEET 1 OF 5

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

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.



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DRAWING No: W-2000-0034

REV. D

DESCRIPTION: CT5100 EX HEATED

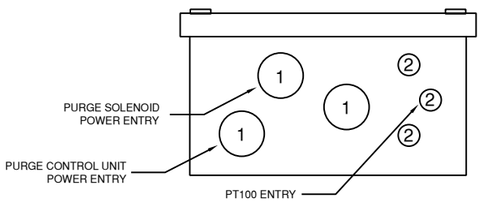
DRAWN BY	JMC
CHECKED BY	??
ISSUE DATE	23/MAR/2016

SHEET 2 OF 5

BALLOON I.D. NO.
DRAWING SHEET LOC.
DRAWING SHEET NO.

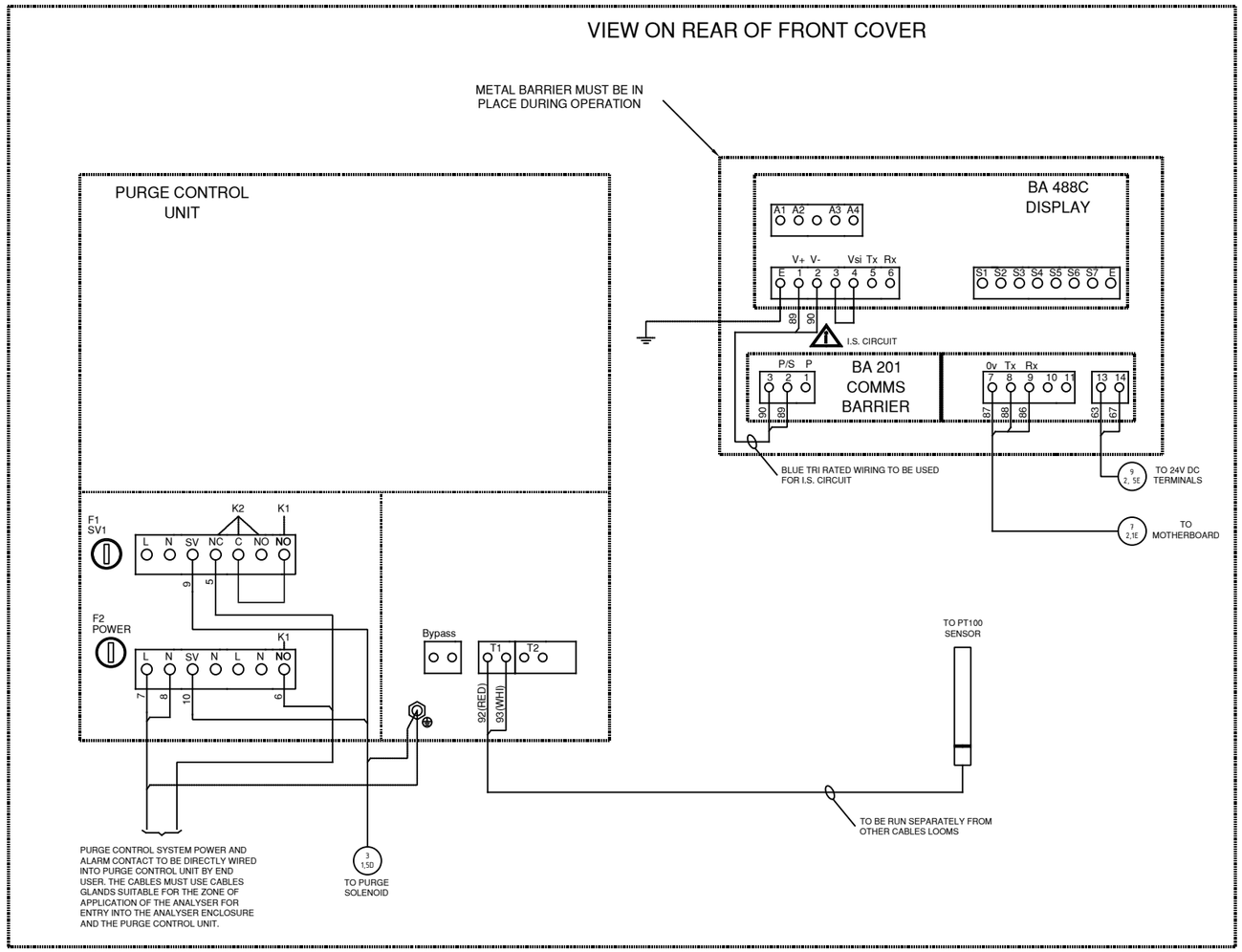
TEMPLATE: 7.3.3.00001-06 DATE LAST SAVED:8-Nov-17 08:17 SAVED BY:JChalmers DRG No:W-2000-0034 REVISION:D

VIEW ON BOTTOM OF
PURGE CONTROL UNIT



NOTE ;
1. CABLE ENTRIES MARKED (1) ARE M20 X 1.5, CABLES ENTRIES MARKED (2) ARE M12 X 1.5
2.. ALL CABLES ENTERING THE PURGE CONTROL UNIT MUST DO SO THROUGH SEPARATE CABLE GLANDS
2. ALL UNSED CABLE ENTRIES TO BE FITTED WITH SUITABLE BLANKING PLUGS
3. REFER TO MANUAL PAGES 17 & 18 FOR FURTHER GUIDANCE ON THE PURGE CONTROL UNIT WIRING

VIEW ON REAR OF FRONT COVER



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DESCRIPTION: CT5100 EX HEATED

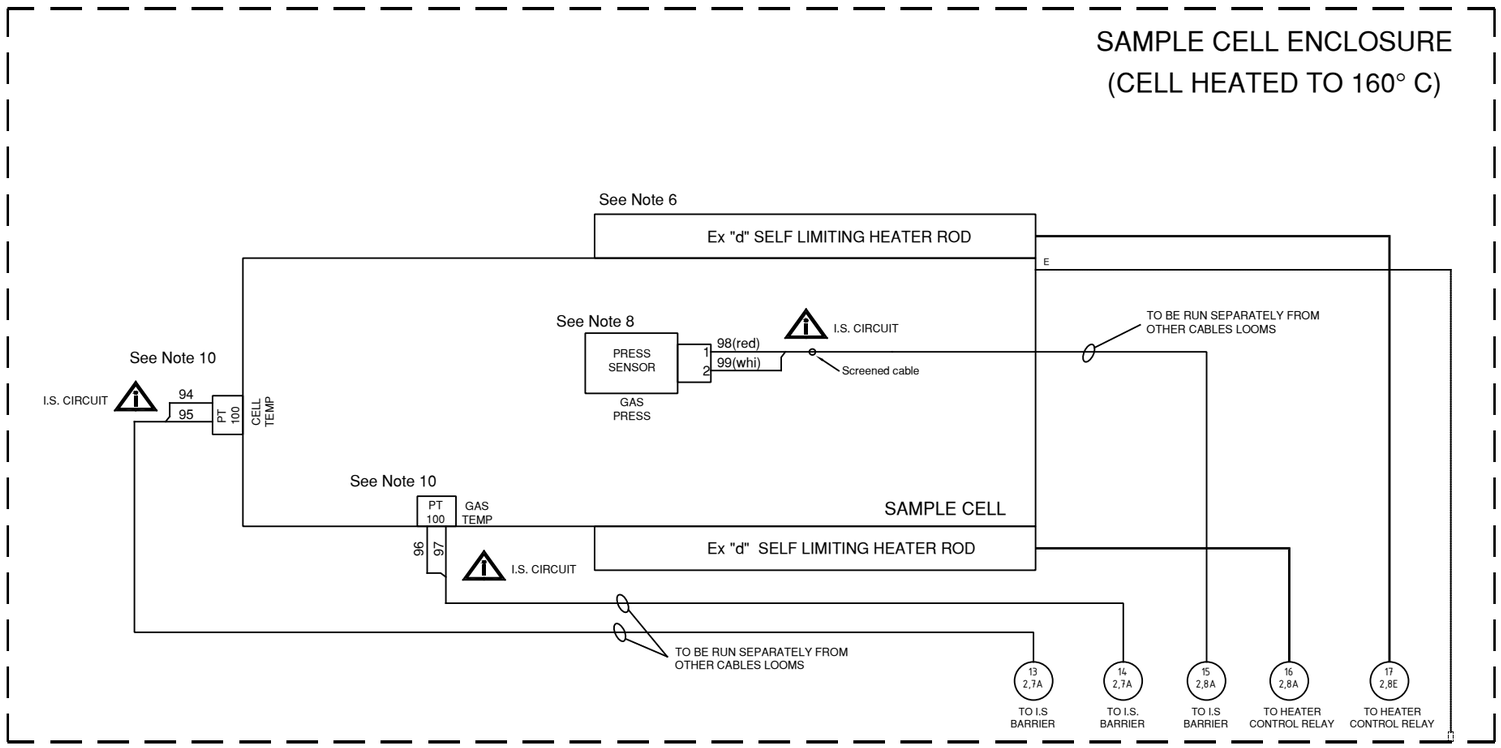
DRAWN BY	JMC
CHECKED BY	??
ISSUE DATE	23/MAR/2016

SHEET 3 OF 5

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

TEMPLATE: 7.3.3.00001-06 DATE LAST SAVED:8-Nov-17 08:08 SAVED BY:JChalmers DRG No:W-2000-0034 REVISION:D

SAMPLE CELL ENCLOSURE
(CELL HEATED TO 160° C)



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ISSUE DATE	23/MAR/2016

SHEET 4 OF 5

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

MOD / REV	DESCRIPTION OF CHANGE	CCAR	BY / DATE	APR'D / DATE
C	TRANSFERRED TO NEW TEMPLATE, CERTIFICATION LABEL ADDED. STATUS RELAYS ON SHEET 2 ENLARGED FOR CLARITY OF READING. CHANGE CONTROL SHEET ADDED	CCAR 0013 CN 1571	JMC 19/10/18	MD 20/10/18
D	TERMINALS 4,5,6,7,8,9 AND 10 FOR PURGE CONTROL SYSTEM WIRING REMOVED FROM SHEET 1. WIRING FOR PURGE POWER AND ALARM ON SHEET 3 SHOWN CONNECTING DIRECTLY INTO PURGE CONTROL UNIT BY END USER. WIRING FOR PURGE SOLENOID SHOWN CONNECTING DIRECTLY INTO PURGE CONTROL UNIT ON SHEET 3. CABLE GLAND LAYOUT OF PURGE CONTROLLER AND NOTES ON WIRING ADDED TO SHEET 3	CCAR 0018 CN 1749	JMC 11/03/19	MD 11/03/19

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SHEET 5 OF 5	

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

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