



**EnCal 3000 Quad
Gas Chromatograph
Hardware Manual**

73022350 g 22.06.2017

Contact Information	3
Safety Information	4
Gas quality measurement system EnCal 3000 Quad	5
1 Process Gas Chromatography – General Introduction	7
1.1 Analytical Principle.....	7
1.1.1 Column	8
1.1.2 Detector.....	9
1.1.3 Sample Injector	10
1.2 Process Gas Chromatography	11
2 Functional Design	12
2.1 Introduction	12
2.2 Enclosure.....	13
2.3 Assembly of major components and internal components.....	14
2.4 Channel	15
2.5 Processor Board	19
2.6 Interconnection Board.....	22
2.7 Electrical connection	23
2.8 Cabinet Heaters.....	24
2.9 Internal sample system	25
2.9.1 Double Block and Bleed Function	27
2.9.2 Internal Sample Bypass	27
2.10 Gas Connections.....	28
2.11 Breather	29
2.12 Cable Glands.....	30
2.13 External Switch	30
3 Technical Specifications	31
4 Data Communication	34
4.1 Local TCP/IP Data Communication	34
4.2 Local Serial ModBus Data Communication	35
4.3 Remote Access	36
4.4 ModBus Communication	37
5 Hardware Installation	38
5.1 Installation specifications.....	38
5.1.1 Weight and Dimensions	38
5.1.2 Installation clearance.....	38
5.1.3 Wall mounting	39
5.1.4 Connection of utilities	40
5.1.5 Connections to the EnCal 3000 Interconnection board	41
5.2 Hardware Start-up.....	44
APPENDIX 1: CERTIFICATES ENCAL 3000	46
APPENDIX 2: DECLARATION OF CONFORMITY ENCAL 3000	52

Only Elster GmbH published User Manuals are to be used. Changes or translations of this User Manual require the written consent of Elster GmbH.
All obligations of Elster GmbH arise solely from the contracts concluded and the General Terms and Conditions applicable upon conclusion of the contract.

Warranty Conditions

You will find our current Warranty Conditions in the General Terms and Conditions, e.g. on our website: www.elster-instromet.com/en/general-terms-of-business

Contact Information

Elster GmbH (Manufacturer)
Steinern Str. 19-21
55252 Mainz-Kastel / Germany

Phone: +49 6134 605 0
Email: Info@elster.com
Website: www.elster-instromet.com

Technical Assistance Center:
Phone: +49 231 93 71 10 88
Email: support@elster.com
Website: www.elster-instromet.com

Safety Information

Electrical Safety

The EnCal 3000 Quad is a gas analyser designed to be installed in hazardous areas. For this purpose it is certified according to:



ATEX II 2 G Ex d IIB T4 Gb and IECEx Ex d IIB T4 Gb

In compliance with:

IECEX:

IEC 60079-0: 2011 Sixth edition

IEC 60079-1:2014 seventh edition

ATEX:

EN 60079-0: 2012

EN 60079-1: 2014

Detailed information on this certificate can be found in APPENDIX

The operation and maintenance of such equipment should only be performed by qualified personnel.

Fuse replacement must only be performed by Elster GmbH authorized personnel.

The following basic rules must be observed in all circumstances:



The flameproof enclosure may not be opened when an explosive gas atmosphere may be present. The process pressure shall be limited to 2 MPa to ensure that the pressure rise inside the flameproof enclosure remains below 10 kPa. The functional pressure must be lower see chapter 3 and section 5.1.4 containing the specifications. Before any start-up, verify all connections of the unit for tight sealing. For information on the dimensions of the flameproof joints the manufacturer shall be contacted.



WARNING! ELECTROSTATIC HAZARD!

Because of the potential electrostatic charging of the paint layer, the housings should only be cleaned by using a moist cloth to prevent charging
BOTH CASES MUST BE EARTHED!

Important disclaimer:



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

Installation instructions mentioned in this manual are intended for information only. The installation of this equipment must be conform to any national, local, or company codes applicable to the location. Elster-Instronet assumes no responsibility for compliance with these requirements. It is suggested that a review of the codes be made prior to installation.

Gas quality measurement system EnCal 3000 Quad

The EnCal 3000 Quad is a special version of the Encal3000. It contains two housings and can contain up to four analytical channels.

This option has been developed especially for extended analysis applications that cannot be solved with only two channels. A possible example is the combination of an analysis C9 with the two standard channels and the additional analysis of hydrogen and oxygen with a third channel, and the analysis of hydrogen sulfide and carbonyl sulfide with a fourth channel. With the simultaneous use of up to four channels, it is possible to analyse all components in one system.

The measuring unit is the real gas chromatograph. It performs the analysis by measuring technology autonomously. It is possible to install additional optional Encal3000 controllers. The subsystems communicate with each other via Modbus (see Figure 1).

This manual describes the Hardware of the Encal3000 Quad gas chromatograph (measuring unit). The other subsystems are described in separate manuals.

The parameterization of the measuring unit is done with the PC program "RGC 3000". The parameterization of the optional Encal3000 controller is done with the PC program "Gas Works".

1 Process Gas Chromatography – General Introduction

1.1 Analytical Principle

The analytical principle is shown in Fig. 1-1:

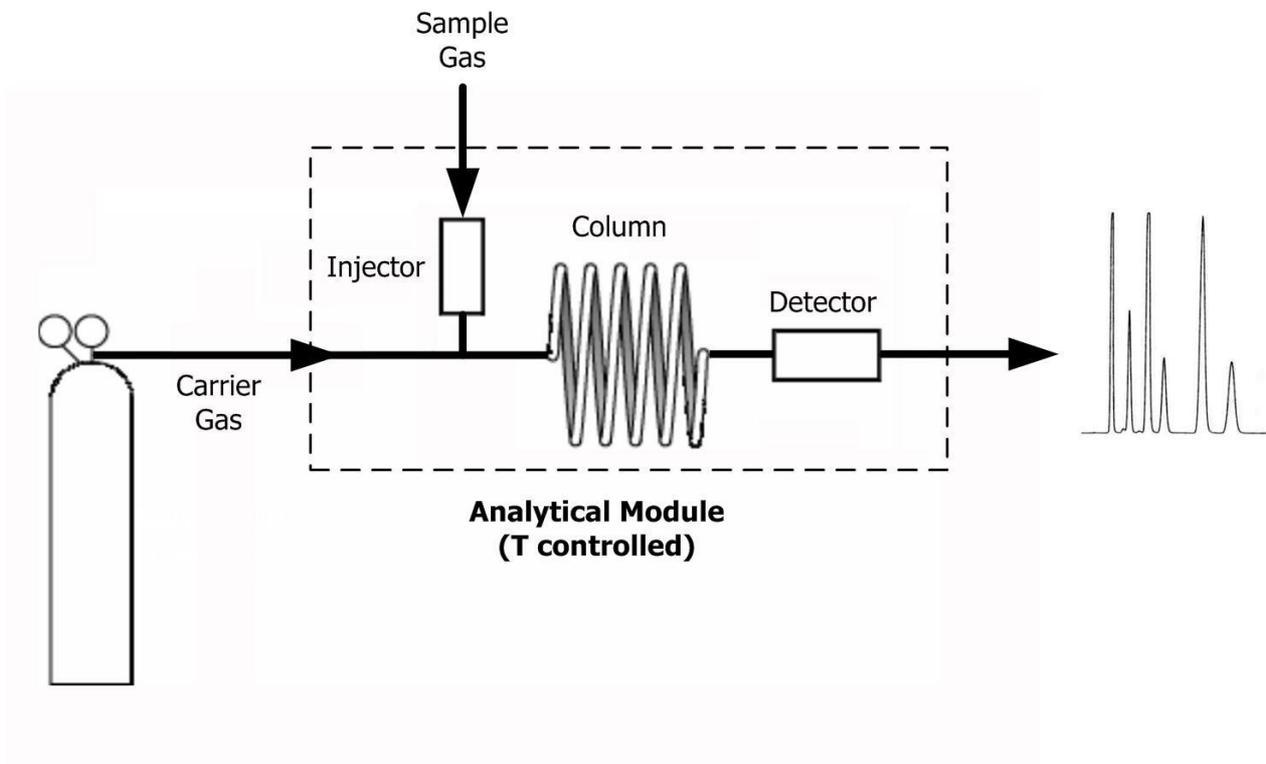


Fig. 1-1 Principle of a Gas Chromatography

A very small volume of sample gas (typically much less than 1 ml), which is a mixture of several components, is injected into a stream of carrier gas, which takes the sample gas through the column. This column acts as a separator through the difference in absorption rate of the different components of the sample gas, they are separated from each other during their passage through the column and elute as individual components. The concentration of each component is then measured at the end of the column by a detector. From the knowledge of the concentrations of each component, any property of the gas can be calculated.

1.1.1 Column

A GC column is a relatively long spiral of tubing with very small internal diameter. Typical dimensions of the used columns in the Encal3000 Quad are a length of several meters and internal diameters of <0.1 mm. They are made of inert materials like fused silica and stainless steel. Every GC column has a so-called stationary phase inside, which acts as an absorption layer for the gas molecules flowing through the column.

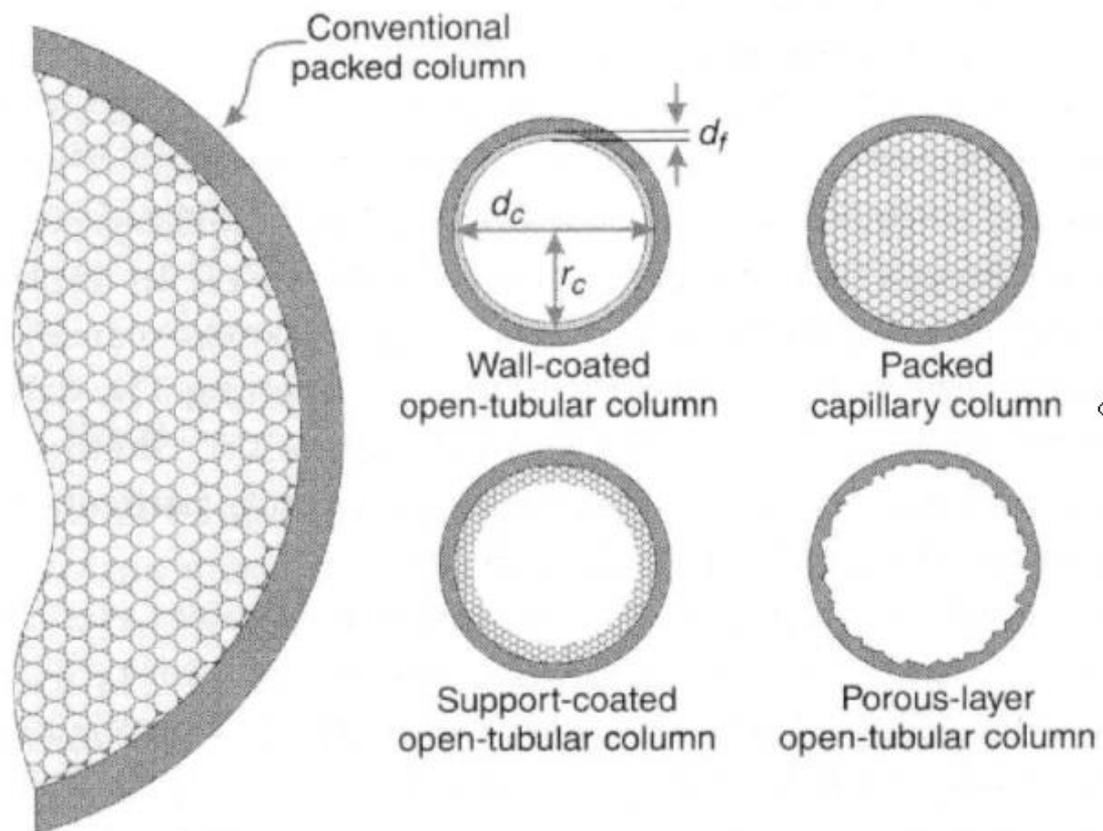


Fig. 1-2 Different types of gas chromatographic columns

Various configurations are used depending on the components to measure:

- Wall coated open tubular column: the stationary phase is a thin liquid layer coated on the inner wall of the column (for example type 5CB)
- Packed column: the stationary phase is coated on a packing, which is equally distributed throughout the column (for example type HSA)
- Support coated open tubular column: the stationary phase is a coated packing, which itself is coated on the inner wall of the column (for example type M5S / molesieve)
- Porous layer open tubular column: the stationary phase is a porous layer on the inner wall of the column (for example type PPU)

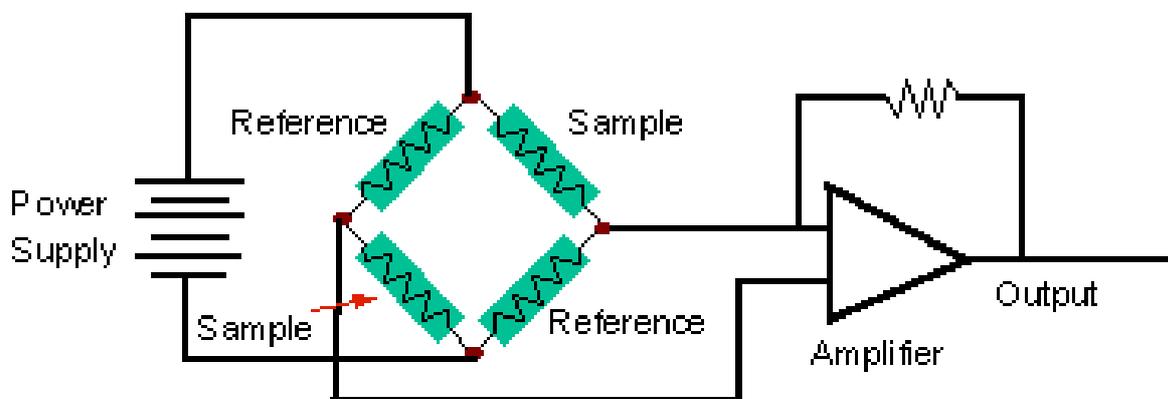
1.1.2 Detector

In the natural gas industry, the most popular detector is the TCD: Thermal Conductivity Detector. It's a relatively simple, very efficient and very robust detector.

Another reason for the popularity of the TCD in the natural gas industry is the fact that gas chromatographs are used mainly for the measurement of gas properties like heating value, Relative density and Wobbe index. The calculation of these parameters is based on the concentrations of the main gas components.

TCDs newer design in MEMS technology (MEMS = Micro-Electro-Mechanical System), which are also used in the Encal3000 Quad are much smaller in terms of volume. The components can be integrated at the same time much more accurately, so that the analytical precision is for example 1 ppm for n-pentane.

Traditionally the two TCD's (reference + measurement detector) are integrated in a so-called Wheatstone configuration, which increases significantly the signal-to-noise ration of the measurement.



© CHP 1995

fig. 1-3 Typical electrical TCD circuit

1.1.3 Sample Injector

The sample injection must assure a precise injection of sample into the flow of the carrier gas.

In principle the amount injected must be very precisely controlled, both in volume, pressure, temperature and flow (to avoid viscosity effects) to guarantee a high level of repeatability of the analytical results, but in practice the normalisation of the measured concentrations will compensate for a large part of the fluctuations of these parameters.

However, to reach a repeatability for the heating value below 0.02 %, these parameters do have effect and need to be controlled to a high degree.

The used MEMS technology allows a fundamental improvement of the sample injection quality compared to the traditional fine-mechanical technologies used for most of the current process GC's on the market. The picture below shows a typical MEMS sample injector, etched in silicon channel, with membrane valves to control flow directions.

This injector allows for a very precise control of the injection volume and temperature, on a remote base.

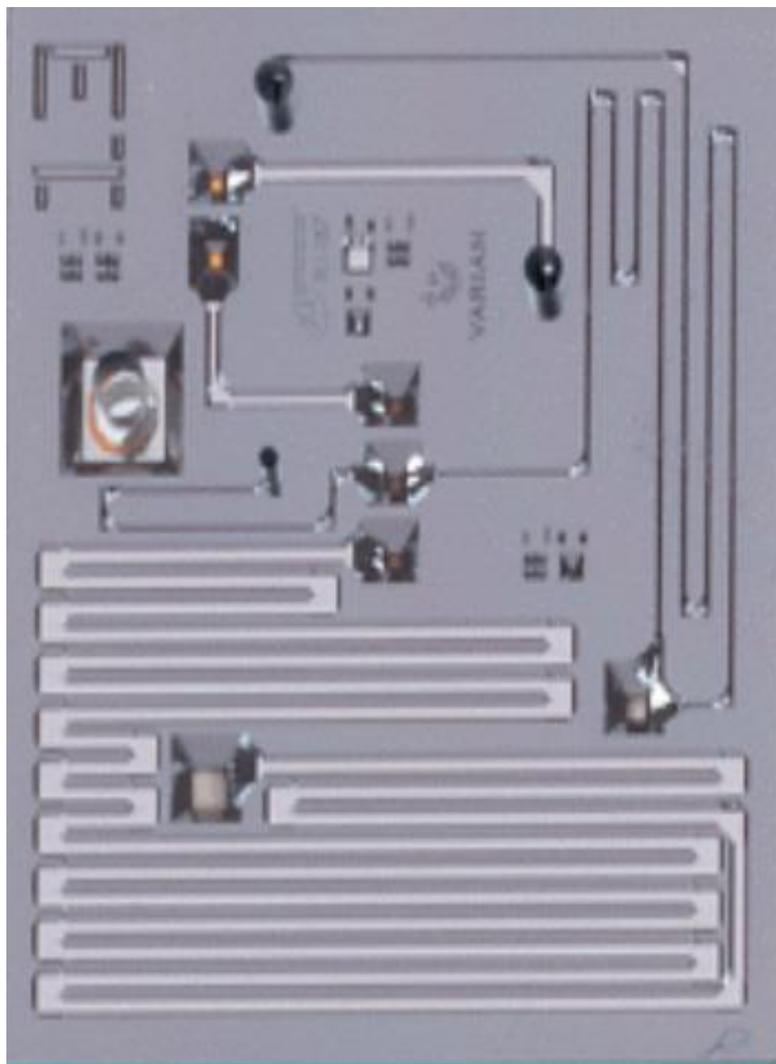


fig. 1-4 MEMS Sample Injecto

1.2 Process Gas Chromatography

The EnCal3000 Process Gas Chromatographs (PGC) transfers the core laboratory technique to process conditions. Apart from the analytical performance specifications, a PGC therefore needs to be designed to match the following specifications:

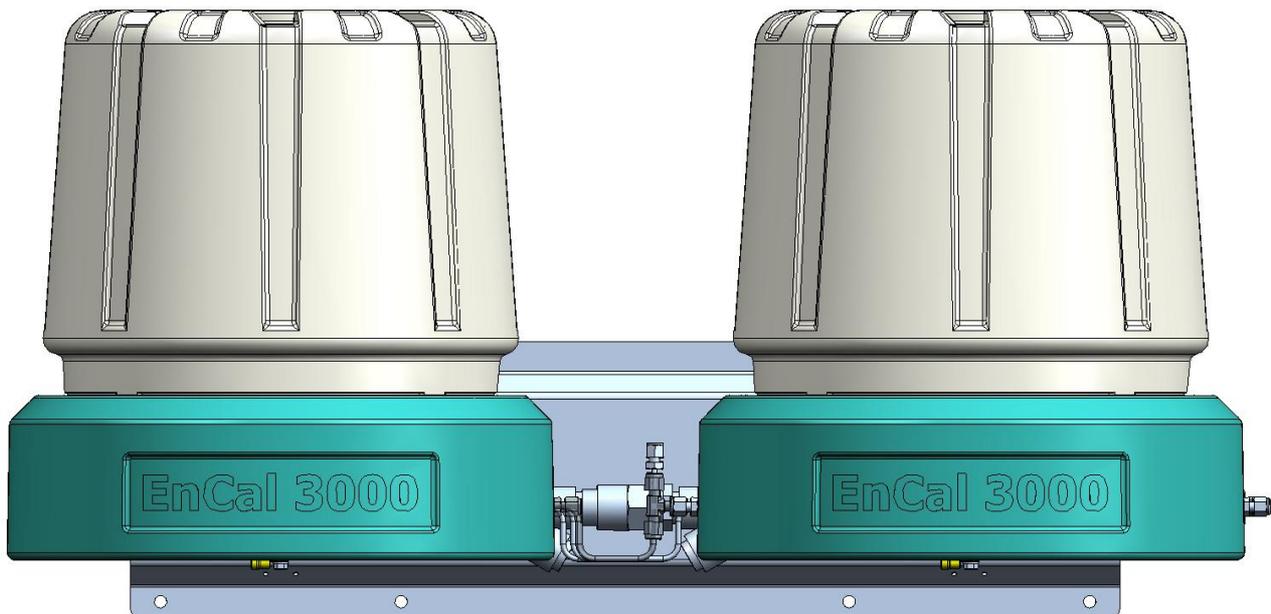
- Explosion safety.
- Extreme environmental conditions:
 - High and low temperatures
 - Dust and precipitation
 - Electro-magnetic influence
 - Wind
 - Corrosive atmospheres
 - Vibrations and shocks
- Complete stand-alone operation, no operator interference during normal operation:
 - Automatic and continuous analysis of different streams
 - Control and processing of analytical measurement executed internally, no peripheral device needed
 - Automatic calibration and verification
- Standard maintenance limited to yearly intervals, without need for specifically trained people
 - High reliability of the components
 - High degree of protection to any contaminant (liquids, vapour or particles) in the sample gas
- Analytical results available in industrial formats (for natural gas industry serial ModBus or ModBus TCP/IP)
- Internal data storage of all data, including averages, calibration data, events and alarms, during the last 35 days, to permit the operator to retrieve data in the past in case the continuous analysis was interrupted for any reason.

The EnCal 3000 Quad is designed to meet or exceed all of the above requirements. At the same time the unit uses analytical technology which can compete with the highest standards used in the laboratory world, surpassing any PGC currently used in the natural gas industry.

2 Functional Design

2.1 Introduction

The Encal 3000 Quad is the combination of two housings in one measurement System. In the two housings is place for up to four analytical channels that are controlled by one processor board. This System has been especially developed for extended analysis applications which cannot be solved with just two channels. One possible example is the combination of a calorific value analysis up to C9, the analysis of hydrogen, oxygen and the sulphur components hydrogen sulphide and carbonyl sulphide. For the analysis up to C9 the two standard channels are used, for the analysis of hydrogen and Oxygen a third channel and for the sulphur components a fourth channel is required. With up to four channels it is possible to analyse all typical components of interest in one system.



The two housings are mounted on a metal plate to have a stable connection. The right housing, further referred as “Master unit” contains the first two channels, the processor board for the control of the measurement system and the sample selection. The left housing, further referred as “Slave unit” contains the third and optionally fourth channel (depending in the application). Both housings have a separate power supply board (interconnection board).

The slave unit shares the output of the stream selection in the master unit and therefore no additional stream selection is needed. The required gas connections between the two housings are preinstalled.

The most important features of the Encal3000 Quad are:

- Compact EX-d design
- Complete stand-alone operation
- Capillary and micro packed columns in combination with MEMS analytical components
- Fast analysis (extended analysis of higher hydrocarbons up to C12 within 5 minutes)
- Highest analytical performance available on the market :
 - Uncertainty < 0.1 % for a wide range of gases
 - Repeatability < 0.02 %
- Up to 5 sample streams sequential without external stream selection
- Integrated sample system
- Internal data storage for the last 35 days of all data
- Suitable for extreme environmental conditions

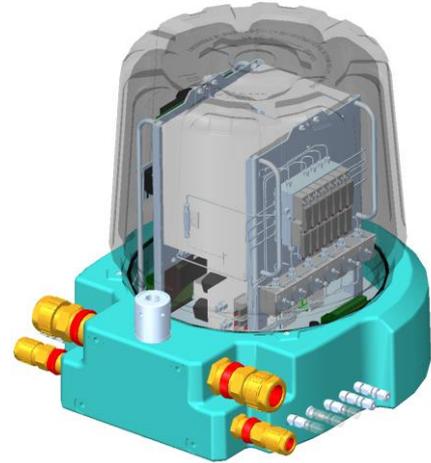
The following paragraphs give a general description of the main parts of the measurement system.

2.2 Enclosure

The two enclosures of the Encal 3000 Quad are a custom EX design, with various specific features.

Essentially the explosion proof enclosures are consisting of a low base, to which a relatively high cap is attached through a screw connection. Once the cap is removed from the base, almost all the internal components are directly reachable:

- Up to two analytical modules in each housing (which do each a part of the total analysis, in parallel)
- One Processor board (only in the Master Unit)
- Internal sample system in the Master Unit (stream selection and pressure regulation)
- All electrical field connections like Ethernet, ModBus, analogue IN, digital I/O, solenoid drivers, switches and jumpers (only in the Master Unit) and fuses (in both Units).



Only if the Interconnection Board, which connects the analytical channels and the Processor Board, has to be exchanged, the unit has to be taken apart. For all other check or maintenance procedures, only the cap has to be removed.

The device can be mounted to the wall. The mounting holes at the back of each housing are used for the connection of the housings. In this steel connection are some holes with a size of 8.5 mm available for the connection to the wall.

The gas tubing (sample lines, cal gas and helium in and out, vent lines) and all electrical connections can be directly connected to the Master Unit. Helium is connected also to the Slave Unit with the tubes between the two units. If Argon is used as a second carrier gas for the Slave unit it is directly connected to it, all other gas tubing are connected to the Master Unit.

The design of the enclosures is allowed for the extremists conditions imaginable in natural gas applications:

- Explosion proof certified for ATEX II 2G Ex-d IIB T4 and IECEx (equivalent FM approval pending)
- IP 66 ingress protection against dust and precipitation (suitable for offshore applications)
- Standard temperature range: 0 to +55°C (32 to 130°F), optional extension with internal heating to -20°C (-4° F), with internal heating and external insulation to -40°C (-40°F)
- EMC certification according to EN 61000-6 - 2/4 (Industrial devices)
- Vibration and shock test acc. IEC 60068-2-31 and 64
- Coating according to Shell specifications DEP 40.4800.30 for off-shore applications

2.3 Assembly of major components and internal components

fig. 2-1 shows the exploded view of the different internal components of the Master Unit of the EnCal3000 Quad. The components in the slave unit are in principle the same, except that, the pressure regulators for each stream and the processor board are not installed because they are only needed in the Master Unit.

The frame is used for mounting the components. It allows the removal of all the direct and individual components, with the exception of the interconnection board. The components can be removed directly and individually by unscrewing just a few screws.

If the Interconnection Board must be replaced, the frame has to be removed from the enclosure base first. This arrangement permits the service engineer to easily review the board in case malfunctions would occur.

The detailed description of the functionalities of each component will be done in the following paragraphs.

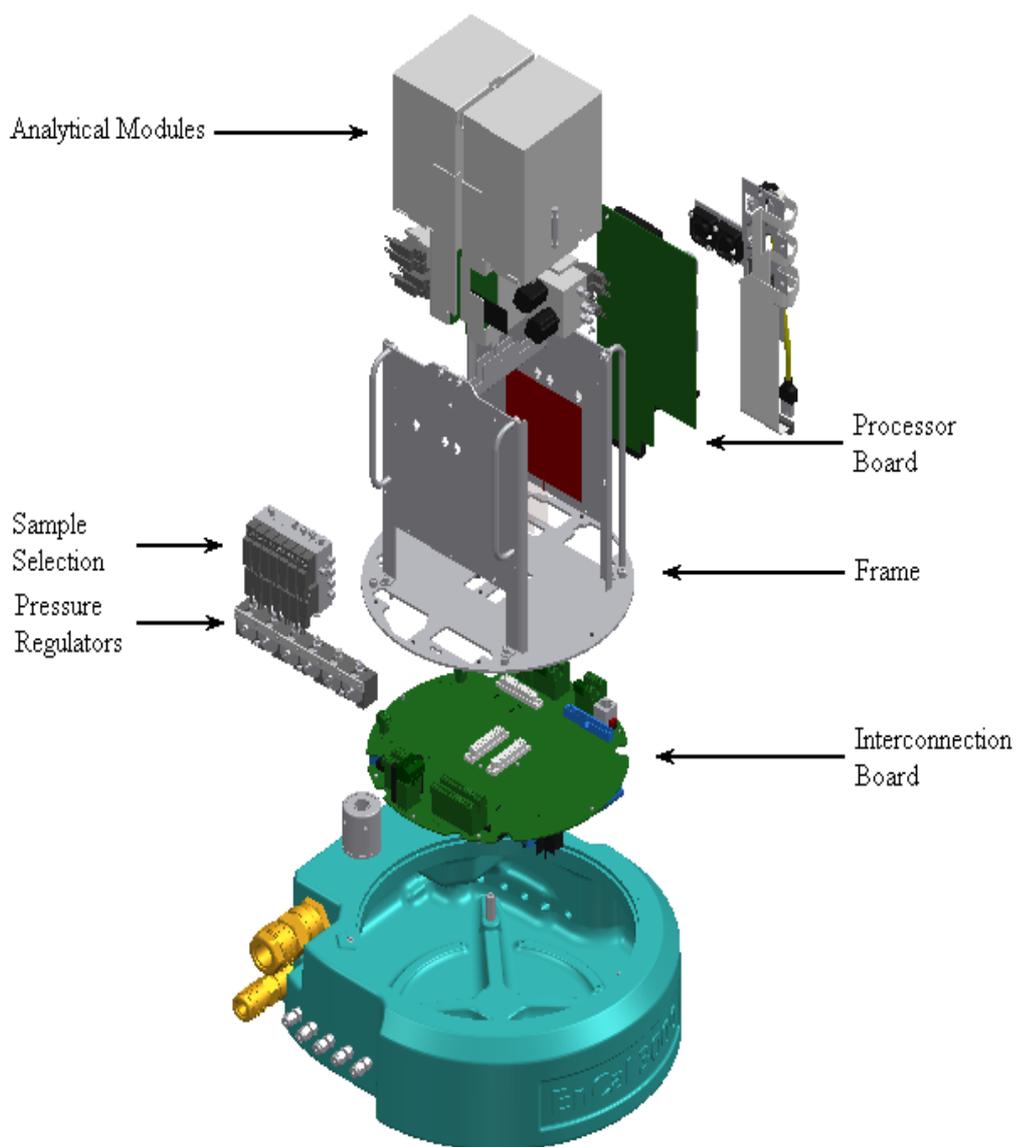


fig. 2-1 Exploded View on the Internal Parts of the EnCal 3000 Quad

2.4 Channel

A channel consists of the following subcomponents:

- Analytical Module. This is the heart of the EnCal3000: it contains the column, sample injector, detector and the heaters for the columns and the injector
- AMI (Analytical Module Interface): electronic circuit which controls the analytical components of the Analytical Module. It has its own EDS (Electronic Data Sheets) which stores the local configuration parameters
- EPC: Electronic Pressure Control for adjusting the pressure of the analytical column
- Channel Controller: electronic circuit which controls the communication between AMI and Processor Board, and also controls the EPC (Electronic Pressure Control) and valves needed for the control of the internal gas flow circuit.

Both AMI and Channel Controller have their own EDS (Electronic Data Sheets) which stores the local configuration parameters. This enables to swap to channels without a need for reconfiguration, uploading the internal settings is sufficient to fully install a new channel in an existing unit.

The Analytical Module uses different columns for different applications. In an EnCal 3000 Quad up to four columns can be selected, the following columns are possible:

- 1.) HSA-0,4m Channel for Nitrogen, Methane, Carbon Dioxide, Ethane and Ethylene
- 2.) 5CB-8m Channel for higher hydrocarbons Propane to Nonane
- 3.) 5CB-4m Channel for higher hydrocarbons Nonane to Dodecane
- 4.) PPU-10m Channel for Hydrogen Sulphide, Carbonyl Sulphide, water vapour, methanol
- 5.) M5A-10m molesieve Channel for Helium, Hydrogen, Oxygen, Nitrogen and Carbon Monoxide
- 6.) 13CB-12 Channel for odorants like THT and TBM, Methylmercaptane and Dimethylsulphide (DMS)
- 7.) AL2O3-Channel for saturated hydrocarbons from Propane to n-Pentane and unsaturated hydrocarbons like Propylene, Propadiene, i-Butene, 1-Butene, trans-2-Butene, cis-2-Butene and 1,3-Butadiene
- 8.) COX-1m for Helium, Hydrogen, Nitrogen, Methane, Carbon Monoxide, Carbon Dioxide and Ethane

For the M5A column, two additional internal humidity filters are required, which are mounted on the module. These filters are used to reduce humidity to a minimum. Humidity can penetrate by diffusion of air into the analytical column.

Without the filter, this humidity would reach the analytical module and be absorbed by the column material. Therefore, the retention times of the measured components would reduce always so that the separation of the measured components is deteriorated and a heating up of the column would be required after about 3 months.

With the filters ensures that a heating up of the M5A column is not necessary within a year (calibration cycle). As the capacity of the attached filter is very low, the filter should be exchanged with each recalibration. For the carrier gas argon always an additional external humidity filter should be used.

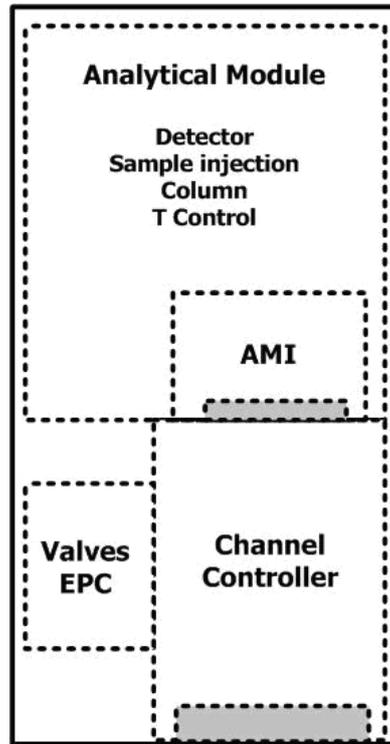
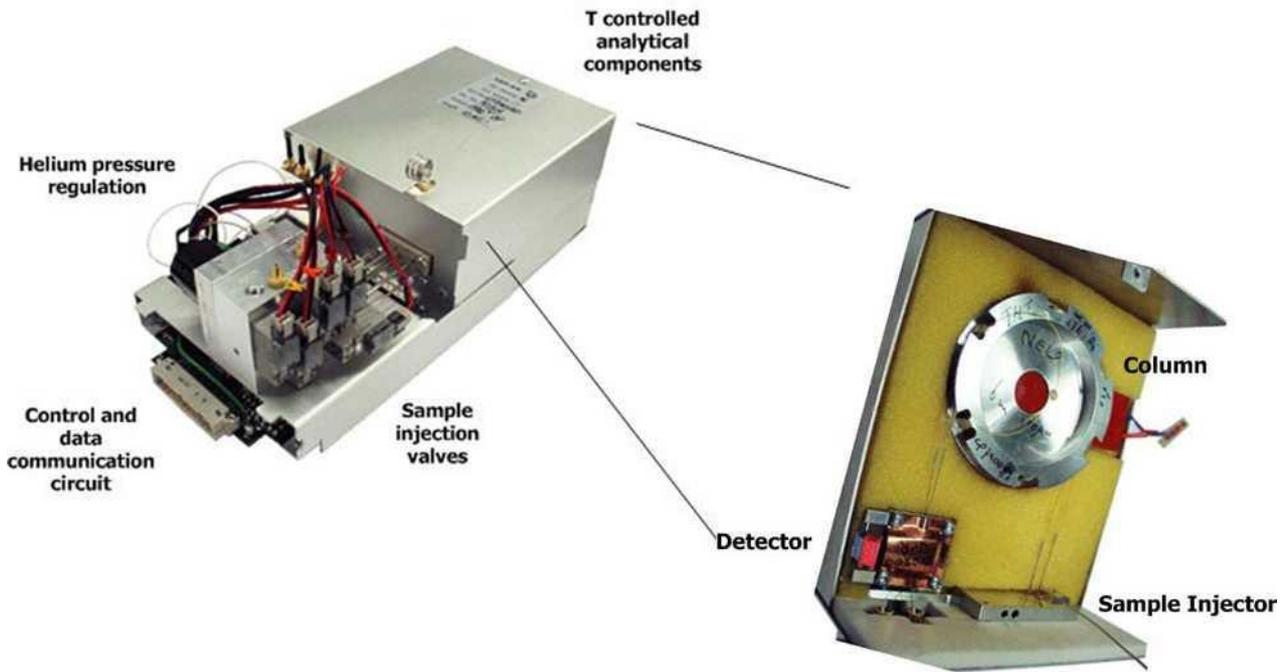


fig. 2-2 Overview of Channel Components

The next page shows the internal gas flow configuration of the channels.

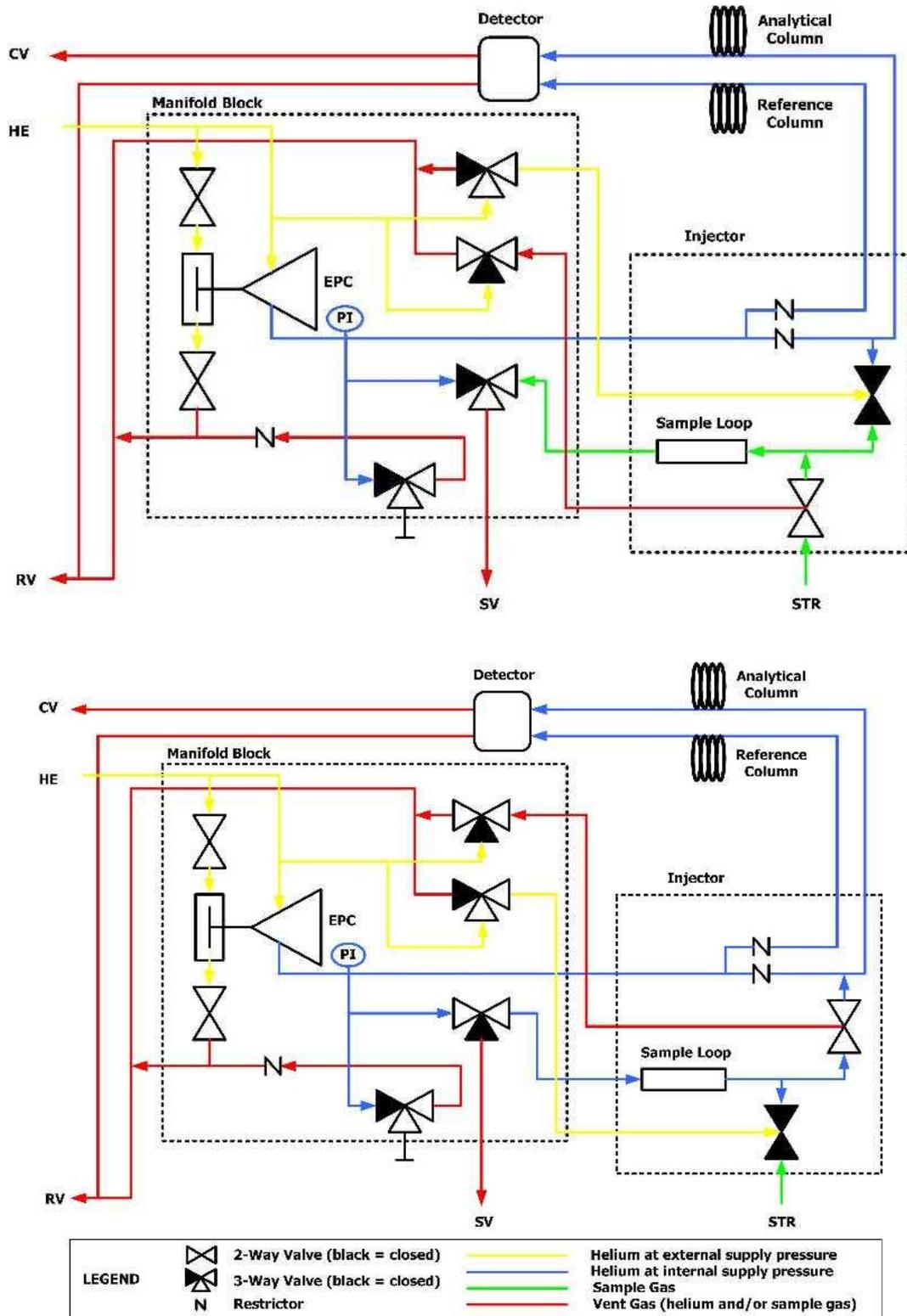


fig. 2-3 Internal Gas Flow Circuit for each Analytical Channel of the EnCal 3000 Quad, during Normal Operation (top) and sample Injection (below)

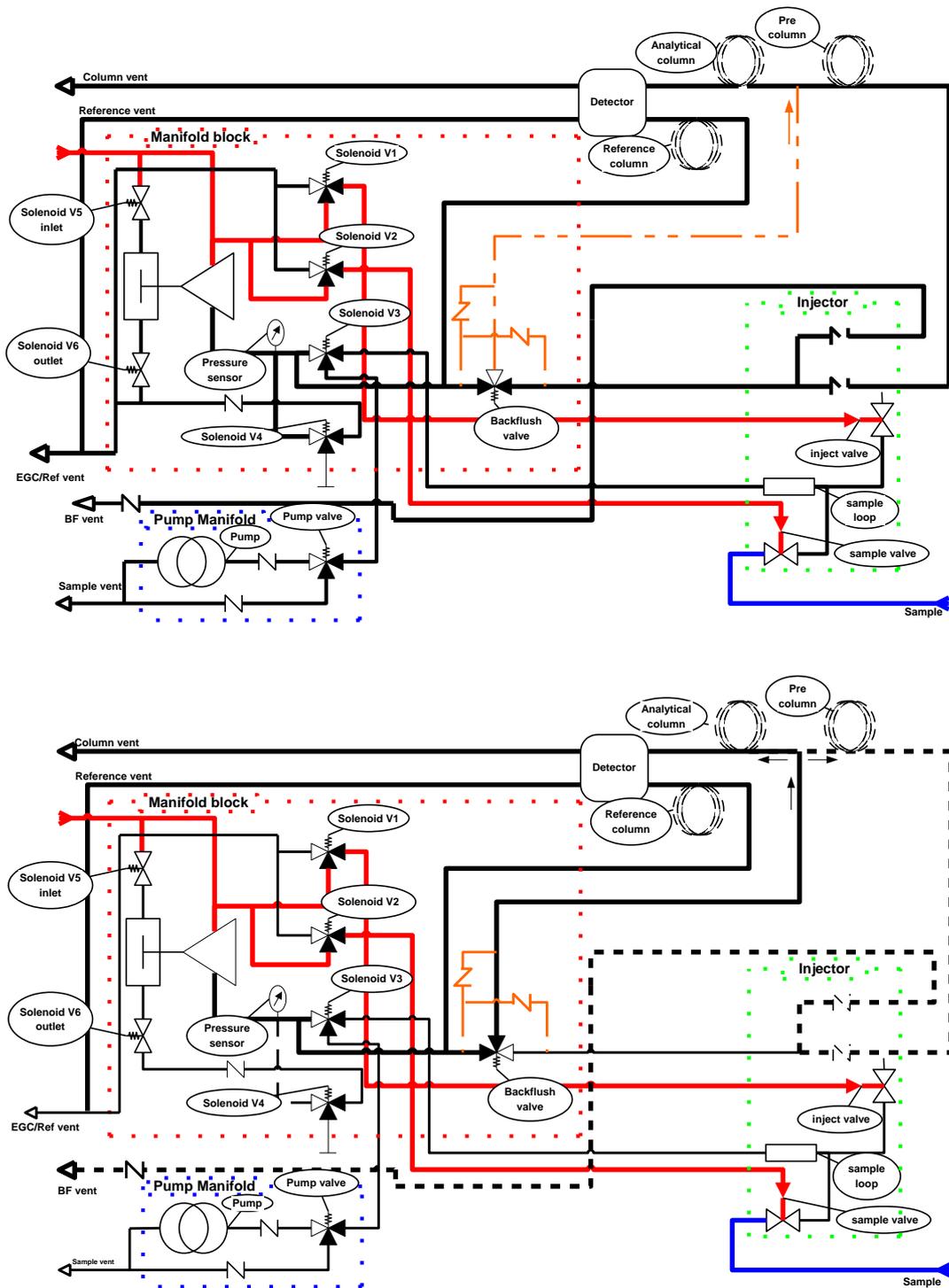


fig. 2-4 Internal Gas Flow Circuit for each Analytical Channel with backflush of the EnCal 3000 Quad,
 before activating backflush valve (top) and after activating backflush valve (below)

2.5 Processor Board

The main components of the board are:

- Arm9 Processor
- A Flash-Memory 32 MB for local data storage
- The Ethernet-Port
- Data communication ports (COM1-4) for serial Modbus, Analogue and Digital I/O
- USB Port
- I/O Controller for Communication to the analytical channels
- Pressure- and Temperature Sensor

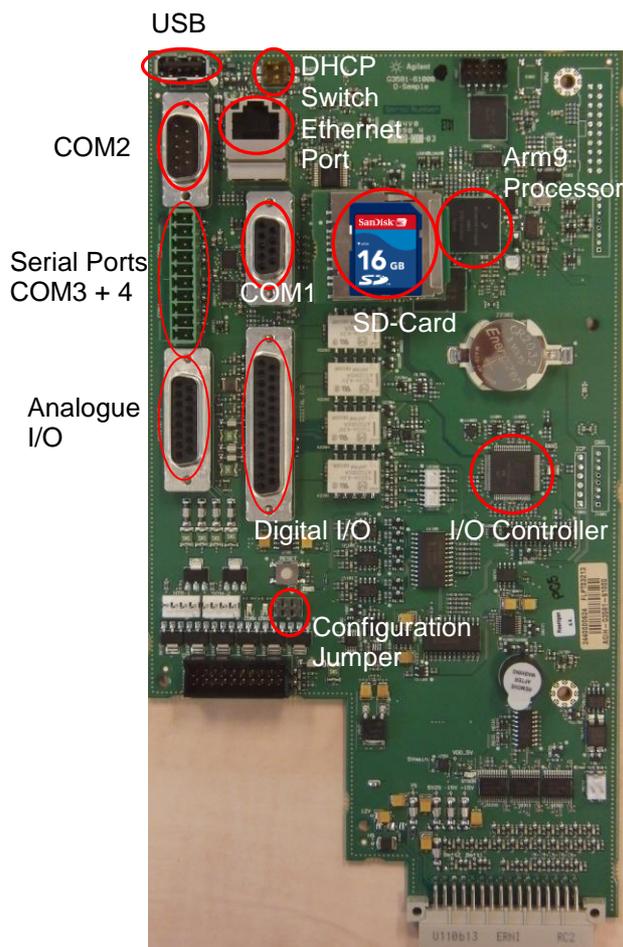


fig. 2-5 Processor Board connections

Save parameters in the measuring unit

Setting the "Configuration Jumpers" can protect the parameters on the measuring unit computer witch was loaded by using the software RGC 3000. This configuration Jumper is on the mainboard (see fig. 2-6). If the jumper is set, the parameters inside the measuring unit cannot be override. Changes in the parameters can only be transferred to the measuring unit, if the jumper is not set. The setting of the jumper can be checked on the display of the "instrument status" page. See Section 3.2 of the software manual. How to set the jumper is shown in Figure 2.6.

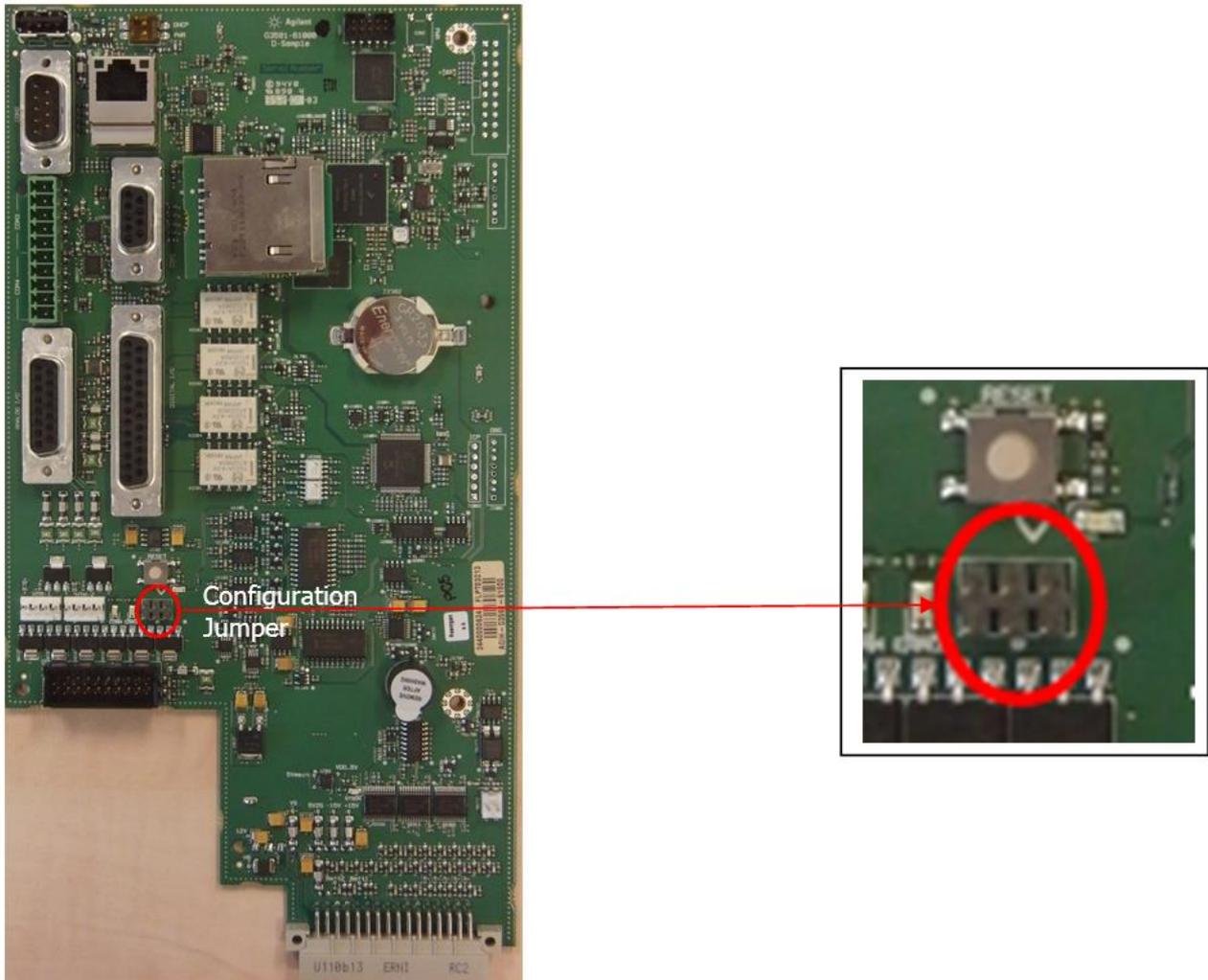


fig. 2-6 Save parameters in the measuring unit

When installed in the EnCal 3000 Quad, two flat cables are making the connection between the communication ports of the Processor Board and the Interconnection Board, which provides field connections (Phoenix connector) for the data communication signals.

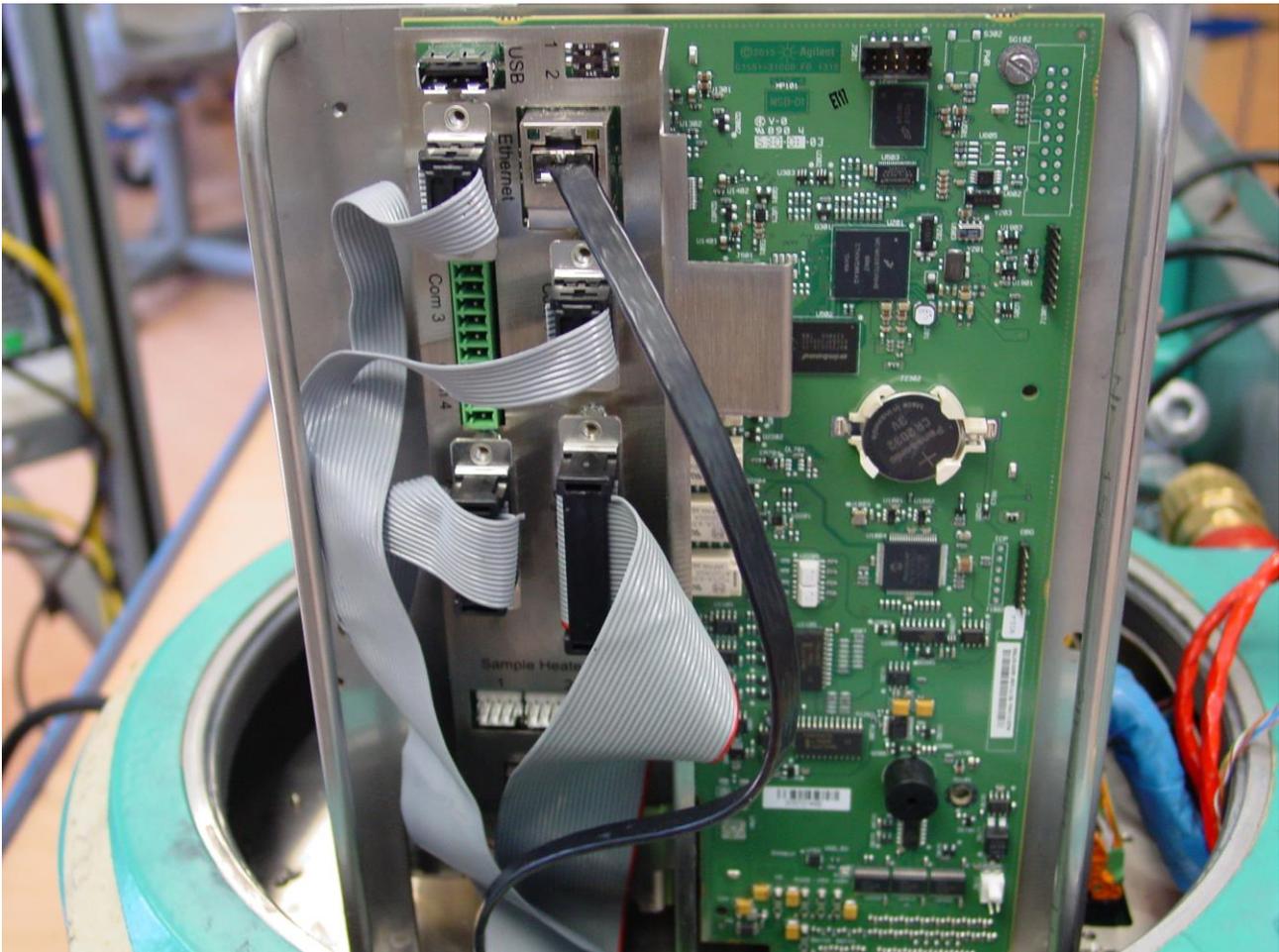


fig. 2-7 Processor board with ribbon flat cables mounted in the EnCal 3000 Quad „Master“

2.6 Interconnection Board

This board has the following functions:

- Power supply input (24 VDC)
- DC/DC converter (18 – 36 VDC)
- Connection of Processor Board with Analytical Modules
- Field data communication connectors
- Actuation of stream select solenoids
- Enclosure temperature regulation
- Internal DC/DC conversion for various circuits

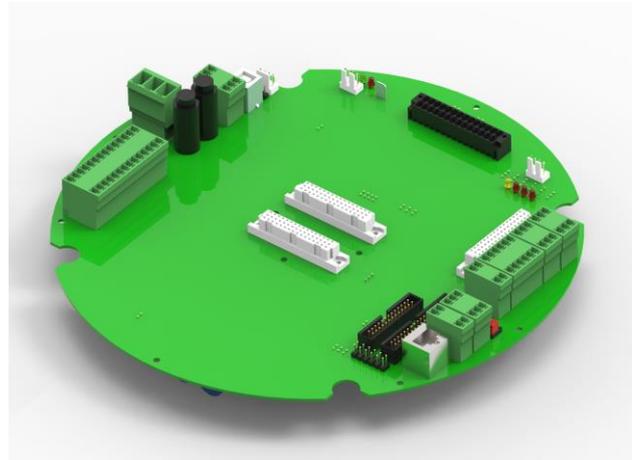


fig. 2-8 Interconnection Board

The scheme below shows the overall electrical configuration of the EnCal 3000.

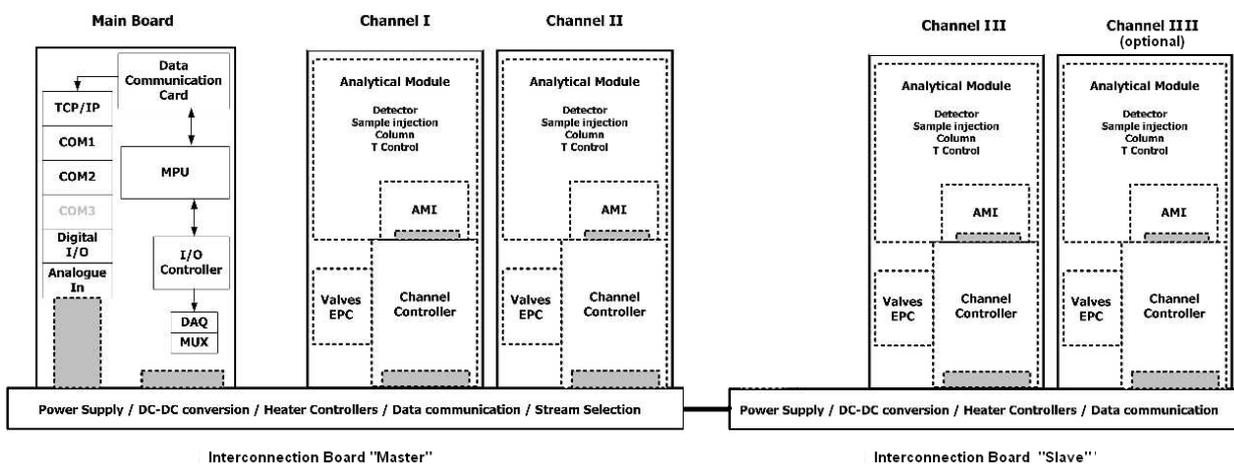


fig. 2-9 Overall Electrical Configuration of the EnCal 3000 Quad

2.7 Electrical connection

The power connection of EnCal3000 Quad is made in each unit by a 3-pin connector on the interconnection board.

The processor board is only available in the master unit, therefore for the data transfer from channel 3 and 4, between the Master and the Slave Unit exists. The Power Supply becomes connected in each housing separately.

With the help of connections the interconnection boards are connected 1 to 1 in the two housings and transfer the data. These wire connections should not be changed by the customer.

There are no customer connections for data transfer in the Slave Unit, these are all made in the Master Unit.

The following figure shows the location of the plug connection for data transfer (black plug) on the Interconnection boards and in the device. Above the connection on the Interconnection Board is visible, the lower part of the figure shows the position of connection in the real device.

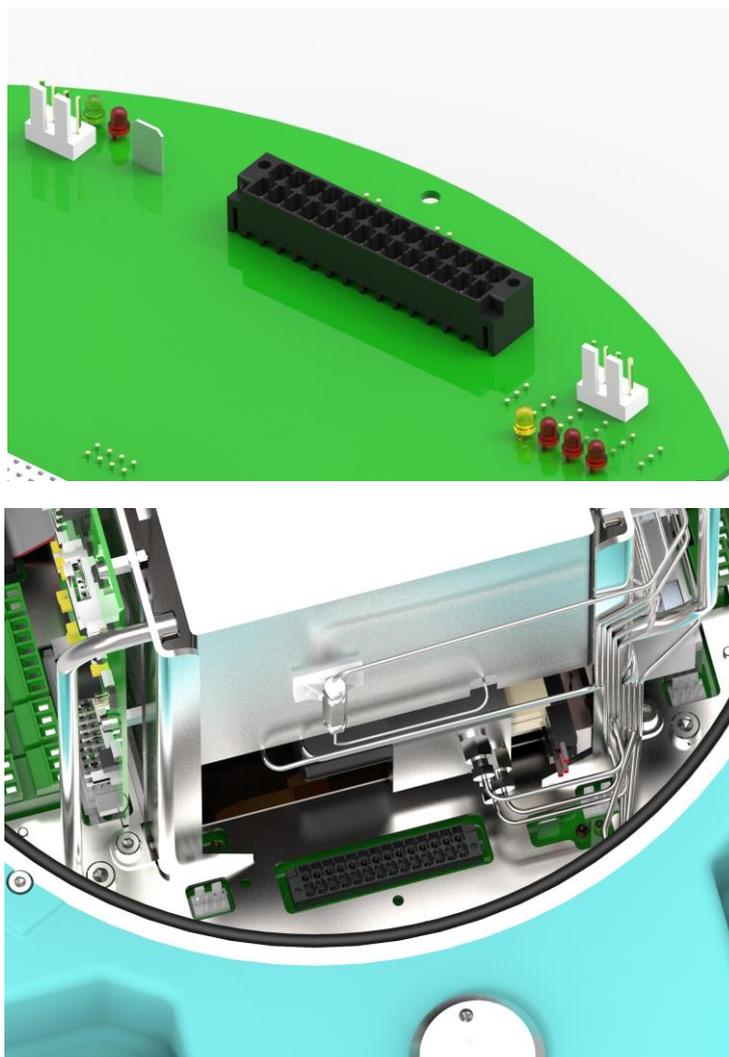


fig. 2-10 Internal data connection for the Encal3000 Quad

2.8 Cabinet Heaters

The cabinet heaters are used for frost protection. They are attached directly to the mounting plates and provide additional heat when the internal enclosure temperature goes below 10°C (50°F). Figure 2.11 shows the location of the cabinet heaters. For an EnCal3000 Quad these heaters have to be installed in both housings, the principle is illustrated for one housing in the following picture.

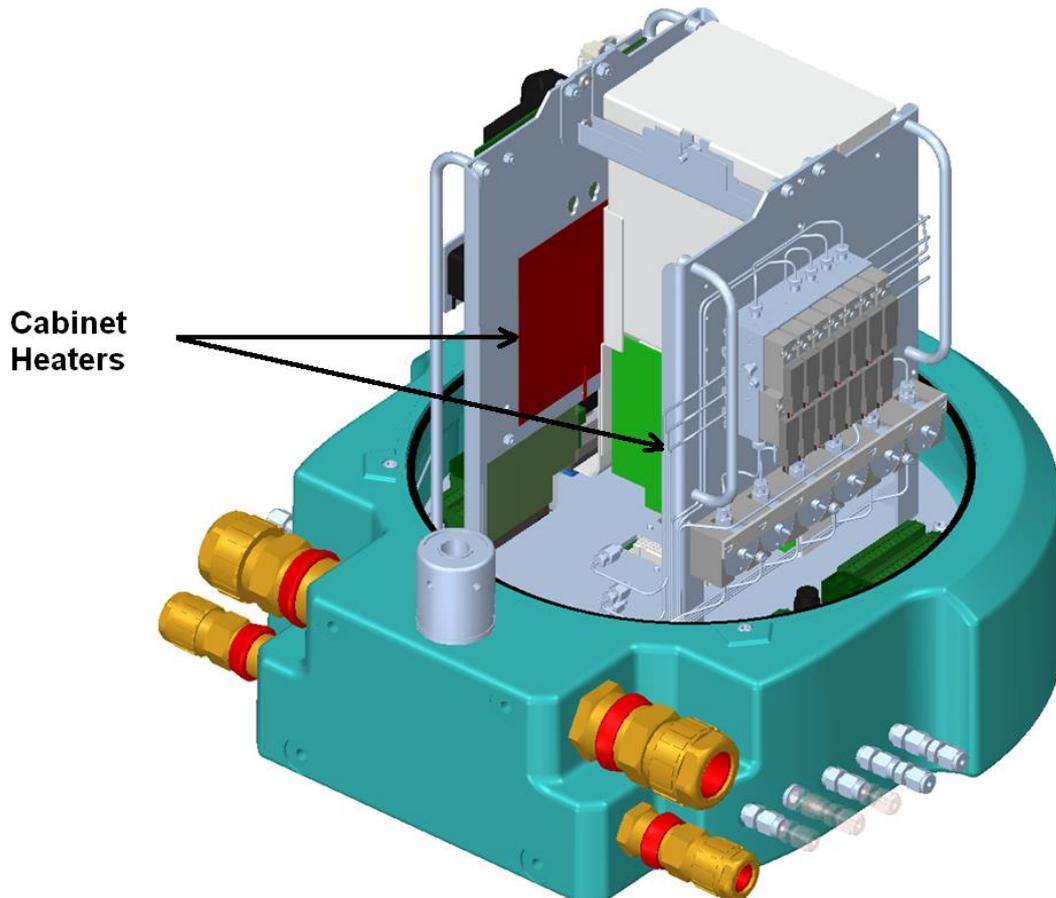


fig. 2-11 Cabinet heaters location in the EnCal 3000

For the regulation of the heaters standard thermostats with a fixed setting are used. These thermostats are connected to the interconnection board (see also fig. 5.5, connectors J20 - J23). They are located close to the connectors for the power supply of the heaters (see following figure).

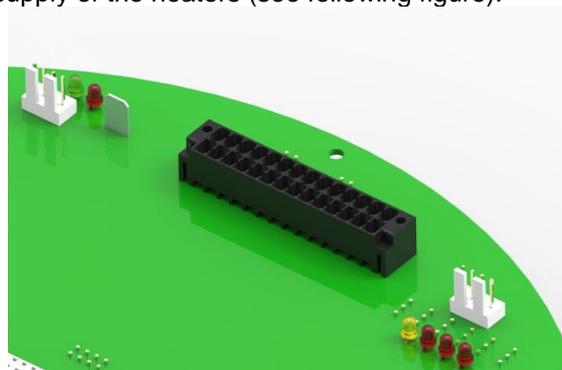


fig. 2-12 Power supply (white connectors) for cabinet heaters

2.9 Internal sample system

The internal sample system has the following functions:

- Double block and bleed stream selection (up to 5 streams / 1 cal)
- Pressure regulator. Advised input pressure is 2 barg. Input pressure range is 1 to 5 barg
- Split of the helium and sample gas to the 2 analytical columns
- Combination of the vent lines of the 2 modules
- Purge of the cabinet with Helium (optional)
- Integrated fast loop function (stream purge)

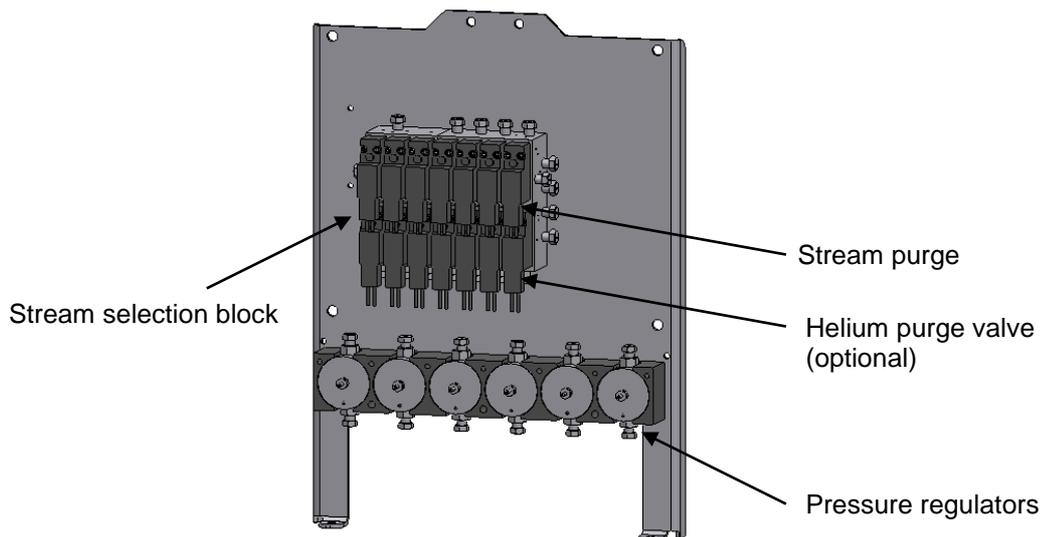


fig. 2-13 Front view of the internal sampling/stream selection system

Helium Purging (optional)

Helium enters the manifold and is split to both analytical modules. Through a purge valve the helium can be vented into the housing, to expel the air in the housing (activated by time relay 3). Additionally to this the column vent is released into the housing which is nearly pure helium. If there is a leak in the housing no combustible mixture can be formed because of the absence of air. The housing withstands the pressure of an explosion but by purging the housing with Helium the chance of internal damage is also reduced significantly. The purge and the small amount of helium that is vented into the housing also protects the internal components against moisture or other aggressive components entering the housing through the breather.

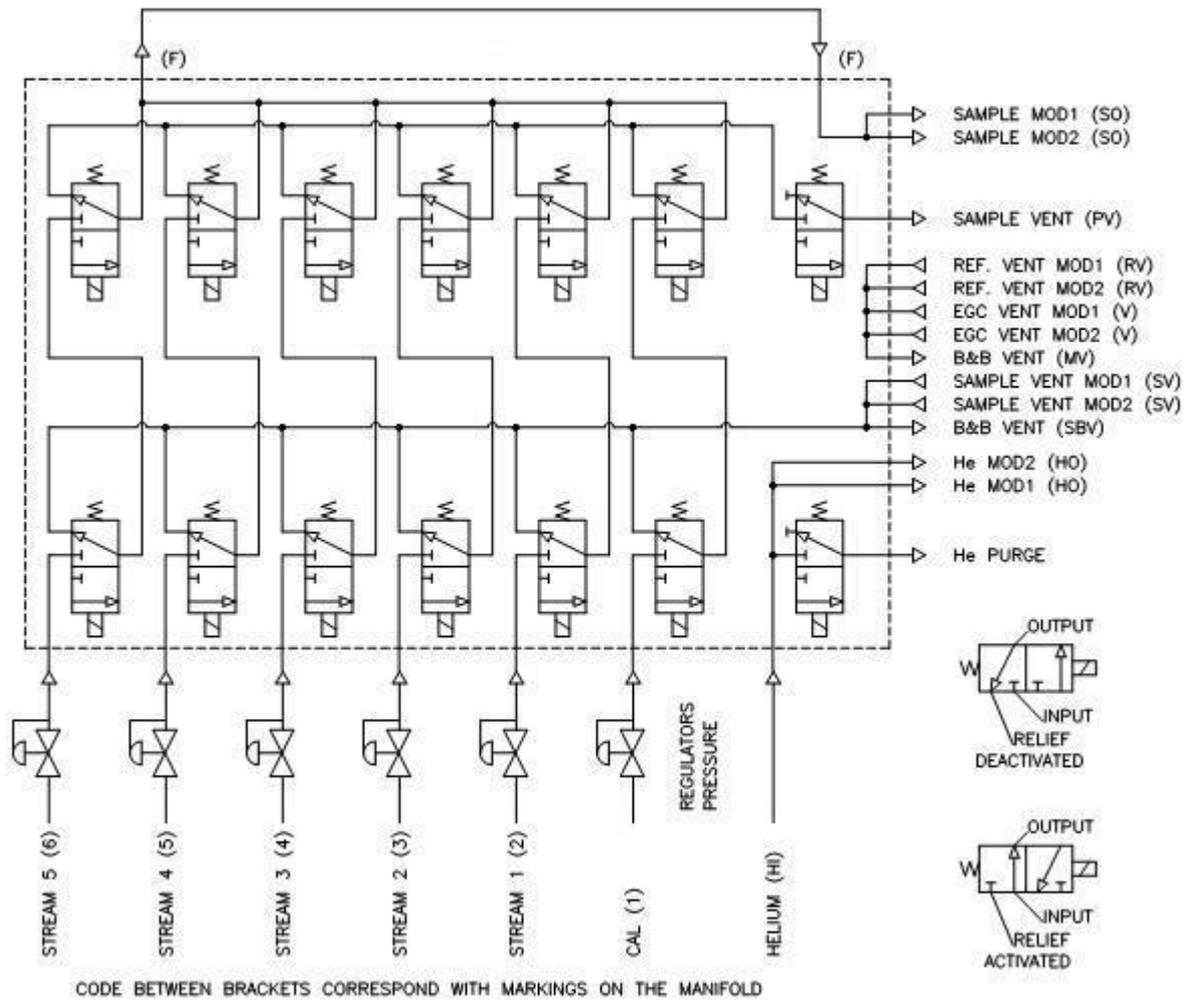


fig. 2-14 Flow diagram Sample Conditioning and Selection System

2.9.1 Double Block and Bleed Function

After small particles are filtered out by the inlet filters in the inlet couplings, the pressure is reduced to approximately 0.8 barg. From the pressure regulators the gas will flow to the manifold. There are several valves mounted on the manifold.

The two most right valves are purge valves. The upper purge valve is the sample bypass valve (Activated by timed relay 2). The lower is a helium purge valve and activated by timed relay 3.

The stream and calibration valves form pairs that are actuated at the same time.

The valves left from the purge valves are used for the calibration. Next to the calibration valves there are 1 up to 5 pairs used for the streams. Depending on the configuration the manifold can support up to 3 or up to 6 streams (including the calibration gas stream). Unused positions on the manifold are blocked.

Gas will enter at the first (lower) valve which will guide the flow to the second (upper) valve in actuated situation. The second valve guides the flow into a common channel. In deactivated situation, the input from the first valve is blocked and the output is linked to the relieve port of this valve, which vents to the SBV vent. The input of the second valve is also blocked so it is not possible to build up pressure between both valves. In case one or both valves would leak, the pressure between the valves won't rise above the pressure that is present in the common channel because of the vent to the SBV vent, so mixing up the streams is not possible.

2.9.2 Internal Sample Bypass

The output from all second valves is combined on the common channel. Depending on which channel is activated, a section of this channel and the deactivated valves, form a dead volume. The outputs from deactivated valves are therefore relieved to a second common vent channel, which is blocked by the sample bypass valve. Activating this valve will result in a flow from the activated valves, through the deactivated valves, to the bypass valve. This refreshes all second valves and the common channels with the new gas, so all dead volumes are refreshed. Actuating the bypass valve results in a flow that is approximately 15 times higher than the normal flow. The purge valve should be activated for a short period (± 30 seconds default) when a new stream is selected.

The new stream is selected one analysis prior to the injection, so during the analysis the new sample is already flushed through the manifold. The best moment to activate the sample purge is ending 10 seconds before the injection and then extended to the front depending on the purge duration. For long sample lines or higher sample line pressures the purge time may be extended to where the new stream was selected. Keep in mind the purge time also applies to the calibration gas which must be purged, but larger purge times and frequent purging will deplete the bottle faster. Further information for the needed setting in the software can be found in the software manual.

The flow through the analytical modules will be reduced during the activation of the bypass, but will continue. Closing the bypass valve will restore the normal flow to the analytical modules. After the sample gas has passed the manifold it becomes split for the transport to the two analytical channels that are installed in the master unit. The vent outputs from both modules are returning to the manifold and are combined to two venting outputs. The sample output from the manifold in the Master Unit is connected with the inlet for the sample gas connection from the Slave Unit. In the Slave Unit the sample gas flow is also split for the transport to the two analytical channels that are in the slave unit. The sample gas flow can be also increased for the Slave Unit with an additional Purge Valve. The output gases from these channels are combined again and become transported to the SBV connection of the Slave Unit.

2.10 Gas Connections

Each gas connection consists of:

- Male Connector 1/8" with internal particle filter 2 μ (adapter in following figure) and adaptation to 1/8" or 3 mm for the carrier gas, calibration and sample gas inlets. This can be replaced without removing the cap of the analyser
- Male Connector 1/8" with optional adaption to 3mm for output gas
- Adapter, fixed to the housing
- Tubing 1/16", soldered to the adapter and connected at the other end with the internal sampling system. This tubing serves as flame arrestor. Its length has to be bigger than 25 cm (19") and should not be shortened by the customer

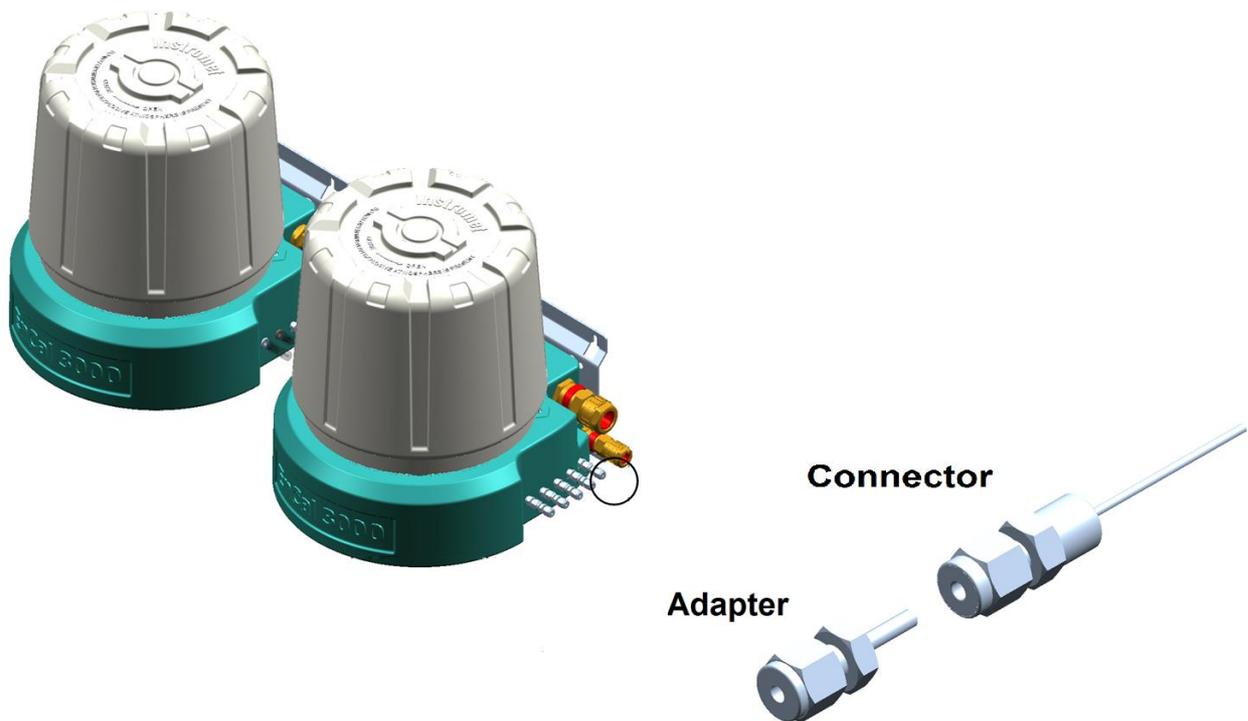


fig. 2-15 Gas Connection of the EnCal 3000 Quad



WARNING!! DO NOT LOOSEN THE CONNECTORS (AS DESCRIBED ABOVE) FROM THE ENCAL 3000 HOUSING. THE SOLDERED TUBE WILL BE DAMAGED!! THE JOINT BETWEEN CONNECTOR AND HOUSING IS AN INTEGRAL PART OF THE ENCAL 3000's SAFETY APPROVAL. IF THE CONNECTOR IS ACCIDENTALLY LOOSENED PLEASE SWITCH OFF THE ENCAL 3000 AND CONTACT THE MANUFACTURER OR YOUR LOCAL ELSTER-INSTROMET AGENT.

2.11 Breather

The breather at the back of the enclosure is needed to comply with the ATEX rule which restricts the pressure in the enclosure to 100 mbar overpressure, in case of total leakage, i.e. if all gas inlet tubing would be internally disconnected at the same time.

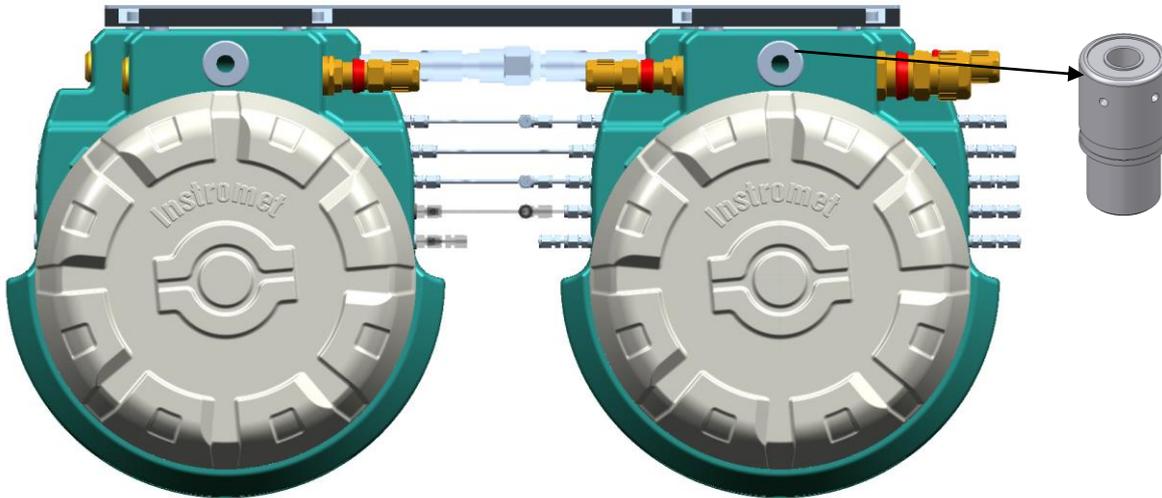


fig. 2-16 EX breather as required by ATEX directive

The breather used on the EnCal 3000 is an Ex-d certified device with IP 66 rating, and a vent flow of about 600 l/h at 100 mbar overpressure in the enclosure. It is sealed with Loctite to prevent loosening by unauthorised persons.

When installed outside it should be protected against dirt and rain, i.e. by connecting a swan neck tube to it, the breather has a 3/8 NPT connection. Any tube connected should have an internal cross section of at least 28mm² (3/8") tube or larger.

The breather should always vent atmospheric without large pressure fluctuations. The output of the breather must not be blocked because the valve would not function properly otherwise!

2.12 Cable Glands

Three cable glands can be connected to the enclosure base of the Master unit: up to two M25 and up to three M20 cable glands. For the standard configuration see chapter 5 “Hardware installation”.

Most installations will use one for data communication cable (TCP-IP and/or Serial ModBus) and another for Power Supply (24 VDC). Additionally also signal cables (such as alarm contacts, carrier gas control, etc) might be used as long as they are combined in the same cable.

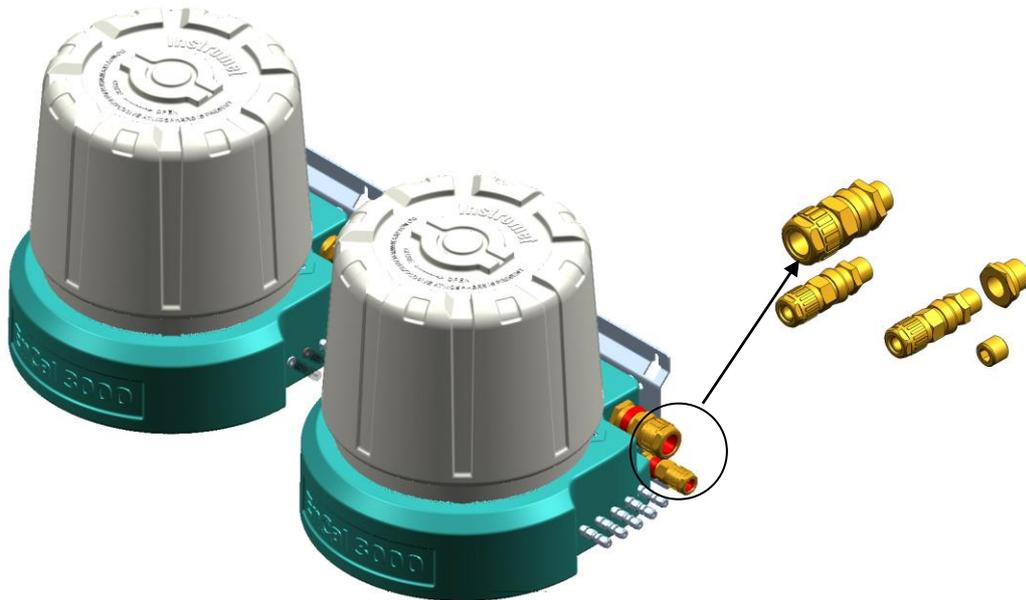


fig. 2-17 Location of Cable Glands at the right of the Enclosure Base

Cable glands with a sealing system are typically required. Installation directive EN 60079-14 recommends for Ex-d devices with an internal volume > 2 dm³ the so-called “Barrier Glands”, incorporating compound filled seals around the individual cores or other equivalent sealing arrangements. The cable glands and blind covers of unused openings must be installed correctly and non-flammable.

2.13 External Switch

To comply with Electrical Safety Standards IEC 60947-1 and IEC 60947-3, an external switch has to be located close to the analyser, enabling an operator to close down the unit in case of emergency. It has to be marked with "Disconnecting Device". Practical implementation of this requirement will differ from site to site. In any case the external switch installation has to comply with all national, local, and company codes applicable to the location.

3 Technical Specifications

Below the main technical specifications:

Mechanical	
Dimensions	Two combined Housings: Base Ø 37 cm x Height 37 cm (Ø14" x Height 14")
Installation Clearance	100 cm x 42 cm x Height 70 cm (40" x 17" x Height 28")
Weight	<60 kg for the complete Quad device
Approvals	ATEX II2G Ex-d IIB T4 (IIC certification pending) and IECEx NEC Class I, Div. I, Groups B, C & D (pending) IP 66 Vibration and shock test acc. IEC 60068-2-31 and 64

Analytical																													
Hardware	up to 4 parallel isothermal GC modules with narrow-bore capillary column technology in combination with MEMS based analytical components																												
Analysis Output	Extended analysis of any natural gas up to C ₉ (standard) or C ₁₂ (optional) Heating Value, Density, Wobbe Index																												
Component Range	<table border="0"> <tr> <td>for natural gas (standard)</td> <td>possible additional components</td> </tr> <tr> <td>N₂ : 0.005 – 20 %</td> <td>CH₄S, TBM: 0.0001 – 0.002 %</td> </tr> <tr> <td>CH₄ : 55 – 100 %</td> <td>THT: 0.0002 – 0.002 %</td> </tr> <tr> <td>CO₂ : 0.001 – 20 %</td> <td>C₁₀ : 0.0001 – 0.002 %</td> </tr> <tr> <td>C₂ : 0.001 – 14 %</td> <td>C₁₁, C₁₂: 0.0001 – 0.001 %</td> </tr> <tr> <td>C₃ : 0.001 – 6 %</td> <td>C₆ H₆, C₆ H₁₂: 0.0001 – 0.1%</td> </tr> <tr> <td>i, n-C₄ : 0.001 – 3 %</td> <td>C₇ H₈, C₇ H₁₄: 0.0001 – 0.1%</td> </tr> <tr> <td>neo-C₅ : 0.005 – 0.25 %</td> <td>H₂ : 0.001 – 10 %</td> </tr> <tr> <td>i, n-C₅ : 0.001 – 0.25 %</td> <td>O₂ : 0.005 – 4%</td> </tr> <tr> <td>C₆ : 0.001 – 0.1 %</td> <td>H₂S : 0.0002 – 1%</td> </tr> <tr> <td>C₇ : 0.001 – 0.05 %</td> <td>COS : 0.0001 – 1%</td> </tr> <tr> <td>C₈ : 0.001 – 0.02%</td> <td>He : 0.001 – 1 %</td> </tr> <tr> <td>C₉₊ : 0.001 – 0.01 %</td> <td>H₂O: 0.001 – 0.05%</td> </tr> <tr> <td></td> <td>CH₃OH: 0.005 – 0.1%</td> </tr> </table> <p>Concentrations outside this scope might be possible, but verification with Elster-Instramet is needed.</p>	for natural gas (standard)	possible additional components	N ₂ : 0.005 – 20 %	CH ₄ S, TBM: 0.0001 – 0.002 %	CH ₄ : 55 – 100 %	THT: 0.0002 – 0.002 %	CO ₂ : 0.001 – 20 %	C ₁₀ : 0.0001 – 0.002 %	C ₂ : 0.001 – 14 %	C ₁₁ , C ₁₂ : 0.0001 – 0.001 %	C ₃ : 0.001 – 6 %	C ₆ H ₆ , C ₆ H ₁₂ : 0.0001 – 0.1%	i, n-C ₄ : 0.001 – 3 %	C ₇ H ₈ , C ₇ H ₁₄ : 0.0001 – 0.1%	neo-C ₅ : 0.005 – 0.25 %	H ₂ : 0.001 – 10 %	i, n-C ₅ : 0.001 – 0.25 %	O ₂ : 0.005 – 4%	C ₆ : 0.001 – 0.1 %	H ₂ S : 0.0002 – 1%	C ₇ : 0.001 – 0.05 %	COS : 0.0001 – 1%	C ₈ : 0.001 – 0.02%	He : 0.001 – 1 %	C ₉₊ : 0.001 – 0.01 %	H ₂ O: 0.001 – 0.05%		CH ₃ OH: 0.005 – 0.1%
for natural gas (standard)	possible additional components																												
N ₂ : 0.005 – 20 %	CH ₄ S, TBM: 0.0001 – 0.002 %																												
CH ₄ : 55 – 100 %	THT: 0.0002 – 0.002 %																												
CO ₂ : 0.001 – 20 %	C ₁₀ : 0.0001 – 0.002 %																												
C ₂ : 0.001 – 14 %	C ₁₁ , C ₁₂ : 0.0001 – 0.001 %																												
C ₃ : 0.001 – 6 %	C ₆ H ₆ , C ₆ H ₁₂ : 0.0001 – 0.1%																												
i, n-C ₄ : 0.001 – 3 %	C ₇ H ₈ , C ₇ H ₁₄ : 0.0001 – 0.1%																												
neo-C ₅ : 0.005 – 0.25 %	H ₂ : 0.001 – 10 %																												
i, n-C ₅ : 0.001 – 0.25 %	O ₂ : 0.005 – 4%																												
C ₆ : 0.001 – 0.1 %	H ₂ S : 0.0002 – 1%																												
C ₇ : 0.001 – 0.05 %	COS : 0.0001 – 1%																												
C ₈ : 0.001 – 0.02%	He : 0.001 – 1 %																												
C ₉₊ : 0.001 – 0.01 %	H ₂ O: 0.001 – 0.05%																												
	CH ₃ OH: 0.005 – 0.1%																												
Performance	Uncertainty < 0.1 % for all calculated properties Repeatability < 0.01 % for all calculated properties Linear dynamic range 10 ⁶ Detection limit for C ₅ : 1 ppm, Detection limit for C ₉ : 2 ppm Analysis time 5 minutes for C ₉ analysis or C ₁₂ analysis																												
Temperature range	0°C to 55°C (32°F to 130°F), extendable to -40°C to 55°C (-40°F to 130°F)																												
Approvals	PTB Metrological Certificate																												

Electrical	
Power Supply	24 VDC, 50 W nominal (120 W start-up peak) for non-heated version 24 VDC, 120 W nominal (240 W start-up peak) for heated version (ambient < 0 °C) Created with Quint-PS-100-240AC / Quint-PS-24DC/24DC/10 / Siemens PSU / Siemens Logo or equivalent power supplies. The power will be lower once the unit has reaches its operation temperature depending on the ambient temperatures.
Interfaces	Ethernet UTP 10 Base-T for ModBus TCP/IP and PC link Two RS 232/485 ports (user selectable) for ModBus RTU 3 analogue I/O for local sensors (4-20 mA or 0-10 VDC)
Fuses	F1 and F2 each 5A for 24V power supply
Battery back-up	Lithium Button battery, Panasonic Type BR 2032 3V
Approvals	EMC according to EN 61000-6-2 and EN 61000-6-4

Software	
Analyser	Pro™: complete stand-alone operation, inclusive all calculations and generation of report formats, without need for operator intervention. Calculations according to ISO 6976, GPA 2172, ASTM D3588 or GOST 31369
PC	RGC 3000: Windows based program for configuration, diagnostics and report generation (Compatible with Windows XP, Windows Vista and Windows 7)
Data Logging	History Log: local storage of last 35 days of all analytical data (analysis, events, alarms, averages, last chromatogram, calibration data) according to API Report 21.1. All data available on remote workstation in XML format
DCS	Remote monitoring and trending of the system as an integral part of the Instronet Supervisory Suite

Gas Cylinders

Helium / Argon	<p>Quality 5.0 or better Optional 2 bottles with automatic change system Supply pressure 5.5 barg Flow \pm 4 ml/min per column (max. 16 ml/min with four columns)</p>
Calibration gas	<p>Composition preferably close to pipe line composition Quality 2.0 or higher (with a maximal uncertainty of 1% relative deviation for each component) Supply pressure 1 to 4 barg nominal Pressure peak protection up to 4 barg Flow \pm 30 ml/min</p>

Installation

Location	Outdoor installation, close to sample point. Only sun shade required	
Mounting	Wall mounted	
Gas connections	Swagelok 1/8" or on request 3mm	
Electrical connections		
	Power Supply	M20/M25 cable gland for armoured cable \varnothing 11-17 mm / 17-26 mm
	Data Communication	M20/M25 cable gland for armoured cable \varnothing 11-17 mm / 17-26 mm

4 Data Communication

4.1 Local TCP/IP Data Communication

The main Data Communication Port of the EnCal 3000 Quad is the TCP/IP port, although 2 serial ModBus ports are also available (see next paragraph). The TCP/IP Port (Ethernet UTP 10 Base-T) is necessary for connection with RGC 3000 (Windows based interface for configuration, diagnostics and report generation), but is also used by preference for ModBus communication with Flow Computers, DCS systems, PLC and other ModBus hosts, if they are able to handle ModBus TCP/IP. If not, ModBus serial to TCP/IP are easily available nowadays. For existing systems the 2 serial ModBus ports can of course also be used.

The picture below shows a typical set-up:

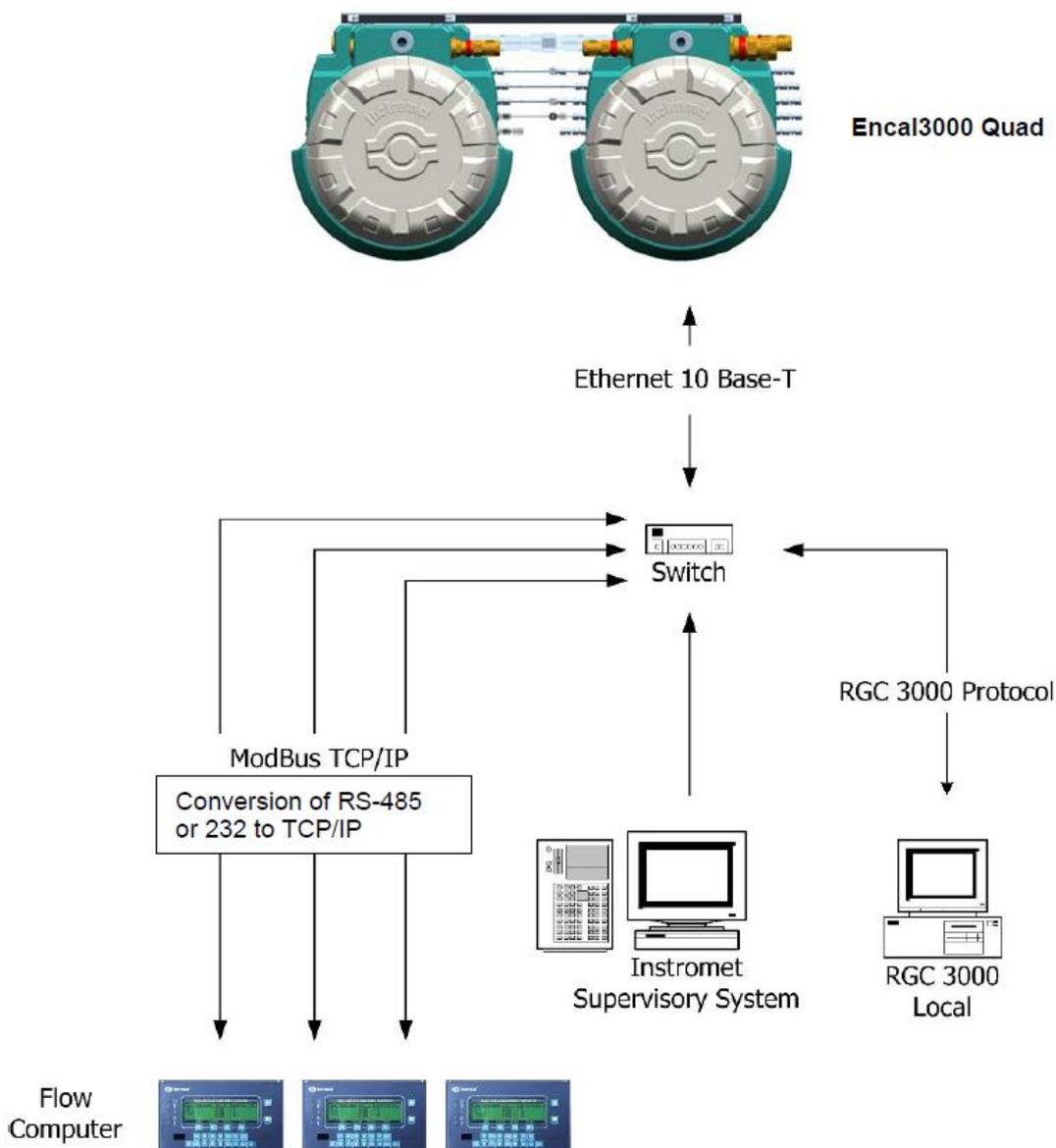


fig. 4-1 Typical Data Communication Set-up for Ethernet Communication with the EnCal 3000 Quad

4.2 Local Serial ModBus Data Communication

Flow computers or another ModBus host could also be directly connected to one of the 2 serial ModBus ports internally integrated in the EnCal 3000 Quad.

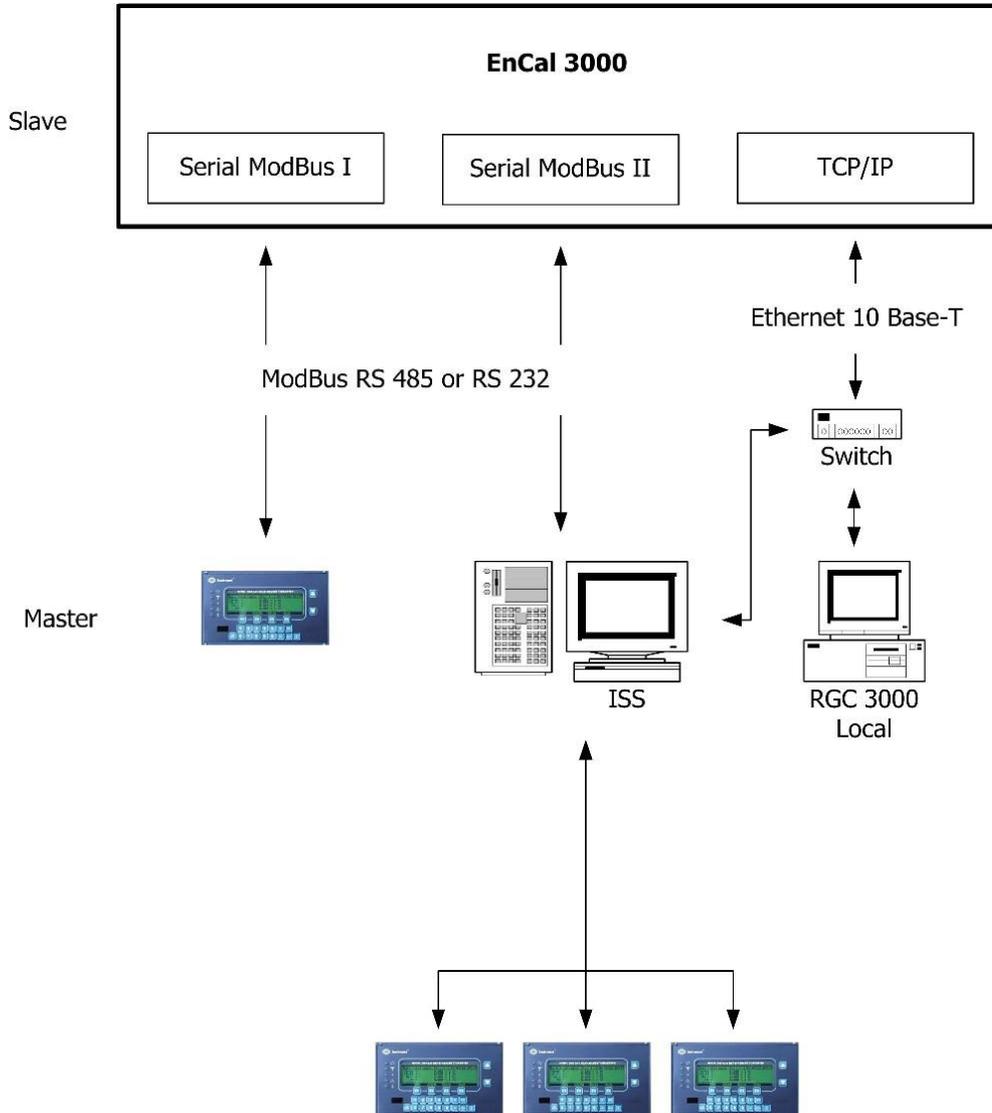


fig. 4-2 Typical Data Communication Set-up for TCP/IP combined with Serial ModBus Communication with the EnCal 3000 Quad

4.3 Remote Access

The schematic below shows the different options for remote access to the EnCal 3000 Quad:

Through Internet:

- Or through a direct connection of the Ethernet switch with Internet (through cable or ADSL modem, or wireless)
- Or through a VPN connection with the customer's network, if the Ethernet switch or the local PC is integrated in this network. In this case the customer has to give (if required only temporarily) a User Account and Login ID to the remote PC.

If network connection is not available, telephone line connection is also possible:

- Or by using an Ethernet modem with dial-in capability
- Or by using the internal modem of the local PC, and a remote access program like PC Anywhere.

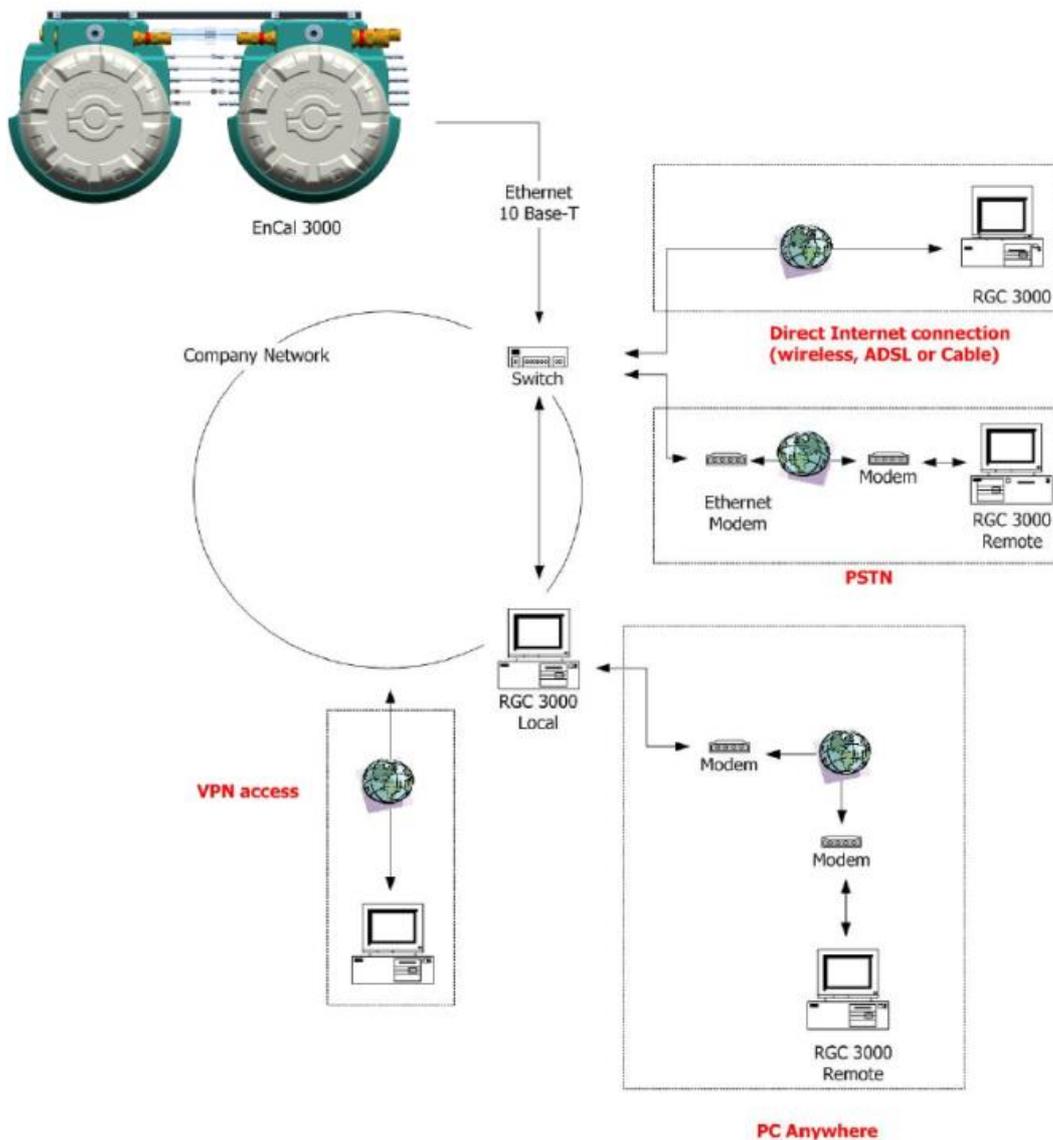


fig. 4-3 Remote Access to the EnCal 3000 Quad

4.4 ModBus Communication

The picture below shows the ModBus Configuration screen for the EnCal 3000 Quad (see also Software Manual)

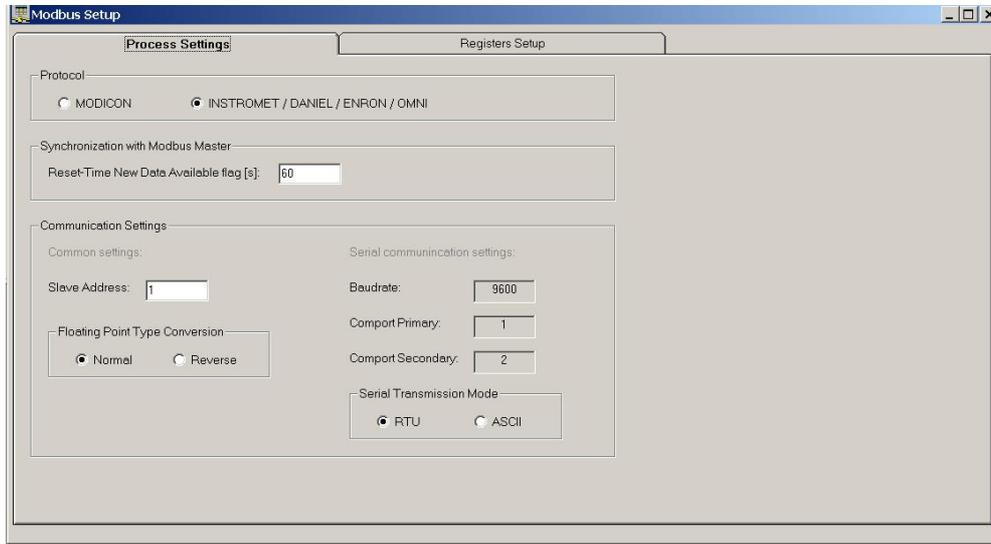


fig. 4-4 ModBus Configuration Screen

The ModBus registers are user configurable:

#	Active	Register Type	Register #	Data Type	Parameter ID.	Channel	Peak#
15	<input checked="" type="checkbox"/>	2. Holding Register (RW)	7009	3. Float	2401. Appl.: Stream Component Norm%(Double, CHAN=stream, PEAK)	1. Stream 1	9

2. Holding Register (RW)	3. Float	2401. Appl.: Stream Component Norm%(Double, CHAN=stream, PEAK)	1. Stream 1
0. Coil Status (RW)	0. Bit	2401. Appl.: Stream Component Norm%(Double, CHAN=stream, PEAK)	0. None
1. Input Status (R)	1. Int16	2402. Appl.: Stream Alarm on Index(Int32, CHAN=stream, PEAK=index)	1. Stream 1
2. Holding Register (RW)	2. Int32	2403. Appl.: Stream Overall Alarm Status (Int32, CHAN=stream)	2. Stream 2
3. Input Register (R)	3. Float	2404. Appl.: Stream Compressibility (Double, CHAN=stream)	3. Stream 3
		2405. Appl.: Stream Wobbe Superior (Double, CHAN=stream)	4. Stream 4
		2406. Appl.: Stream ISO Hs (Double, CHAN=stream)	5. Stream 5
		2407. Appl.: Stream ISO Hi (Double, CHAN=stream)	6. Stream 6
		2408. Appl.: Stream ISO Abs.Density (Double, CHAN=stream)	

fig. 4-5 ModBus Register Details

- Register Type: Either Read Only (R) or Read/Write (RW), and either bit (Status) or register size
- Register #: User selectable. For the Instromet protocol be aware of the following restrictions:
 - 0 – 4999 : 2 bytes per Registers
 - 5000 – 6999: 4 bytes Integers
 - 7000 – higher: 4 bytes Floating Point
 The Modicon protocol always uses 4 registers
- Data Type: Bit when Status is defined, Integer (16 bit or 32 bit) or Float when Register is defined
- Parameter ID: Instruction set which is available in EnCal 3000 Quad.
- Channel: This column is reserved to define channel # or stream #, depending on the type of Parameter ID defined
- Peak #: Component number, if applicable

For further details concerning the Modbus communication please refer to the Software Manual of RGC 3000.

5 Hardware Installation

5.1 Installation specifications

5.1.1 Weight and Dimensions

Weight:	< 60 kg for complete Quad device	
Dimensions:	Analyser	: two combined housings Ø 37 x H 37 cm (Ø 14.5" x H 14.5")
	Installation Clearance	: 100 cm x 42 cm x H 70 cm (40" x 17" x H 28")

5.1.2 Installation clearance

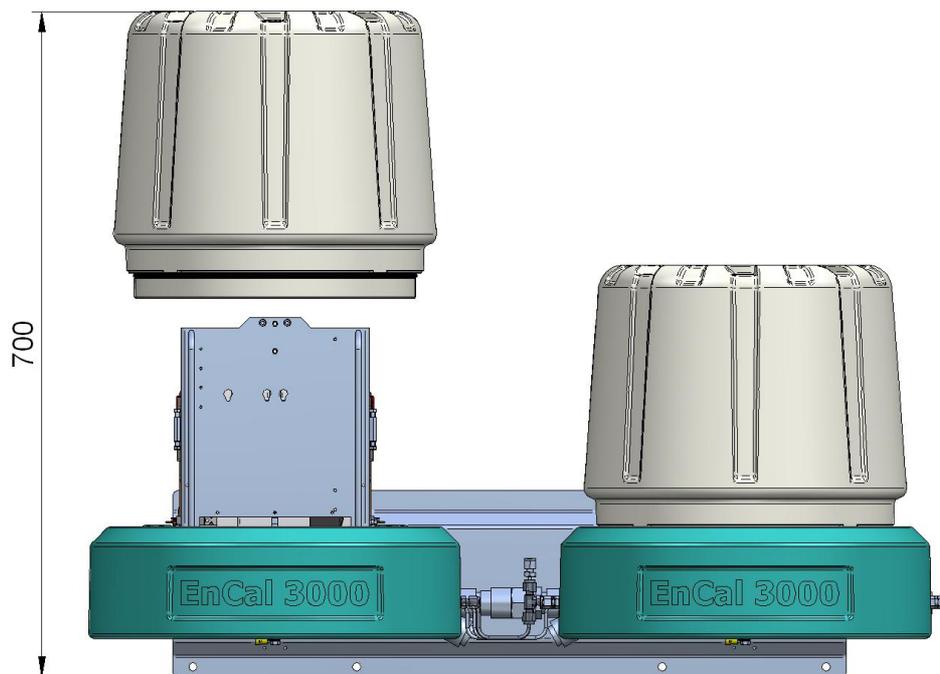


fig. 5-1 Mounting Dimensions and Installation Clearance I

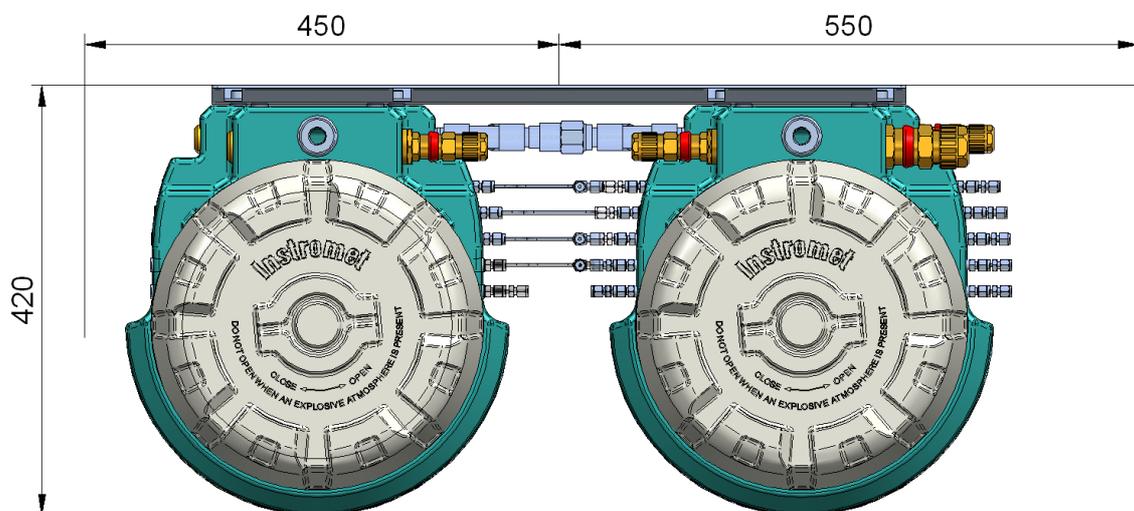
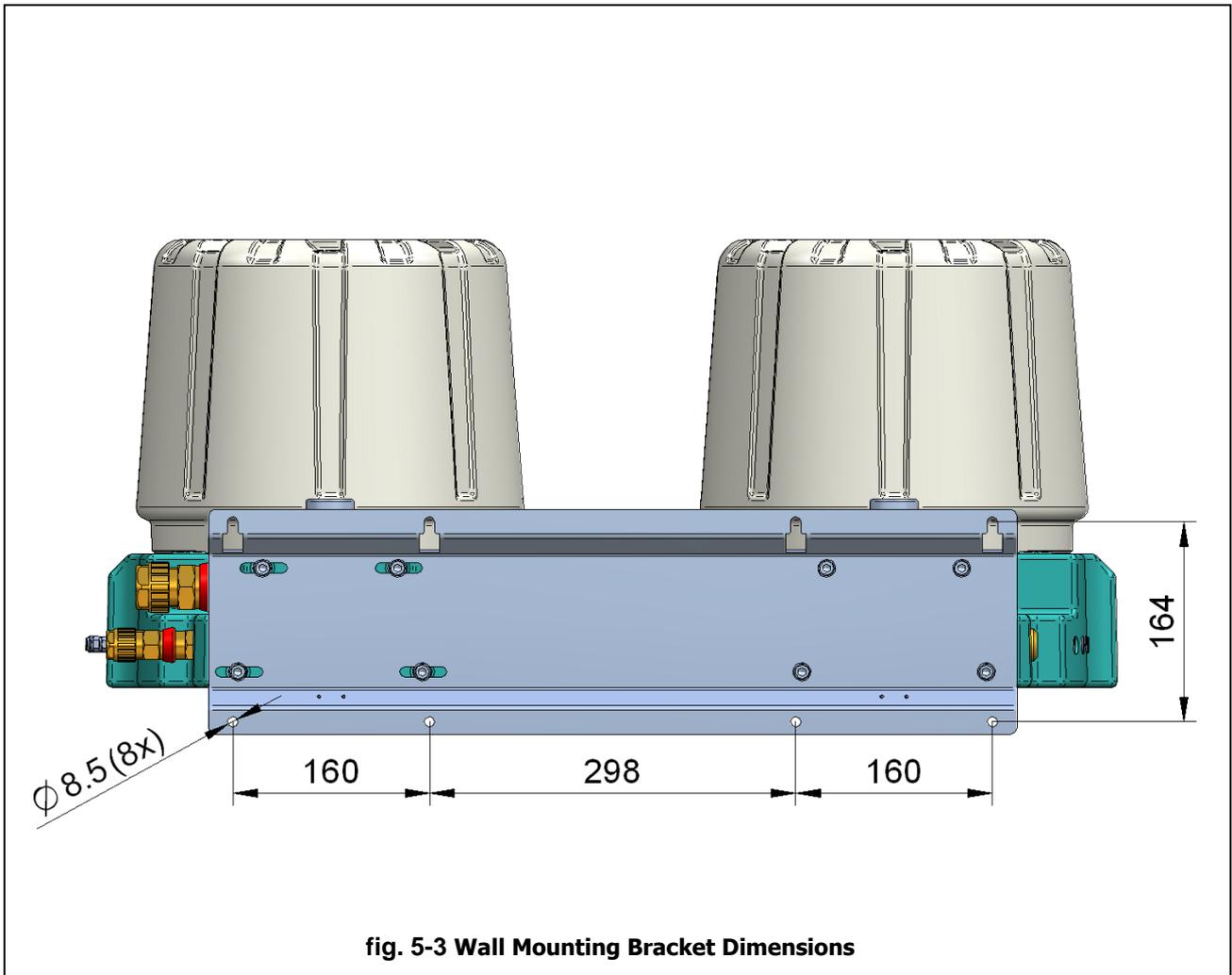


fig. 5-2 Mounting Dimensions and Installation Clearance II

5.1.3 Wall mounting



Because the weight of the EnCal 3000 surpasses 55 kg, care must be taken when lifting or transporting the unit. Make sure to carry the unit with at least 3 persons when no means for lifting and carrying are available

5.1.4 Connection of utilities

Gas lines:	HE	Helium	5-6 barg (71-86 PSig) Recommended pressure 5.5 barg
	AR	Argon	5-6 barg (71-86 PSig) Recommended pressure 5.5 barg (Second carrier gas only to analyse biogas or hydrogen in natural gas. In standard applications this connection is not used and closed without piping inside.)
	STR1	Stream 1	1-4 barg (15-57 PSig)
	STR2	Stream 2	1-4 barg (15-57 PSig)
	STR3	Stream 3	1-4 barg (15-57 PSig)
	STR4	Stream 4	1-4 barg (15-57 PSig)
	STR5	Stream 5	1-4 barg (15-57 PSig)
	CAL	Calibration Gas	1-4 barg (15-57 PSig)
	PV	Purge Vent	
	SBV	Sample + Block and Bleed Vent	

All gas and vent lines do have a 1/8" (or optional 3 mm) Swagelok connections to the EnCal 3000

Following figure shows the location of the connections to the EnCal 3000 Quad.

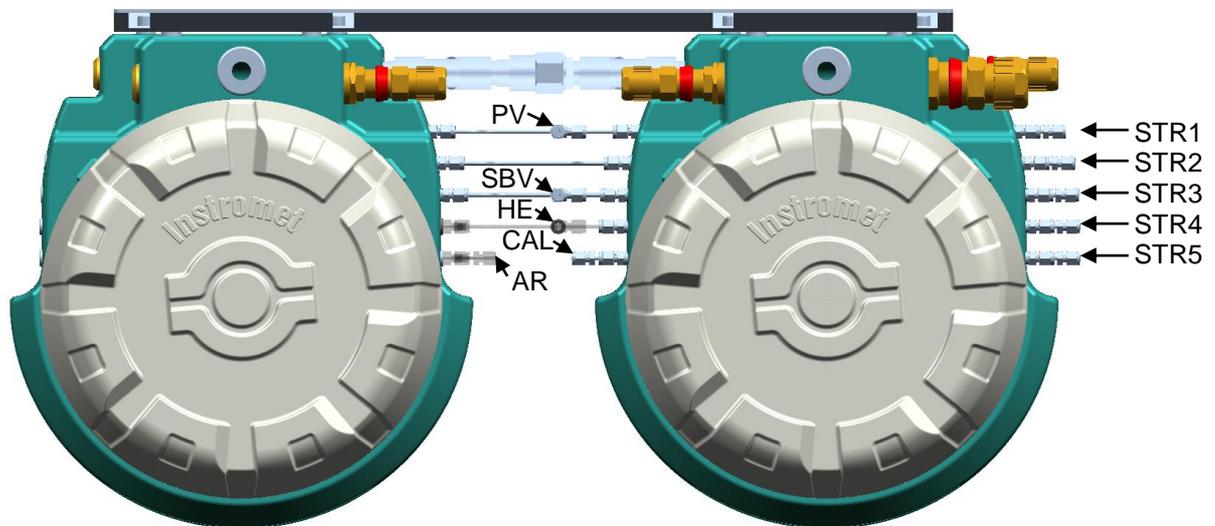


fig. 5-4 Connections to the EnCal 3000 Quad

If the second carrier gas Argon is not needed for any channel than the connection for AR becomes plugged.

Power Supply cable

- 24 VDC / 240 W max
- Conductor cross section: AWG 12-13 (2.5 - 4 mm²)
- Armoured cable required for outdoor installation – OD between 12 and 25 mm

Data Communication

- Ethernet : shielded twisted 4 wire cable or industrial CAT5
- ModBus Serial : shielded twisted pair

5.1.5 Connections to the EnCal 3000 Interconnection board

The drawing below shows the top lay-out of the Interconnection Board at the bottom of the unit. It contains all the connectors for external cables. All the wiring with the other electronic boards is done in the factory, and may not be changed during field installation.

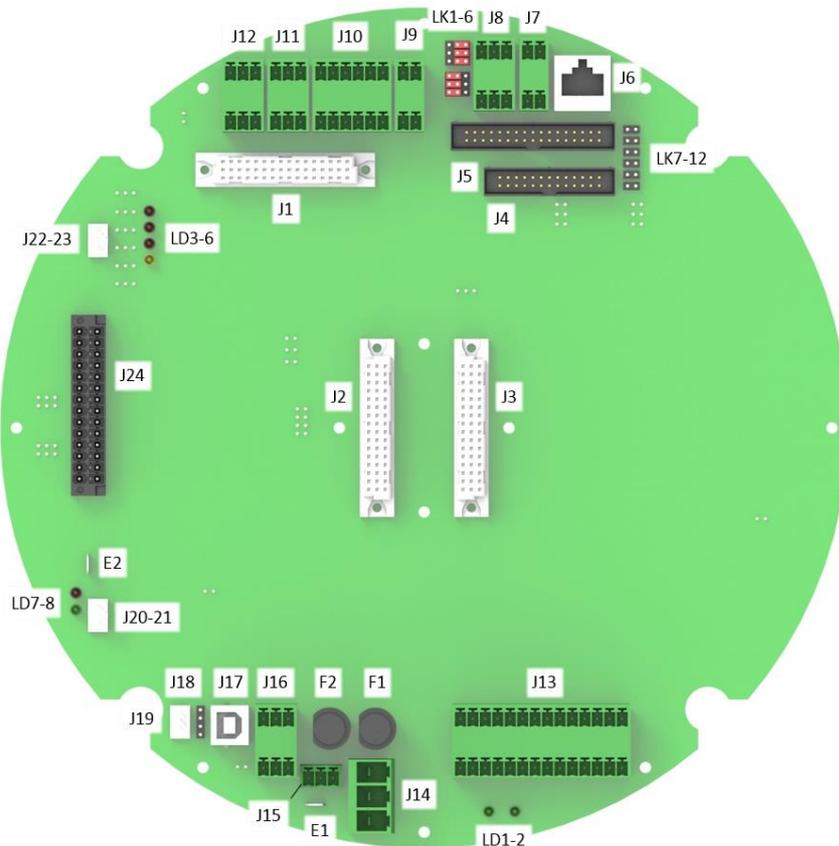


fig. 5-5 Interconnection Board: top view lay-out

J1	Connection of Processor Board	J17	Connection for communication cable used for parameterization of the regulation for the internal heating
J2	Connection for Analytical Module 1	J18	Connection for temperature sensor for regulation of the internal heating
J3	Connection for Analytical Module 2	J19	Connection of over temperature protection for internal heating
J4	26-pin Connector for first part of data connection cable between IC-Board and processor board	J20-23	Power supply connection for internal heating
J5	34- pin Connector for first part of data connection cable between IC-Board and processor board	J24	Connector for data communication between Master and Slave housing
J6	Ethernet cable connection	E1-E2	optional connector for shield of cables
J7	Connection for TCP-IP communication	F1	Fuse 5A for die analytical Modules
J8	Connection for Modbus-Communication	F2	Fuse 5A for heating circuit
J9	Connection for Digital Inputs (passive)	LD1	LED 24V Power Supply
J10	Connection for Analogue Inputs (0-10 V DC)	LD2	LED 12V Supply for analytical modules and Vents
J11	Connection for 24V supply of external transmitters (24V, 25 mA)	LD3-6	LEDs Diagnostic of Analogue Outputs
J12	Connection for Analogue Outputs (4-20mA)	LD7-8	LEDs Diagnostic of internal Heating
J13	14-pin Connector for supply of timed relays and Vents	LK1-6	Jumper-Connections for RS232 and RS485
J14	24V Power Supply Connection	LK7-12	Jumper-Connections for data communication cable between IC-Board and processor board
J15-J16	Additional optional 24V supply		

Power Supply Connection:

Power Supply is 24 VDC, with conductor size AWG 12-13 (2.5 – 4 mm²). The Interconnection boards of master and slave units are connected to the connector J14. It is a 3-pin plug connector, but only two-wire connection (+ and -) are needed. Don't connect a third wire for the ground. Instead of that the devices should be grounded at the bottom of each housing at a M5 connection or at a free M8 connection at the mounting plate.

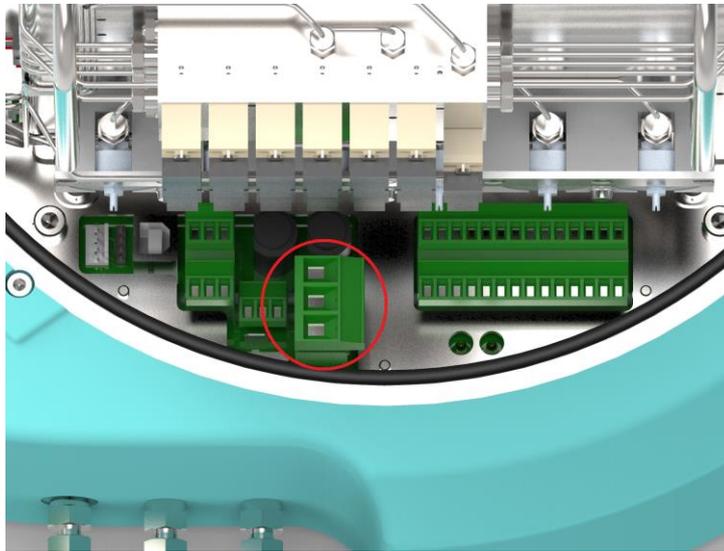


fig. 5-6 Location of Power Supply connector (J14)

Ethernet connection:

The Ethernet connection is used for connection with a PC or ModBus TCP/IP clients. It uses 4 wires, connected to connector J7. See picture below for location and wiring scheme.

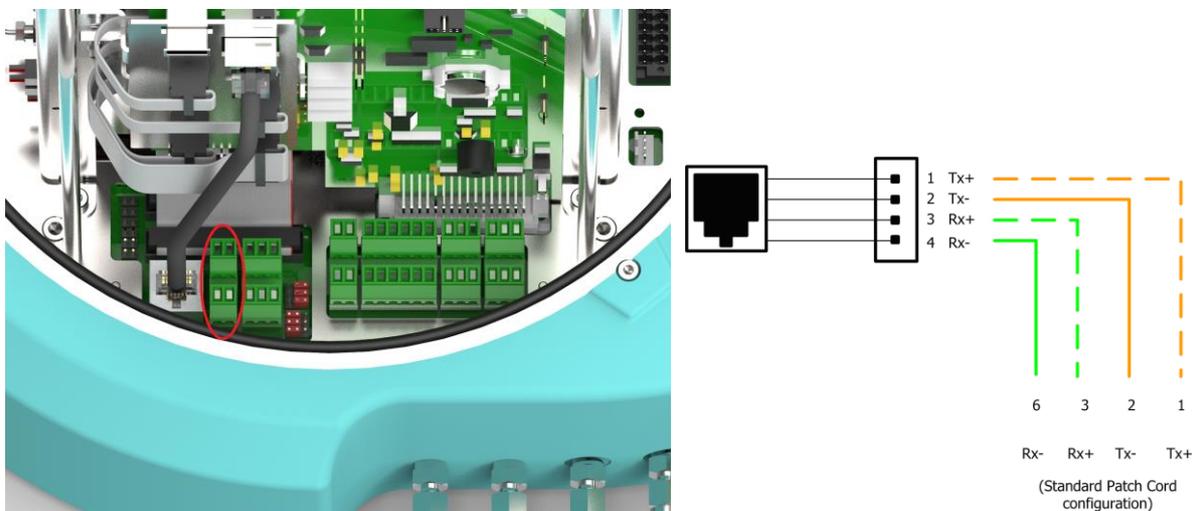


fig. 5-7 Location of Ethernet connector (J7) and wiring scheme

Serial ModBus connection

The Serial ModBus connection is used for connection with Serial ModBus clients like for example Flow Computers. The EnCal features 2 Serial ModBus ports with identical output. They are both independently configurable for RS232 or RS485 communication through link settings 301 to 304 (see pictures below for location, wiring scheme and link settings).

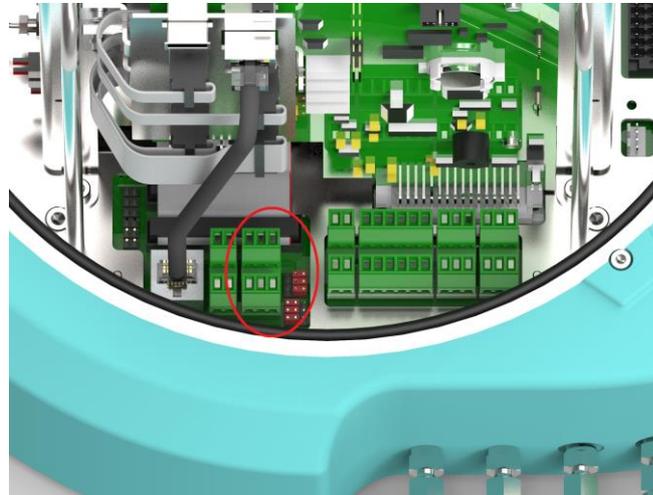
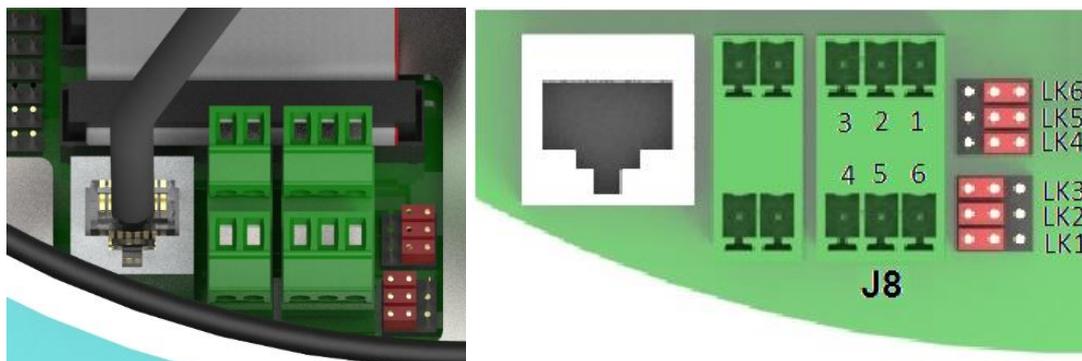


fig. 5-8 Location of Serial ModBus connector (J8)



Position in J8	Signal	Jumper Setting	Port-Type	Remarks
1	A	LK1 right	RS485	Like shown in the above picture
2	B	LK2 right	RS485	
3	0	LK3 right	RS485	
4	A	LK4 right	RS485	
5	B	LK5 right	RS485	
6	0	LK6 right	RS485	
1	A	LK1 left	RS232	Like shown in the above picture
2	B	LK2 left	RS232	
3	0	LK3 left	RS232	
4	A	LK4 left	RS232	
5	B	LK5 left	RS232	
6	0	LK6 left	RS232	

fig. 5-9 Modbus Connection and Link settings (J8)

5.2 Hardware Start-up



Electrical Installation in Hazardous Areas

The start-up should be done by an experienced technician, with a proven knowledge of electrical installations in explosion proof areas. Always remember to make sure there is no hazardous condition present during installation. Follow the instructions below carefully and make sure you have fulfilled all necessary safety steps before powering up the EnCal 3000.

Gas connections:

- Make sure the helium cylinder is tightly secured to the wall and the regulators are tightly mounted on the cylinder. Check the helium and Argon quality (5.0 – equivalent to Zero Grade classification - or better). Do not connect yet the tubing to the helium inlet at the EnCal 3000. Open carefully the helium regulator and check the helium pressure at the outlet of the regulator. Adjust to 5.5 barg (80 psig). Purge the tubing before connecting to the EnCal 3000 for about 30s. Make the connection with inlet HE. Check for leaks.
- Make sure the calibration gas cylinder is tightly secured to the wall and the regulators tightly mounted on the cylinder. Check the calibration gas certificate. The tube should be flushed once before it is connected to the Encal3000. Open carefully the calibration gas regulator and check the calibration gas pressure at the outlet of the regulator. Adjust to 1-4 barg (15-57 psig). Purge the tubing before connecting to the EnCal 3000 for about 30 seconds. After the connection a check for leaks is required.
- Check the stream gas pressure at the connection point with the EnCal 3000. Adjust to 1-4 barg (15-57 psig). Purge the tubing before connecting to the EnCal 3000 for about 30s. Make the connection with inlet **STR1**. Check for leaks. Repeat this procedure for the other streams if applicable.
- Do a leak test of the total system.

Power Supply cable:

- Standard industrial 2-wire cable.
(The use of an external junction box is responsibility of the customer / installer)
- Power rating 50 W nominal (120 W start-up peak) for non-heated version (ambient T > 0°C or 32°F).
- Power rating 120 W nominal (240 W start-up peak) for heated version (ambient T < 0°C or 32°F).
- For the location of the internal connector see figure 5.6.

Data communication cable:

- Ethernet cable (PC and/or ModBus TCP/IP clients):
Standard straight cable, shielded twisted 4 wire cable or industrial CAT5 quality. For the location of the Ethernet connector see figure 5.7.
- Serial Modbus:
 - Standard industrial data communication cable twisted pair
 - 3-wire for RS 485 communication
 - 3-wire for RS 232 communication

- 2 serial ModBus ports are available, each of them independently user configurable into RS 232 or 485 (Pin lay-out and link location see figures 5.8 and 5.9)

Mount the cap on the unit, hand-tight fixed. Turn up the security screws to prevent removing of the cap by accident or ignorance.

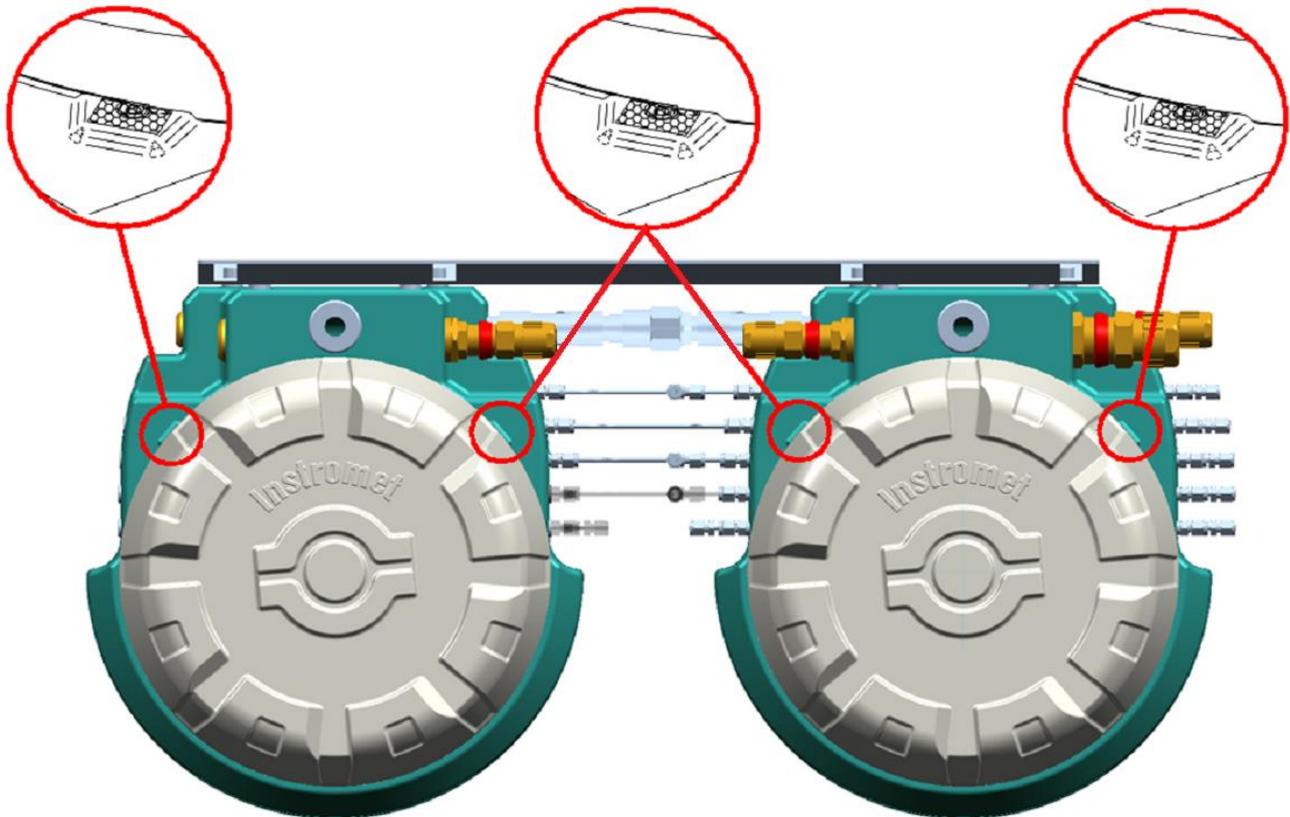


fig. 5-10 Location of security screws to fix the cap after mounting on the base



Check one more time if all gas connections are leak tight connected and all cable glands for electrical connection are securely tight. Check also one more time the different gas pressures for correct settings

Apply power to the unit (24 VDC) by turning on the external switch.

The unit will automatically start-up. The start-up sequence takes about 5 minutes, including temperature and pressure stabilisation, and system flushing. After this sequence the unit is ready for the software configuration.

APPENDIX 1: CERTIFICATES ENCAL 3000



CERTIFICATE

(1) EC-Type Examination

(2) Equipment and protective systems intended for use in potentially explosive atmospheres - Directive 94/9/EC

(3) EC-Type Examination Certificate Number: **KEMA 05ATEX2191 X** Issue Number: 3

(4) Equipment: **Gas Analyzer type ENCAL 3000**

(5) Manufacturer: **Elster-Instromet GmbH**

(6) Address: **Steinern Straße 19 – 21, 55252 Mainz-Kastel, Germany**

(7) This equipment and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) DEKRA Certification B.V., notified body number 0344 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the directive.

The examination and test results are recorded in confidential test report number 212675200/3

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0 : 2012 EN 60079-1 : 2014

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-Type Examination Certificate relates only to the design, examination and tests of the specified equipment according to the Directive 94/9/EC. Further requirements of the directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment shall include the following:

**II 2 G Ex d IIB T4 Gb**

This certificate is issued on 23 April 2015 and, as far as applicable, shall be revised before the date of cessation of presumption of conformity of (one of) the standards mentioned above as communicated in the Official Journal of the European Union.

DEKRA Certification B.V.



T. Pijpker
Certification Manager

Page 1/2

 Integral publication of this certificate and adjoining reports is allowed. This Certificate may only be reproduced in its entirety and without any change.

DEKRA Certification B.V. Meander 1051, 6825 MJ Arnhem P.O. Box 5185, 6802 ED Arnhem The Netherlands
T +31 88 96 83000 F +31 88 96 83100 www.dekra-certification.com Registered Arnhem 09085396



(13) **SCHEDULE**

(14) to EC-Type Examination Certificate KEMA 05ATEX2191 X Issue No. 3

(15) **Description**

The Gas Analyzer type ENCAL 3000 is used to measure the concentrations of the different components of a gas.

Ambient temperature range -40 °C to +55 °C.

Electrical data

Power supply 24 Vdc, max. 170 W

Installation instructions

The instructions provided with the equipment shall be followed in detail to assure safe operation.

(16) **Test Report**

No. 212675200/3.

(17) **Specific conditions of use**

The flameproof enclosure shall not be opened when an explosive gas atmosphere may be present.

The process pressure shall be limited to 2 MPa to ensure that the pressure rise inside the flameproof enclosure remains below 10 kPa.

For information on the dimensions of the flameproof joints the manufacturer shall be contacted.

(18) **Essential Health and Safety Requirements**

Covered by the standards listed at (9).

(19) **Test documentation**

As listed in Test Report No. 212675200/3.



IECEX Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION IEC Certification Scheme for Explosive Atmospheres

for rules and details of the IECEx Scheme visit www.Iecex.com

Certificate No.:	IECEX KEM 10.0094X	Issue No: 2	Certificate history:
Status:	Current	Page 1 of 4	Issue No. 3 (2015-12-10)
Date of Issue:	2015-04-30		Issue No. 2 (2015-04-30)
Applicant:	Elster GmbH Steinern Straße 19-21 55252 Mainz-Kastel Germany		Issue No. 1 (2014-03-21)
Equipment:	Gas Analyzer type ENCAL 3000		Issue No. 0 (2010-12-31)
<i>Optional accessory:</i>			
Type of Protection:	Ex d		
Marking:	Ex d IIB T4 Gb		

*Approved for issue on behalf of the IECEx
Certification Body:*

T. Pijpker

Position:

Certification Manager

*Signature:
(for printed version)*

Date:

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website.

Certificate issued by:

DEKRA Certification B.V.
Meander 1051
6825 MJ Arnhem
The Netherlands





IECEX Certificate of Conformity

Certificate No: IECEx KEM 10.0094X Issue No: 2
Date of Issue: 2015-04-30 Page 2 of 4
Manufacturer: Elster GmbH
Steinern Straße 19-21
55252 Mainz-Kastel
Germany

Additional Manufacturing
location(s):

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:

The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2011 Explosive atmospheres - Part 0: General requirements
Edition:6.0
IEC 60079-1 : 2014-06 Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"
Edition:7.0

This Certificate does not indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.

TEST & ASSESSMENT REPORTS:

A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in

Test Report:

NL/KEM/ExTR10.0103/00 NL/KEM/ExTR10.0103/01

Quality Assessment Report:

DE/TUN/QAR11.0003/01



IECEx Certificate of Conformity

Certificate No: IECEx KEM 10.0094X

Issue No: 2

Date of Issue: 2015-04-30

Page 3 of 4

Schedule

EQUIPMENT:

Equipment and systems covered by this certificate are as follows:

Description

The Gas Analyzer type ENCAL 3000 is used to measure the concentrations of the different components of a gas.

Ambient temperature range -40 °C to +55 °C.

Electrical data

Power supply : 24 Vdc, max. 170 W.

CONDITIONS OF CERTIFICATION: YES as shown below:

The flameproof enclosure shall not be opened when an explosive gas atmosphere may be present.

The process pressure shall be limited to 2 MPa to ensure that the pressure rise inside the flameproof enclosure remains below 10 kPa.

For information on the dimensions of the flameproof joints the manufacturer shall be contacted.



IECEX Certificate of Conformity

Certificate No: IECEx KEM 10.0094X

Issue No: 2

Date of Issue: 2015-04-30

Page 4 of 4

DETAILS OF CERTIFICATE CHANGES (for issues 1 and above):

New manufacturer adress.

Update to the latest standards.

QAR, NL/DEK/QAR12.0007/00 removed from certificate. Production has been relocated to Mainz-Kastel.

APPENDIX 2: DECLARATION OF CONFORMITY ENCAL 3000



EU Declaration of Conformity No. **DEMZE1621**
 EU-Konformitätserklärung Nr.



Type, Model
 Typ, Ausführung

EnCal3000

Manufacturer
 Hersteller

Elster GmbH, Postfach 1880, D - 55252 Mainz-Kastel; Steinern Straße 19-21

Product
 Produkt

Gas Chromatograph
 Gaschromatograph

This declaration of conformity is valid for the following Directives:

Diese Konformitätserklärung gilt für folgende Richtlinien:

until 19 April 2016: / bis 19. April 2016:

2004/108/EG (EMC)	94/9/EC (ATEX)
-------------------	----------------

from 20 April 2016: / ab 20. April 2016:

2014/30/EU (EMC)	2014/34/EU (ATEX)
------------------	-------------------

The object of the declaration described above is in conformity with the relevant harmonization legislation from the European Union:

Der oben beschriebene Gegenstand der Erklärung erfüllt die einschlägigen Harmonisierungsrechtsvorschriften der europäischen Union:

EN 61000-6-2:2005 EN 61000-6-4:2007	EN 60079-0:2012 EN 60079-1:2014
--	------------------------------------

Certificates and interventions by notified bodies:

Bescheinigungen und Maßnahmen durch notifizierte Stellen:

Not applicable Entfällt	KEMA 05 ATEX 2191 X
	EU-type examination EU-Baumusterprüfung
	DEKRA Certification B.V. Meander 1051 6825 MJ Arnhem Netherlands

This declaration of conformity is valid for products labelled accordingly:

Diese Konformitätserklärung gilt für entsprechend gekennzeichnete Produkte:

CE	CE ₀₀₄₄ Ex II 2G Ex d IIB T4 Gb
-----------	--

The production is subject to the following surveillance procedures:

Die Herstellung unterliegt folgenden Überwachungsverfahren:

Directive Annex II Richtlinie Anhang II	Directive Annex IV+VII Richtlinie Anhang IV+VII
	Notified Body 0044 TÜV NORD CERT GmbH D-30519 Hannover

This declaration of conformity is issued under the sole responsibility of the manufacturer. If alterations are made to the product or it is modified, this declaration becomes void with immediate effect.

Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller. Bei Umbau des Produkts oder Änderungen am Produkt verliert diese Erklärung mit sofortiger Wirkung ihre Gültigkeit.

Elster GmbH

Signed for and on behalf of
 Unterzeichnet für und im Namen von

Mainz-Kastel, 06.04.2016

Place and date of issue
 Ort und Datum der Ausstellung



Dr. Harald Dietrich, Managing Director