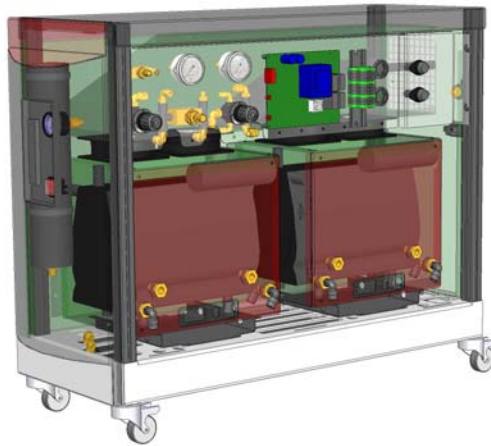




MATHESON TRI•GAS

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USER MANUAL



LCMS M-4 NITROGEN GENERATOR

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This manual is valid for the LCMS M-4 nitrogen generator in its standard version. Matheson Tri-Gas can therefore not be held liable for specifications of the delivered system that may deviate from the standard version.

For information concerning adjustments, maintenance or repairs not contained in this manual, please contact Matheson Tri-Gas.

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1 Introduction

1.1 General

The *LCMS M-4* nitrogen generator is a product of Matheson Tri-Gas. This manual forms an integral part of the product. The manual describes the installation, daily operation, maintenance and troubleshooting.

Content

Read the manual carefully before you start with the LCMS M-4 nitrogen generator. Familiarize yourself with the content.

Changes to Product

Only execute changes to the LCMS M-4 nitrogen generator after explicit prior written permission by Matheson Tri-Gas. Non-conformance to this rule, as well as any consequential damage, loss and costs are the responsibility of the owner and the user.

Information

All information in this manual, including additional drawings and technical descriptions, remains the property of Matheson Tri-Gas and may not be used (otherwise than for the use of this product), copied, multiplied or published to or for a third party without explicit prior written permission by Matheson Tri-Gas.

1.2 Pictograms in this manual

In this manual the following pictograms are used:



Warning

A warning shows a hazard that can cause death or serious injury. Follow the instructions.



Caution

A caution shows a danger that can cause damage to the equipment. Follow the instructions.



Electricity

High voltage: danger of electric shock.



Warning

Risk for death due to suffocation



Risk of fire

Oxygen-enriched air leads to an increased risk of fire in the event of contact with inflammable products.



High-pressure risk

Follow the instructions with respect to compressed gasses.



Environment

Instructions with respect to the environment

1.3 Identification and service

The identification plate is located on the right hand side of the LCMS M-4 nitrogen generator. The identification plate shows the characteristics of the LCMS M-4 nitrogen generator.

For service and technical assistance, please contact:

MATHESON TRI-GAS

166 Keystone Drive
Montgomeryville, PA 18936

Phone: 215-641-2700

Fax: 215-641-2714

Email: mtgmmville@matheson-trigas.com

1.4 Certificates

The LCMS M-4 nitrogen generator meets the following requirements:

Subject	Applicable standard
Directive for electromagnetic compatibility (EMC)	EN-50081-1, EN50082-2
Low Voltage Directive	NEN EN 60204-1
Pressure equipment directive (PED)	Sound engineering practice
Quality assurance	ISO 9001:2000
Environmental care	ISO 14001:1996

1.5 Intended uses

The LCMS M-4 nitrogen generator is intended to make nitrogen out of normal ambient air. The system is based on gas separation membranes. The system is not to be used for any other purpose. Matheson Tri-Gas will not accept any liability for improper use.

The LCMS M-4 nitrogen generator is in compliance with the prevailing directives and standards. Only use this LCMS M-4 nitrogen generator in a technically perfect condition, in conformity with the purpose as described above.

1.6 User responsibilities

Only well-trained personnel are allowed to work on the LCMS M-4 nitrogen generator. The user must be aware of hazards related to operating the LCMS M-4 nitrogen generator and processes connected to the LCMS M-4 nitrogen generator. The user is responsible for the safety of the personnel. All personnel working on the LCMS M-4 nitrogen generator must have free access to the applicable manuals.

1.7 Liability

Matheson Tri-Gas will not accept any liability if:

- The instructions in this manual are ignored.
- Replacement parts are used which are not approved by the manufacturer.
- The LCMS M-4 nitrogen generator is operated incorrectly.
- The system is fed with other gasses than air.
- The LCMS M-4 nitrogen generator is modified without notification and authorization of the manufacturer.
- Maintenance and repair are not carried out according to the instructions.

2 Health, safety and environmental compliance

2.1 General

Correct use of the LCMS M-4 nitrogen generator nitrogen generator is important for your personal safety and for trouble-free functioning of the LCMS M-4 nitrogen generator. Incorrect use can cause damage to the LCMS M-4 nitrogen generator or can lead to incorrect gas supply.



Warning


- Read this manual before you start the installation and putting into operation of the LCMS M-4 nitrogen generator. Prevent accidents and damage to the LCMS M-4 nitrogen generator.
- Contact your supplier if you detect a problem that you cannot solve with this manual.
- Use the LCMS M-4 nitrogen generator only for its intended purpose. Refer to section 1.5.
- Only service technicians that are qualified to work on electric and pneumatic equipment, are allowed to do the installation, maintenance and repairs. Unqualified people are not allowed to repair the equipment. Refer to section 1.6. Lift the LCMS M-4 nitrogen generator with a forklift. Follow the instructions for operating the forklift.
- Do not tamper or experiment with the equipment. Do not exceed the technical specifications for the LCMS M-4 nitrogen generator. Refer to chapter 4.

2.2 Nitrogen and oxygen

The LCMS M-4 nitrogen generator generates nitrogen as a product. Oxygen enriched air is released as waste.



Warning

- Nitrogen can cause suffocation!
 - Oxygen-enriched air leads to increased risk of fire in the event of contact with flammable products. Make sure that there is adequate ventilation at all times!
- 
- The LCMS M-4 nitrogen generator is not designed for installation in an explosion proof classified area.
 - Do not install the LCMS M-4 nitrogen generator in an area where explosive mixtures may occur.

2.3 Electricity



Warning

- Only service technicians that are qualified to work on electric equipment, are allowed to do the installation, maintenance and repairs.
- Disconnect the main power supply before you do the maintenance or repair.
- If a service technician has to work on the LCMS M-4 nitrogen generator while electricity is connected then the service technician must be very careful with respect to the electric hazards.

2.4 Safety precautions



Warning

- Make sure that the ventilation rate is sufficient in the room where the enriched oxygen is ventilated, or lead the enriched air outside.
- Keep the ambient temperature between 50 and 95°F (10 and 35 °C).
- Install the peripheral equipment, piping and nitrogen storage vessels according to standard procedures.
- Do regular maintenance to the LCMS M-4 nitrogen generator, to ensure proper and safe operation. Refer to section 8.
- Make sure that instructions concerning health and safety are compliant with the local rules and regulations.

2.5 Environmental compliance

The use and maintenance of the LCMS M-4 nitrogen generator does not include environmental dangers. Most parts are made of metal and can be disposed in the regular way. The packaging of the LCMS M-4 nitrogen generator is 100% recyclable.



Make sure that instructions concerning health, safety and environment are compliant with the local rules and regulations.

3 Description

3.1 General

The LCMS M-4 nitrogen generator separates compressed air produced by an on-board compressor into nitrogen and an air stream enriched with oxygen. The separation system is based on membranes.

3.2 Separation principle

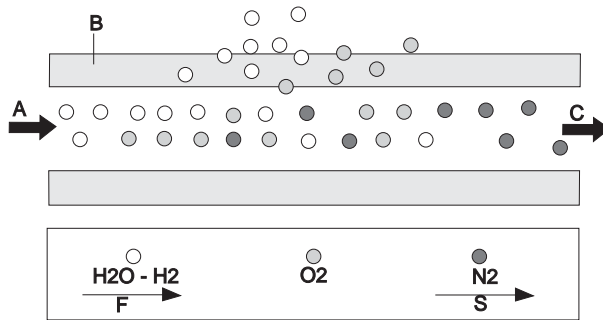


Fig. 3-1: Separation principle

- | | |
|-------------------------|-------------------|
| A Pressurized air inlet | E Nitrogen outlet |
| B Hollow fiber membrane | F Fast permeation |
| C Separation layer | G Slow permeation |
| D Support layer | |

Ambient air contains nitrogen (78.1%), oxygen (20.9%), argon (1%), carbon dioxide, water vapor and traces of other inert gasses. Pressurized air (A) is led through hollow fiber membranes (B). The various air components diffuse through the porous wall of the membranes.

The diffusion rate differs for the various gasses:

- Oxygen and water vapor have a high diffusion rate and diffuse rapidly through the membrane wall.
- Nitrogen has a low diffusion rate and diffuses slowly through the membrane wall.
- Pressurized nitrogen enriched air is released at the outlet of the membranes (E) which can be stored in a nitrogen storage vessel.

3.3 Parts

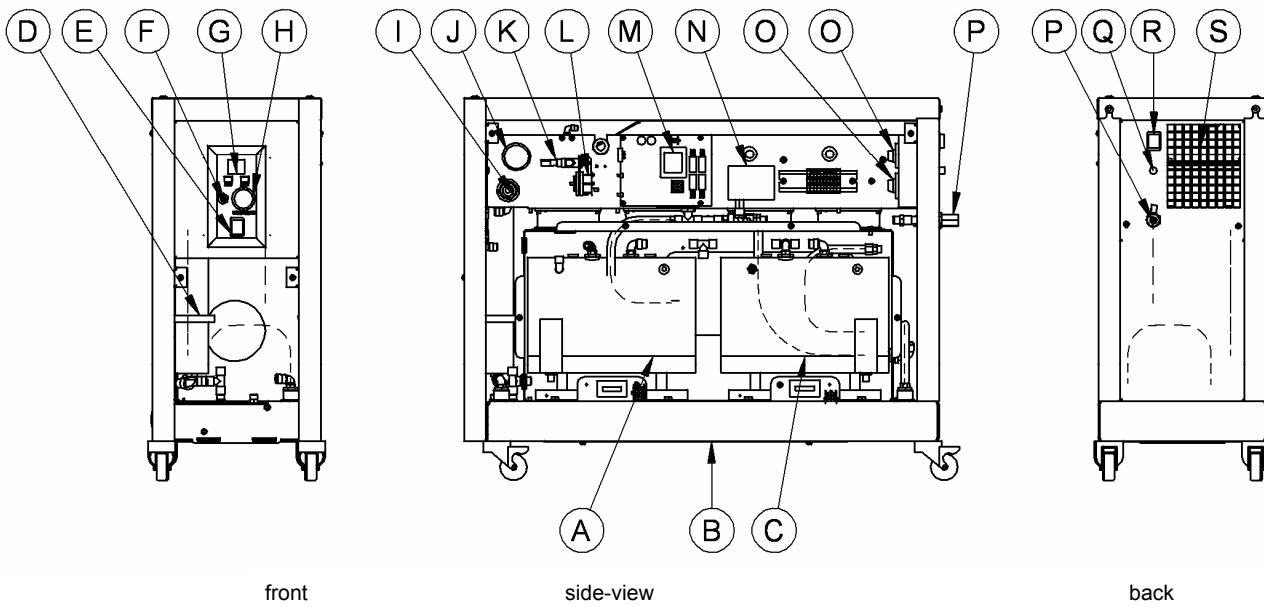


Fig. 3-2: LCMS M-4 Nitrogen Generator

- | | |
|---------------------------------------|--|
| A High/low pressure compressor | K Flow control valve (FVC3) |
| B Hollow fibre membrane (M) | L O ₂ -sensor |
| C Low pressure compressor | M Printed circuit board with two digit service display |
| D Inlet carbon filter | N Pressure switch (PSH) |
| E Power switch | O Fuses |
| F Flow control valve (FCV) | P Ball valve (V2) |
| G O ₂ -display | Q Power inlet socket |
| H Delivery pressure gauge (PI2) | R Main switch |
| I Pressure control valve (PCV) | S Cooling air exhaust outlet |
| J Compressed air pressure gauge (PI1) | |

3.4 Process Diagram

The LCMS M-4 nitrogen generator can be connected directly to the application (Fig. 3-3) or to a buffer vessel (Fig. 3-4).

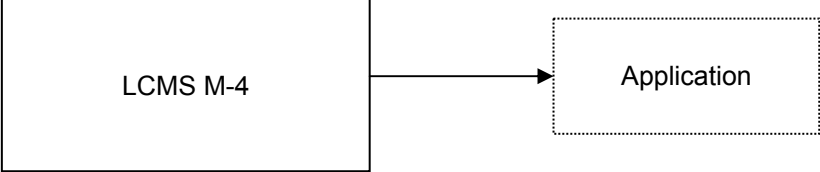


Fig. 3-3

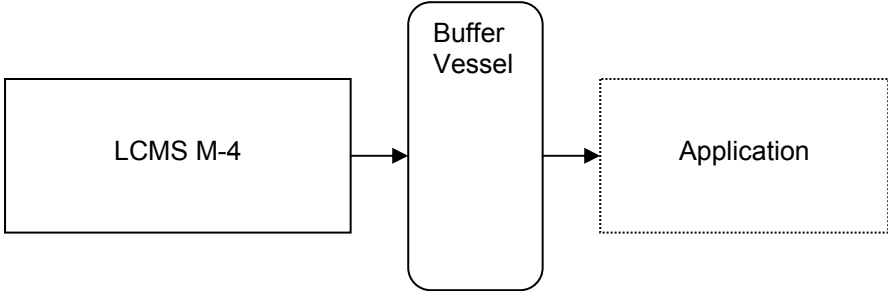
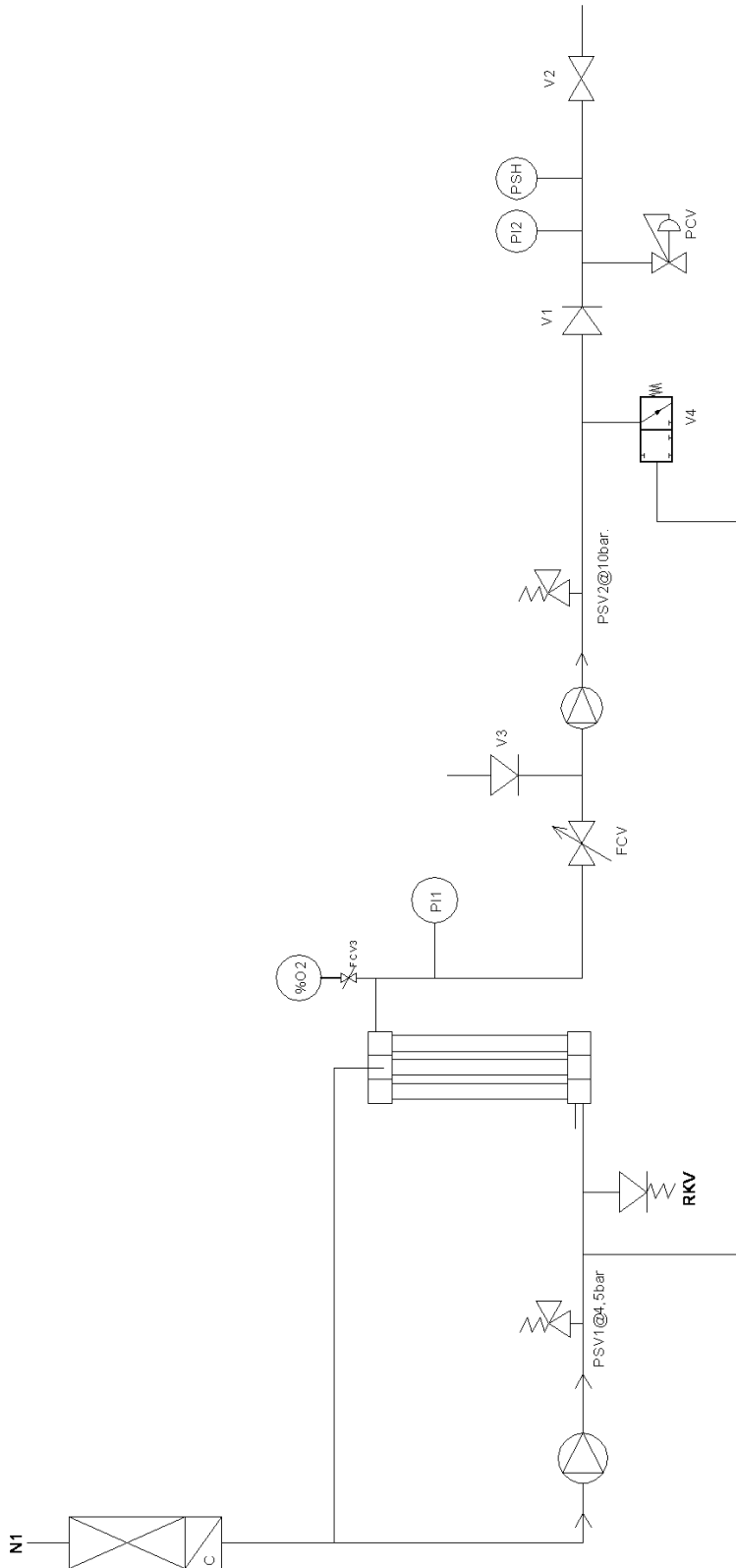


Fig. 3-4

3.5 Process Schematic



N1	Air inlet
C	Inlet carbon filter
LP	Air compressor
RKV	Start up valve
M	Gas separation membrane
PI1	Membrane pressure indicator
FCV	Flow control valve
HP	Nitrogen compressor
PCV	Nitrogen pressure relief valve
PSH	Pressure switch
PI2	Nitrogen pressure indicator
V1	Check valve
N2	Nitrogen outlet
V2	Ball valve
V4	Depressurisation valve

4 Technical specifications

4.1 General

Delivery pressure	
Maximum delivery pressure	115 psig / 8 bar(g)

Ambient conditions	
Temperature	50 to 95 °F / 10 to 35 °C
Air quality	Normal clean ambient air, relative humidity < 90%
Noise level	Basic: < 58 dB(A)

Dimensions and connections	
Dimensions (H x W x D) [inch]	27-1/2 x 35-1/2 x 12-1/4
Dimensions (H x W x D) [cm]	70 x 90 x 31
Net weight	204 lbs / 92.5 kg
Connections	Outlet: 1/4" FPT

Electrical data	
Voltage/frequency	110VAC/60Hz, 230VAC/50Hz
Power consumption	1.4 kW

Parts	
LCMS M-4 nitrogen generator	1x LCMS M-4 nitrogen generator 1x Instruction Manual
Options (on demand)	Storage vessel

Table 4-1: General data

4.2 Production capacity

4.2.1 Capacity LCMS M-4 nitrogen generator

	Operation Parameters								
Purity %	99.9	99.7	99.5	99	98	97	96	95	93
NLPM*	7.6	12	13	18	23	26	30	32	38

Table 4-3: Capacity

*Nominal conditions:

- Ambient temperature: 68 °F / 20 °C
- Ambient pressure: 14.7 psia / 1013 mbar(a).

4.3 Maintenance items

Part	Part number
Maintenance kit <ul style="list-style-type: none">• 1x Carbon filter	LCMS-FILT-KIT
Oxygen sensor	LCMS-O2-SEN

5 Installation

Follow the paragraphs in this chapter to install the LCMS M-4 nitrogen generator.

5.1 Transport



Warning

- Transport the LCMS M-4 nitrogen generator upright.
- Use the original container to transport the unit over long distances.
- Lift the LCMS M-4 nitrogen generator with a forklift.
- For qualifications of personnel, refer to section 2.1.

5.2 Location



IMPORTANT

- The LCMS M-4 nitrogen generator contains compressors that generate heat; for optimal performance and lifetime it is necessary that cooling air can be vented without resistance. A minimum clearance distance from walls or other objects of at least 20" (50 cm) on all sides (back, left, right and top) is a necessity; also efficient local ventilation at the unit's ventilation outlet is highly recommended especially when the unit is installed under a bench

Install the LCMS M-4 nitrogen generator on a fixed location. The location must meet following requirements:

- Minimum clearance of 20 " (50 cm) on all sides (back, left, right and top) as to facilitate heat removal
- Indoors
- Dry
- Avoid direct exposure to sunlight
- Away from heat sources
- Properly ventilated room.
- Easy accessibly for operating and service

5.3 Unpack and check equipment

1. Open the packaging.
2. Make sure that all components are delivered. Refer to Table 4-1.

5.4 Connect to application



Warning

- Do not connect the power at this time.
- Make sure that the tubes are free of dust, particles, metal parts and curls, liquids and grease before you connect the LCMS M-4 nitrogen generator.
- Connect the outlet of the unit to the application

5.5 Set up the LCMS M-4 nitrogen generator

1. Make sure that the connections are correct and fixed properly.
2. Leak-check the connections and tubing between the LCMS M-4 nitrogen generator and the application.

6 Operation

6.1 Start LCMS M-4 nitrogen generator

1. Turn the power on to the LCMS M-4 nitrogen generator (switch in the back).
2. Switch on the LCMS M-4 nitrogen generator (switch in the front).
3. It will take 3 minutes before the LCMS M-4 nitrogen generator will start to run.
4. The system is ready for use.
5. The LCMS M-4 nitrogen generator will deliver as much nitrogen as required; excess nitrogen will be vented.

6.2 Stop LCMS M-4 nitrogen generator

1. Switch off the power switch before you perform maintenance.
2. Depressurize the system by venting the nitrogen outlet.
3. Make sure that the system is fully depressurized by checking the pressure gauges in the system.

6.3 Control panel

The control panel (see Figure 6-1) consists of a display and two buttons [menu] and [reset]. The meaning of the codes (also indicated on the front panel) is as follows:

- | | | |
|----|------------|---|
| C1 | Warming up | The heater is warming the module inlet |
| C2 | Run | System is producing nitrogen |
| C3 | Stand by | Nitrogen production has been stopped automatically by pressure switch because storage vessel is full. |

Alarms:

- | | |
|----|---------------------------|
| A1 | Poor nitrogen quality |
| A2 | Oxygen sensor failure |
| A3 | High internal temperature |

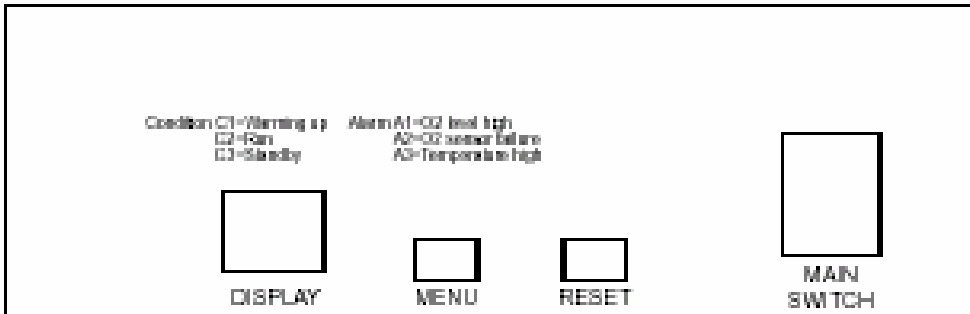


Figure 6-1

By repeatedly pressing the [menu] button you can scroll through a short cyclic menu of parameters (Figure 6-2). This will not influence the unit. When the function buttons have not been pressed for 2 minutes the display will show the status of the unit.

- After pressing the [menu] button once the oxygen level will be displayed (range 0.0-9.9 %).
- After pressing the [menu] button another time the display will show **H.0**. This indicates the running hours of the compressor(s). The running hours are stored in 5 digits, the first being the digit to the right of the digit (hour). The next digits can be read by pressing the [reset] button twice and writing down the consecutive digits to 5 digits number: e.g. **H.0.0.0.1.2.** is 12 running hours.
- Pressing the [menu] button again will return the status indicator.

[Menu]: Press the [Menu] button once
 [Reset]: Press the [Reset] button once

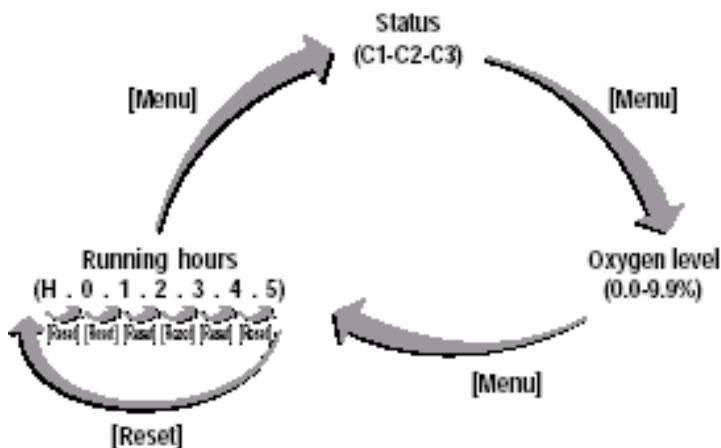


Figure 6-2 Cyclic menu structure

7 Troubleshooting

7.1 Error list

Error	Possible cause	Possible solution
Delivery of nitrogen too low or non-existent	Ambient temperature is too high	Lower the temperature, if possible Check whether the minimum clearance between the LCMS M-4 nitrogen generator and the walls is large enough.
	Inlet carbon filter is spent	Exchange the inlet filter
	LCMS M-4 nitrogen generator is switched off	Switch on the LCMS M-4 nitrogen generator
	Leak in piping	Check for leaks in the piping.
	Nitrogen outlet line is blocked.	Check/open the outlet line
	Alarm A1 (poor nitrogen quality)	explained below
	Alarm A2 (oxygen sensor failure)	explained below
	Alarm A3 (high internal temperature)	<ul style="list-style-type: none"> • Ambient temperature is too high (over 95°F/35°C). • In-/outlet gratings are clogged. • Cooling fans are not or insufficiently functioning. • Compressors are overloaded.
Residual oxygen content too high	Pressure in nitrogen storage vessel over 8 bar(g) because of erroneous setting of pressure switch	Readjust pressure switch
	Ambient temperature lower than normal	Increase temperature or readjust purity
	Purity setting has changed over time	Readjust purity

Table 7-1: Error list

8 Maintenance

8.1 Maintenance schedule

Part	Action	Frequency
Filters	Replace inlet carbon filter	<ul style="list-style-type: none">• 1x per year
Oxygen sensor	Replace oxygen sensor	<ul style="list-style-type: none">• 1x per 3 years

Table 8-1: Maintenance scheme

8.2 Inlet filter element replacement

1. Switch off the LCMS M-4 nitrogen generator.
2. Let the system depressurize.
3. Disconnect the inlet filter from the tubing.
4. Unscrew the brackets.
5. Remove the inlet filter.
6. Replace the new filter and fix it with the brackets.
7. Connect the inlet filter to the tubing.
8. Switch the LCMS M-4 nitrogen generator back on.

8.3 Oxygen sensor replacement

1. Switch off the LCMS M-4.
2. Remove the right-side cover from the LCMS M-4.
3. Carefully remove the sensor cap (E). Do not pull at the tube.
4. Unscrew the screw ring (D).
5. Disconnect connector (A).
6. Install the new sensor (C).
7. Switch on the LCMS M-4.
8. Calibrate the oxygen sensor. Refer to §8.4

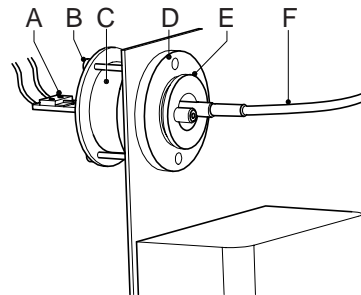


Fig. 8-1: Replace oxygen sensor

8.4 Oxygen sensor calibration

1. Check the sample flow of the sensor (300 cc/min.) coming out of the tube (F) that is connected to the sensor cap (E). The flow can be adjusted with the needle valve (FCV3).
2. Remove the sensor cap (E) and expose the sensor to ambient air.
3. The signal may be monitored using a multimeter inserted in CN2 (fig. 8-3) (across a 10 Ohm precision resistor), or by remote receiver.
4. A small non-metallic screwdriver, with a 1.2 x 0.5 mm tip, is required to adjust the potentiometer.
5. The value should read 174mV. Adjust the oxygen level if the value in the display differs. Turn the small adjustment screw (B) to set the level to 174mV (which corresponds to 20.9% O₂ level).
6. Reconnect the tube (F) and the sensor cap (E) with the sensor (C).

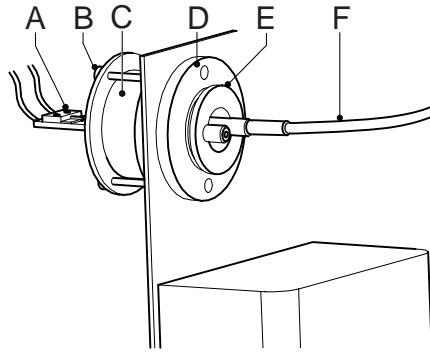


Fig. 8-2: Calibrate oxygen sensor

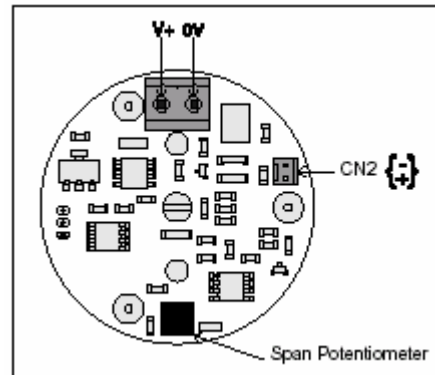


Fig. 8-3 Oxygen sensor print board

8.5 Pressure switch control

8.5.1 Adjusting the pressure switch

The pressure switch (PSH) can switch the LCMS M-4 on and off depending on the pressure level in a storage vessel. The pressure switch (PSH) setting can be read at the front of the pressure switch, inside the cabinet of the LCMS M-4.

The pressure at which the unit switches off can be read off on the "range" scale.

The switch-on pressure can be set using the "differential" scale. The switch on pressure is equal to the shut-off pressure minus the differential:

$$P_{on} = P_{off} - \text{DIFFERENTIAL}$$

The default switch-off pressure is 115 psig (8.0 bar(g)) If desired it may be set to a lower value.

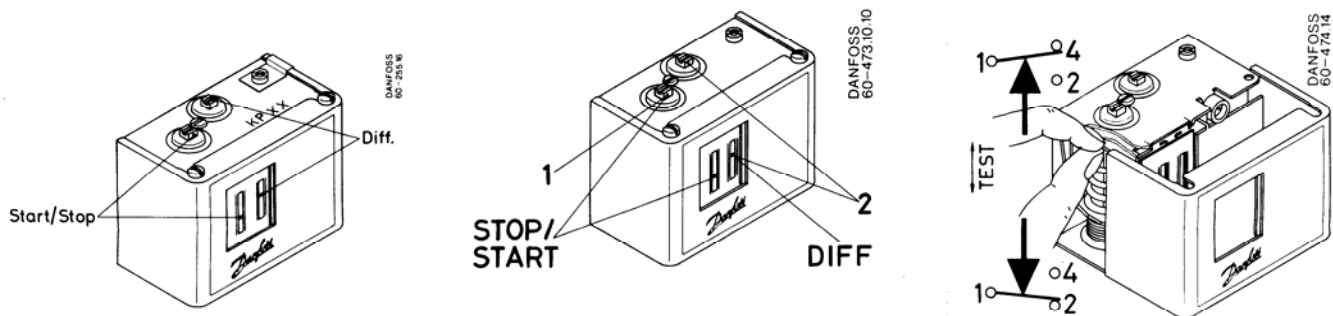


Fig. 8-4: Pressure switch

8.5.2 Control of the outlet pressure

The outlet pressure of the LCMS M-4 nitrogen generator can be controlled in two ways depending on whether the nitrogen is stored in a vessel or not.

No storage vessel installed: excess nitrogen will be vented; The LCMS M-4 will run continuously; the pressure switch serves as a safety. To set the PSH for this situation, do the following:

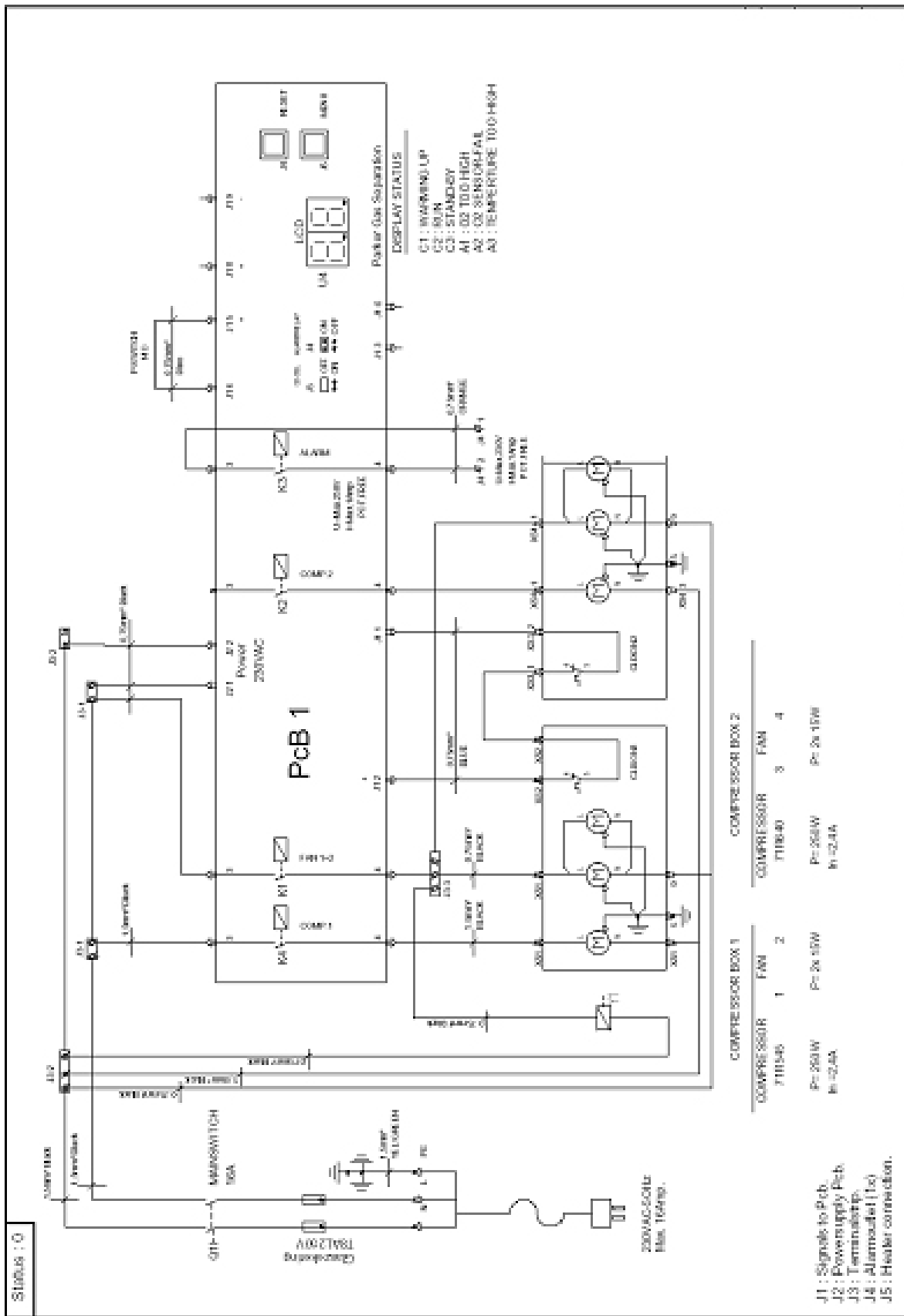
- Set the pressure switch such that the switch of pressure is 120 psig (8.5 bar(g)) according to 8.5.1
- Open PCV completely (turn left).
- Close the ball valve V2 at the outlet while the system is running.
- Adjust the back pressure valve PCV such that the pressure gauge PI2 on the front reads no more than 115 psig (8.0 bar(g)). Lower pressure settings will extend compressor life and reduce power usage.
- Open the ball valve V2 at the outlet.

Storage vessel installed: excess nitrogen will be stored; The LCMS M-4 will start and stop automatically. To set the PSH for this situation, do the following:

- Close PCV completely (turn right).
- Set the pressure switch to the desired storage vessel pressure but no more than 115 psig (8.0 bar(g)). Switch-off pressure according to 8.5.1. Lower pressures will extend compressor life and reduce power usage.
- Set the differential at 12 psi (0.8 bar). Smaller differentials will result in frequent switching which will shorten the life of the compressors.

NOTE: After the unit switches off due to reaching switch off pressure in the storage tank, the unit cannot switch on within 5 minutes after the switch-off. The switch-on delay is there to prevent too frequent start-up of the compressors that shorten the compressor life.

9 Electrical schematic



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