Leybold

ECODRY plus

Multi-stage roots vacuum pump

Operating instructions 300902516_002_C1

162025V001

162035V001

Original instructions

Copyright notice

Published: 11/2/2023

Trademark credit

Leybold and the Leybold logo are trademarks of Leybold GmbH, Bonner Strasse 498, D-50968 Cologne.

Disclaimer

The content of this manual may change from time to time without notice. We accept no liability for any errors that may appear in this manual nor do we make any expressed or implied warranties regarding the content. As far as practical we have ensured that the products have been designed and constructed to be safe and without risks when properly installed and used in accordance with their operating instructions.

We accept no liability for loss of profit, loss of market or any other indirect or consequential loss whatsoever.

Product warranty and limit of liability are dealt with in our standard terms and conditions of sale or negotiated contract under which this document is supplied.

You must use this product as described in this manual. Read the manual before you install, operate, or maintain the product.

Contents

Contents

Contents

List of Figures

List of Tables

1 Safety and compliance

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use. Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions.

The instruction manual is an important safety document that we often deliver digitally. It is your responsibility to keep the instruction manual available and visible while working with the equipment. Please download the digital version of the instruction manual for use on your device or print it if a device will not be available.

1.1 Definition of Warnings and Cautions

Important safety information is highlighted as warning and caution instructions which are defined as follows. Different symbols are used according to the type of hazard.

WARNING:

If you do not obey a warning, there is a risk of injury or death.

CAUTION:

If you do not obey a caution, there is a risk of minor injury, damage to equipment, related equipment or process.

NOTICE:

Information about properties or instructions for an action which, if ignored, will cause damage to the equipment.

We reserve the right to change the design and the stated data. The illustrations are not binding.

1.2 Trained personnel

For the operation of this equipment “trained personnel” are:

- skilled workers with knowledge in the fields of mechanics, electrical engineering, pollution abatement and vacuum technology and
- personnel specially trained for the operation of vacuum pumps

1.3 Safety symbols

The safety symbols on the products show the areas where care and attention is necessary.

The safety symbols that we use on the product or in the product documentation have the following meanings:

	**Warning/Caution** Risk of injury and/or damage to equipment. An appropriate safety instruction must be followed or a potential hazard exists.
	**Warning - Heavy object** Risk of injury or damage to equipment. Identifies a possible hazard from a heavy object.
	**Warning - Dangerous voltage** Risk of injury. Identifies possible sources of hazardous electrical shock.
	**Symbol - Protective earth** Identifies an electrical equipment earth (ground) terminal.
	**Warning - Use protective equipment** Risk of injury. Use appropriate Personal Protective Equipment (PPE) when performing the task.
	**Symbol – Waste Electrical & Electronic Equipment (WEEE)** The equipment must be discarded carefully. Obey local and national regulations for disposal of this equipment. Identifies compliant product supplied with a manufacturing date (YYYY/MM).

2 General description

2.1 Overview

WARNING: INCORRECT USE OF EQUIPMENT

Risk of injury or damage to the equipment. Incorrect use of the equipment can cause damage to the equipment or injury to people. The user is responsible for the safe operation, installation and monitoring of the system.

The ECODRY plus product family is a range of dry, multi-stage roots vacuum pumps that offers high pumping speed in a compact form. The pump is connected by a power cord and is designed for use on clean duty applications.

The cord ratings are:

Supply voltage (V)	Current (A)	Frequency (Hz)
100 - 127	14	50 or 60
200 - 240	7	

The pump is not designed for use with flammable, corrosive, toxic, or other hazardous gases. Gas or oxygen can mix in the pump.

The dry pumping system can be used in either transient or steady state gas load conditions. The pump can sustain continuous operation with a maximum power consumption of 850 W. When the load is more than 850 W motor power the speed temporarily reduces.When high load passes the motor speed is increased, or when the transient overload protection has recovered. Refer to *Table: Performance data* on page 16 for information on maximum inlet pressure.

Refer to *Figure: General view* on page 11, the system is supplied with an DN 25 ISO-KF inlet port and an DN 25 ISO-KF exhaust port.

The pump mechanism is operated by an electric motor driven by an internal pump controller. The rotational elements of the pumping mechanism are simply supported at the end by lubricated bearings. PFPE lubricant is used and this is contained in both the gearbox and motor ends of the pump module, these are "sealed for life" and the lubricant does not need to be replaced until the pump service interval is reached.

The system is air cooled by a fan installed internally in the pump enclosure. The pump has a thermal protection device that will stop the motor if a thermal overload occurs, for example due to high ambient temperature. If the thermal protection is triggered, you must restart the pump after it has cooled down.

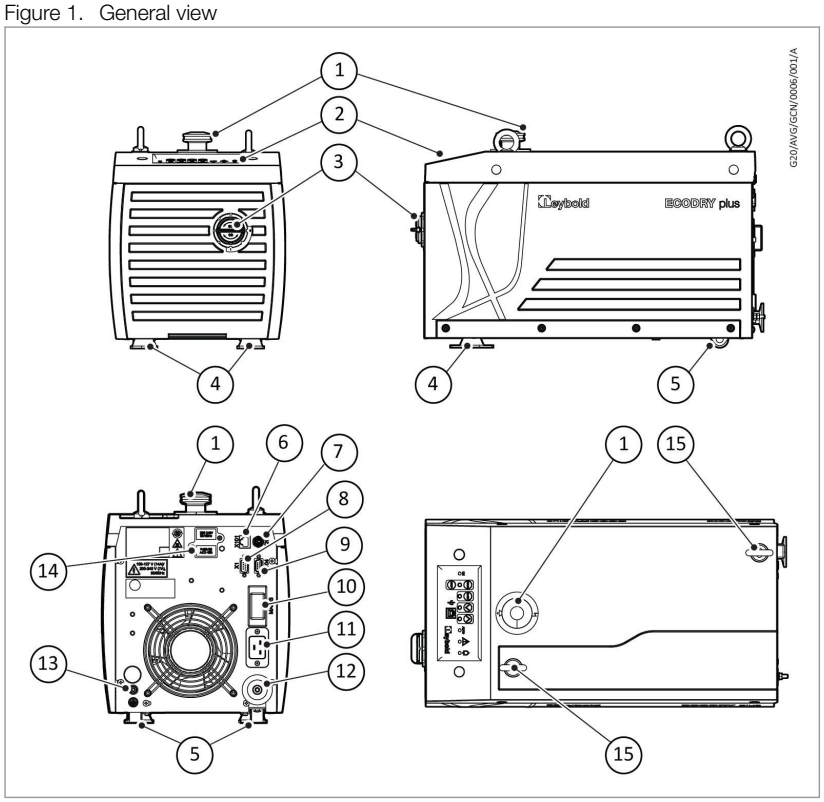
The pump is designed to pump the residual gases used in high vacuum systems. The gases are:

- Air
- Nitrogen
- Krypton
- Argon
- Helium

You can use the pump to pump water vapour. You must use the gas ballast when water vapour is pumped. The water vapour must not condense in the pump.

To use the pump for a gas that is not listed, contact the supplier for advice. Failure to contact the supplier can invalidate the warranty of the pump. Do not use the pump for aggressive or corrosive gases.

Figure 1. General view



1. *Inlet port*
2. *Dashboard or interface*
3. *Gas ballast*
4. *Vibration isolator*
5. *Castors x 2*
6. *X101, RJ45 connector*
7. *X201, M8 Aux Connector*
8. *X1 SUB-D 9 pin (male)*
9. *X104 SUB-D 9 pin (female)*
10. *Mains circuit breaker*
11. *Mains connector socket*
12. *Exhaust port*
13. *Protective earth stud*
14. *Voltage selection cover plate*
15. *Lifting eye position*

2.2 Pump controller

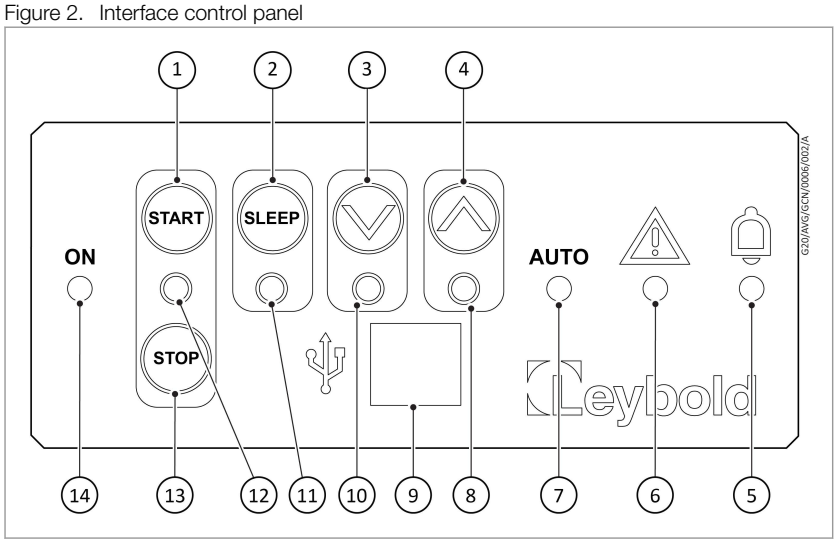
The pump controller contains the drive electronics to control the pump operation. The pump controller controls the supply of electric current to the motor as per the operating conditions.

The interface control panel is connected to the pump controller. The pump can be operated:

- manually, with the buttons on the user interface control panel. Refer to *Figure: Interface control panel* on page 12.
- remotely, with the serial communications (X104) or digital and analogue process control (X1), through the SUB-D 9 pin connector. Refer to *Connection for remote control and monitoring* on page 24.

2.3 Interface control panel

Figure 2. Interface control panel



1. *Start button*
2. *Standby button*
3. *Standby decrease button*
4. *Standby increase button*
5. *Alarm indicator LED*
6. *Service indicator LED*
7. *Auto-run indicator LED*
8. *Standby increase indicator LED*
9. *USB port (not for operation)*
10. *Standby decrease indicator LED*
11. *Standby indicator LED*
12. *Run indicator LED*
13. *Stop button*
14. *Power status LED*

2.3.1 Auxiliary connector socket

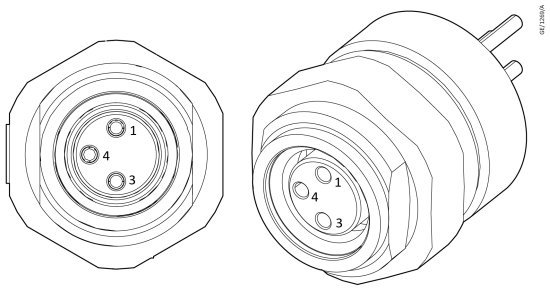
An auxiliary control connection on the rear panel controls an optional inlet valve. This inlet valve can be operated in parallel with the normal pump output signal. Refer to *Figure: General view* on page 11. The valve is usually closed and:

- will open when the normal signal becomes active (pump at speed)
- will close when you select the stop button or if there is a fault condition.

The reaction time will be in line with the valve selection and the output signal is 24 V d.c., refer to *Figure: Valve connector* on page 13 for the polarity of the connector pins when the connector is energized.

The auxiliary connector is regulated to 24 V d.c. to control the accessories. If the auxiliary load current exceeds the value in *Table: Auxiliary load currents* on page 13, the output will shut down to protect the pump controller. Refer to *Table: Recommended mating plugs* on page 13 for the recommended mating plugs.

Figure 3. Valve connector



Pin number	Signal
1	+ 24 V
3	GND
4	PE

Table 1. Auxiliary load currents

Description	Data
Connector plug	Plug M8 male Kst 0°Series 768 99-3379-100-03 Binder
Voltage output	24 V d.c. -25%, +10% (18 V d.c. to 26.4 V d.c.)
Output power	1 Channel with 4 Watt

Table 2. Recommended mating plugs

Mating connector plug	Phoenix part number
Screw connection, straight	SACC-M 8MS-4CON-M-SW
Solder connection, straight	SACC-M 8MS-4CON-M
Screw connection, right angle	SACC-M 8MR-4CON-M-SW
Solder connection, right angle	SACC-M 8MR-4CON-M

2.4 Logic interface

The logic interface is designed to support the two connectors, both are located on the rear of the pump.

- Serial control is connected through a X104 SUB-D 9 pin (female) connector.
- Parallel control is connected through a X1 SUB-D 9 pin (male) connector.

The signals on the logic interface are:

- control inputs: switch type and analogue signals that control the pump.
- status outputs: to identify the status of the system tab.

For control modes refer to *Table: Control panel interface* on page 27.

For logic interface data refer to *Logic interface data* on page 28.

2.5 Gauge connection

A compatible pressure gauge can be connected to the RJ45 (X101) socket on the rear panel. Refer to *Accessories* on page 57, for suitable gauges.

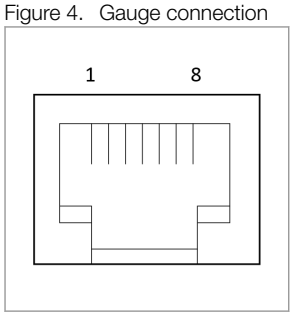
CAUTION: GAUGE MALFUNCTION

Risk of damage to equipment. Do not make connections to the gauge identification pin (pin 4). Failure to do so can cause the gauge to malfunction.

CAUTION: GAUGE CONNECTION

Risk of damage to equipment. Do not connect a gauge input and analogue input signal at the same time. This will result in the wrong speed demand.

Figure 4. Gauge connection



1. *Electrical supply positive*
2. *Electrical supply ground*
3. *Pressure measurement input signal*
4. *Not connected*
5. *Signal ground*
6. *Not connected*
7. *Not connected*
8. *Not connected*

2.6 Auto-run

The auto-run setting configures the pump to start automatically when the power is switched on, without any customer intervention.

You can configure the auto-run through serial communications, or with the start or stop button. Push and hold the start or stop button for more than eight seconds to enable or disable the auto-run setting. The auto-run LED displays the auto-run setting.

The pump can be stopped by either manual, parallel or serial control modes when in auto-run mode.

Note:

Refer to Operation safety on page 26 for guidelines on how to configure different operational modes and any associated warnings to consider.

2.7 Pump controller configuration

The integral pump controller monitors the power and temperature of the pump. The pump controller protects the user and the pump when the pump is operated under sustained high load or in fault conditions.

The pump controller is connected to the interface control panel and the pump can be operated:

- manually, with the buttons on the user interface control panel. Refer to *Figure: Interface control panel* on page 12.
- remotely, with serial or parallel communications through the SUB-D 9-pin connector located on the rear of the pump. Refer to *Connection for remote control and monitoring* on page 24.

3 Technical data

3.1 Operating and storage conditions

Table 3. Operating and storage conditions

Range	Data
Ambient operating temperature range	5 °C to 40 °C
Ambient operating humidity range	80% up to 31 °C Reducing linearly to 50% at 40 °C
Maximum operating altitude	3000 m
Ambient storage temperature range	-30 °C to 70 °C
Maximum humidity (storage in original packaging)	≤ 95 % RH
Equipment type	Indoor use
Enclosure protection	IP20

Table 4. Environmental conditions

Pollution	Pollution degree 2
Installation	Installation category II
Altitude restriction	Maximum 3000 m
Area of use	Indoor

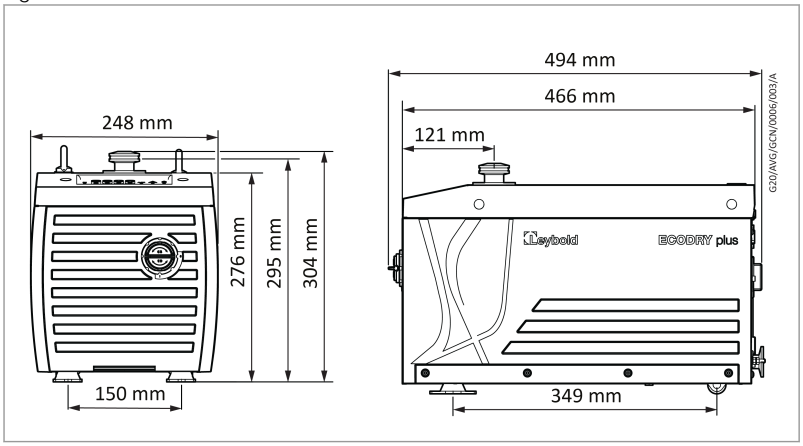
3.2 Mechanical data

Table 5 Mechanical data

Range	25	35
Mass	28 kg	28.10
Inlet connection	DN 25 ISO-KF	
Overall dimensions (L x W x H)	494 x 248 x 304 mm	
Maximum tilt angle for operation	± 5°	
Maximum tilt angle for transport	30°	
Nominal rotational speed	15000 rpm	
Outlet connection	DN 25 ISO-KF	

Technical data

Figure 5. Dimensions



3.3 Performance

Table 6 Performance data

	25	**35**
Maximum pumping speed (m^3/hr)*	25	35
Maximum continuous inlet pressure ambient (mbar)	1013†	
Maximum chamber size for evacuation (l)	No limit	
Typical ultimate pressure (mbar)	0.01	
Maximum continuous exhaust pressure (mbar(g))	200	
Suck-back protection	Exhaust valve design	
Leak tightness (static) (mbar l/s)	$< 1 \times 10^{-6}$	

** Values for maximum pumping speed are obtained at standard ambient temperature and pressure. At higher temperatures or different ambient pressures pump performance may be compromised and the rotational speed may drop below nominal.*

† At high inlet pressures pump rotational speed may reduce to sustain continuous operation.

Figure 6. Performance graph

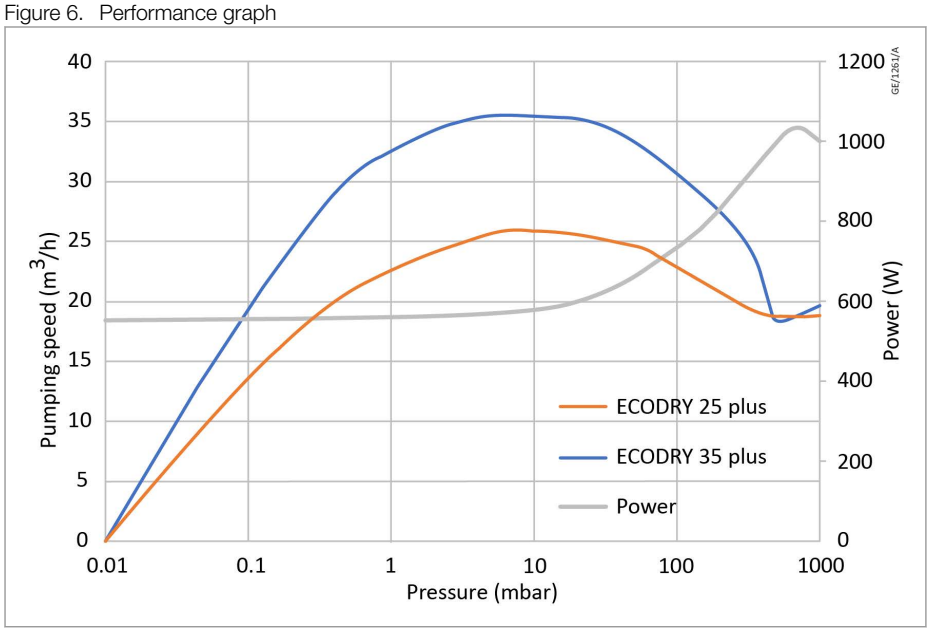


Table 7 Sound data

Declared dual-number noise emission values in accordance with ISO 4871		
	25	**35**
Measured A-weighted emission sound pressure level, L_{pA} at ultimate vacuum 1 m from the pump in free space	52	
Uncertainty, K_{pA}	2.5 dB(A)	
Values determined in accordance with ISO 3744: 2010		

3.4 Materials exposed to gases pumped

The materials and the components exposed to the gases in the pump are:

- Iron
- Aluminium alloy
- Steel
- Fluoroelastomer (seals)
- PFPE lubricant

3.5 Electrical data

Table 8. Electrical rating for continuous operation

Pump	Supply voltage (V a.c. rms)	Phase	Frequency (Hz)	Input current (A rms)
All variants	200 - 240 ± 10%	Single	50 or 60	7.0
	100 - 127 ± 10%	Single	50 or 60	14.0

Technical data

Table 9. Recommended regional supply protection

Area	Voltage	Rating
UK	230 V	10 A, 250 V a.c. rms
Europe	230 V	10 A, 250 V a.c. rms
US	120 V	15 A, 250 V a.c. rms
Japan	100 V	15 A, 250 V a.c. rms

4 Installation

CAUTION: SAFETY INSTRUCTIONS

Follow all safety instructions and take note of all appropriate precautions.

WARNING: BLOCKED EXHAUST PIPELINE

Risk of damage to equipment. Make sure the exhaust pipeline is not blocked. If an exhaust isolation valve is used, make sure that the pump is not operated with the valve closed.

Possible hazards on the dry pumping system include electricity, process chemicals, and Fomblin® (PFPE) oil:

- Contact us or the local service centre for more information for advice or assistance on installation.
- Do not remove the temporary covers from the system inlet and exhaust until ready to connect.
- Do not operate the system unless the inlet and exhaust are connected to the vacuum and exhaust extraction system.
- Isolate the other components in the process system from the electrical supply to prevent accidental operation.
- Electrical supplies are potentially hazardous energy sources. Lockout and tagout before you do the maintenance.
- Obey all national and local rules and safety regulations when you install the system.
- Tighten the cables, hoses and pipework during installation to prevent a trip hazard.
- Make sure that the installation area is clean and free from debris and contamination before you install the pump.
- Make sure that all facilities given in this manual are available for the system to perform correctly.

4.1 Unpack and inspect

WARNING: DAMAGED PUMP

Risk of injury to people or damage to equipment. Do not use the pump if it is damaged. Failure to do so can result in injury to people and/or damage to equipment.

CAUTION: PUMP LIFE

Risk of damage to equipment. Unpack the pump carefully and avoid excessive shock to the pump. Excessive shock will damage the bearings and reduce the life of the pump.

Refer to *Table: Mechanical data* on page 15 for the mass of the pump.

The pump is supplied in recyclable packaging.

1. Open the cardboard box from the top.

2. Remove the packing material. Keep all the packing materials for use in the inspection and if the pump is returned for service.
3. Examine the pump for damage. If the pump is damaged, notify your supplier and the carrier immediately. Give the supplier and the carrier the information that follows:
   - part number of the pump
   - serial number of the pump
   - order number
   - supplier's invoice number
4. Do not use the pump if the pump is damaged.
5. If the pump is not to be used immediately, store the pump in the conditions given in *Storage* on page 55.
6. Do not remove the seals until the pump is ready to be installed on the vacuum system. The pump is supplied with sealed inlets and an outlet to prevent the entry of dust and vapour.

4.2 Mechanical installation

WARNING: HEAVY OBJECT

Risk of physical injury. Use suitable equipment to lift the pump.

WARNING: TRIP HAZARD

Risk of injury or damage to equipment. Make sure that any cables and/or pipe work attached to the pump are fixed carefully to avoid a slip/trip hazard and to prevent any damage to the cable.

WARNING: LIFTING EYE INTEGRITY

Risk of injury or damage to equipment. Make sure that the maximum angle between the paired slings used to lift the system is 45 degrees. Increased angle could compromise the lifting eye integrity.

WARNING: INSTALLATION SAFETY

Risk of injury or damage to equipment. Install the pump in the vacuum system before you connect the power supply. This will make sure that the pump is not operated and this will avoid injury during the installation.

WARNING: STATIC PRESSURE

Risk of damage to equipment. Do not step or stand on the pump, it is not designed to withstand large static loads.

WARNING: HEAVY OBJECT

Push-pull hazard with strain injury. Push or pull the pump system only for short distance and over flat surfaces. Lift the system with a correct lifting equipment or two persons must lift if the floor is uneven or there are obstacles present.

WARNING: EXHAUST BLOCKAGE

Risk of injury or damage to equipment. A peak pressure of 3 bar(g) can be generated in the pump if the exhaust or pipework attached to the exhaust are blocked.

WARNING: HAZARDOUS SUBSTANCES

Risk of injury or damage to equipment. The pump is intended for clean applications only. It is not suitable for use with hazardous production materials.

CAUTION: INSTALLATION SAFETY

Risk of injury or damage to the environment. Follow all local legislation when the pump is installed or removed to reduce the impact of the pump on the environment.

CAUTION: HIGH NOISE LEVEL

Risk of hearing damage. When the pump is operating and is not connected to the vacuum system (with open inlet) the noise level may exceed 85 dB(A).

CAUTION: CONDENSATE DRAINAGE

Risk of damage to equipment. Use a catchpot to prevent the drainage of condensate back into the system. Condensate that drains back into the system could damage the pump.

Obey the instructions that follow when you install the pump:

- Make sure that there is no blockage to access the pump electrical supply cable or the other controls.
- Make sure that there is a minimum air gap of 100 mm on all sides of the pump to allow effective air circulation.
- Make sure that the system is on a firm and level surface that can support the mass of the pump.
- Make sure that the system is installed away from combustible materials.
- Level the pump to a maximum of 5 degrees (measured at the pump inlet).
- You must do a risk assessment of the location and make sure that you can move the pump safely and as per the local and national manual handling guidelines.

To move the pump:

1. Use suitable lifting equipment attached to lifting eyebolts (refer to *Figure: General view* on page 11) to move the dry pump system close to its final operating position. Refer to *Table: Mechanical data* on page 15 for pump mass.
2. Secure the dry pump system with the rubber stand-off and two small castors (refer to *Figure: General view* on page 11).
3. Remove the plastic caps from the inlet and exhaust before you connect the pump to the vacuum system. Use appropriate ISO-KF vacuum fittings for connection to the system.

Installation

Obey the instructions that follow when you connect the pump to the vacuum system:

- Connect the pump to an exhaust line to minimise noise and exhaust emissions.
- Make sure that the pipeline connected to the pump inlet is as short as possible. To maximise the pumping speed, maintain the largest internal diameter of pipeline connections where possible.
- Support the vacuum pipeline to reduce load on coupling joints.
- Make sure that the pump exhaust line is not blocked as a pressure of 3 bar(g) can be generated in the exhaust pipework. Connect the pump with appropriate pipework and fittings.
- If necessary, install flexible bellows in the system pipelines to reduce the transmission of vibration and to prevent load on the coupling joints. The pressure rating of the bellows must be higher than the highest pressure generated in the system. We recommend that you use the manufacturer's bellows.
- Make sure that the sealing surfaces are clean and are not scratched.

4.3 Leak test the system

CAUTION: SYSTEM LEAK TEST

Risk of injury or damage to equipment. Leak test the system after installation. Seal the leaks found to prevent leakage of (potentially hazardous) pumped gases out from the system and leakage of air into the system which will affect the performance.

We will accept no liability or warranty claims for damages caused from flammable mixtures because of air leaks.

1. Leak test the vacuum system after installation of the pump.
2. Seal all leaks found.

4.4 Electrical installation

WARNING: ELECTRICAL CONNECTION

Risk of electric shock. The electrical installation must be performed by a qualified person. Always make the electrical connections after the pump has been installed on the vacuum system.

WARNING: INSTALLATION SAFETY

Risk of electric shock or damage to equipment. The pump must be electrically installed in accordance with regional and local codes, and must obey the local and national safety requirements.

WARNING: HAZARDOUS VOLTAGE

Risk of electric shock or damage to equipment. The logic interface is 30 V maximum rated PELV and must only be connected to PELV interfaces. Failure to use a correctly rated supply could result in electric shock.

WARNING: ELECTRICAL CONNECTION

Risk of electric shock. Make sure that the pump is switched off and is not connected to the electrical supply when the mains voltage is selected on the pump.

The pump is a cord-connected device and must be installed in accordance with local electrical regulations.

The pump is supplied from a single phase 100 - 127 V a.c./200 - 240 V a.c. mains supply system. The branch circuit, supplying the pump, must be protected with a 10 A (200 - 240 V) or 15 A (100 - 127 V) branch circuit protection.

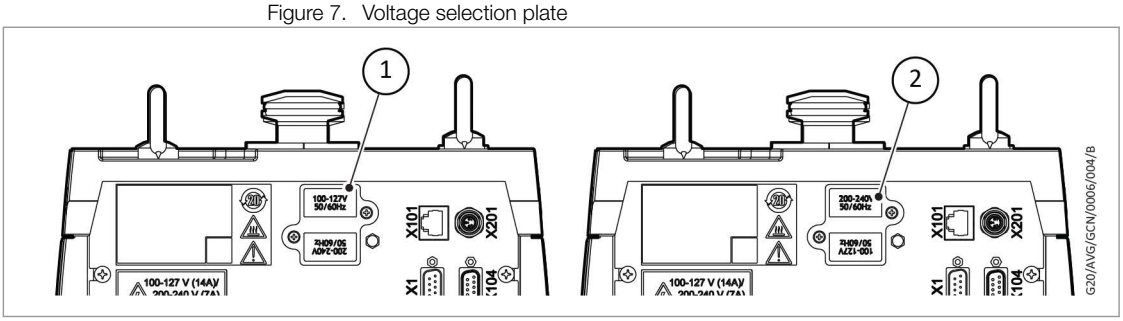
4.4.1 Pump voltage setting

To set the correct voltage:

1. Isolate the pump from the electrical supply.
2. Remove the screws on the voltage selection plate.
3. Rotate the voltage selection plate to point towards the required voltage setting (refer to *Figure: Voltage selection plate* on page 23).

   The selector cover plate will make sure that the rocker switch below the plate is set to the correct voltage.
4. Make sure that the screws are tightened and the voltage selection plate is fully secured before you reconnect the electrical supply and operate the pump.

Figure 7. Voltage selection plate



1. Low voltage *2. High voltage*

4.4.2 Connect the electrical supply

WARNING: PROTECTIVE EARTH CONNECTION

Risk of electric shock. Make sure that the pump and electrical cables are suitably protected against earth (ground) faults. We recommend you attach a protective earth (ground) conductor (with a cross sectional area of 2.5 mm^2/14 AWG) to the protective earth (ground) stud.

Make the electrical connection to the pump mains connector port (refer to *Figure: General view* on page 11) with an appropriate cord set. Refer to *Table: Mains cables* on page 57.

The pump must be grounded through the conductor of the mains input connector.

4.5 Connection for remote control and monitoring

To operate the pump with parallel or serial control, the two SUB-D 9 pin connectors can be used. The female connector (X104) is for serial communication, the male connector (X1) is for parallel control (refer to *Figure: General view* on page 11).

Refer to *Analogue speed control* on page 31 for details of the logic interface pins.

5 Commission the pump

To commission the pump:

1. Make sure that the voltage selection is set to the correct value required for the application. Refer to *Figure: Voltage selection plate* on page 23.
2. Make sure that all openings to atmospheric pressure in the foreline vacuum system are closed.
3. Connect the power cord.
4. Set the mains circuit breaker (refer to *Figure: General view* on page 11) to ON. Make sure that the power indicator LED (refer to *Figure: Interface control panel* on page 12) illuminates. If the LED does not illuminate, contact us.
5. Press the start button (refer to *Figure: Interface control panel* on page 12) until the run indicator LED (refer to *Figure: Interface control panel* on page 12) begins to flash.
6. When the dry pumping system starts and continues to operate, if an alarm condition is indicated:
    a. shut down the dry pumping system, refer to *Shut down the pump* on page 33.
    b. refer to *Fault finding* on page 52
    c. if problem has not been rectified, contact us.
7. After you commission the dry pumping system:
    a. to continue to operate the system, refer to *Start the pump* on page 32.
    b. to shut down the system, refer to *Shut down the pump* on page 33.

6 Operation

6.1 Operation safety

WARNING: DAMAGED PARTS

Risk of electric shock. Do not operate the pump with any parts of the enclosures removed or damaged as there may be a risk of an electric shock.

WARNING: OPERATIONAL SAFETY

Risk of injury or death of people. Do not expose any part of the human body to the vacuum as this could result in injury or death of people.

CAUTION: PUMP TEMPERATURE

Risk of injury or damage to equipment. Do not touch the pump inlet manifold or exhaust when the pump is running as the temperatures of these parts could be high. The pump will be warm for some time after the pump has stopped.

CAUTION: AUTOMATIC START

Risk of injury or damage to equipment. The system has an auto-run mode which, if configured, is designed to automatically start the pump system once power is applied.

CAUTION: CONDENSATE DEPOSITION

Risk of damage to equipment. Do not use the pump to pump particulates or condensate. Deposition may occur within the pump which can degrade the pump performance and reduce the pump life.

Note:

The control interface is determined by the interface that starts the pump. Once started, the pump can only be stopped by the interface that it was started from, except in auto-run mode. In auto-run mode, the stop button on the user interface panel will override the signal and stop the pump.

The ECODRY Plus pump system is suitable for industrial applications and has been designed to meet industrial levels of EMC immunity as defined in EN61326. The ECODRY plus pump system is also suitable for domestic installations and has been designed to meet Class B, Group 1, EMC emissions as defined in EN55011. Group 1, is defined as equipment which does not use RF energy as an intrinsic part of operation or process.

6.2 Operational modes

The pump can be controlled by:

- Manual control mode – with the buttons on the user interface panel, refer to *Figure: Interface control panel* on page 12.
- Parallel control mode – through the X1 SUB-D 9 pin (male) connector, located on the rear of the pump.

- Serial control mode – through the X104 SUB-D 9 pin (female) connector, located on the rear of the pump.
- Auto-run

6.2.1 Control panel interface

Refer to *Figure: Interface control panel* on page 12 for the pump control functions.

Table 10. Control panel interface

Operation	Button	Status
Apply power	Mains power	The pump will remain off (factory default). The power indicator will illuminate.
Start the pump	Start button	The pump will accelerate up to full running speed. The run indicator will flash while the pump accelerates. The run indicator will remain on when the pump reaches full speed.
Select and de-select the standby speed	Standby mode select button	When engaged, the standby indicator will illuminate and the pump will run at the standby speed setting. The pump is set by default at 75% of full speed.
Increase or decrease the pump speed when in standby mode	Standby speed increase button	The pump speed will increase. The increased standby indicator will remain illuminated when the pump reaches a maximum of 100% of full speed.
	Standby speed decrease button	The pump speed will decrease. The decreased standby indicator will remain illuminated when the pump reaches a minimum of 50% of full speed.
Select and de-select the Auto-run function	Start or stop button (> 8 sec)	When engaged, the auto-run indicator will illuminate. The pump will restart automatically after the power has been restored.
Stop the pump	Stop button	The pump will decelerate from full/standby speed to zero speed. The run indicator will flash while the pump decelerates. The run indicator will turn off when the pump reaches zero speed.

6.2.2 Start and stop

Use the buttons (*Figure: Interface control panel* on page 12) to start and stop the pump.

Note:
The stop command does not isolate the pump from the electrical supply.

6.2.3 Standby

In standby mode, the pump operates at a reduced speed to improve the service life of the pump. The noise and power consumption decreases and the vacuum performance is reduced when the pump operates at standby speed.

1. Push the standby button to select the standby mode. The pump will initially run at factory default standby speed (75% of full speed).

2. Adjust the speed with the increase and decrease standby speed buttons. The maximum standby speed is 100% of the default run speed and the minimum standby speed is 50% of the default run speed.

   A single short push will change the speed by 1% of the default run speed. Hold the button to change the speed by 1% per second.
3. Once adjusted, the pump will return to the new user defined speed each time standby speed is selected.
4. Push the standby button to return to normal run speed.

Table 11. LED indicators

Refer to *Figure: Interface control panel* on page 12.

Description	Function
Power indicator	Indicates that electrical mains supply to the pump is ON.
Run indicator	Indicates that the pump is running.
▪ LED continuously ON	▪ Pump runs at full speed
▪ LED flashing	▪ When changing speed
▪ LED OFF	▪ Pump is not running
Standby mode indicator	Indicates that the standby mode has been selected.
Standby speed increase indicator	The indicator will blink with every short push of the standby speed increase button. The indicator will remain ON when maximum standby speed has been reached.
Standby speed decrease indicator	The indicator will blink with every short push of the standby speed decrease button. The indicator will remain ON when minimum standby speed has been reached.
Auto-run indicator	Indicates that the auto-run mode has been selected.
Service indicator	Indicates that a service interval has been reached.
Alarm indicator	Indicates an alarm has been triggered.

6.3 Logic interface data

The pumps have a X1 SUB-D 9 pin (male) connector, logic interface connector - X1. This connector is located on the user interface panel (*Figure: General view* on page 11).

A suitable connector mating half must be used (not supplied) to connect the pumps to the customer control system. Refer to *Table: Logic interface pins* on page 29 for the electrical connections.

Table 12 Interface technical data

Description	Value
Connector	X1 SUB-D 9 pin (male) connector
START/STOP - control input:	
Enable control voltage: low (closed)	0 to 0.8 V d.c. (I_{OUT} = 0.55 mA nominal)
Disable control voltage: high (open)	4 to 26.4 V d.c. (internal pull-up to a Thevenin equivalent circuit: 5.3 V and 11 kOhms nominal)
STANDBY enable - control input:	
Enable control voltage: low (closed)	0 to 0.8 V d.c. (I_{OUT} = 0.3 mA nominal)
Disable control voltage: high (open)	4 to 26.4 V d.c. (internal pull-up to a Thevenin equivalent circuit: 2.5 V and 10.3 kOhms nominal)

Description	Value
Analogue speed input	0 to 10 V d.c. directly proportional to the motor speed example 0 V = 0 Hz, 10 V = 250 Hz
Voltage accuracy	± 5% full scale
NORMAL status output: ▪ Type ▪ < Normal speed (default 80%) ▪ > Normal speed ▪ Maximum current rating ▪ Maximum voltage rating	 ▪ Open collector transistor plus pull up resistor ▪ OFF (4.7 k pull up + diode to 12 V d.c.) ▪ ON (< 0.8 V d.c. sinking 10 mA) ▪ 10 mA ▪ 28.8 V d.c.
Analogue 10 V reference	+ 10 V d.c. analogue voltage reference unipolar output with diode protection
Voltage accuracy output	± 2% full scale
Current	≤ 5 mA for specified accuracy

Table 13 Logic interface pins

Pin number	Signal	Polarity	Use
1	Rotor Speed - Analogue Output	0 to + 10 V d.c. (2 mA)	Analogue output signal, proportional to mechanical rotational frequency (+ 10 V = 100% full speed)
2	STANDBY enable - Control Input	Active low, digital input	Connect to pin 4 (0 V) to enable STANDBY speed.
3	+ 10 V Analogue Reference - Control Output	+ 10 V d.c. (5 mA)	+ 10 V analogue output reference voltage, unipolar output, diode protected.
4	0 V Control Reference	-	0V reference for all control and status signals listed within this table.
5	NORMAL - Status Output	-	Logic low, when the pump rotational speed is at normal speed or above.
6	Analogue Speed - Control Input	0 to + 10 V d.c.	0 - 10 V analogue input: 0 V = 0% speed, + 10 V = 100% speed
7	Analogue Common	-	0 V Reference signal for speed control
8	0 V Control reference	-	0 V reference for all control and status signals listed within this table.
9	START/STOP - Control Input	-	Connect to pin 4 (0 V) to start the pumps.
	Housing	-	Pump Housing PE

6.4 Parallel control and monitoring

CAUTION: EMF RISK

Risk of damage to equipment. If you use normal and fail lines to drive the coils of d.c. relays, include a back EMF suppression diode in parallel with each relay coil to protect the pump.

Connect the control equipment to the control input pins of the logic interface mating half. Refer to *Table: Logic interface pins* on page 29 to identify the logic interface connector pins. The control inputs are:

- Start
- Standby speed
- Analogue speed

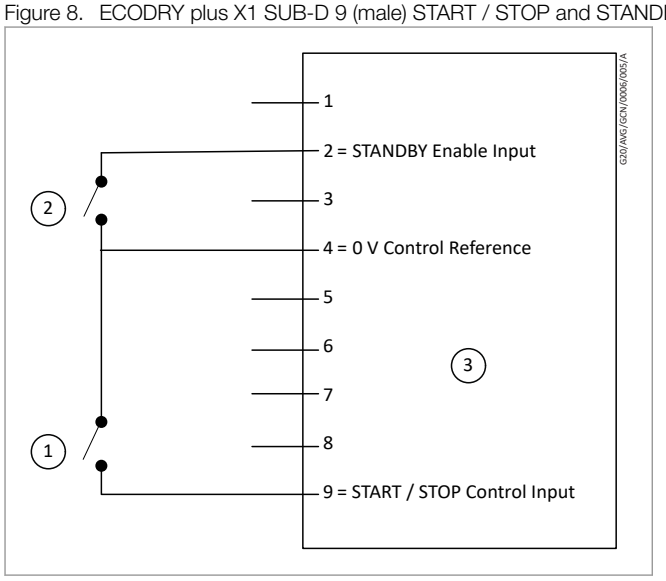
The NORMAL output can go down up to 100 mA when controlling an external relay coil with an external coil voltage of + 24 V d.c. The external + 24 V voltage source must be referenced to the common control voltage of the pumps, i.e. pin 4 of the X1 SUB-D 9 pin (male) connector customer. Alternatively, if the NORMAL output is connected to + 10 V reference output of the pumps, i.e. pin 3 of the X1 SUB-D 9 pin (male) connector, a 4.7 kOhm pull-up resistor is recommended to be kept within the current rating of + 10 V reference rail.

6.4.1 X1 Control Interface

The X1 logic control interface connector is located on the rear of the pump. The pump can be incorporated within a plant control system by means of the X1 logic control interface and controlled in parallel control mode through this interface. See *Parallel control and monitoring* on page 29. Parallel control mode is then enabled by starting the pump via the parallel control interface. Parallel control mode is enabled by connecting pin 9 to pin 4, i.e. the START/STOP digital input is connected to 0 V.

Furthermore, the STANDBY speed demand can be enabled via the parallel control interface. This is achieved by connecting pin 2 to pin 4 on the X1 logic control connector.

Figure 8. ECODRY plus X1 SUB-D 9 (male) START / STOP and STANDBY operation configuration



1. START/STOP switch *2. STANDBY switch*
3. Logic control interface

6.5 Analogue speed control

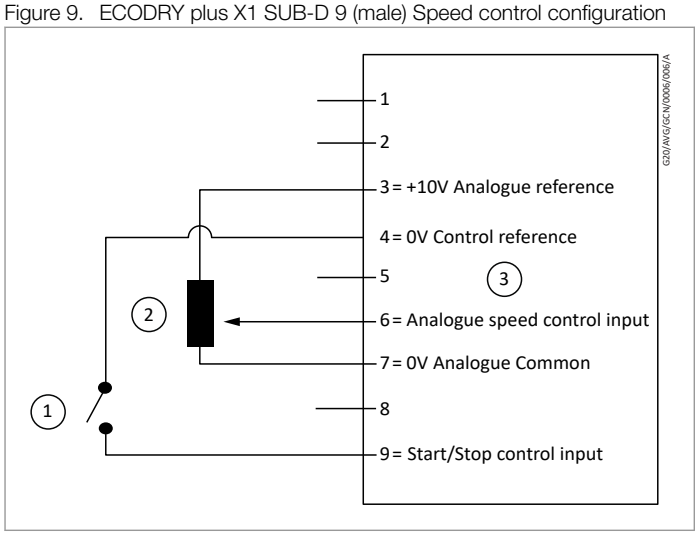
CAUTION: CONNECTION SAFETY

Risk of damage to equipment. Physical connection to the analogue speed input (X1, pin 6) and the gauge input (X101) at the same time, will result in the wrong speed control reference signal. For correct operation of the analogue speed input, all physical connections to the gauge input must be removed.

The analogue speed input (X1, pin 6) is a process control source that enables the pump to run at variable operating speeds. This speed control source is an alternative to STANDBY speed control. Furthermore, the analogue speed input cannot be used if the gauge input is active.

The analogue speed input functionality is disabled by default. To enable this functionality, the ECODRY plus service tool must be used to configure the pump for analogue speed control. Please contact your local distributor for more details.

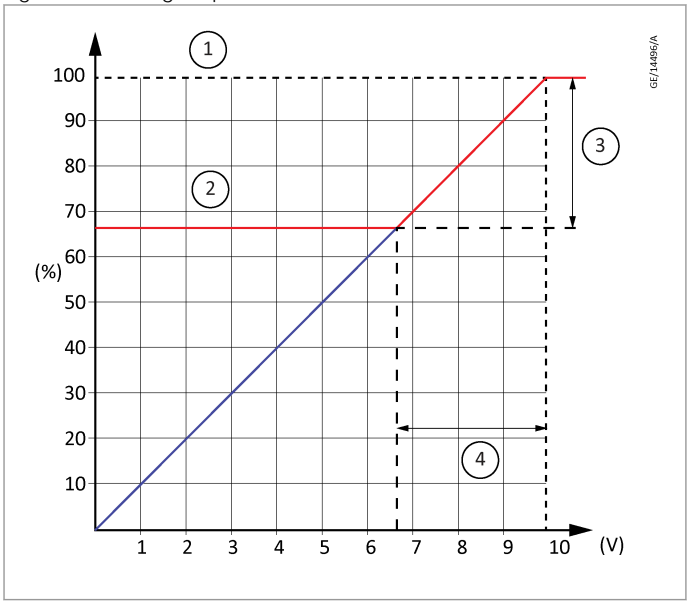
Figure 9. ECODRY plus X1 SUB-D 9 (male) Speed control configuration



1. START/STOP switch *2. Analogue control speed source*
3. Logic control interface

Operation

Figure 10. Analogue speed control



1. *Upper speed clamp - Maximum standby setting = 250 Hz*
2. *Lower speed clamp - Minimum standby speed setting = 125 Hz*
3. *Active speed range - 50.00 % to 100.00 % (125Hz to 250 Hz)*
4. *Active Voltage range - 5.00 V to 10.00 V*

Note:
0.1 V = 1% of default run speed.
Voltages below 5 V will result in a clamped speed of 50% of full speed.

6.6 Operational modes

- A +10 V input results in a mechanical running speed which is equal to 100% of the default run speed, that is 250 Hz.
- The minimum running speed provided by the analogue speed control source, is clamped at the minimum standby speed setting (approximately 50% of the default run speed).
- The maximum running speed provided by the analogue speed control source is clamped by the maximum standby speed setting (100% of the default run speed).

6.7 Start the pump

WARNING: EXHAUST PIPELINE BLOCKAGE

Risk of damage to equipment. Do not operate the pump if the exhaust pipeline is restricted or blocked as the pump will not operate correctly and may be damaged.

To start the pump:

1. Make sure that the vacuum system isolation valve is closed (if installed).
2. Make sure that the mains supply to the pump is isolated.
3. Connect a recommended lead to the electrical socket on the pump. Refer to *Figure: General view* on page 11.
4. Supply the power.

5. Start the pump with the appropriate control source:
   - Use the start button in manual control mode, refer to *Figure: Interface control panel* on page 12.
   - Use the start/stop control input in parallel control mode.
   - Use start command in serial control mode.
6. Open the vacuum system isolation valve, if installed.

6.8 Shut down the pump

CAUTION: PUMP SUPPLY ISOLATION

Risk of injury. Do not remove the inlet connections until the pump has been allowed to stop rotating and the power and gas supply has been isolated. The pump can take up to three minutes to stop completely.

WARNING: ELECTRICAL SUPPLY

Risk of damage to equipment. Do not disconnect the pump from the electrical supply until the pump has stopped completely.

The pump can be shut down with either the front panel controls or the X1 SUB-D 9 pin (male) connector in either parallel or serial control mode.

Note:
If the pump is to be shut down for storage, remove any process gases by running on a gas ballast for at least one hour.

To shut down the pump:

1. Close the gas ballast
2. Close the vacuum system isolation valves to prevent suck-back into the vacuum system (where fitted).
3. Stop the pump system with the appropriate control source:
   - use the stop button in manual control mode, refer to *Figure: Interface control panel* on page 12.
   - use the start/stop control input in parallel control mode.
   - use stop command in serial control mode.
4. Isolate the mains supply.

If the pump is to be stored, we recommend you either keep the pump under vacuum or fill the pump with dry nitrogen to prevent condensation in the pump. To keep the pump under vacuum, we recommend you seal the inlet and run the pump for at least 20 seconds.

6.9 Restart the pump

If the pump is automatically shut down because of an alarm condition, correct the alarm condition before you restart the pump. To restart the pump, refer to *Start the pump* on page 32.

6.10 X104 SUB-D9 (female) Serial RS-485 Interface

Alternatively, the X104 RS-485 interface can be used to operate and control the pump in serial control mode.

Table 14. Pin assignment serial interface X104 (female)

Pin	Description	Description
1	Not connected	
2	T+	Termination
3	T-	Termination
4	Not connected	
5	Ground (GND)	
6	R-	Receive -
7	R+	Receive + (Tx/Rx+)
		Bridged internally to Pin 9
8	S-	Send – (Tx/Rx-)
		Bridged internally to Pin 6
9	S+	Send +
Housing	Shield	Grounded

6.11 MODBUS RTU Protocol

The MODBUS RTU Protocol specifies the serial communications interface for the pumps. The serial communications interface is defined as follows:

- Half-duplex, RS-485, physical layer
- MODBUS RTU standard/open protocol

Throughout this section, all MODBUS addresses and values are specified using the C notation for hexadecimal (0x). The word ‘character’ is used to represent a 16-bit block of data.

Background

The pumps includes a serial communication interface to enable both control and monitoring functions.

6.11.1 Physical layer

UART interfaces

The ECODRY plus serial link allows connection of the customer’s MODBUS network to the pumps through an RS-485 Multiprotocol transceiver.

Table 15. Default comms configuration

Configuration Description	MODBUS Address	MODBUS Data	Description
Slave Address	0x0090	0x0001	Slave Address = 1
RS-485 Baud Rate	0x00A0	0x0002	2= 38400 Bits per second
Parity	0x00B0	0x0000	0 = even parity+ 1 stop bit
Number of Data Bits	N/A	N/A	8 Bits (fixed)
Number of Stop Bits	N/A	N/A	1 Bit (fixed)

Byte Order

Following the transmission of a start bit, the 8 data bits are transmitted LSB to MSB followed by either a parity bit and then a stop bit, or if No parity is used, 2 stop bits.

Note:
In the case of asynchronous serial links without parity bits, 1 stop bit is more common than 2. However, MODBUS specifies 2 stop bits where no parity is used to maintain 11 bits per transmitted character.

6.11.2 Data link layer

The pumps must support only the MODBUS RTU mode of operation.

Addressing

- The pump always acts as a slave device.
- ECODY plus Slave Address: configurable from 1 to 247
- The ECODRY plus shall only respond to correctly formatted MODBUS messages addressed to it, that is, those messages whose first byte matches the slave address of the pumps.

CRC checking

The pumps must calculate a 16-bit Cyclic Redundancy Check (CRC) value for the incoming message. This calculation may be incrementally calculated every time a new byte is received.

Once the end of the message has been detected, the preceding 2 bytes shall be assumed to be the CRC bytes. The CRC calculation on the incoming message (excluding the 2 CRC bytes) shall be finalised and a CRC comparison shall be made.

The CRC calculation shall be started by pre-loading a 16-bit register with a seed value of 0xFFFF.

During the generation of the CRC, each 8-bit character shall be exclusive ORed with the register contents. The result shall be shifted in the direction of the Least Significant Bit (LSB), with a zero filled into the Most Significant Bit (MSB) position. If the LSB was 1, the register shall be exclusive ORed with the polynomial value 0xA001, otherwise no exclusive OR shall take place.

This process shall be repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte shall be exclusive ORed with the register's current value, and the process shall repeat for eight more shifts. The final content of the register, after all the bytes of the message (excluding the 2 CRC bytes) have been applied, is the CRC value.

When the CRC is appended to the message, the low-order byte shall be appended first, followed by the high-order byte.

6.11.3 Application protocol layer

The pumps must support a subset of the MODBUS function codes as listed.

Code	Description
03 (0x03)	Read holding registers (Module configuration data)
04 (0x04)	Read input registers (Module configuration data)
16 (0x10)	Write holding registers (Module configuration data)

Supported MODBUS Functions

The pump must support a subset of the MODBUS exception codes as listed.

Exception code	Name
01	Invalid function code
02	Invalid data address
03	Invalid data value
04	Slave device failure

6.11.4 ECODRY plus Protocol

Table 16 Examples of read commands

Command Description	Read: Run second Reads the run seconds of the pump
Slave Address	0x01
Function Code	0x04
Start Address Upper	0x00
Start Address Lower	0x80
Data Quantity Upper	0x00
Data Quantity Lower	0x02
CRC-16 Upper	-
CRC-16 Lower	-

Table 17 Examples of write commands

Command	Description	Slave Address	Function Code	Start Address		Data quantity		Number of Bytes	Starting Data		CRC-16	
				Upper	Lower	Upper	Lower		Upper	Lower	Upper	Lower
Write: START	STARTS the pump via MODBUS	0x01	0x10	0x00	0x50	0x00	0x01	0x02	0x00	0x02	TBD	TBD
Write: STOP	STOPS the pump via MODBUS	0x01	0x10	0x00	0x50	0x00	0x01	0x02	0x00	0x01	TBD	TBD

6.11.5 Register Addresses

Parameter Scaling

A real value of a parameter measured or sensed through feedback circuitry can be calculated from the channel register value, in Q15 format, and the Full Scale Value as follows:

1. $V_{real} = (V_{Q15}/2^{15}) * V_{FSV}$
2. $V_{real} = [(V_{Q15} - 2^{16})/2^{15}] * V_{FSV}$

For HEX value, of a parameter, ≤ 7FFF (means positive value) use equation (1).

For HEX value, of a parameter, > 7FFF (means negative value) use equation (2).

- Example 1: DC link Voltage channel reads 50A1 which is ≤ 7 FFF (positive value) then apply equation (1).

Decimal value of 50A1 HEX is 20641, so

DC link $Voltage_{real} = (20641/2^{15})* 500 = 314.95$ V where 500 is the Full Scale Value, V_{FSV}, of the Voltage.

- Example 2: Motor Current channel reads E0C1 which is > 7 FFF (negative value) then we apply equation (2).

Decimal value of E0C1 HEX is 57537, so

Motor $Current_{real} = [(57537-2^{16})/ 2^{15}]*25 = - 6.1$ A where the 25 is the , Full Scale Value, I_{FSV} of the Current.

Full Scale Values of the system are as follows:

Address	Parameter	Full Scale Value	Units
0x0040	Frequency	400	Hz
0x0041	Voltage	500	V
0x0042	Current	25	A
0x0043	Temperature	200	°C
0x0044	Analogue	20	V

Table 18 Examples of MODBUS holding register (Pump operation)

Address	Designation	Type/Unit	Description
0x0050	System Command Register 01	enumeration/ na	0x0000 = NULL* 0x0001 = STOP 0x0002 = START 0x0003 = STANDBY 0x0004 = RUN
0x0055	Speed Demand	Q15/ Hz	Speed demand input. Speed demand used by the application will be limited to lower and upper values in Run Speed Minimum and Maximum.

Address	Designation	Type/Unit	Description
0x00E0	Run Speed Setting.	Q15/Hz	Speed demand input. Speed demand used by the application will be limited to lower and upper values in Run Speed Minimum and Maximum.
0x0051	Configuration command register 01	enumeration/ na	0x0000 = NULL 0x0001 = STORE Notes: ▪ The store command writes user data to non-volatile memory. ▪ The store command does not include operational History. ▪ Depending on the size of the data, the store command may take a significant time to complete and may return a response before the store is complete or may wait until the store is complete. ▪ A separate store command is provided in the Service command register for Operational History. ▪ The null command has no effect other than clearing the configuration command register 01.

** The NULL command has no effect other than clearing the system command register 01.*

Table 19 Examples of MODBUS input register (Monitor values)

Status Registers (Group Address = 0x0060)			
Address	**Monitored Parameter**	**Type/Unit**	**Description**
0x0060	System Status Register 01	Bit field	This status word reflects commands sent over the MODBUS link.
			15(MSB)= CHANGES: Set if any parameters, normally resident in volatile memory but shadowed in non-volatile memory, have not been stored to non-volatile memory. (Cleared by STORE command).
			14 = FACTORY_SETTINGS: Set if the user settings have not been adjusted from the factory default values. Cleared by any changes to the user parameters. Set again after a completed RESTORE command. Also cleared by cycling the power if changes to user parameters had not been stored to non-volatile memory.
			13 = IN_CONTROL_MODE: See bits 6 and 7 below
			12 = Reserved.
			11 = Reserved.

Status Registers (Group Address = 0x0060)			
Address	**Monitored Parameter**	**Type/Unit**	**Description**
			10 = SERIAL ENABLE SWITCH: Reflects the state of the Serial Enable Switch and therefore of the Serial link function.
			9 = Reserved.
			8= Reserved.
			13;7;6 = IN_CONTROL_MODE: Decoded as follows: 000 = None in control 001 = MODBUS serial in control 010 = Toggle switch input in control (i.e START line) 011 = Momentary switch input in control (i.e Debug interface) 100 = Reserved 111 = Reserved
			5 = ABOVE_OVERL_SPEED: Set if running above the overload speed threshold.
			4 = ABOVE_RAMP_SPEED: Set if running above the ramp speed threshold.
			3 = NORMAL: Set if running above NORMAL speed.
			2 = STANDBY: Set if the STANDBY command accepted.
			1 = ACCEL (aka Running): Set if START command accepted and the drive operating, applying voltage to the motor.
			0(LSB) = DECEL (aka Stopping): Set if pump is decelerating. Clear if the pump is STOPPED.
0x0061	System Status Register 02	Bit field	This status word reflects the internal state of the Drive. The precise meaning of the bits reserved for the finite state machine (FSM) will vary between applications.
			15(MSB)= MASTER_ALERT: This bit is set to indicate that a warning or alarm is present in the Master drive.
			14 = SLAVE_ALERT: This bit is set to indicate that a warning or alarm is present in the Slave drive
			13 = FSM_TIMEOUT: FSM Timeout
			12 = FSM4: Reserved for FSM state.
			11 = FSM3: Reserved for FSM state.
			10 = FSM2: Reserved for FSM state.
			9 = FSM1: Reserved for FSM state.
			8= FSM0: Reserved for FSM state.
			7 = ALARM: A fault is present. This bit is set if any bit in the Fault Register is set.
			6 = WARNING: A warning is present. This bit is set if any bit in the Warning Register is set and the corresponding bit in the Warning Mask Register is also set.

Status Registers (Group Address = 0x0060)			
Address	**Monitored Parameter**	**Type/Unit**	**Description**
			5 = RESET PENDING: Drive about to reset following a software upgrade or external reset request
			4 = SERVICE DUE: A service is due. See Service Register
			3 = LOW_LINK_VOLTAGE: Drive inhibited when LinkVoltage drops below UnderVoltageThreshold
			2 = UVREG: Upper voltage regulator active (this is a normal operating condition during deceleration with electronic braking)
			1 = LPREG: Lower power regulator active (this is a normal operating condition during acceleration in a drive with a power regulator implemented)
			0(LSB) = UPREG: Upper power regulator active (this is a normal operating condition during deceleration with electronic braking in a drive with a power regulator implemented)
0x0062	Warning Register 01	Bit field	15(MSB)= SELF_TESTING_WARNING: Non-critical problem with EEPROM or other internal function. See Diagnostic registers for details
			14 = PPREG: Pump Protection Regulator active - indicates that the transient overload time/capacity has been exhausted and the input current and/or output current and/or power are being restricted to rated values.
			13 = Reserved
			12 = POWER_FAIL: Indicates detected loss of mains supply.
			11 = HIGHTC: Controller temperature above the upper limit/controller temperature sensor short circuit
			10 = HIGHTS: Inverter heat-sink temperature above the upper limit/inverter heat-sink temperature sensor short circuit
			9 = HIGHTM: Motor temperature above the upper limit/motor temperature sensor short circuit
			8= Reserved
			7 = UTCREG: Upper controller temperature regulator active (drive cooling may be inadequate)
			6 = UTSREG: Upper heat sink temperature regulator active (drive cooling may be inadequate)
			5 = UTMREG: Upper motor temperature regulator active (motor cooling may be inadequate)
			4 = LVREG: Lower voltage regulator active (could be due to mains failure)
			3 = LOWVCC: Auxiliary supply voltage, Vcc, is low. (indicates that the power supply voltage has started to collapse, and the processor will lose power imminently - EEPROM writes are inhibited if this bit is set)

Status Registers (Group Address = 0x0060)			
Address	**Monitored Parameter**	**Type/Unit**	**Description**
			2 = LOWTC: Controller temperature below -5 °C - could indicate an open circuit thermistor
			1 = LOWTS: Inverter heat-sink temperature below -5°C - could indicate an open circuit thermistor
			0(LSB) = LOWTM: Motor temperature below 0 °C – could indicate an open circuit thermistors
0x0063	Latched Fault Register 01	Bit field	15(MSB)= ACCELERATION T/O: Acceleration Timeout
			14 = OVERLOAD T/O: Overload Timeout
			13 = SC_MODE_INTERLOCK: Serial Enable deactivated after a serial Start command
			12 = SELF TEST FAULT: The firmware has detected a problem with the hardware that prevents further operation of the drive. Exact problem indicated by one of the following bits in the Diagnostic Register 01:- SINK_TEMPERATURE_SENSOR_FAULT; FLASH_MEMORY_CRC_BOOT_ERROR; FLASH_WRITE_PROTECT_FAULT; FLASH_CAL_DATA_CRC_ERROR; OSTEST _FAULT; WATCHDOG TIMEOUT; INTERNAL_COMMS_ LOSS And/or the following bits in the Diagnostic Register 02:- PLL_LOSS_OF_LOCK; VOLTAGE_DOUBLER_FAULT; IGBT_SHORT_CIRCUIT; IGBT_OPEN_CIRCUIT; CURRENT_SENSOR_FAULT; VOLTAGE_SENSOR_ FAULT; MOTOR_SHORT_CIRCUIT; MOTOR_OPEN_CIRCUIT See individual bits for conditions required to reset each fault
			11 = NO_PARAMETER_SET: Indicates that the drive requires a parameter set upload to configure it for the target application. (Set when Motor Control Method parameter = Lockout). Non-resettable fault.
			10 = Reserved
			9 = EEPROM FAULT: EEPROM Parameter Upload Incomplete or subsequent EEPROM communication failure. See Diagnostic Register for details. Try to repair with parameter set upload. Non-resettable fault.
			8= PWM TRIP: Indicates that the drive output stage is inhibited. (Bit set if the PWM_TRIP signal is low.) [May be reset via TRIP_RESET if the hardware trip source has cleared]
			7 = Reserved
			6 = Reserved
			5 = IPM FAULT: Indicates the inverter power stage Integrated Power Module (6 IGBT switches) is faulty.

Status Registers (Group Address = 0x0060)			
Address	**Monitored Parameter**	**Type/Unit**	**Description**
			4 = UNDERT: Indicates an excessively low temperature or a temperature sensor failure condition (Bit set if the instantaneous state of UNDERT_MON signal is low.) [May be reset via TRIP_RESET if the hardware trip source has cleared]
			3 = OVERT: Indicates an OVER-TEMPERATURE condition (Bit set if the instantaneous state of OVERT_MON signal is low.) [May be reset via TRIP_RESET if the hardware trip source has cleared]
			2 = OVERI: Indicates an OVER-CURRENT condition (Bit set if the instantaneous state of OVERI_MON signal is low.) [May be reset via TRIP_RESET if the hardware trip source has cleared]
			1 = OVERV: Indicates an OVER-VOLTAGE condition. (Bit set if the instantaneous state of OVERV_MON signal is low.) [May be reset via TRIP_RESET if the hardware trip source has cleared]
			0(LSB) = OVERF: Indicates an OVER-SPEED condition. (Bit set if the instantaneous state of OVERF_MON signal is low.) [May be reset via TRIP_RESET if the hardware trip source has cleared]
0x0066	Diagnostic Register 01	Bit field	15(MSB)= Reserved
			14 = INRUSH_THERMISTOR_ NOT_BYPASSED
			Inrush circuit has over-heated due to repeated power cycling so the drive cannot start, or pre-charge relay open for some other reason. The self-test warning will be set, possibly following a delay. The self-test fault bit will be set if this condition prevents the drive from running. Power should be removed and the drive left to cool down for 5 minutes before re-applying the power. Note that the raw state of the pre-charge relay output is set in the Digital Output Register at 0x1CA1. Non-resettable after fault indicated.
			13 = WATCHDOG TIMEOUT Power on self-test warning – generates fault log and then automatically clears the fault and restarts. Self-resetting fault
			12= Reserved
			11= EEPROM_LOW_VCC_ WRITE_DISABLE Resettable Warning. EEPROM write access blocked because internal 15 V rail voltage is below the threshold.
			10= EEPROM_WRITE_ VERIFY_WARNING Resettable Warning

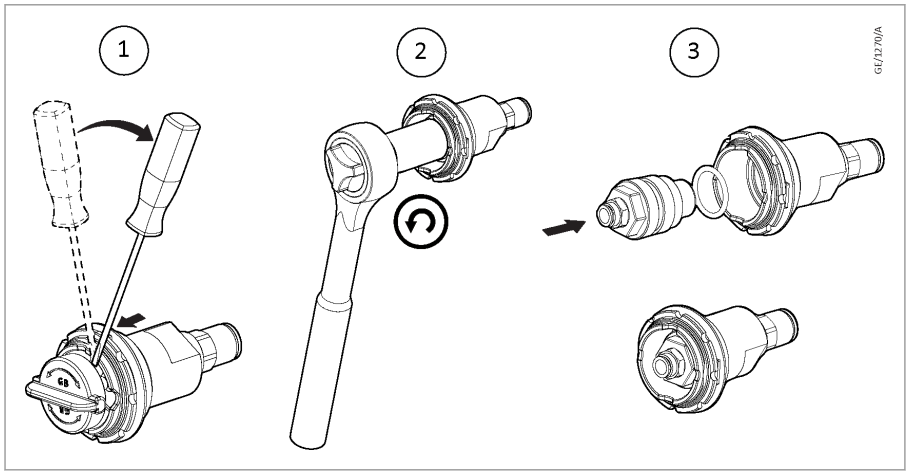
Status Registers (Group Address = 0x0060)			
Address	**Monitored Parameter**	**Type/Unit**	**Description**
			9= EEPROM_TIMEOUT_ WARNING Resettable Warning
			8= EEPROM_INVALID_ NUMBER_OF_BYTES Resettable Warning
			7= FLASH_MEMORY_ CRC_BOOT_ERROR
			Non-resettable fault detected by the boot loader - need to repeat the FLASH download process.
			6= FLASH_WRITE_ PROTECT_FAULT
			Non-resettable fault detected by the boot loader - need to repeat the FLASH download process.
			5= FLASH_CAL_DATA_CRC_ERROR Non-resettable fault – if fault is not cleared by a power cycle the Processor board must be replaced.
			4= EXTERNAL_RESET
			Power on self test warning – generates a fault log and then automatically clears the fault and restarts.
			3= SINK_TEMPERATURE_ SENSOR_FAULT Non-resettable fault. The software monitoring of the sink temperature sensor indicates that this sensor is not working correctly.
			2= EEPROM_COMBINED_ GAIN_OF_ZERO
			Non-resettable fault
			1= EEPROM_INVALID_ BLOCK_CRC
			Non-resettable fault
			0(LSB)= EEPROM_INVALID_ MAP_ID
			Non-resettable fault
0x006A	Diagnostic Register 02		15(MSB)= Reserved
			14 = Reserved
			13 = Reserved
			12= Reserved
			11= Reserved
			10= Reserved
			9= Reserved
			8= Reserved
			7= PLL Loss of Lock. Phase Locked Loop Loss of Lock
			6= VOLTAGE_DOUBLER _FAULT Set to indicate that the voltage doubler is not in the state commanded (detected from measurement of mains input voltage and Vdc). Note that the raw state of the voltage doubler relay output is set in the Digital Output Register at 0x1CA1. Non-resettable fault.
			5= Reserved

Status Registers (Group Address = 0x0060)			
Address	**Monitored Parameter**	**Type/Unit**	**Description**
			4= Reserved
			3= Reserved
			2= Reserved
			1= Reserved
			0(LSB)= Reserved
Monitor Values (Group Address = 0x0070)			
Address	Monitored Parameter	Type/Unit	Description
0x0070	Frequency Reference	Q15/Hz	Nominal speed
0x0071	Motor Frequency	Q15/Hz	Stator Frequency Applied to the Motor
0x0072	Cumulative Operation Time at Previous Fault.	Int/second	Time
0x0074	Motor Current	Q15/A	RMS Current
0x0075	DC Link Voltage	Q15/V	Voltage
0x0076	Motor Power	Q15/W	Power
0x0077	Motor Temperature	Q15/°C	Temperature
0x0078	Sink Temperature	Q15/°C	Temperature
0x0079	Controller, DSP, Temperature	Q15/°C	DSP Temperature
0x007A	Vcc Supply	Q15/V	Rail Voltage
0x007B	Rotor Speed	Q15/Hz	Rotor Speed for IM or Synchronous Machine
Drive Operational History (Group Address = 0x0080)			
Address	Monitored Parameter	Type/Unit	Description
0x0080	Run Seconds	Int/second	Drive running time
0x0082	Powered Seconds	Int/second	Drive powered up time
0x0084	Fault Total Count	Int/na	Number of faults (trips) since manufacture, i.e. since initialisation of the fault log.
0x0085	Fault Count	Int/na	Number of faults (trips) since last requested reset of the fault count.
0x0089	Drive Power Cycle Count	Int/na	Count the number of power-on events.

6.12 Gas ballast operation

Gas ballast is operated by a black plastic knob that may be positioned to either position 0 (which means the gas ballast is closed), position 1, or any other elevated rim result that feeds air to the pumping mechanism with a flow of approximately 20 slm.

6.13 Gas ballast adaptor fit



The manually operated gas ballast knob can be replaced by a gas ballast adaptor which enables external electrically actuated valves or a controlled gas supply to be used through a 1/4 inch push fit connector. To install the gas ballast adaptor:

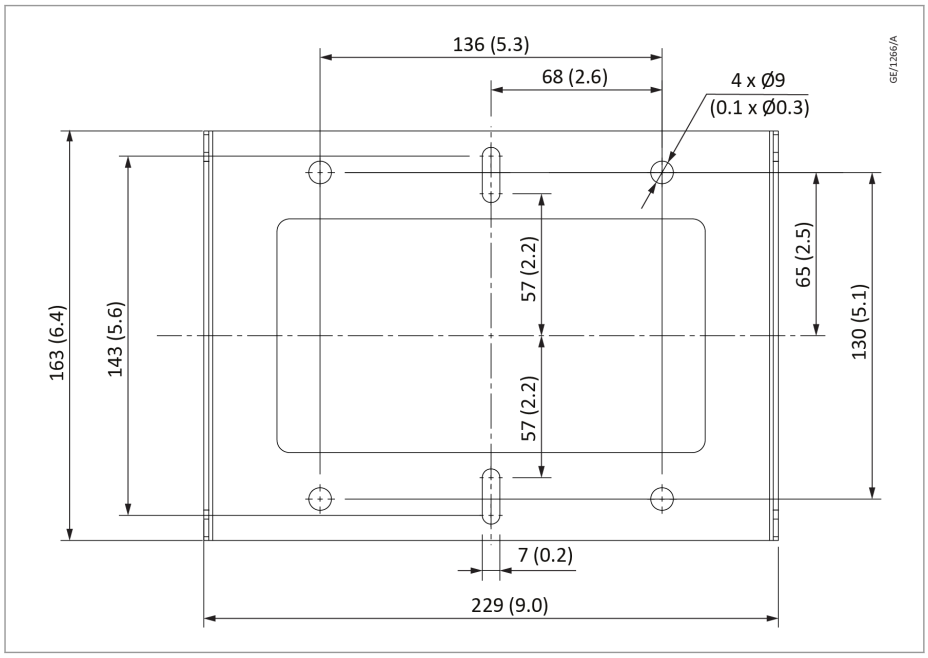
1. The gas ballast knob must be pulled out from gas ballast spindle by flat headed screwdriver or any similar tool can be used to lever the fitting free. To help position the tool underneath the knob it may be necessary to partially rotate the knob in-between notches.
2. Once the GB knob has been removed the internal valve can be extracted using an 21 mm socket wrench.
3. The adapter can now be installed using a 21 mm socket wrench. Make sure that a clean O-ring is assembled onto the adapter before you start installation.

6.14 Extra silencer removal

The pump is furnished by an additional removable silencer in the form of a drilled M12 plug that can be removed by allen key of size 10. Removal is advised when the exhaust of the pump is connected to additional exhaust pipeline to gain up to 2 m^3/h in pumping speed from atmosphere.

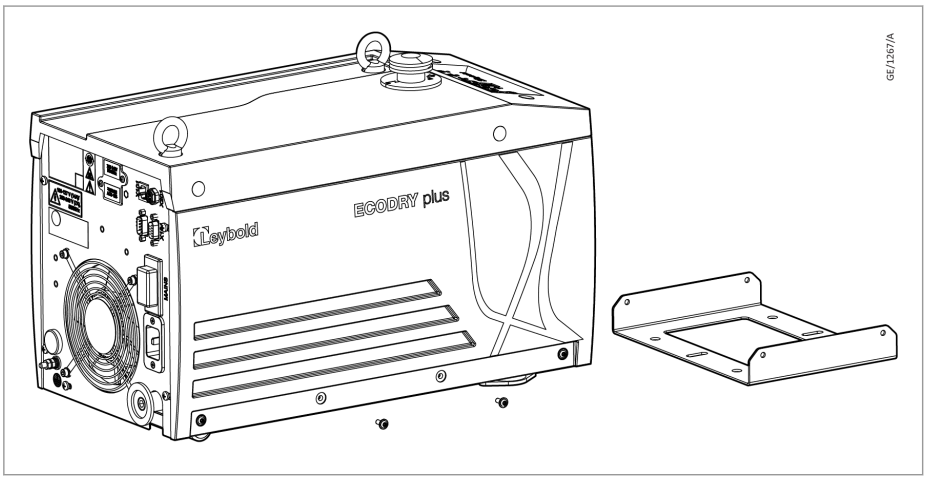
6.15 Mounting kit use

A mounting frame is available as an accessory (part number 162800A001). This can be used to mount the pump to a cart or bolt it to the floor. The mounting frame has four holes and two slots for M6 bolts. These are aligned with the corresponding mounting positions on our Phoenix leak detector carts (center slots) or TURBOLAB turbo carts (four holes).



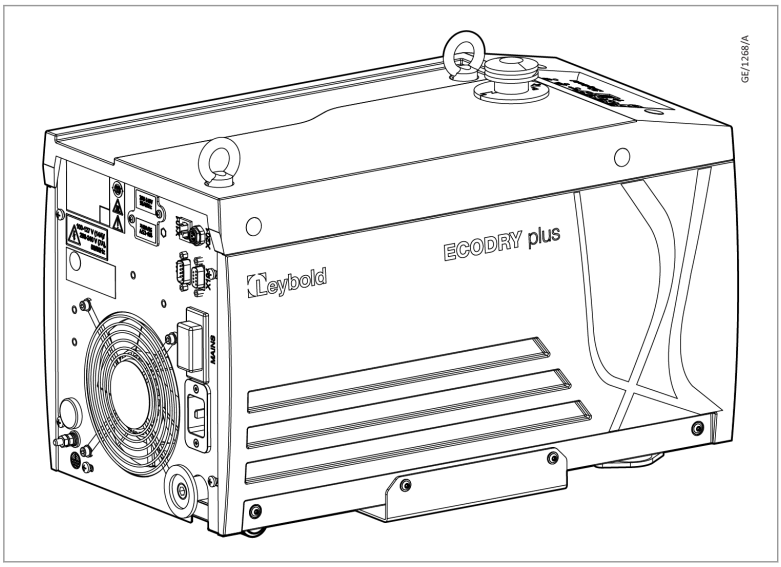
Installation instructions:

1. Remove the four marked screws at the side of the pump in the pump enclosure. Store these screws in a safe position.



2. Use suitable M6 screws to mount mounting frame at the target location.
3. Lift or roll pump on the mounting frame with the pump centered on the mounting frame.

4. Use included screws and washers to fix pump to mounting frame.



6.16 Pressure gauge connectivity and automatic eco-mode

A active Pirani gauge, e.g. TTR 91, TTR 91 N, TTR 91 R, TTR 101, TTR 911 N, or compatible can be connected to the connector labelled X101 on the back of the pump. Please use a screened Type A connecting cable from our catalogue. Using a suitable T-piece the pressure gauge can be connected to the ECODRY plus inlet. The measured inlet pressure can be monitored using the software tool LEYASSIST or can be used to enable automatic speed control of the ECODRY plus based on the actual pressure for power consumption and noise reduction.

When a pressure gauge is detected, automatic eco-mode is automatically activated in the default configuration. In this mode the ECODRY plus runs with full speed for initial pumpdown of the system. Once the target ultimate pressure is reached and for example the turbomolecular pump has reached full speed resulting in a lower and stable gasload, the ECODRY plus is reducing automatically the rotation speed to the configured standby speed running with lower power consumption and lower noise. Only, if additional gas load is created and the inlet pressure is increased above the configured threshold pressure, full speed is activated again.

The corresponding threshold values can be configured using the LEYASSIST software tool on a connected PC. LEYASSIST can be also used to monitor the measured inlet pressure during the process and to deactivate this operation mode.

Default parameters:

Lower Standby Pressure Setpoint	When the pump is started at high pressure it's running at full speed. When the measured pressure is falling below this setpoint, the speed is reduced from full speed to standby speed.	0.1 mbar
Upper Standby Pressure Setpoint	When the pressure is exceeding this value the speed is switched back to full speed again.	0.5 mbar

LEYASSIST can be downloaded free of charge from our website under *www.leybold.com* > Downloads > Download Software > Software for ECODRY plus. A PC connection cable connected to the front USB connector or the serial interface on the back of the pump (X104) is required for configuring the pump.

7 Maintenance and service

7.1 General maintenance

The system requires no user maintenance. Maintenance must be done by trained personnel. The frequency of the maintenance depends on the process and can be adjusted according to the user experience. Refer to *Maintenance plan* on page 49 for the maintenance schedule.

We recommend a monthly visual inspection of the dry pump system. Check that the electrical supply cord, hoses and pipelines connected to the pump are in good condition and are secured properly.

7.2 Maintenance plan

More frequent maintenance may be required if the pump is used to pump aggressive gases or vapours, solvents, organic substances and acids, or if the pump is operated continuously at high operating temperature.

Table 20 Maintenance plan

Operation	Frequency (months)	Service indicator	Reference
Inspect and clean the inlet strainer	12	No	*Inspect and clean the inlet strainer* on page 49
Inspect and clean the external fan cover if required	12	No	*Clean the external fan grill* on page 49
Replace the pump bearings	60	Yes	*Replace the pump bearings* on page 50
Replace the pump controller	120	Yes	*Replace the pump controller* on page 50
Electrical safety check	60	No	*Electrical safety check* on page 50

Note:
The pump must be returned to the Service Technology Centre (STC) for maintenance. For service indicator codes, refer to Table: Service indicator codes on page 50.

7.3 Inspect and clean the inlet strainer

Inlet strainer is pump accessory, refer to *Accessories* on page 57. In case of inlet strainer is used, should be cleaned according to these instructions. Whenever the pump is disconnected from the vacuum system or annually:

- Remove the inlet strainer from the pump inlet, refer to *Figure: General view* on page 11.
- Clean the pump inlet and remove the debris that may have accumulated.
- Examine the inlet strainer and if necessary, clean it with a cleaning solution suitable for the substances pumped.
- Install the inlet strainer before you reconnect the pump to the vacuum system. Refer to *Mechanical installation* on page 20.

7.4 Clean the external fan grill

If the fan cover is not kept clean, the air flow over the pump can be restricted and the pump may overheat.

To clean the fan grill:

1. Switch off the pump and disconnect from the electrical supply.
2. Use a dry cloth and a soft brush to remove dirt and deposits on the fan cover.

7.5 Replace the pump bearings

The service indicator, (flashing ON 3 sec/OFF 1 sec) is activated to indicate that a bearing replacement service interval has been reached. Bearing wear cannot always be detected under normal operating conditions. This service interval is a recommendation that a bearing replacement is required and is useful in the preventative maintenance plan.

Note:
Failure to replace the pump bearings on time can damage the pumping mechanism.

To reset the service indicator, refer to *Table: Service indicator codes* on page 50.

Bearing replacement is not possible by the customer, the pump must be returned to a Service Technology Centre for maintenance.

7.6 Replace the pump controller

The service indicator, (flashing ON 3s / OFF 3s) is activated to indicate that the pump controller must be replaced. Contact us for further details.

To reset the service indicator, refer to *Table: Service indicator codes* on page 50.

Controller replacement is not possible by the customer, the pump must be returned to a Service Technology Centre for maintenance.

7.7 Electrical safety check

Test the earth continuity and the insulation resistance of the pump system in accordance with local regulations for the periodic test of electrical equipment.

The earth continuity must be less than 0.1 Ω and the DC insulation resistance greater than 1.0 MEG Ω. If the pump fails any of these tests, contact us or the supplier.

7.8 Service indicator codes

The controller has a service indicator, refer to *Figure: Interface control panel* on page 12. The service indicator will flash a specific code whenever a service interval is reached. See *Table: Service indicator codes* on page 50 for service levels.

Table 21. Service indicator codes

Service flash code	Comments
ON 3s/OFF 1s	Pump bearing service
ON 3s/OFF 3s	Pump controller service

8 Service

It is recommended that the pump should be serviced every 5 years. The pump should then be returned to a Service Technology Centre.

Our products are supported by a world-wide network of Service Technology Centres offering a wide range of options including:

- Complete remanufacturing (includes 6 months warranty)
- Exchange pump (includes 12 months warranty)

Both services include decontamination, repair, rebuild, and test to factory specification.

A local Service Technology Centre can also provide trained engineers to support the exchange pump option. For more information about service options, contact us or the nearest Service Centre.

8.1 Return the equipment or components for service

Before you send your equipment to us for service or for any other reason, you must complete a Declaration of Contamination Form. The form tells us if any substances found in the equipment are hazardous, which is important for the safety of our employees and all other people involved in the service of your equipment. The hazard information also lets us select the correct procedures to service your equipment.

If you are returning equipment note the following:

- If the equipment is configured to suit the application, make a record of the configuration before returning it. All replacement equipment will be supplied with default factory settings.
- Do not return equipment with accessories fitted. Remove all accessories and retain them for future use.
- The instruction in the returns procedure to drain all fluids does not apply to the lubricant in pump oil reservoirs.

Download the latest documents from *leybold.com/en/downloads/download-documents/declaration-of-contamination/*, follow the procedure in HS1, fill in the electronic HS2 form, print it, sign it, and return the signed copy to us.

NOTICE:

If we do not receive a completed form, your equipment cannot be serviced.

9 Fault finding

A list of fault conditions and their possible causes is provided to assist in basic troubleshooting. If you are not able to rectify a fault, call your supplier or your nearest Service Technology Centre for advice.

Fault	The pump has failed to start or has stopped
Cause	**The electrical supply fuse has blown.**
Remedy	Make sure that the external electrical supply is switched on and that the power indicator LED (refer to *Figure: Interface control panel* on page 12) is illuminated. If the LED does not illuminate, contact us.
Cause	**The motor controller has not reset after an over temperature event.**
Remedy	Disconnect the main power supply and wait for at least one minute and attempt to restart the pump. If the pump still does not start, contact us. If the alarm indicator LED (refer to *Figure: Interface control panel* on page 12) flashes, it indicates that the pump has high current load from possibly a high inlet pressure/flow. Adjust the inlet pressure/flow until the pump performance recovers.

Fault	The pump has failed to achieve the required performance
Cause	**The pressure measurement technique or gauge head is not suitable or gives an incorrect indication of pressure.**
Remedy	Make sure that the vacuum measurement equipment is calibrated and is updated. The correct gauge range must be selected for the application. Contact us for further assistance on gauge selection, if required.
Cause	**The vacuum fittings are dirty or damaged.**
Remedy	Make sure that the vacuum fittings are clean and scratch free.
Cause	**There is a blockage or high pressure in the exhaust line.**
Remedy	Make sure that the exhaust valves fitted are not closed when the pump is in operation.
Cause	**The motor controller is current limiting the supply.**
Remedy	If the alarm indicator LED (refer to *Figure: Interface control panel* on page 12) flashes, it indicates that the pump has high current load from possibly a high inlet pressure/flow. Adjust the inlet pressure/flow until the pump performance recovers.
Cause	**The pump performance is different at the working application load.**
Remedy	The pump does not have a flat performance curve, peak pumping speed can vary with inlet pressure and gas load. Check the actual performance against the performance curve shown in *Technical data* on page 15.

Fault	The pump is noisy
Cause	**The pump is contaminated with solid particles.**
Remedy	Contact us or the supplier for further information.

Cause	**Blocked rotors**
Remedy	When the pump gets hot and if debris may have been ingested or condensed within the pump, the rotors may be stuck. Let the pump cool down to room temperature, then restart, once operational run the pump with the gas ballast applied for at least 2 hours to try and clear any internal blockages. If the problem persists is recommended to contact supplier for further information and advice.

Fault	**The pumping speed is poor or pump down time is too long**
Cause	**The pipelines connections are too small in diameter.**
Remedy	Make sure that the pipework has sufficient conductance (user's responsibility) and the pump performance is not compromised.
Cause	**There is a leak in the system.**
Remedy	Leak test the pump system in accordance with the requirements specified in *Table: Performance data* on page 16.
Cause	**The motor controller is current limiting the supply.**
Remedy	Adjust the inlet pressure/flow until the pump performance recovers.
Cause	**The pump chamber is too big.**
Remedy	Make sure that the chamber size does not exceed the limits specified in *Table: Mechanical data* on page 15.

9.1 Alarm indicator codes

When the fail condition becomes active, the red alarm indicator shows a flashing sequence.

- If the error light is on continuously, this indicates a problem has been found with the embedded software. In this case, switch the power supply on and off.
- If the indication is not cleared, a software download may be required. In this case, contact us or the supplier.
- If the alarm indicator is flashing, identify the error flash code. Refer to *Table: Flashing error codes* on page 53.

Note:
There is a sufficient off period between each subsequent cycle repetition to mark the start of a new flash sequence. The duration of a long flash (L) is equal to 3 times the duration of a short flash (0.5 s).

Table 22 Flashing error codes

Error flash position	Error flash sequence	Comment	Actions
0	s-s-s-s-s-s	Overload timeout	Check if the pump is not under constant high pressure or the inlet or outlet is not blocked.
1	L-s-s-s-s-s	Controller software error	Switch the power to the pump off and on and see whether the error code appears again. If it does, contact us or the supplier.
2	s-L-s-s-s-s	Controller failed internal configuration and calibration operation	Switch the power to the pump off and on and see whether the error code appears again. If it does, contact us or the supplier.

Fault finding

Error flash position	Error flash sequence	Comment	Actions
3	s-s-L-s-s-s	Acceleration timeout	Check if the pump is under constant high pressure or the inlet or outlet is blocked.
4	s-s-s-L-s-s	Over-current trip activated, or other hardware fault	Switch power to the pump off and on and see whether the error code appears again. If it does, contact us or the supplier.
5	s-s-s-s-L-s	Self test fault	Switch the power to the pump off and on and see whether the error code appears again. If it does, contact us or the supplier.
6	s-s-s-s-s-L	Serial control mode interlock	Re-activate the serial enable and send a serial command to clear the error code.

10 Storage

WARNING: HAZARDOUS SUBSTANCES

Risk of injury or damage to equipment. Do not drain oil from the pump. Install the blanking plates to seal the vacuum inlet and outlet ports. The pump must be stored in a horizontal configuration to prevent possible oil leakage.

WARNING: INHALATION HAZARD

Risk of asphyxiation. Do not burn the fluoroelastomer seals, tip seal material or O-rings.

To store the pump:

1. Shut down the pump. Refer to *Shut down the pump* on page 33.
2. Disconnect the pump from the electrical supply.
3. Place and secure protective covers over the inlet and outlet ports.
4. Store the pump in a clean and dry condition until required for use.
5. When necessary, prepare and install the pump. Refer to *Installation* on page 19.

11 Disposal

WARNING: CONTAMINATION HAZARD

Risk of toxic exposure and acid burns. Identify, contain and safely dispose of contaminated items.

Dispose of the pump and any components or accessories safely and in accordance with all local and national safety and environmental requirements.

Our products are supported by a world-wide network of Service Centres. Each Service Centre offers a wide range of options including disposal. Refer to *Service* on page 50 for more information.

Dry pump system materials suitable for recycling include cast iron, steel, PTFE, stainless steel, aluminium, zinc alloy, nickel, mild steel, ABS and polyamide.

Take particular care with:

- Fluoroelastomers which may have decomposed as the result of being subjected to high temperatures.
- Components which have been contaminated with dangerous process substances.

12 Accessories

Contact us for information on the available accessories to support your pump.

Table 23. Accessories

Description	Item number
Mounting kit	162800A001
Gas ballast blank plug	141100A01
Purge gas adapter (restriction/no restriction)	141100A03/141100A02
Inlet screen DN 25 ISO-KF	E41170206

Control and monitoring

Description	Item number
USB connecting cable for X104	161820 USB
USB connection cable A/B (1.8m):	800110V0108

Inlet valve

Description	Item number
SECUVAC DN25 KF 24V Inlet valve	215065
SECUVAC Cable (1.8m)	800103V0040

Pressure gauges

Description	Item number
THERMOVAC TTR 91 R	230049V01
THERMOVAC TTR 916 N	89656V02
THERMOVAC TTR 101 N	230354V01
Gauge cable (1.5m)	800103V0032

12.1 Electrical cables

The table lists the mains cables we currently have with C19 Schurter connector.

Table 24. Mains cables*

EU-CEE 7/7 (Schuko) - IEC 60320 C19, 2.0 m length	161 810 EU
UK-BS 1363 - IEC 60320 C19, 2.0 m length	161 810 UK
USA (115 V) - NEMA 5 - 15P - IEC 60320 C19, 2.0 m length	161 810 US
USA (230 V) - NEMA 6 - 15P - IEC 60320 C19, 2.5 m length	141 103 US
CN 220V (CN GB 2099, 2.0 m)	161 810 CN

** Mandatory requirement for operation.*

P20010342DA

EU Declaration of Conformity

Leybold GmbH
Bonner Strasse 498
D-50968 Koln
Germany

Documentation Officer
Herbert Etges
T: +49(0) 221 347 0
documentation@leybold.com

The product specified and listed below

ECODRY 25 plus	162025V001
ECODRY 35 plus	162035V001
ECODRY 45 plus	162045V001
ECODRY 70 plus	162070V001

Is in conformity with the relevant requirements of European CE legislation:

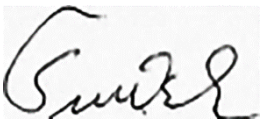
2006/42/EC	Machinery directive *Note: The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Annex 1 No. 1.5.1 of this directive.*
2014/30/EU	Electromagnetic compatibility (EMC) directive Class B Emissions, Class A Industrial Immunity
2011/65/EU	Restriction of certain hazardous substances (RoHS) directive as amended by Delegated Directive (EU) 2015/863

Based on the relevant requirements of harmonised standards:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2023-06-28*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.



Petr Šmérek – Engineering Manager
Scientific Vacuum Division, Lutín, CZ

Jan Večeřa – General Manager
Lutín, CZ

P20010342DA

Declaration of Conformity

Leybold GmbH
Bonner Strasse 498
D-50968 Koln
Germany

Documentation Officer
Innovation Drive
Burgess Hill
West Sussex
RH15 9TW
documentation@leybold.com

This declaration of conformity is issued under the sole responsibility of the manufacturer.

ECODRY 25 Plus	162025V001
ECODRY 35 Plus	162035V001
ECODRY 45 Plus	162045V001
ECODRY 70 Plus	162070V001

The object of the declaration described above is in conformity with relevant statutory requirements:

Supply of Machinery (Safety) Regulations 2008
The objectives of the Electrical Equipment (Safety) Regulations 2016 are governed by Annex 1 1.5.1 of this regulation.

Electromagnetic Compatibility Regulations 2016
Class B Emissions, Class A Industrial Immunity

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Relevant designated standards or technical specifications are as follows:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Statutory Instruments and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2023-06-28*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Signed for and on behalf of Leybold GmbH

Petr Šmérek – Engineering Manager
Scientific Vacuum Division, Lutín, CZ

Jan Večeřa – General Manager
Lutín, CZ

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

EMC (EU, UK): Class B Emissions, Class A Industrial Immunity

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

RoHS (EU, UK): Material Exemption Information

This product is compliant with no Exemptions

REACH (EU, UK)

This product is a complex article which is not designed for intentional substance release. To the best of our knowledge the materials used comply with the requirements of REACH. The product manual provides information and instruction to ensure the safe storage, use, maintenance and disposal of the product including any substance based requirements.

Article 33.1 Declaration (EU, UK)

This product does not knowingly or intentionally contain Candidate List Substances of Very High Concern above 0.1%ww by article as clarified under the 2015 European Court of Justice ruling in case C-106/14.

Additional Applicable Requirements

The product is in scope for and complies with the requirements of the following:

2012/19/EU	Directive on waste electrical and electronic equipment (WEEE)
Product is certified to CSA-C22.2 No.61010-1-12	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements CU 72300521
Product is certified to UL61010-1 3rd Edition	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements CU 72300521
IEC 61010-1:2010/AMD1:2016	Safety requirements for electrical equipment for measurement, control and laboratory use Part 1: General requirements
EN 60529:1991 + A2:2013	Specification for degree of protection provided by enclosures (IP code) - IP code 21

材料成分声明
China Material Content Declaration

表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求。
Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572.

Leybold

Pioneering products. Passionately applied.

Leybold GmbH
Bonner Strasse 498
50968 Cologne
GERMANY
+49-(0)221-347-0
info@leybold.com
www.leybold.com