

ECPS4-LT Operating Instructions

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1. Introduction

This document describes the operating states, status messages, warnings, and error messages that can appear in the system.

In addition, it contains descriptions of some basic functions that could be relevant in case repairs are necessary. The safety instructions listed below are intended to protect you and absolutely must be read and understood.

We have taken the greatest care when creating the content of our documentation, which was based on the latest information available to us. Nevertheless, we would like to point out that this document cannot always be updated at the same time we are developing new technologies for our products. The information and specifications provided can change at any time.

2. Safety

The following instructions must be read before commissioning the system to prevent personal injuries and/or property damage. You must follow the safety instructions at all times.

Read the operating instructions first!

- Follow the safety instructions.
- Note the user information provided.
- Follow the instructions in the documentation of the individual components (in particular of the frequency converter, for example).
- Follow the corresponding additional operating and safety regulations of the owners and the local operating and safety regulations. They may require further measures that go beyond the legal requirements.
- In particular, use the required protective and safety equipment when conducting function tests and test runs!

In general, electric drives, electrical power generating equipment, and other components can be hazardous:

- Electrical voltages 230V/480V:
Potentially hazardous voltages can also be present after switching off such equipment, even 10 minutes after shutdown. For this reason, always check to make sure they are de-energized!
- There is a risk of death if you come into contact with live parts!
- Rotating parts
- Hot surfaces

Protection against magnetic and/or electromagnetic fields during installation and operation

- People with pacemakers, metallic implants, and hearing aids are not permitted to work on hazardous parts, components or systems.
- Even just standing in the hazardous area of such machines can be hazardous to your health. If it is necessary to enter or work in such hazardous areas, then a physician must decide if this is permissible.

Qualification:

- Persons who operate the system should receive instructions on their operation by a qualified person.
- To prevent personal injury or damage to property, only qualified personnel with training in electrical engineering may perform repairs on the device or system.
- For functional tests on cryogenic equipment, additional expertise and instructions are required. When in doubt, consult correspondingly qualified personnel.
- The qualified personnel must familiarize themselves with the operating instructions and the associated documents (cf. the applicable standards and statutory regulations).
- Knowledge of the applicable national accident prevention regulations.

Ensure the following when working on the system:

- It is absolutely essential to comply with the connection requirements and technical data
- Observe the standards for electrical installations, e.g. cable diameters, protective conductors and ground connections.
- Do not touch electronic components and contacts (electrostatic discharges can destroy components).
- When making repairs, use only approved original spare parts according to the manufacturer's specifications.

Proper use

- The transfer system is only one component of an overall system. The suitability and approval requirements for safe operation must be checked throughout the entire installation, if necessary. The system may only be commissioned after checking these requirements.
- When used in special areas of application, e.g. in potentially explosive atmospheres, the relevant regulations and standards must be observed. The installation and fitting of all components must be checked in this regard before commissioning.

Responsibilities and review

- In general, electronic devices are not fail-safe. The installer and/or owner of the machine and system is responsible for ensuring that the drive is reverted to a safe state in the event of a failure of the device. The correspondingly applicable standards and legal regulations regarding the safety of persons and machines as well as for maintaining the functionality of the machine or system must be observed.
- A risk analysis must be performed on the machine or system by the owner. Since electrical systems are hazardous to people, regular inspections of all safety aspects such as the general condition of the system, insulation values and shutdown and emergency stop devices are essential and required by law. The owner must define an inspection interval and have regular inspections carried out. We would be happy to provide you with advice in this regard.

3. Power supply cable

If the transfer system will be operated using a power supply cable, then the following instructions must be followed:

- Always stow the power supply cable securely in the vehicle using the cable rolling or storage devices available, if any.
- Do not pull/drag the plug across the floor.
- The power cable must not come into contact with cryogenic liquid gas. There is a risk of damage to the insulation of the cables. In this case, there is a risk of death! Do not use the system again until the power cable has been replaced.
- Check the plug regularly for proper function. Always insert the plug completely and lock it.
- Do not pull out the plug during operation (when the pump or controller is switched on).
- If the supply of power is disrupted, call in qualified personnel from the unloading area.

4. Transfer process / operating procedure

The basic procedure, in particular the operation of the cryogenic system components such as valves and pumps, etc. must be carried out according to the instructions of the owner and are not part of these operating instructions.

Individual operating steps and key assignments are described directly on the display.

- Park the vehicle safely.
- Put on personal protective equipment!
- Secure the transfer point according to the owner's regulations.
- If necessary, unroll the power supply cable and plug it into a socket provided by the customer.
- Switch on the pump controller.
- Depending on the equipment features, it may be possible to select the type of power supply (power grid or generator).
- Run the cryopump until it is cold.
- Flush and fit the transfer hoses according to the owner's regulations.
- Observe the pressure in the tank and increase via the evaporator, if necessary.
- The current pump temperature and the temperature setting are shown on the display if the pump has not adequately cooled down yet. Once the pump has cooled down, the symbol for the cold run monitoring function changes from red to green.
- If operated off a generator, the diesel engine can now be started by pressing the DIESEL OFF-ON key once.
When the diesel engine is active, the corresponding symbol is shown in green on the display.
Pressing the DIESEL OFF-ON button a second time activates the power take-off.
When the power take-off is active, the corresponding symbol is shown in green on the display.
- Press and hold the START key for at least 3 seconds. This switches on the contactor for the power feed and supplies the frequency converter with voltage.
The power feed contactor symbol changes from open/yellow to closed/green.
The display changes to the pump mode.
- Start the pump using the START key and adjust the circulation until stable via the bypass.
- The PLUS/MINUS key can be used to increase or decrease the power level.
- If necessary, throttle the pump output to achieve stable, constant and cavitation-free operation.
- If the system is overloaded, a warning message will appear and the cryopump load indicator symbol will light up. The speed is automatically reduced. In spite of this, the output quantity should now be reduced by further throttling the pump output so that the system operates within the intended load limits.
Continuous operation when overloaded may cause the system to shut down.
- Monitor the transfer process, output pressure, pressure in the tank and the pressure and fill level in the customer's tank.
- Stop the transfer process at an early stage before the tank is almost empty. Never operate the pump without a liquid medium or when it is cavitating.
- The STOP key stops the pump. Allow the pump to run down.
- Press the STOP key for at least 3 seconds to switch off the contactor for the power feed.
- The system can then be switched off.
- Dismantling of transfer hoses, establishing operational rest etc. in accordance with the owner's regulations.

5. External pump enable

Depending on the equipment features, the external pump enable signal can be connected to other parts of the equipment on the tank truck (e.g. emergency stop devices or volume measuring systems).

The status of the external pump enable is displayed as a symbol.

The external pump enable can prevent the pump from starting or switch off the pump when it is running.

6. Dead man's switch

Depending on its features, the transfer system can be equipped with a dead man's switch.

After a certain pumping time, the dead man's switch prompts the operator to confirm that he is still monitoring the transfer process by pressing a key. If the operator does not confirm this prompt within the time specified, the pump will stop automatically.

The values for the pumping time, acknowledgement time and the time immediately after the start phase may be set to different values depending on the operator.

In general, the presence of an operator at the transfer point can always be acknowledged on the control box using the TMS/DMS button. Various manual control boxes and a flashing light are also available. All systems can be operated equally in combination.

The status is indicated by a symbol on the display.











If the TMS/DMS button is pressed even though there is no request, then the transfer process is switched off.















This means the TMS/DMS button can also be used to stop the system without any problem.

The dead man's switch is only a safety device and is not an emergency stop device in the technical sense.

7. Display symbols

Various operating states, status messages, and warnings are indicated by symbols. The following table lists the symbols that may appear and their meaning.

Symbol	Name	Explanation/Note
	Caution: Malfunction	General fault/warning message, is displayed together with other symbols or text; if necessary, the error code is then displayed automatically
	Caution: Warning	General warning message, displayed together with other symbols or text
	Diesel engine	Diesel engine of traction vehicle active; symbol is grey when the diesel engine is turned off
	Generator power feed	Selection of the generator power source (can only be selected if the corresponding equipment is installed)
	Grid power feed	Selects the power grid as the source of energy (63A industrial socket)
	Contactor power feed switched on	Contactor power feed is switched on; may flash according to the feed type (grid or generator) selected
	Contactor power feed switched off	Contactor power feed is switched off; flashes according to the feed type (grid or generator) selected
	External pump enable	No external pump enable signal, which means no start enable signal for the cryopump; activate/switch on external pump enable to activate start enable
	External pump enable	External pump enable has stopped the pump
	Parking brake applied	Parking brake active; may not be visible when operating pump

Symbol	Name	Explanation/Note
	Parking brake not applied	The parking brake is not applied! The pump cannot be started.
	Insulation monitoring early warning	The insulation monitor in the traction vehicle/generator has reached the early warning threshold. The cause should be checked and eliminated as soon as possible by a specialized workshop. If the insulation value drops further and reaches a critical value, then the system switches off with an insulation fault.
	Cold run monitor	Cryopump is cold
	Cold run monitor	Cryopump is not cold
	Cavitation	Cryopump is in cavitation / unsteady running; check/change operating conditions (throttle pump output, input OK?)
	Cryopump load indicator	load indicator during pump operation; avoid red range, if necessary, reduce the pump output further to reduce the load
	Cryopump load indicator	Max. load limit reached: reduce flow rate, increase throttle / close the pump output valve more; yellow warning indicator flashes when this message is displayed
	Cryopump load indicator	Max. load limit reached for LCO2 medium: adjust flow rate, adjust pump output valve; yellow warning indicator flashes when this message is displayed
	Power level cryopump is off	Selected power level when pump is switched off (level 1 to 6 depending on version, level 1 is shown here)
	Power level cryopump is on	Selected power level when pump is switched on (level 1 to 6 depending on version, level 2 is shown here)
	Medium Current setting (shown here: LIN)	The media setting must match the load so that the correct speed and performance values are used. Possible displays: LIN, LOX, LAR.
	Power take-off	power take-off generator on (only when diesel engine is activated)
	Dead man's switch Shutdown message	Dead man's switch (DMS) has stopped the pump because the operator has not acknowledged the prompt.
	Dead man's switch Warning	Dead man's switch (DMS) prompts for acknowledgement; if the operator does not acknowledge the prompt, then the system switches off the pump

8. Diagnostic menu

The system has a diagnostic menu that can be used in the event of malfunctions, for general monitoring purposes or for telephone support.

The diagnostics menu can be activated by pressing the rocker switch on the display to the left when the pump is active or inactive. The menu indicator on the left flashes, and after a short time the diagnostic menu is displayed. The diagnostic menu has various pages that you can scroll through using the rocker switch left/right key.

If the diagnostic menu is activated when the pump is switched on, then the pump will not be switched off. However, the PLUS/MINUS and START/STOP keys can be operated at all times.

The diagnostic menu has the following structure and assigned values:

Diagnostic menu	Measured value field	Content
Cryopump	M1	Type of control
	M2	Delta value control
	M3	Faster - setpoint - slower control
	M4	Target speed [rpm]
	M5	
	M6	Temperature of cold part [°C]
Electric motor	M1	Target speed [rpm]
	M2	Direction of rotation
	M3	Controller_target speed [rpm]
	M4	
	M5	
	M6	
Frequency converter 1 (FC 1)	M1	DC link voltage [VDC]
	M2	Current [A]
	M3	Engine voltage [VAC]
	M4	Effective power [kW]
	M5	Speed setpoint [rpm]
	M6	Interior temperature [°C]
Frequency converter 2 (FC 2)	M1	ENPO message from FC
	M2	Ready for operation message from FC
	M3	
	M4	Operating hours FC [h]
	M5	Power-on time [min]
	M6	Time of last error (since last time switched on) [min].
Frequency converter 3 (FC 3)	M1	Rated motor output [kW]
	M2	Rated motor current [A]
	M3	Rated motor voltage [VAC]
	M4	Rated motor frequency [Hz]
	M5	Rated motor speed [rpm]
	M6	FC firmware/software version
Generator	M1	
	M2	
	M3	
	M4	
	M5	
	M6	
Various values	M1	CAN bus load [%]
	M2	EPT-SZM/chassis detected yes/no
	M3	Control cabinet fan off/on
	M4	
	M5	
	M6	

9. Fan/cooling

The external fan for cooling the outer coldplate is switched on:

- During the lamp test;
this provides a simple functional test every time the system is switched on
- When one of the following conditions is met:
 - Converter temperature measured above fan switch-on temperature (+/- 2°C hysteresis)
 - Converter temperature warning active

The fan test conducted during the lamp test can be deactivated in the setup. If the fan test is deactivated, it can be triggered manually during the lamp test by pressing the F4 function key on the display.

10. Special LCO2 equipment with 2 drive motors

The system can be used for operation with 2 drive motors depending on the equipment features. In this case, a separate switch box is mounted that enables selection of the drive motors:

- Operate only Motor No. 1
- Operate only Motor No. 2
- Operate Motor No. 1 and Motor No. 2 in parallel

Only operate the toggle switches for Motor No. 1 and Motor No. 2 when the pump is stopped (no load).

Do not use the toggle switches to switch the motors on and off!

The currently activated switching state is shown on the display. If neither of the two motors has been switched on, then the pump cannot be started. If the toggle switches have been activated, the pump can only be started after a delay of about 15 seconds.

11. Error codes

Error messages/fault messages of the system are displayed as a 2-digit error code. If an error occurs, operation of the pump is automatically stopped and the error display is activated.

The error menu can also be opened using the rocker switch on the display. To do this, press the rocker switch to the right once while the pump is stopped. The menu indicator flashes on the right, shortly after which the error menu appears.

You can scroll through the error history using the rocker switch left/right key. The last fault message received is highlighted in red.

The following table lists the possible fault messages and describes the cause and possible solutions.

Error code	Error description	Cause	Solution
04	Cold run monitor transducer short-circuit	<ul style="list-style-type: none"> Short-circuit transducer 	<ul style="list-style-type: none"> Transducer defective Check wiring to PLC/analog input PLC analog input overload
05	Cold run monitor measuring transducer wire broken	<ul style="list-style-type: none"> Broken wire transducer 	<ul style="list-style-type: none"> Transducer defective Check wiring to PLC/analog input
06	Thermocouple short-circuit or broken wire	<ul style="list-style-type: none"> Thermocouple defective 	<ul style="list-style-type: none"> Check or replace thermocouple
07	Cold run monitor temperature increase	<ul style="list-style-type: none"> Temperature change too fast 	<ul style="list-style-type: none"> Check if sensor is correctly mounted/set up Sensor defective? Transducer defective?
15	Cavitation	<ul style="list-style-type: none"> Pressure in tank too low Incorrect throttle setting Defective valves 	<ul style="list-style-type: none"> Check pump output throttle setting Check pressure in the tank Check valves in pump inlet
16	Dry run	<ul style="list-style-type: none"> Pump without medium 	<ul style="list-style-type: none"> Check inlet Check pump outlet valve
17	Emergency stop	<ul style="list-style-type: none"> Emergency stop activated/pressed 	<ul style="list-style-type: none"> Check emergency stop, unlock emergency stop, switch off the power supply Emergency stop contact element OK?
20	Control disabled	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Service required
21	Emergency operation malfunction	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Service required
30	Collective fault message	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Service required
46	Power take-off malfunction	<ul style="list-style-type: none"> PTO control malfunction / no feedback 	<ul style="list-style-type: none"> Have a service workshop check the function; have engagement conditions checked (parking brake, vehicle at a standstill, transmission in neutral etc.)
47	Diesel control malfunction	<ul style="list-style-type: none"> Target speed not reached by the drive motor 	<ul style="list-style-type: none"> Have function checked by service workshop
55	Generator over temperature	<ul style="list-style-type: none"> Generator overheated 	<ul style="list-style-type: none"> Check ventilation, possibly an electrical/mechanical defect on generator?
56	Generator voltage	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop
57	Generator contactor	<ul style="list-style-type: none"> Generator contactor control malfunction (depending on equipment features) 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop
58	Insulation monitor	<ul style="list-style-type: none"> The insulation monitor has triggered 	<ul style="list-style-type: none"> Stop the transfer process immediately and contact a specialized workshop to determine the insulation defect/cause.
59	Circuit breaker tripped	<ul style="list-style-type: none"> System overload or possibly defective aggregate 	<ul style="list-style-type: none"> Reset the circuit breaker; if the circuit breaker trips repeatedly, contact a specialized workshop to determine the cause.
70	FC collective error	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop
71	FC power supply failure	<ul style="list-style-type: none"> Undervoltage; customer fuse or generator defective 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop All phases correctly connected/present?
72	FC DC link undervoltage	<ul style="list-style-type: none"> Undervoltage 	<ul style="list-style-type: none"> Check supply voltage on all phases
73	FC current consumption too high	<ul style="list-style-type: none"> Overload (continuous) Defect on electric motor or converter possible 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop
74	FC DC link overvoltage	<ul style="list-style-type: none"> Run-down at high speed without liquid in the pump (operating error?) 	<ul style="list-style-type: none"> If it occurs repeatedly, diagnosis by a specialized workshop
75	FC overload I ² xt	<ul style="list-style-type: none"> Overload 	<ul style="list-style-type: none"> Reduce load
76	FC overload Ixt	<ul style="list-style-type: none"> Overload 	<ul style="list-style-type: none"> Reduce load

Error code	Error description	Cause	Solution
77	FC motor temperature	<ul style="list-style-type: none"> Motor overheated 	<ul style="list-style-type: none"> Allow motor to cool down, reduce load if possible If it occurs repeatedly, diagnosis by a specialized workshop (mechanical/electrical defect)
78	FC temperature	<ul style="list-style-type: none"> Converter overheated 	<ul style="list-style-type: none"> Allow converter to cool down Check fan for proper function
79	FC power unit	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop
80	FC current input	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop
81	FC Ixt 5 Hz	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop
82	FC ENPO contact	<ul style="list-style-type: none"> No feedback from FC although request present 	<ul style="list-style-type: none"> Emergency stop activated? Contact OK? Wiring to FC contact ENPO OK? Voltage applied to ENPO input? FC CAN offline?
83	FC warning message DC link undervoltage	<ul style="list-style-type: none"> Undervoltage 	<ul style="list-style-type: none"> Check supply voltage on all phases
84	FC warning message I ² t integrator active	<ul style="list-style-type: none"> Overload 	<ul style="list-style-type: none"> Reduce load
85	Motor protection switch triggered	<ul style="list-style-type: none"> Special equipment 2 motor operation 	<ul style="list-style-type: none"> Check function of 2-motor circuit and fuse in separate terminal box Check motor and/or pump (overload, electrical defect, mechanical defect)
91	On-board voltage	<ul style="list-style-type: none"> On-board voltage for display less than 15V for more than 2 sec. On-board voltage for main controller less than 15V for more than 2 sec. Main controller fuse for VBB1 or VBB2 defective 	<ul style="list-style-type: none"> Measure on-board voltage Check vehicle battery, check on-board power supply during start-up Check power supply/fuses while operating from grid supply; check phases L1/L2/L3
92	CAN1	<ul style="list-style-type: none"> CAN error traction vehicle 	<ul style="list-style-type: none"> PLC traction vehicle power supply? Function of traction vehicle OK when no trailer attached? <ul style="list-style-type: none"> Plug connection traction vehicle
93	CAN-TRUCK	<ul style="list-style-type: none"> AUF CAN error 	<ul style="list-style-type: none"> Vehicle control unit connection Vehicle control unit parameter settings Terminating resistors AUF CAN Additional devices installed?
94	CAN Truck ID	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Special equipment
95	CAN Trailer ID	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Special equipment
97	Display offline	<ul style="list-style-type: none"> Display defective No power to display 	<ul style="list-style-type: none"> Check display connections Check power supply to display If other devices are simultaneously malfunctioning: <ul style="list-style-type: none"> Check CAN bus status Check terminating resistors Defective subscriber?
98	FC offline	<ul style="list-style-type: none"> CAN communication to frequency converter malfunction 	<ul style="list-style-type: none"> FC connection? Power cable/connection terminal correctly connected and undamaged? FC CAN setting OK? If other devices are simultaneously malfunctioning: <ul style="list-style-type: none"> Check CAN bus status Check terminating resistors Defective subscriber?
99	I/O module 1 offline	<ul style="list-style-type: none"> Special equipment 	<ul style="list-style-type: none"> Diagnosis by a specialized workshop

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