KIMO RHVAC Controls

Product Manual

FrigoPack 2.2…90FEP-EMC-12

Multi-stage compressor packs with up to 4 compressors

FrigoSoft 2.4

Valid for:

REFRIGERATION INVERTER FEP:	***FrigoPack* FEP**	**at or above Firmware 5.6g**
REFRIGERATION SOFT STARTERS:	***FrigoPack* SM2/SE3**	
KIMO COMPRESSOR CROSS-REFERENCE LIST	**CCP_T400-0606 / CCS_T400-0606 / CCT_T400-0606**	
Refrigeration and A/C Software	***FrigoSoft* MM-CP-RAH/2.4 (at or above Version 1d)** **Display: `FrigoSoft24.2-1x`** **CONFIG: `FS 2.4.2-1x`**	

Installation details

Serial number:
(see name plate) _____

Where installed:
((for your own information)) _____

Type of mounting: ☐ Electrical enclosure to IP54 ☐ Wall mounting with top cover to IP40

03.05.16

Changes
The manufacturer reserves the right to make corrections, amendments, additions, or changes to the contents, product data or other information without previous notice. No responsibility or liability for damages, injuries or expenses resulting there from can be taken.

KIMO RHVAC Controls

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Contents

IMPORTANT INFORMATION

Scope of this Product Manual

This product manual describes the operation of ***FrigoPack*** Refrigeration Inverters.

It is not intended that this product manual describes the function of the apparatus or system into which the ***FrigoPack*** Refrigeration Inverter is installed.

This product manual is for use by qualified persons who are required to design an installation or to install, set up, commission, service, operate the ***FrigoPack*** Refrigeration Inverter.

These instructions do not purport to cover all details or variations in equipment, nor to provide for ever possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the Purchaser's purposes, the matter should be referred to the supplier.

Reference to information on Safety, Warnings and Risks

These operating instructions are a supplement to the Product Manual of *MotorMaster* Frequency Inverter for applications with *FrigoPack* kits and with *FrigoSoft* Refrigeration Software. The application, warning and safety information, specified in both manuals, must be carefully observed.

This product manual contains instructions and information for the correct installation, wiring and for the electrical connections to ***FrigoPack*** kits with ***MotorMaster*** Frequency Inverters by a suitably qualified and trained electrical installer.

This installation can depend on the required mode of operation, which should be determined by the specialist refrigeration planner.

The section COMMISSIONING, SETTING UP includes instructions and recommendations for the correct setting up and modification of the ***MotorMaster*** Refrigeration Inverter to match the refrigeration installation.

FrigoPack and EMC

The EMC regulations must be observed when operating the AC drive inverter from the public power supply. The EMC supply filters which are required (radio interference suppression level B in compliance with EN 61000-6-3 (EN 5008-1)) are integrated in the ***MotorMaster* 2.2/4.0FECP** of ***FrigoPack*** (external EMC filters are supplied with other sizes).
Additional information regarding EMC-correct installation (e.g. ground connections, shielded motor cables) should be taken from this product manual.

FrigoPack and pressure sensors

The following recommendations for setting up are only valid if the pressure sensors specified by KIMO are used:

- Suction pressure: - -0,5 ... +7,0 bar ≙ 4...20 mA
- Discharge pressure: - 0,0 ... 25,0 bar ≙ 4...20 mA

Available Product Manuals and Application Information

Documentation	Contents	Status
Product Manual **PMM-FEP.2**	• Technical data, information on installation, safety, EMC, CE, and UL, options etc. • General setting up and commissioning	Supplied with each ***FrigoPack*** Refrigeration Inverter
CCP-0606 / **CCS-0606 /** **CCT-0606** **KIMO COMPRESSOR CROSS-REFERENCE LIST**	***FrigoPack*** selection 400...460 V	Available on request
	Suggested electrical equipment	

1 OVERVIEW

FrigoPack / ***FrigoSoft*** Systems were developed in close cooperation with specialist refrigeration and A/C companies and allow the operation of refrigeration systems in all areas of refrigeration, A/C and heat-pump technology to be optimized.

In addition to higher cooling quality, the energy-saving potential is a decisive criterion. The extra cost of ***FrigoPack*** can be paid back in a relatively short time.

1.1 Applications

Refrigeration:
- Suction-pressure control and discharge-pressure limiting by variable-speed operation of a master compressor.
- Control of condensing pressure

Air conditioning, heat pumps, water chillers:
- Suction-Pressure Limiting (ice protection) and Discharge-Pressure Limiting by variable-speed operation of the Master Compressor.
- Operation with external temperature controller.

Suitable compressor types:
- Semi-hermetic reciprocating compressors
- Screw compressors
- Fully hermetic reciprocating compressors of some manufacturers
- Scroll compressors of some manufacturers
- Open-type compressors

Operation with multi-stage compressor packs:
- Suitable for use with up to 4 stages (more on enquiry)
- Can be used with compressors with capacity control (cylinder-bank off-loading).

1.2 User benefits

Improved cooling quality:
- Almost ideal constant-pressure characteristic in the suction line even with changing requirements of the refrigeration installation
- Reduced temperature deviation at the refrigeration points
- Higher relative humidity
- Less icing of the evaporator
- Longer permissible times between defrosting.

Note:
Rapid pressure changes cause instability with the expansion valves on the evaporator. This results in poor evaporator performance and unstable temperature conditions.

Wide range of operation:
- Operation at an optimum operating point without frequent on/off compressor switching
- Similar control performance with fewer compressors.

Increased power:
- A compressor when operated at 60 Hz rotates at approx. 1.750 1/min. Most compressors are designed for operation at this speed.
- Approx. 20 % increase in refrigeration capacity of speed-controlled compressor compared with 50 Hz fixed-speed operation.

Advantage:
Smaller compressors can be used, in particular if compressors are used at frequencies within the range 65...90 Hz.

Energy saving:
- Energy saving by stepless control of refrigeration capacity. Typical values:
  - up to 40 % with refrigeration installations using a single compressor
  - up to 25 % with conventional multi-stage compressor racks
- Operation with a higher evaporation temperature with the same refrigeration capacity (further energy saving)
- Higher COP factor under partial load conditions.

Electrical supply:
- Reduction of switch-on current surges
- Lower number of compressor starts - in particular at low refrigeration capacity
- Smooth build-up of supply current (requirement of many electricity supply companies)
- Elimination of breakages to pipes and fittings due to smooth start.

1.3 Features

Variable-speed operation of Master Compressor:

- Optimum operation of the Variable-speed Compressor (**VsC**) without unnecessary starting
- Continuous stepless adjustment to match required refrigeration capacity
- Increase of compressor capacity by operating at 60 Hz (or more for special applications e.g. 75 Hz, 80 Hz, etc.).

Available controls:

- **Refrigeration:**
  - Suction-pressure control with 2 selectable setpoints.
- **A/C und heat pumps:**
  - Suction-pressure limiting (ice protection) with 2 selectable limit values.
- **Refrigeration, A/C and heat pumps:**
  - Rapid reduction in speed of master compressor when a set limit of discharge pressure is reached
- **Condensing Pressure**
  - Integrated control of condensing pressure using an external CondensPack Voltage Controller or Frequency Inverter for the condenser fans.

Operation with multi-stage compressor packs:

- Control of additional fixed-speed compressors (**FsC**s) up to 3 **FsC**s
- Can be used with compressors with cylinder off-loading (Capacity Control).

Special functions with the speed-controlled compressor:

- Skip speeds to prevent mechanical resonances
- Adjustable minimum and maximum speed of the Variable-speed Compressor (**VsC**) depending on make and type of compressor
- Control of oil pressure switch or crankcase heater, unloaded start, or condenser fans.
- Force to higher lubrication speed to ensure oil transport (important with vertical hermetic compressors).

Installation test, system charging:

- Pressure sensor not required
- Special manual mode (LOCAL).

Supply of all electrical control components as kits:

- Selection of the individual components not necessary.

No programming required:

- Pre-adjusted ready to go
- No setting up of complicated parameters
- The setpoint for suction pressure is the only setting required
- Fast and simple commissioning without prior knowledge of frequency inverter technology.

Plain-language display on Programming Pad:

- Suction pressure and discharge pressure (option)
- Motor operating data (current, frequency etc.)
- Humidity, temperature etc. (for specific applications).

Control of the multi-stage compressor racks:

- Control is by the integrated intelligent step control of the frequency inverter
- Adjustable timers to prevent compressors from switching on and off too frequently (e.g. when operating with a low refrigeration capacity).

Fault processing:

- Phase failure, overload
- Monitoring of connection to pressure sensors
- Internal monitoring of electrical faults such as supply undervoltage
- Processing of external safety circuit (e.g. with HP/LP pressure cut-out switches)
- Automatic delayed autostart following a supply or installation fault, 10 start attempts.

Closed-loop control:

- P and I action of suction pressure controller is adjustable (possibility of installation "fine-tuning")
- Simple setup recommendations for typical installations.

Other special functions can be activated:

- Other control features
- Icing protection of evaporator for air-conditioning and heat pump applications
- Operation with an external control system while maintaining all advantages
- High pressure limiting by reducing the speed of the master **VsC** (very important to maintain maximum availability with a condenser fan failure).

2 REFRIGERATION COMPRESSORS

2.1 KIMO COMPRESSOR CROSS-REFERENCE LIST

The **KIMO COMPRESSOR CROSS-REFERENCE LIST** between ***FrigoPack*** Refrigeration Inverters and Soft Starters and corresponding compressors of various manufacturers is available on enquiry.
These cross references are only intended to be used for general guidance with normal applications.

Piston-type refrigeration compressors have to be able to start under conditions of high suction or condensation pressure which can present a considerably higher starting load than with normal operation. The estimation of electrical operating current for normal operation is **NOT** suitable for rating an inverter.

We therefore recommend that only compressors with the largest available motor are used for variable-speed operation. For further information see "The use of intelligent electronic frequency inverters for the closed-loop speed control of compressor banks" (available at www.frigokimo.com).

This is taken into consideration in the **KIMO COMPRESSOR CROSS-REFERENCE LIST**.

2.2 Starting piston-type compressors

Should there be a starting problem with unfavourable installations or compressor operating conditions then the following action is recommended:
- Verify suitability of compressor type (including motor type) and associated ***FrigoPack*** as in the **KIMO COMPRESSOR CROSS-REFERENCE LIST**.
- Refer to **TROUBLE SHOOTING LIST** (see section 10).

If the above does not indicate any causes of the problem, then send full details of the problem and all relevant full information on the installation using the forms:
- **CONFIGURATION OVERVIEW / PROBLEM REPORT**
- **CHECKLIST AND ADDITIONAL DATA FOR PROBLEM REPORT**

(see Section 10) to KIMO.

With critical applications we recommend the use of a start unloader (a solenoid valve between the high and low pressure sides of the compressor is opened on start). A suitable relay to control the solenoid valve is provided for on the ***FrigoPack*** Refrigeration Inverter.

A further step is the use of a pressure limiting valve in the suction line.

The Direct-On-Line (DOL) starting current of a compressor is typically 5...6 rated current. When using ***FrigoPack*** this can be reduced as follows:

- Refrigeration inverter: 1.1 x rated current
- Soft starter without start unloader: 3...4 x rated current.
- Soft starter with start unloader: 2...3 x rated current.

We recommend that the R134A refrigerant is used for normal cooling or air conditioning. This has the following advantages compared with other refrigerants:
- approx. 33 % lower energy consumption
- lower pressure difference between suction and high pressure sides.

Compressors not listed or from other manufacturers can also be used with ***FrigoPack*** Refrigeration Inverters. We recommend that the compressor manufacturer concerned is contacted or that the advice of KIMO is sought.

The minimum speed (frequency f_{min}) and the maximum speed (frequency f_{max}) depend on the type and manufacturer of the compressor. Typical values for piston compressors are f_{min} = 25 Hz and f_{max} = 60 Hz. The frequency range in the **KIMO COMPRESSOR CROSS-REFERENCE LIST** is for general guidance only. If there is any doubt then the manufacturer of the compressor should be consulted.

3 PRODUCT OVERVIEW

3.1 Function

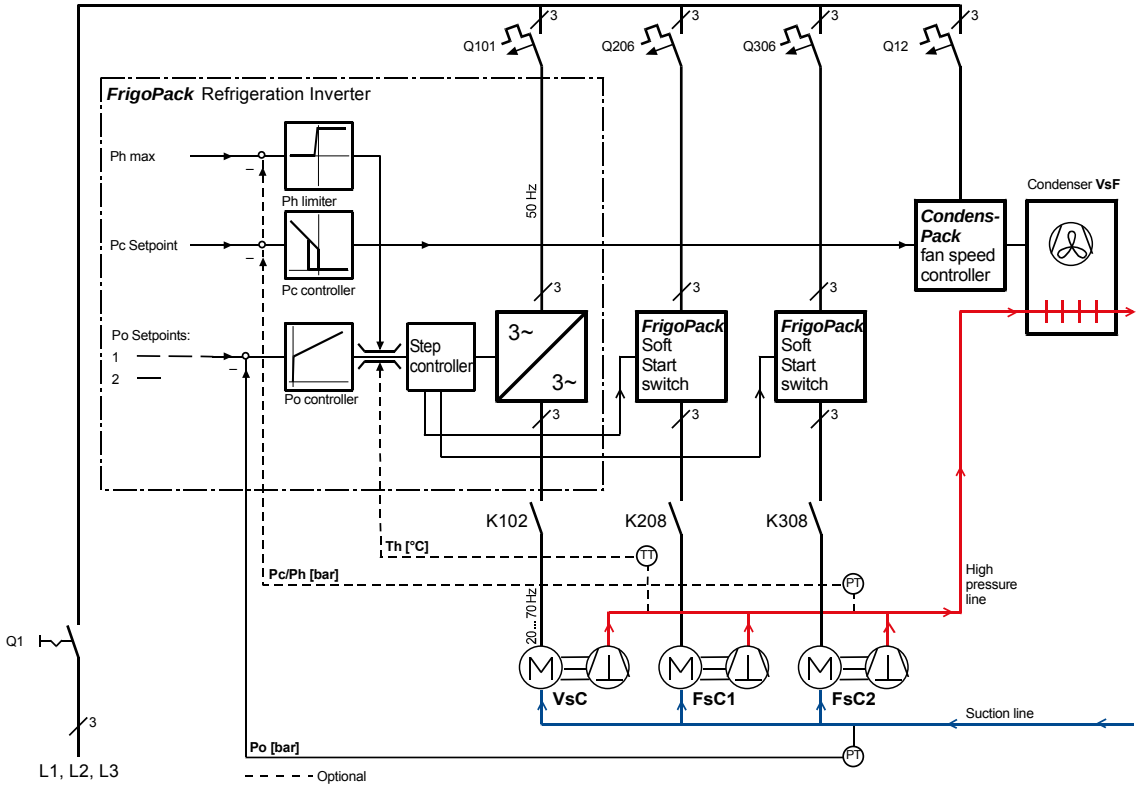

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Fig. 3.1a: Block diagram of the closed-loop refrigeration control
(Po: Evaporating pressure, Pc: Condensing pressure
VsC: Variable-speed compressor, **FsC**: Fixed-speed Compressor)

The integrated closed-loop suction pressure control ensures that the speed of the **VsC** is set corresponding to the actual refrigeration requirement. An **FsC** is only switched-in if the refrigeration power of the **VsC** is no longer sufficient. The integrated ***FrigoSoft*** software of the ***FrigoPack*** system can control up to 3 **FsC**s. An external compressor pack step-controller is not required and is also not permissible (otherwise there would be competing with the integrated suction pressure controller). The minimum running and switch-off times, specified by the various compressor manufacturers, are taken into account in the software.

Fig. 3.1a is a block diagram of the closed-loop control and compressor-pack control for control of a refrigeration system.

With A/C or heat pump operation this structure is modified as follows (see Fig. 3.1b):

- An actuating value from the external temperature controller is processed with a cooling function to serve as the setpoint for Suction-Pressure Po
- The measured suction pressure Po limits the setpoint of suction pressure.

In order to increase the system availability, a high-pressure limiter control function is optionally available. This is extremely useful in the following cases:

- When the condensing power for high refrigeration power is not sufficient in summer
- Dirt or obstructions are in the condenser
- One or more condenser fans have failed
- The evaporator has ice build-up when used in the heat pump mode
- Noise abatement restrictions only allow the condenser, depending on the time of day, to be used at reduced speed.

When a limit pressure is exceeded, the speed of the **VsC** is automatically reduced.

If there is a power failure, then the ***FrigoPack*** automatically restarts after the supply voltage has returned provided the "Enable" signal is still present.

An integrated "Auto-restart control" automatically attempts to clear internal or external faults (ext. safety circuit) and restarts the compressor after a delay time. There are two possible reactions:

- If the fault is no longer present, the compressors start and operation continues normally
- If the fault is still present, the ***FrigoPack*** attempts to start a total of 10 times before it finally goes into a permanent fault condition. In this case the complete system must be checked and reset.

Figs. 3.1a and 3.1b show the integrated control of condensing pressure using an external CondensPack Voltage Controller or Frequency Inverter for the condenser fans.

FrigoPack electronic soft-start switches provide a maintenance-free and soft starting and stopping of the Fixed-speed Compressors (**FsC**). The starting current of the compressors is considerably reduced.

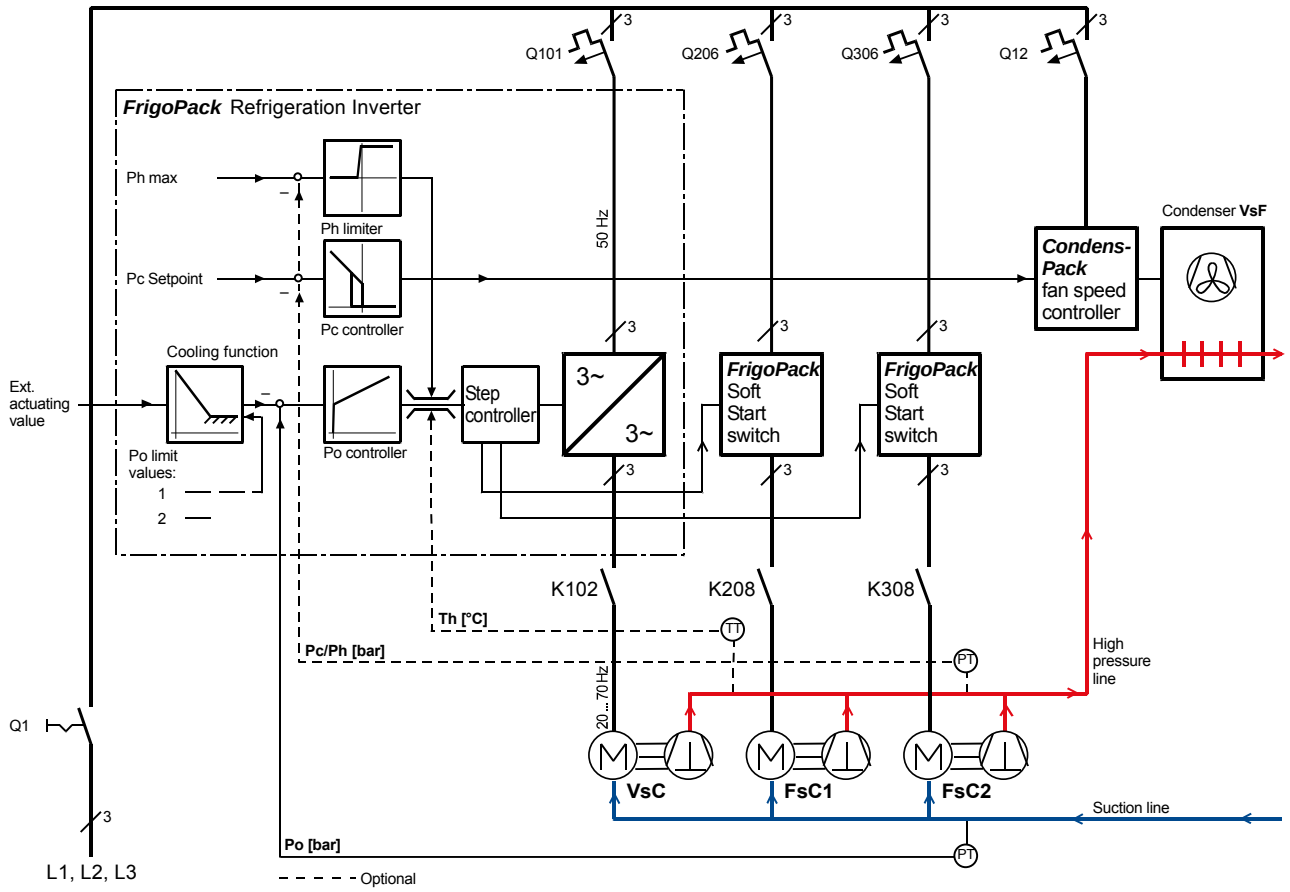

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Fig. 3.1b: **Block diagram of the closed-loop airconditioning or heat pump and compressor-pack control**
(Po: Evaporating pressure, Pc: Condensing pressure,
VsC: Variable-speed compressor, **FsC**: Fixed-speed Compressor)

3.2 *FrigoPack* kits

FrigoPack kits consisting of:

- ***MotorMaster Refrigeration Inverter***
- ***SoftCompact*** / ***LEKTROMIK*** soft starter
- EMC filter (integrated or external for foot print or book-style mounting)
- Programming Pad
- Brass cable gland for motor cable
- Interface module for refrigeration technology
- Refrigeration Software ***FrigoSoft*** 2.4.2

Interface module for refrigeration technology

FrigoPack is intended for installation in an electrical enclosure. If the environment is dry and dust-free, ***FrigoPack*** can be mounted outside an electrical enclosure provided certain recommended accessories are used.

3.2.1 *MotorMaster Refrigeration Inverters*

- Latest-generation FIs with on-board intelligence (multitude of logic and control functions)
- Various diagnostic functions and fault history storage
- Designed to meet the stringent EMC DIRECTIVE for connection to public electricity supplies (Interference suppression to limit B)
- High current reserves (up to 180 % short duration)
- Versions suitable for use with 230V, 460V or 500 V 3Ph supply voltages are available.

3.2.2 *SoftCompact and LEKTROMIK Soft Starters*

- Electronic soft starters for the smooth starting of the fixed-speed compressor (**FsC**)
- Prevention of current and pressure surges on starting
- Fulfils the requirements of electrical supply companies.
- Maintenance-free starting and stopping of the Fixed-speed Compressors (**FsC**).

3.3 Overview of available accessories

- **Pressure transducers and suitable parts:**
  We recommend that only the following two-wire pressure transducers (Huba Control type) are used:
  - **A REFR-P-TRANSD-LP7+PL**:
    Suction pressure within the range -0.5...+7.0 bar
  - **A REFR-P-TRANSD-HP25+PL**:
    Discharge pressure within the range 0...+25 bar.

- **Temperature sensor PT1000**
  The following PT1000 temperature sensor may be used to limit the exhaust-gas temperature:
  - **A REFR-T-SENSOR-PT1000**

- **Supply and/or motor chokes:**
  Supply chokes are recommended where a reduction in the supply harmonics is required. KIMO supply chokes can also be used as motor chokes. Motor chokes are required for the operation with long cable runs to the motor:
  - ***FrigoPack* 6.0FEP**: ≥ 25 m
  - ***FrigoPack* 2.2/4.0/5.5...90FEP**: ≥ 50 m

  The indicated cable length is the TOTAL cable length (i.e. sum of lengths all part cables) which is connected to the motor terminals of ***MotorMaster***.

- **Motor filter:**
  Motor filters reduce the stressing on the motor winding of the compressor when operated with a frequency inverter. Most compressor manufacturers recommend motor filters.

- **Top cover IP40:**
  The top cover IP40 is required for mounting ***MotorMaster*** outside of the electrical enclosure. The ingress of small particles into the top of the ***MotorMaster*** is prevented.

- **Terminal boxes for EMC filters:**
  The use of these terminal boxes is required for adhere to the safety regulations when mounting ***MotorMaster***s outside of the electrical enclosure.

- **Auto/Booster transformers:**
  Autotransformers are required for operation at special supply voltages.

  The output power of ***FrigoPack*** can also be increased by up to 15 % when used with 3AC 400 V supplies (used as Booster Transformer).

- **Output relays for special functions:**
  Special relays with extremely low current and with integrated free-wheel diode:
  - **A RELAY-DC12V**: 12 V coil
  - **A RELAY-DC24V**: 24 V coil

Important
KIMO can assist only any installation or commissioning problem if the recommended accessories from KIMO are used.

4 TECHNICAL DATA

For technical data on ***MotorMaster*** Frequency Inverters refer to Product Manual PMM-**FEP**.

5 PLANNING THE INSTALLATION

5.1 General recommendations

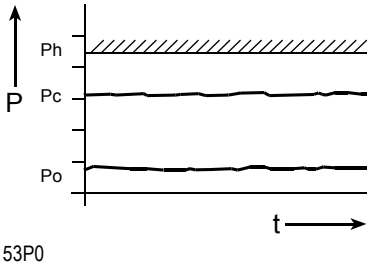
Detailed information for planning the installation have been published in the KI LUFT UND KÄLTETECHNIK, Issue 1 and 4/2003. A revised issue in **English** is available on request.

5.2 Selecting the *FrigoSoft* mode

FrigoPack includes advanced and proven refrigeration ***FrigoSoft*** software which has been designed for use with the following modes of operation:

Refrigeration:

Refrigeration - Mode 1:
- Operation with internal adjustable setpoint of suction pressure
- Preferred mode suitable for most applications.



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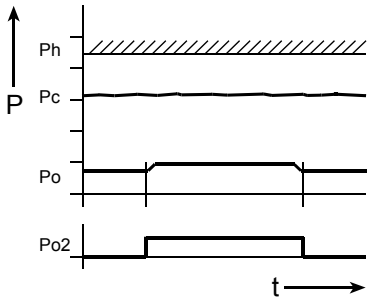
Refrigeration - Mode 2:
- Operation with two internal adjustable setpoints of suction pressure
- External setpoint selection with digital input
- Usually used for different day/night operation with a time switch.



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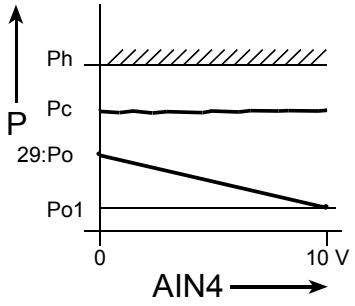
Refrigeration - Mode 3:
- Operation with external setpoint control of suction pressure (via analog input)
- For operation with an external controller.



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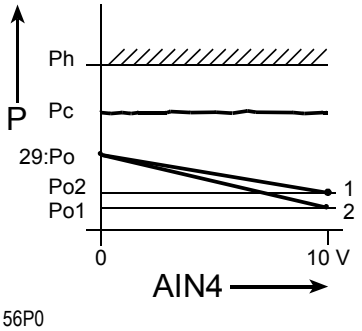
Air conditioning (A/C) and heat pumps:

A/C / Heat pump - Mode 4:
- Operation with external actuating value of refrigeration or heat capacity (via analog input)
- For operation with an external temperature controller
- Anti-icing protection.



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Each mode of operation is described separately in the following.
Take special note of the following information:
- Connection of the pressure sensor and digital control connections
- Accessories
- Settings.

5.2.1 Refrigeration - Mode 1: Operation with one internal adjustable setpoint for suction pressure

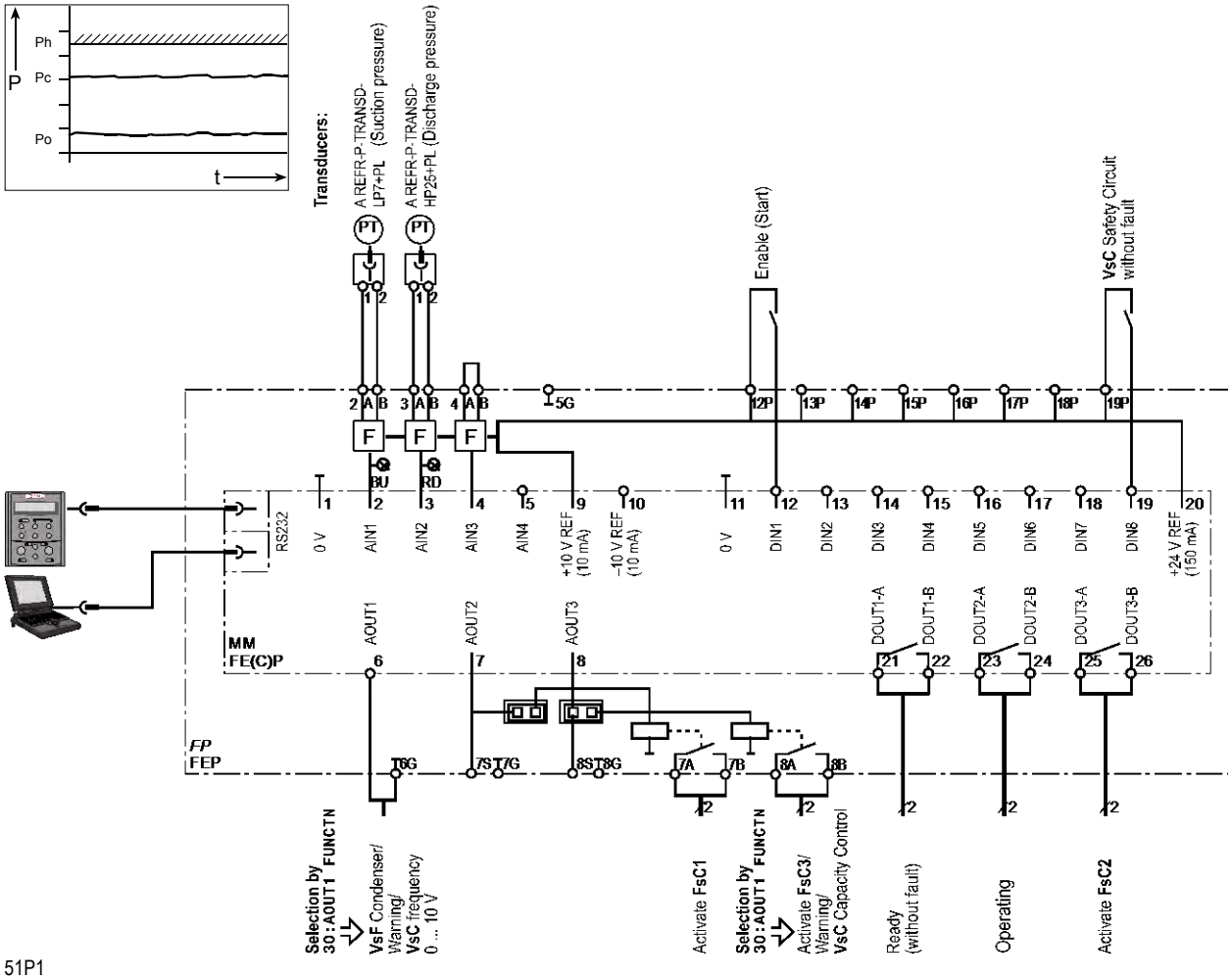

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Fig. 5.2.1: Connection for operation with one internal adjustable setpoint for suction pressure

Operation:
- Digital closed-loop control of suction pressure
- One internal adjustable setpoint
- Fixed-speed Compressor (**FsC**) activated when refrigeration power of Variable-speed Compressor (**VsC**) is not sufficient
- High pressure limiting with **A REFR-P-TRANSD-HP25+PL** (Accessory).

Accessories
- Pressure transducer **A REFR-P-TRANSD-LP7+PL**: Range of Suction pressure: -0.5 ... 7.0 bar
- Pressure transducer **A REFR-P-TRANSD-HP25+PL**: Range of Discharge pressure 0 ... 25 bar

Settings:
- Mode `32:CONTRL FUNCTN`: `INPUT 0`
- Modify values depending on refrigerant

- Po:
- Suction pressure, Setpoint: `08:Po SETP/LIMT1`

	R404A	R507	R407C	R22	R134a
- Factory set value: 3.2 bar, Corresponding to:	-10.8 °C	-11.7 °C	-2.0 °C	-4.9 °C	+10.6 °C

- Pc:
- Condensing pressure, Setpoint: `10:Pc SETPOINT 1`

	R404A	R507	R407C	R22	R134a
- Factory set value: 17.0 bar, Corresponding tc:	+39.7 °C	+38.7 °C	+46.6 °C	+46.8 °C	+62.4 °C

- Ph:
- Discharge-pressure limit: `11:Pc SETP/LIMT2` +2.5 bar

	R404A	R507	R407C	R22	R134a
- Factory set value: 20.0 + 2.5 = 22.5 bar, corresponding to th:	+51.1 °C	+49.9 °C	+57.5 °C	+58.5 °C	+74.0 °C

- Recommendation: Set discharge pressure limit approx. 3.0 bar higher than the condensing pressure.

- Other:
- Refer to section 8.

5.2.2 Refrigeration - Mode 2: Operation with two internal adjustable setpoints of suction pressure

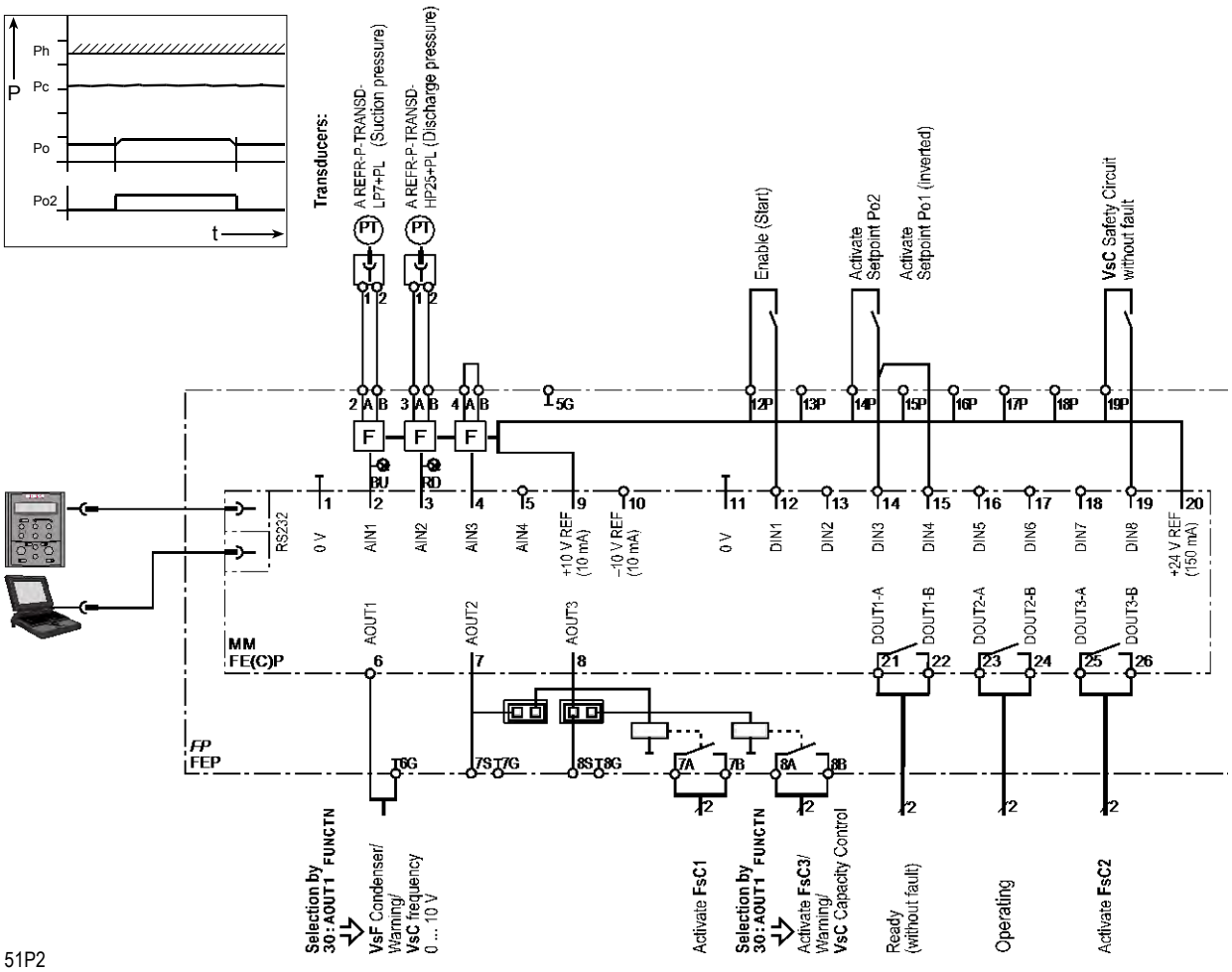

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Fig. 5.2.2: Connection for operation with two internal adjustable setpoints for suction pressure

Operation:
- Digital closed-loop control of suction pressure
- Two internal adjustable setpoints
- Setpoint selection with digital input DIN3 + DIN4
- Fixed-speed Compressor (**FsC**) activated when refrigeration power of Variable-speed Compressor (**VsC**) is not sufficient
- High pressure limiting with **A REFR-P-TRANSD-HP25+PL** (Accessory).

Accessories:
- Pressure transducer **A REFR-P-TRANSD-LP7+PL**: Range of Suction pressure: -0.5 ... 7.0 bar
- Pressure transducer **A REFR-P-TRANSD-HP25+PL**: Range of Discharge pressure 0 ... 25 bar

Settings:
- Mode `32:CONTRL FUNCTN`: `INPUT 0`
- Modify values for each refrigerant

- Po1, Po2:

- Suction pressure, Setpoint 1 (main setpoint): `08:Po SETP/LIMT1`

	R404A	R507	R407C	R22	R134a
Factory set value: 3.2 bar, Corresponding to:	-10.8 °C	-11.7 °C	-2.0 °C	-4.9 °C	+10.6 °C

- Suction pressure, Setpoint 1 (auxiliary setpoint): `09:Po SETP/LIMT2`

	R404A	R507	R407C	R22	R134a
Factory set value: 3.6 bar, Corresponding to:	-8.2 °C	-9,1 °C	+0.6 °C	-2.2 °C	+13.4 °C

- Pc:

- Condensing pressure, Setpoint: `10:Pc SETPOINT 1`

	R404A	R507	R407C	R22	R134a
Factory set value: 17.0 bar, Corresponding tc:	+39.7 °C	+38.7 °C	+46.6 °C	+46.8 °C	+62.4 °C

- Ph:

- Discharge-pressure limit: `11:Pc SETP/LIMT2` +2.5 bar

	R404A	R507	R407C	R22	R134a
Factory set value: 20.0 + 2.5 = 22.5 bar, corresponding to th:	+51.1 °C	+49.9 °C	+57.5 °C	+58.5 °C	+74.0 °C

- Recommendation: Set discharge pressure limit approx. 3.0 bar higher than the condensing pressure.

- Other:
- Refer to section 8.

5.2.3 Refrigeration - Mode 3: Operation with external setpoint control of suction pressure

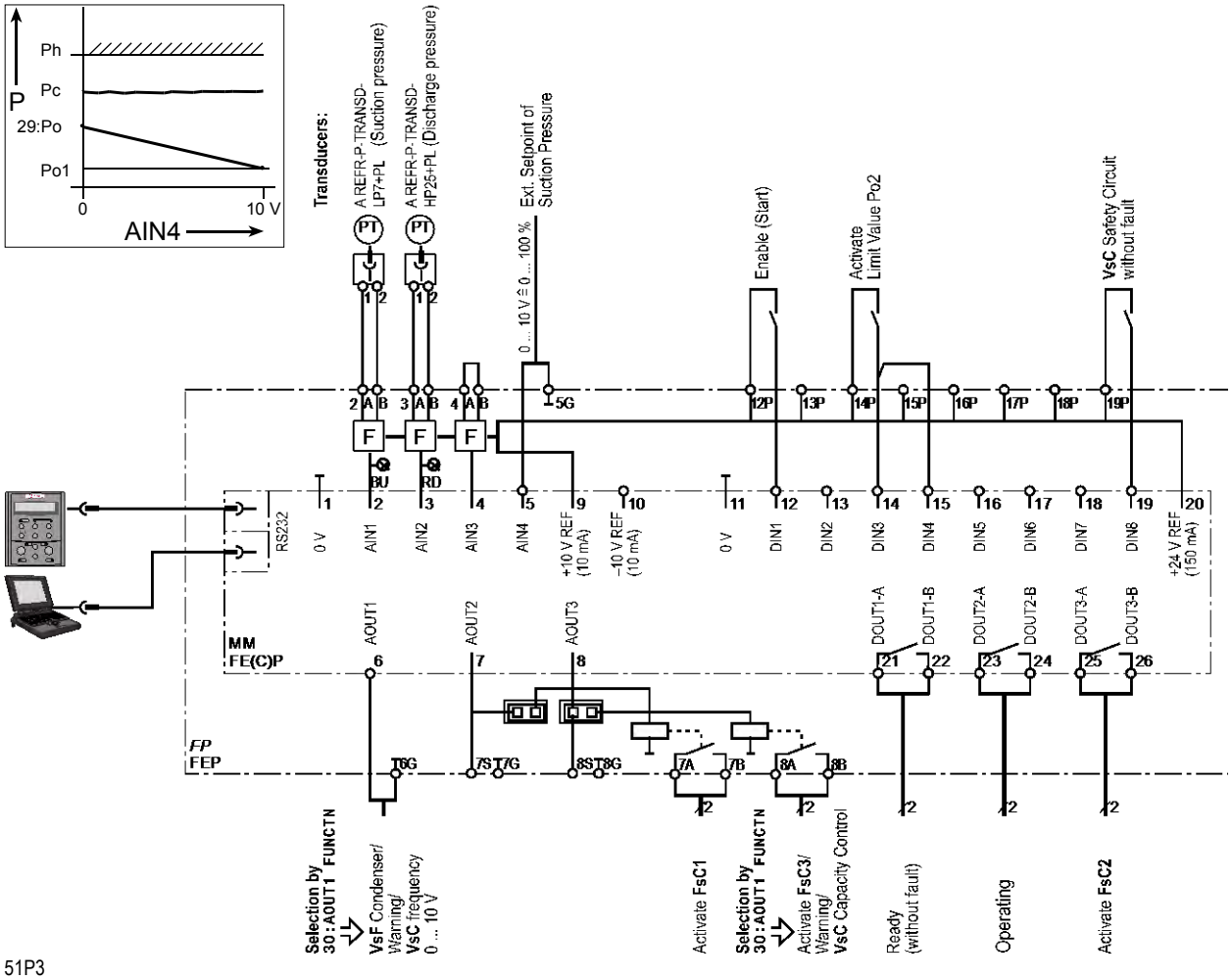

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Fig. 5.2.3: Connection for operation with external setpoint control of suction pressure

Operation:
- Digital closed-loop control of suction pressure
- External analog setpoint 0...+10 V corresponding to Po = -0.5...7.0 bar
- Internal setpoints are disabled
- Fixed-speed Compressor (**FsC**) activated when refrigeration power of Variable-speed Compressor (**VsC**) is not sufficient
- High pressure limiting with **A REFR-P-TRANSD-HP25+PL** (Accessory).

Accessories:
- Pressure transducer **A REFR-P-TRANSD-LP7+PL**: Range of Suction pressure: -0.5 ... 7.0 bar
- Pressure transducer **A REFR-P-TRANSD-HP25+PL**: Range of Discharge pressure 0 ... 25 bar

Settings:
- Mode **32:CONTRL FUNCTN**: **INPUT 1**
- Modify value for each refrigerant

- External setpoint:
- 0...10 V ≙ P_o = **29:Po ACT VAL=0%** ... **08:Po SETP/LIMT1** / **09:Po SETP/LIMT2**

- Pc:
- Condensing pressure, Setpoint: **10:Pc SETPOINT 1**
- Factory set value: 17.0 bar, Corresponding tc:

R404A	R507	R407C	R22	R134a
+39.7 °C	+38.7 °C	+46.6 °C	+46.8 °C	+62.4 °C

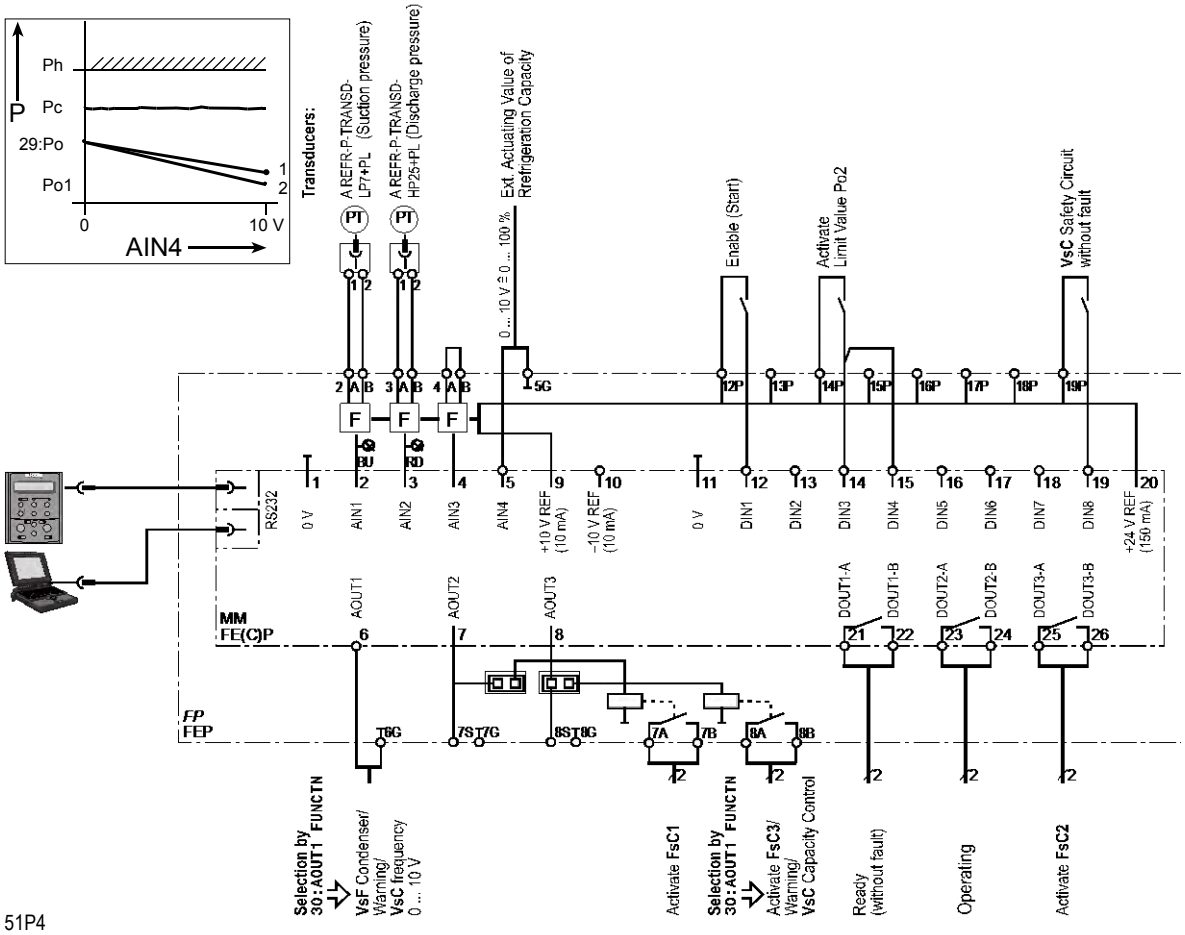
- Ph:
- Discharge-pressure limit: **11:Pc SETP/LIMT2**
- Factory set value: 20.0 + 2.5 = 22.5 bar, corresponding to th:

R404A	R507	R407C	R22	R134a
+51.1 °C	+49.9 °C	+57.5 °C	+58.5 °C	+74.0 °C

- Recommendation: Set discharge pressure limit approx. 3.0 bar higher than the condensing pressure.

- Other:
- Refer to section 8.

5.2.4 Mode 4: A/C / Heat pump - Operation with actuating value from external controller



51P4

Fig. 5.2.4: Connection for operation with actuating value from external controller

Operation:
- External analog actuating value 0...+10 V corresponding to required refrigeration capacity (usually used with an external temperature controller)
- Limiting of suction pressure Po to prevent evaporator icing
- Fixed-speed Compressor (**FsC**) activated when refrigeration power of Variable-speed Compressor (**VsC**) not sufficient
- High pressure limiting with **A REFR-P-TRANSD-HP25+PL** (Accessory).

Accessories:
- Pressure transducer **A REFR-P-TRANSD-LP7+PL**: Range of Suction pressure: -0.5 ... 7.0 bar
- Pressure transducer **A REFR-P-TRANSD-HP25+PL**: Range of Discharge pressure 0 ... 25 bar

Settings:
- Mode **32:CONTRL FUNCTN**: **INPUT 1**
- Parameter **29:Po ACT VAL=0%**: **7.0 bar**
- Modify values for each refrigerant

- Po1, Po2:
- Suction pressure, End value 1 (main value): **08:Po SETP/LIMT1**

	R404A	R507	R407C	R22	R134a
Factory set value: 3.2 bar, Corresponding to:	-10.8 °C	-11.7 °C	-2.0 °C	-4.9 °C	+10.6 °C

- Suction pressure, End value 2 (auxiliary value): **09:Po SETP/LIMT2**

	R404A	R507	R407C	R22	R134a
Factory set value: 3.6 bar, Corresponding to:	-8.2 °C	-9,1 °C	+0.6 °C	-2.2 °C	+13.4 °C

- Pc:
- Condensing pressure, Setpoint: **10:Pc SETPOINT 1**

	R404A	R507	R407C	R22	R134a
Factory set value: 17.0 bar, Corresponding tc:	+39.7 °C	+38.7 °C	+46.6 °C	+46.8 °C	+62.4 °C

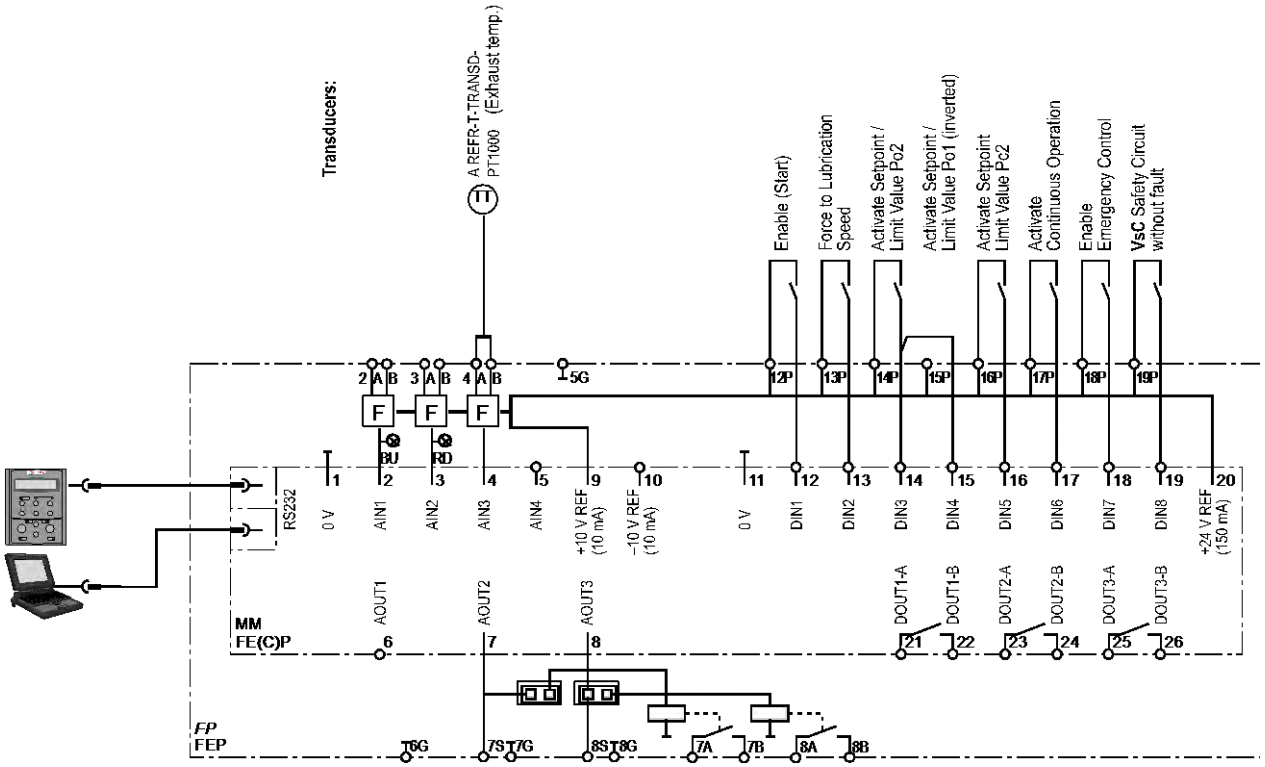
- Ph:
- Discharge-pressure limit: **11:Pc SETP/LIMT2**

	R404A	R507	R407C	R22	R134a
Factory set value: 20.0 + 2.5 = 22.5 bar, corresponding to th:	+51.1 °C	+49.9 °C	+57.5 °C	+58.5 °C	+74.0 °C

- Recommendation:
- Set discharge pressure limit approx. 3.0 bar higher than the condensing pressure.

- Other:
- Refer to section 8.2

5.3 Special functions



51P5

Fig. 5.3: Connection for operation with special functions

The following special functions are available:

Forcing to Lubrication Speed:
The **VsC** compressor runs at maximum speed as long as DIN2 is activated.
This assists the oil transport with unfavourable piping arrangements (e.g. with too low gas velocity) or the lubrication with compressors with a vertical main shaft.
It is recommended that DIN2 is activated with an external adjustable timer (e.g. 15 s every 5 min).

Using a second higher setpoint of Condensing Pressure:
The second higher Setpoint of Condensing Pressure Pc2 is selected as long as DIN5 is activated. This is particularly useful for heat recovery systems (considerable energy saving).
Note: The limiting value of High-Pressure Ph is 2.5 bar higher than the second adjustable setpoint of Condensing Pressure Pc2.

Activating VsC Continuous Operation:
The stopping of the variable-speed **VsC** compressor is inhibited as long as DIN5 is activated.
An exception is if there is very low suction-pressure just before reaching atmospheric pressure.

Typical applications are:
- Air-conditioning equipment making use of a hot-gas bypass system (to achieve very low capacities)
- Ice making machines.

Enabling Emergency Operation:
Emergency Operation (controlled operation of Fixed-speed Compressors **FsC1**...) is enabled as long as DIN7 is activated.
The following are further requirements for Emergency Operation:
- Input DIN1 (Enable) is activated AND
- (Input DIN8 from the **FsC** Safety Circuit is not activated OR
- ***FrigoPack*** itself has a fault).

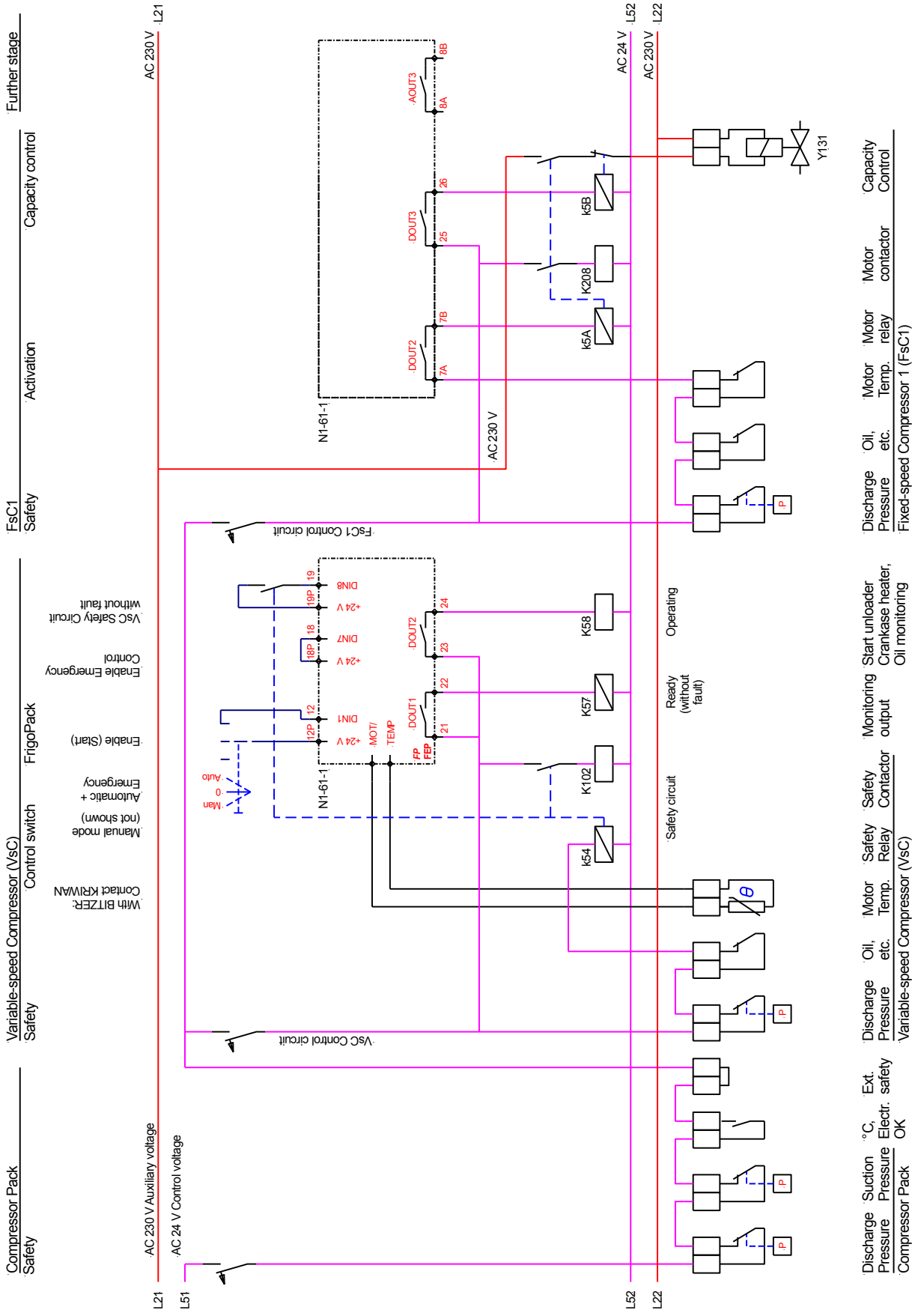
Activating the exhaust-gas temperature limiter:
A PT1000 temperature sensor (see accessories in Section 3.3) is required. This temperature sensor should be mounted on the exhaust pipe as close to the compressor as possible and well thermally insulated.
The measured exhaust-gas temperature is indicated as **`ANALOG INPUT 3`** in the menu **`DIAGNOSIS`**. The value shown multiplied by 2 corresponds to the measured temperature. Calibrate if necessary using the blue trimmer in the area of the grey control terminals of ***FrigoPack***.
Limiting action occurs at and above 100 °C by reducing the maximum speed of the Variable-speed Compressor (**VsC**) up to 20 %.

5.4 Safety and control circuits

The correct design of the safety and control circuits is extremely important to ensure the following:

- Safe operation
- Protection of compressors
- Automatic Emergency Operation if there is a fault
- Automatic recovery from a fault condition (auto restart logic)
- Detailed diagnosis of a fault condition
- Providing fault diagnosis information for remote monitoring systems (LON, ***FrigoDist*** WebServer, ...)

Fig. 5.4 is a simplified overview of the safety and control wiring of a typical system.
KIMO RHVAC can assist with the planning of complex systems or systems with special requirements.



52P0

Fig. 5.4: Simplified overview of the safety and control circuits (Example with Capacity Control)

6 CONNECTIONS, INTERFACES

6.1 Power section

Figs. 6.1a...c show the power wiring of the various frame sizes.

The following recommendations are very important to ensure that a good level of EMC (ElectroMagnetic Compatibility):

1) Keep these terminals spaced away from other terminals. The motor cable can sometimes be connected directly to the terminals of the safety contactor.

2) Terminal for PE of internal and external screened motor cables with good short connection to mounting panel

3) Terminal for screen of internal and external motor cables in addition to large-area electrical bonding to the mounting plate

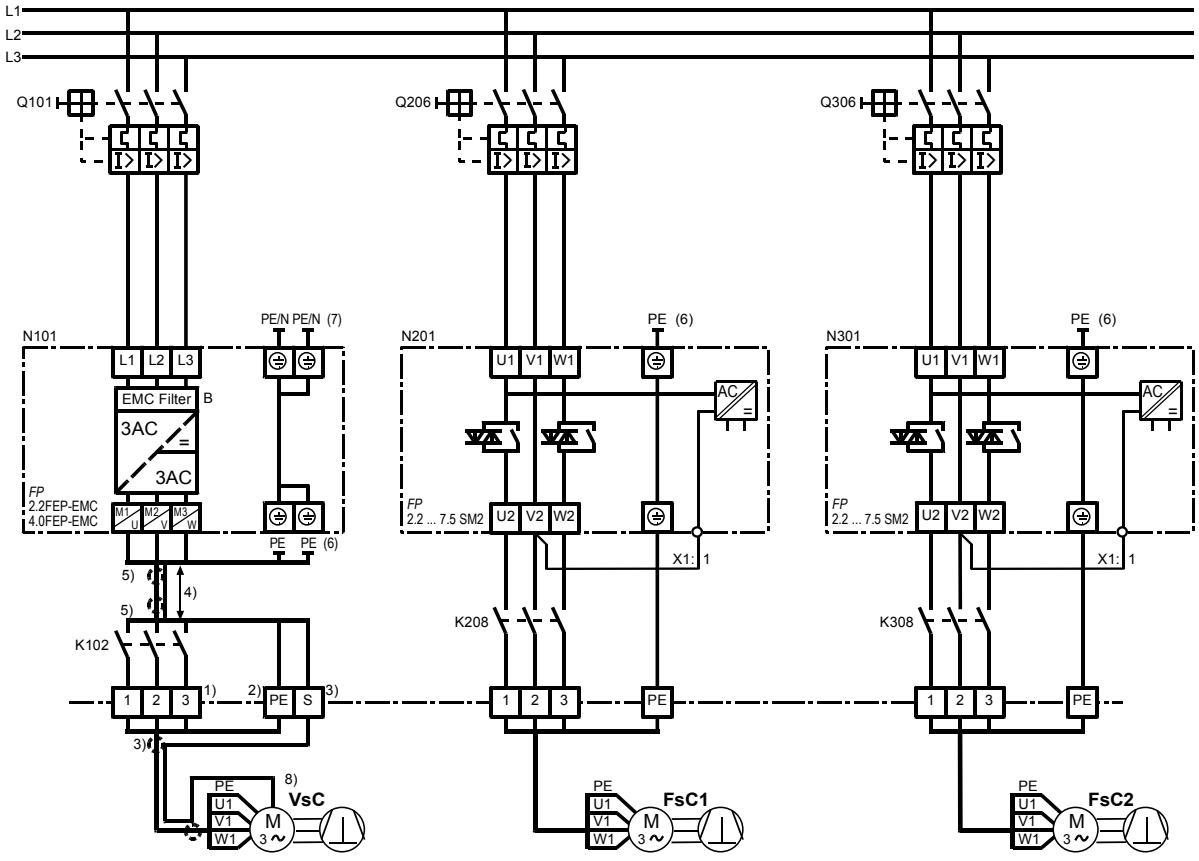
4) Screened motor cable inside the electrical enclosure (ensure adequate spacing to electrical equipment and cables)

5) Connect screen to mounting panel with large-area bonding

6) Direct large-area electrical bonding to mounting panel

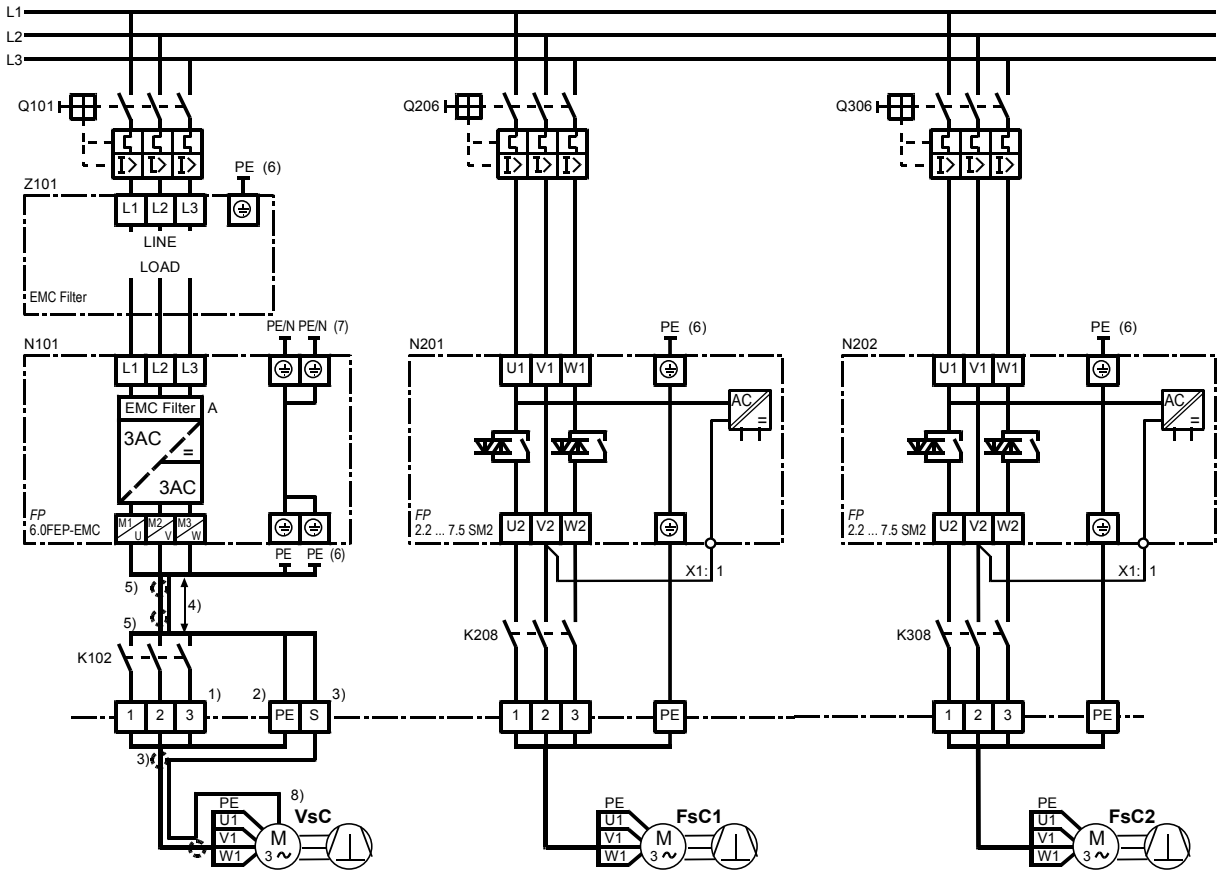
7) Preferred connection:
To mounting panel with large-area bonding /
Alternative connection:
To the neutral of the electrical supply (only if there are problems with earth-leakage circuit breakers in the supply)
Only use this alternative after consulting your supplier. There are several special safety and EMC requirements which must be taken into consideration.

8) Screen connected to the metal motor housing with large area electrical bonding.



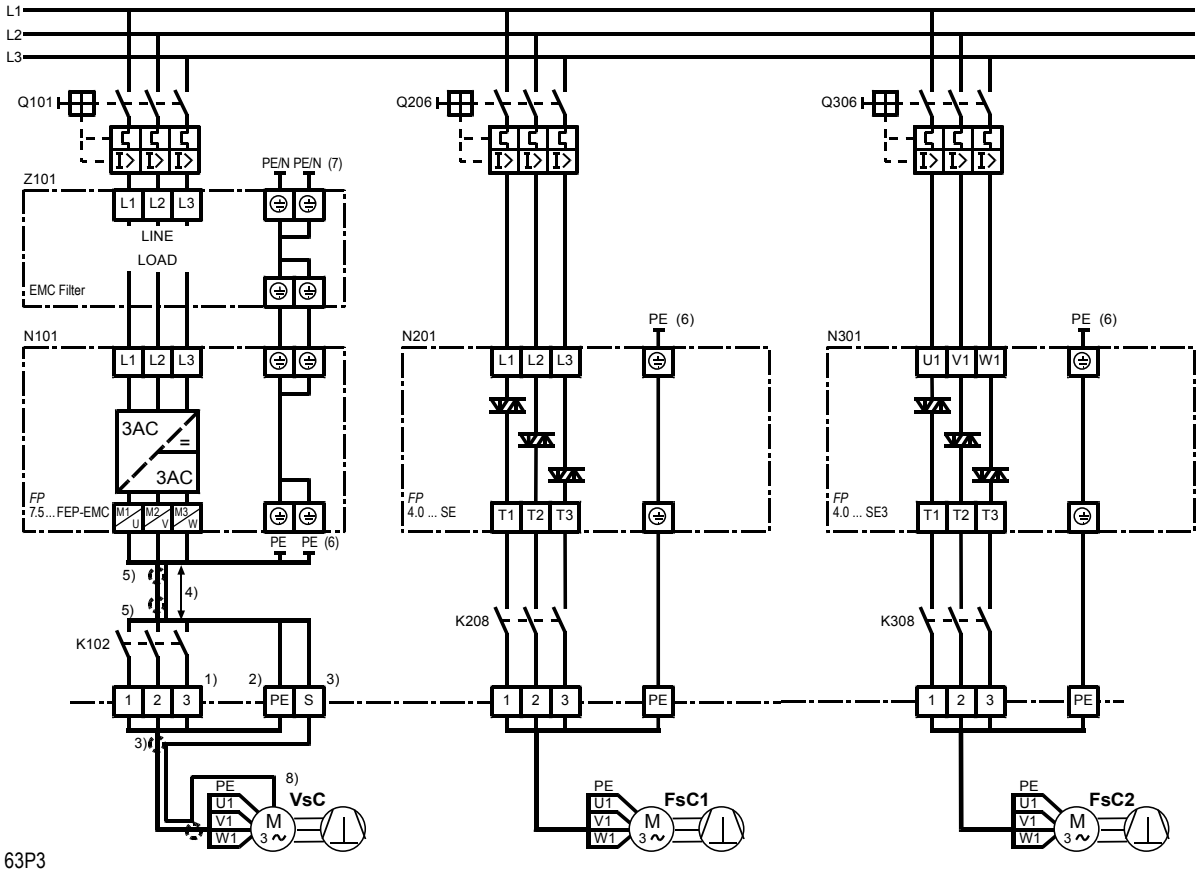
61P3

Fig. 6.1a: ***FrigoPack*** **2.2/4.0FEP - Power wiring**



62P3

Fig. 6.1b: ***FrigoPack*** **6.0FEP - Power wiring**



63P3

Fig. 6.1c: ***FrigoPack*** **7.5 ... 90FEP - Power wiring**

6.2 Motor protection

FrigoPack Refrigeration Inverters are provided with two terminals (MOT/TEMP) for connection to the motor protection circuit of the variable-speed compressor motor. There are four alternative methods of motor protection:

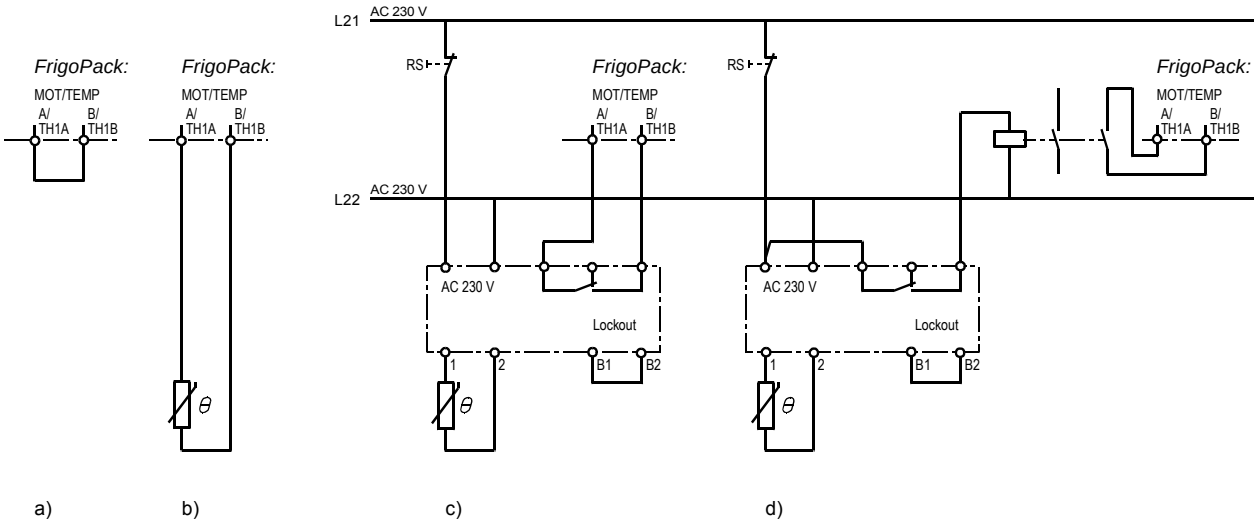
Alternative

a) Without processing:
- Thermistor protection is processed in safety circuit, these two terminals must be linked

b) Direct processing of motor thermistors:
- Connect motor thermistors between these two terminals

c) Processing an external thermistor relay:
- Connect the "normally open" contacts of external thermistor relay (e.g. KRIWAN) between these two terminals

d) Processing an external thermistor relay:
- Connect the "Normally open" contacts of an auxiliary relay wired to an external thermistor relay (e.g. KRIWAN) between these two terminals. With this method the thermistor motor protection can also be connected to the safety circuit.



6JP0

Fig. 6.2: Alternative methods of motor protection

6.3 Control section

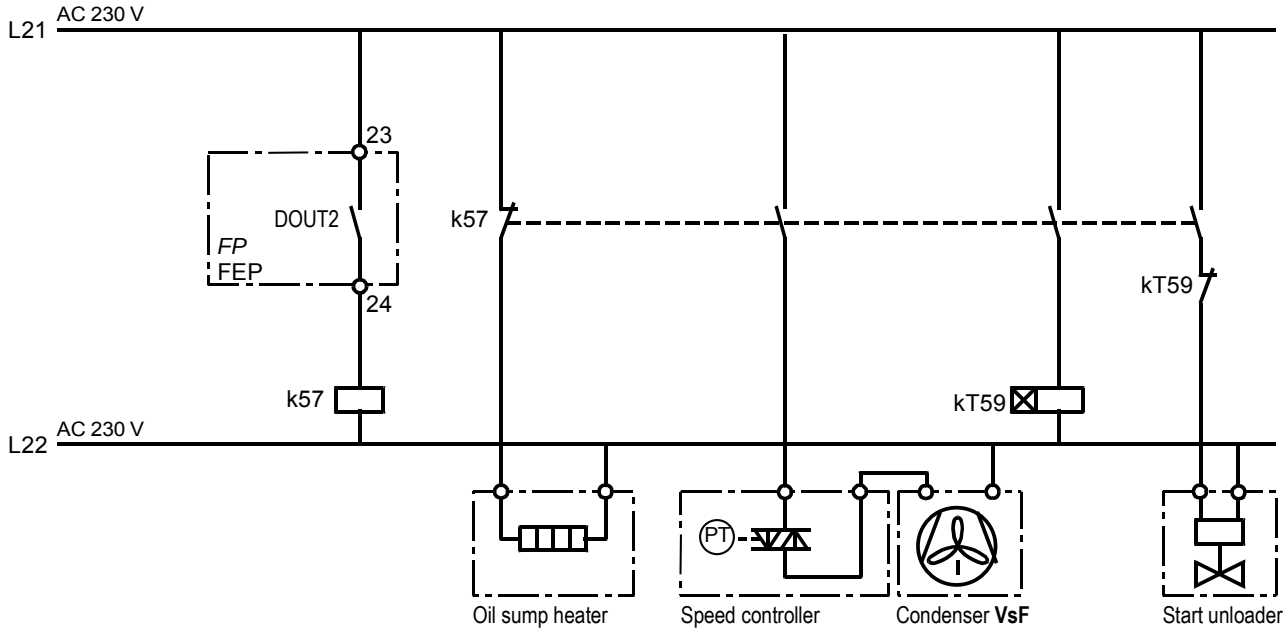
The basic connections to the control section depend on the ***FrigoSoft*** mode of operation, see Section 5.

A relay contact from the safety circuit of the **FsC** must be connected to DIN8 (terminals 19P - 19). A fault in the safety circuit (such as a pressure cut out) will be registered in the trip stack. The auto-restart logic will attempt to reset this trip after a set delay time (see 3.1).

The relay output DOUT2 (terminals 23 - 24) is provided to control the following auxiliary equipment:

- Start unloader (with timer)
- Condenser fan
- Crankcase heater (inverted)
- Oil monitoring.

An circuit suggestion for the control of various auxiliary equipment is shown in Fig. 6.3.



64P0

Fig. 6.3: Control of various auxiliary equipment

6.4 Single Variable-speed Compressor (VsC)

Operation with a bypass connection is recommended to obtain a high level of availability.
A ***FrigoPack*** Economy can often be used for this application.

Please refer to supplier for advice.
Refer to 6.5 for the responsibility for the various tasks.

6.5 Compressor pack

The responsibility for the various open and closed-loop control and safety tasks is as follows:

Compressor type	Task	Responsible
Variable-speed Compressors (**VsC**)	Speed variation	***FrigoPack***
	Normal ON / OFF switching	***FrigoPack***
	Thermal protection of compressor motor	See 6.2
	Safety functions such as pressure switches, oil monitoring	- Compressor safety circuit - Auxiliary relay or contactor at the end of the safety circuit - Contact of auxiliary relay or contactor connected to DIN8 (terminals 19P - 19) of ***FrigoPack*** - Safety contactor
Fixed-speed Compressors (**FsC**)	Multi-step compressor control	***FrigoPack*** / ***MotorMaster*** The operation with an independent multi-step controller is NOT permissible*
	Normal ON / OFF switching	***FrigoPack*** / ***MotorMaster***
	Thermal protection of compressor motor	Compressor safety circuit
	Safety functions such as pressure switches, oil monitoring	- Compressor safety circuit - Auxiliary relay or contactor at the end of the safety circuit - Contact of auxiliary relay or contactor connected to inhibit input of ***FrigoPack*** soft starter - Safety contactor

* A special simplified version of ***FrigoSoft*** is available for operation together with refrigeration control systems with integrated control of suction pressure (WURM, DANFOSS etc.).

6.5.1 Variable-speed Compressor (VsC) + 1..3 Fixed-speed Compressors (FsC)

The control and connection to the ***FrigoPack*** control outputs is shown in Fig. 6.5.1a and 6.5.1b.

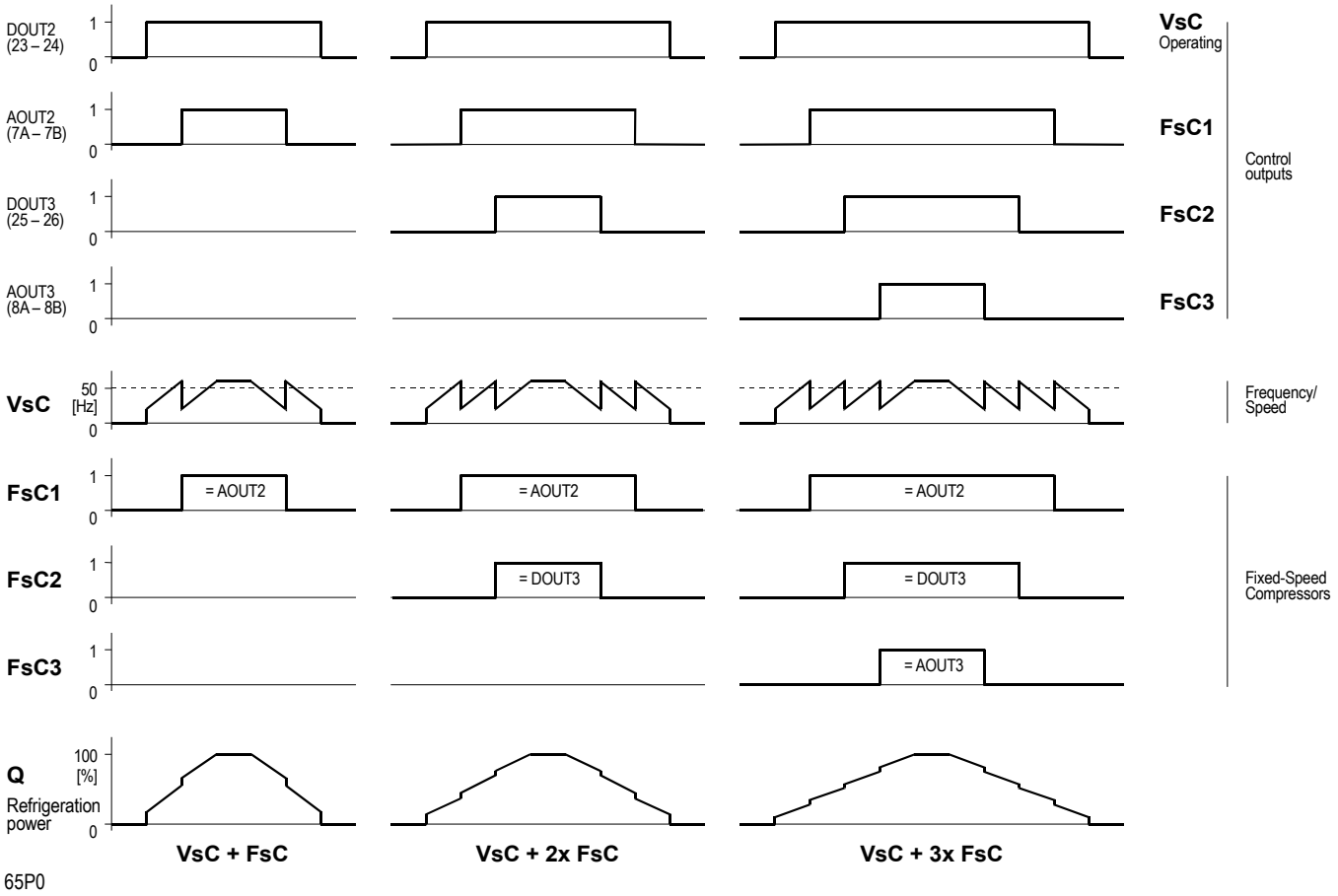


Fig. 6.5.1a: Control of Variable-speed Compressor (VsC) + 1..3 Fixed-speed Compressors (FsC)

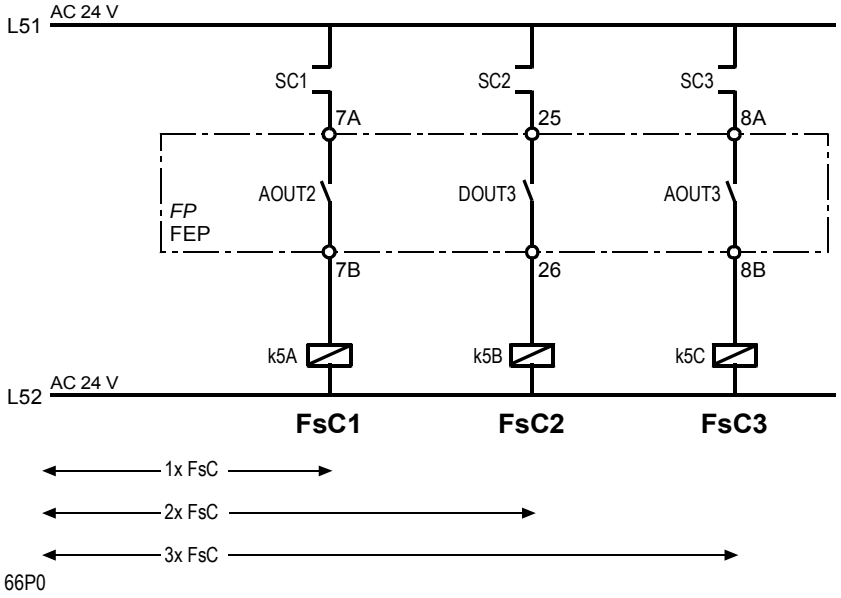


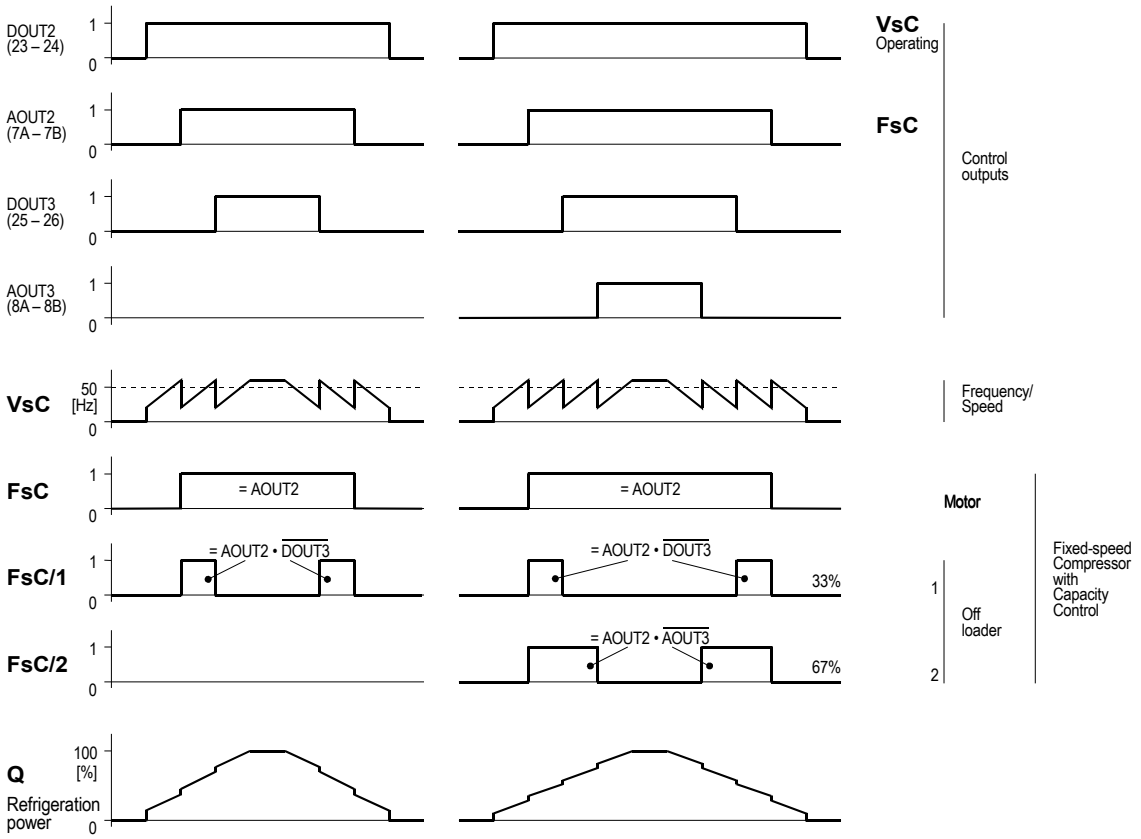
Fig. 6.5.1b: Connection of Variable-speed Compressor (VsC) + 1..3 Fixed-speed Compressors (FsC)
SC: Safety Circuit

6.5.2 Variable-speed Compressor (VsC) + Fixed-speed Compressors (FsC) with capacity control

The use of the following piston-type compressors with capacity control is possible:

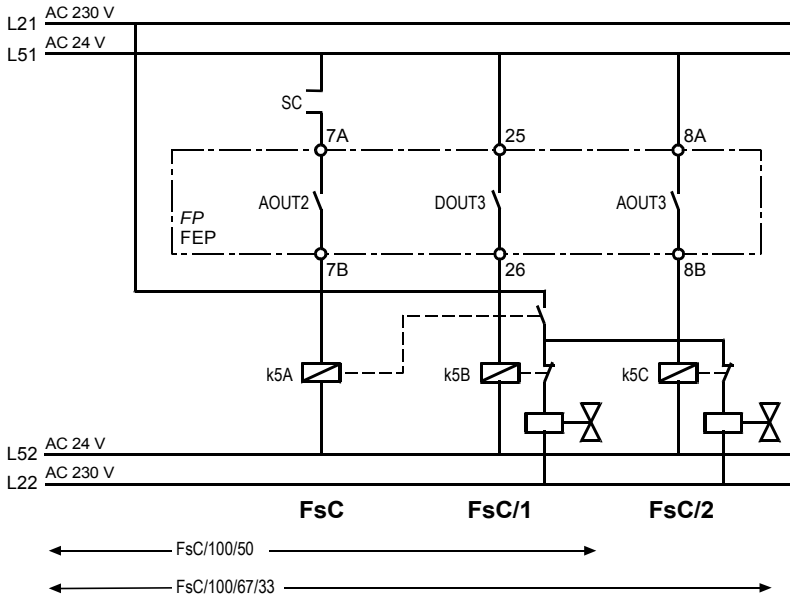
- **4 cylinders: FsC/100/50 %** - Operation with 100 / 50 / 0 % power
- **6 cylinders: FsC/100/67/33/0 %** - Operation with 100 / 67 / 33 / 0 % power.

The control and connection to the ***FrigoPack*** control outputs is shown in Fig. 6.5.2a and 6.5.2b.



67P0

Fig. 6.5.2a: Control of Variable-speed Compressor (VsC) + Fixed-speed Compressor (FsC) with capacity control



68P0

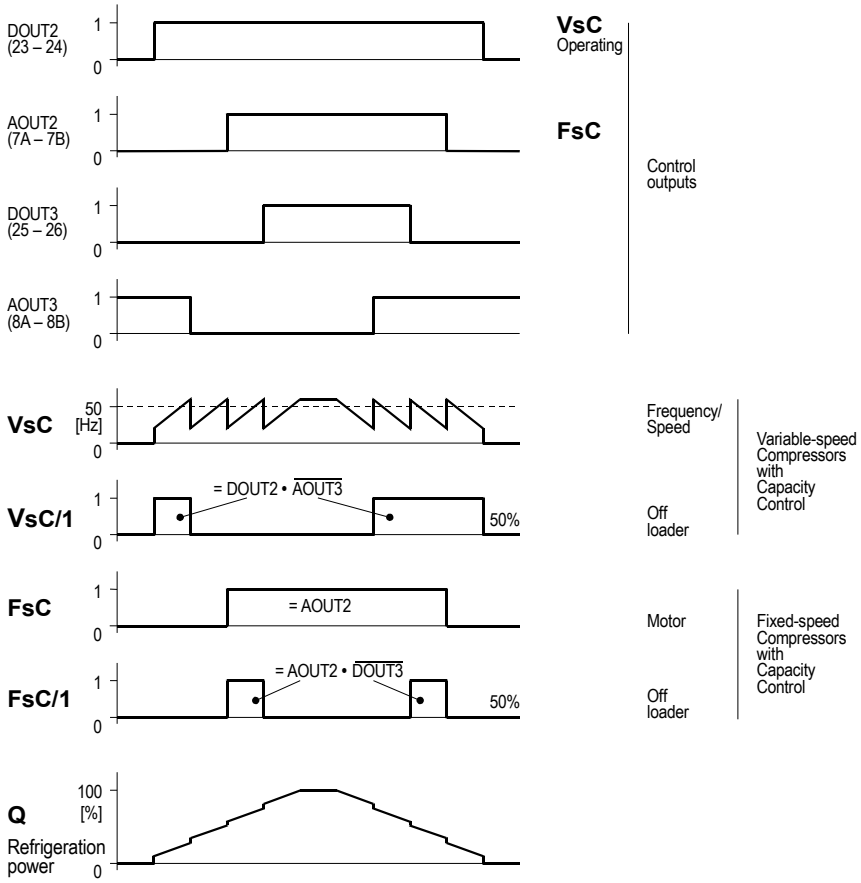
Fig. 6.5.2b: Connection of Variable-speed Compressor (VsC) + Fixed-speed Compressor (FsC) with capacity control
SC: Safety Circuit

6.5.3 Variable-speed and Fixed-speed Compressors (VsC and FsC), both with capacity control

The large range of control when using only two compressors is a particular advantage of this arrangement:

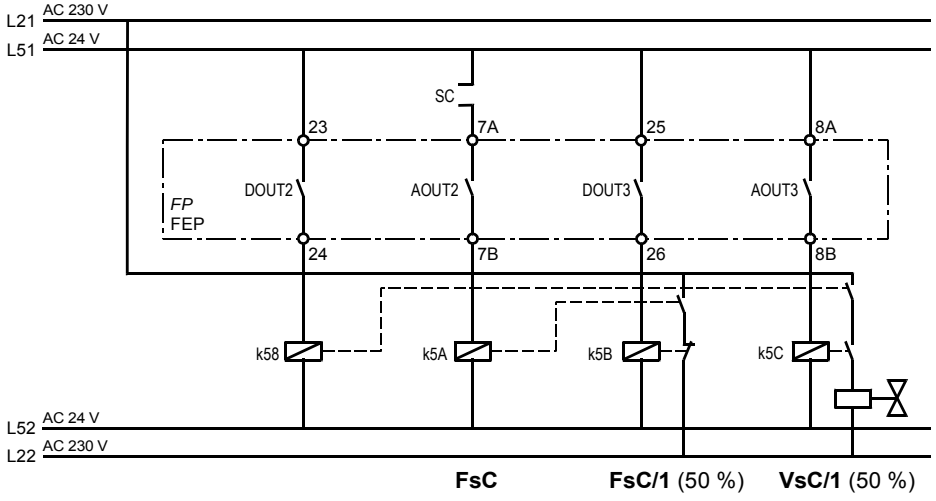
- **4 cylinders: VsC/100/50 % + Refrigeration Inverter** - Operation with 0 / 50 / 100 % power
- **4 cylinders: FsC/100/50 %** - Operation with 0 / 50 / 100 % power.

It is necessary to refer to the compressor manufacturer and conduct a very careful design of the installation when using this arrangement. Particular attention must be paid to the oil transport and cooling of the Variable-speed Compressor (**VsC**). The control and connection to the ***FrigoPack*** control outputs is shown in Fig. 6.5.3a and 6.5.3b.



69P0

Fig. 6.5.3a: Control of Variable-speed and Fixed-speed Compressors (VsC and FsC), both with capacity control



Setting:
31:AOUT3 FUNCTN : INPUT 3

6AP0

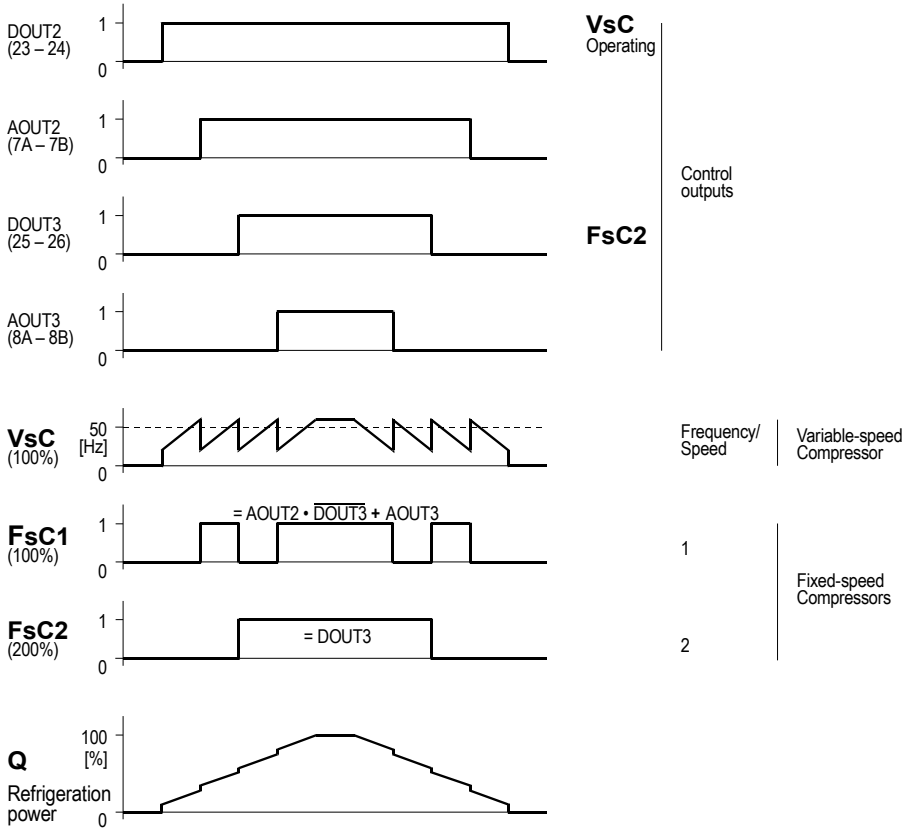
Fig. 6.5.3b: Connection of Variable-speed and Fixed-speed Compressors (VsC and FsC), both with capacity control
SC: Safety Circuit

6.5.4 Variable-speed Compressor (VsC) and two Fixed-speed Compressors (FsCs) with unsymmetrical powers

The large range of control when using only two compressors is a particular advantage of this arrangement:

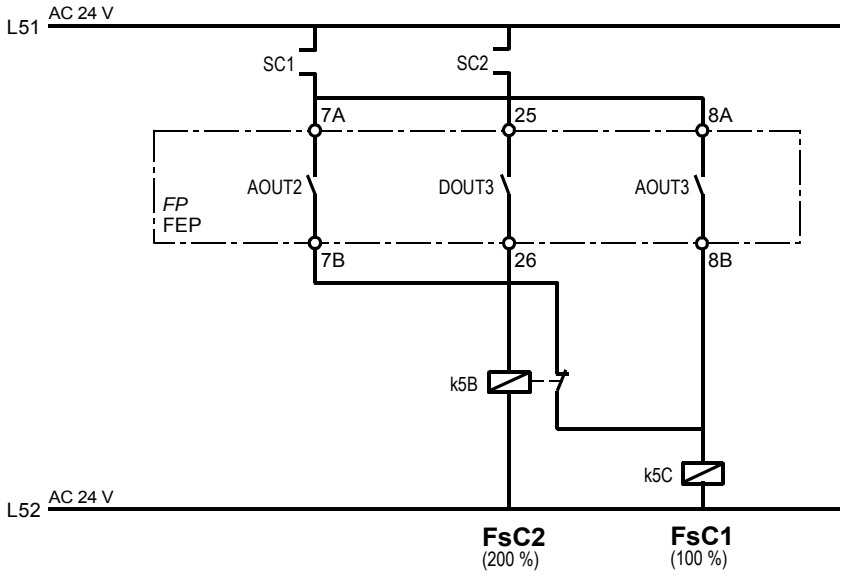
- **VsC:**: - Approx. 100 % (Base power)
- **FsC1:** - Approx. 100 %
- **FsC2:** - Approx. 200 %

The control and connection to the ***FrigoPack*** control outputs is shown in Fig. 6.5.4a and 6.5.4b.



6BP0

Fig. 6.5.4a: Control of Variable-speed Compressor (VsC) and two Fixed-speed Compressors (FsC) with unsymmetrical powers

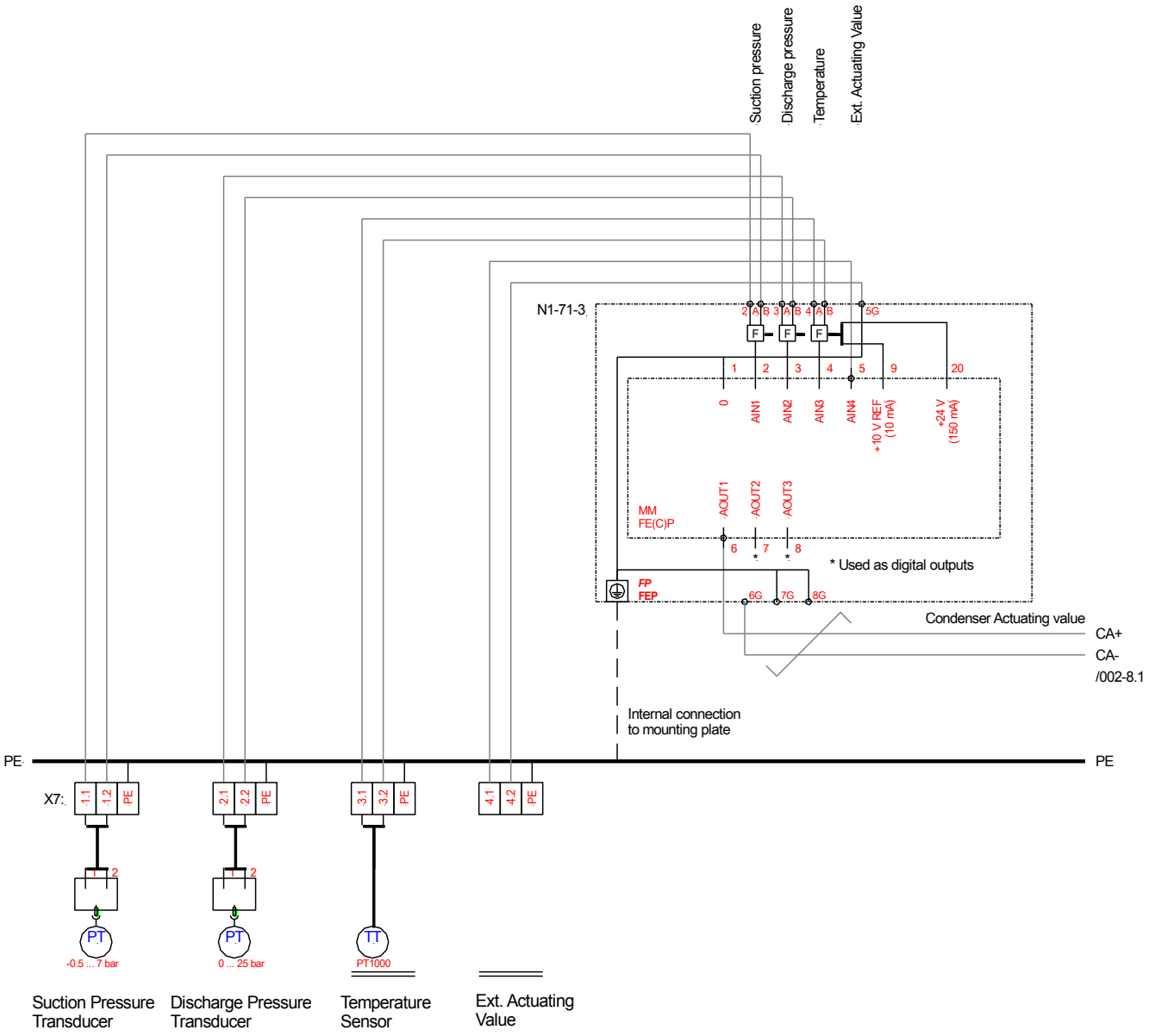


6CP0

Fig. 6.5.4b: Connection of Variable-speed and Fixed-speed Compressors (VsC and FsC) with unsymmetrical powers **SC: Safety Circuit**

6.6 Analog control inputs

Four analog inputs with predetermined functionality are available, see Fig. 6.6.



6LP0

Fig. 6.6: Analog control inputs of the *FrigoPack* Refrigeration Inverter

6.7 Cooling fan

With ***FP* 55...75FEP-EMC** the cooling fan must be externally supplied with 2AC 230 V, see Fig.6.8.1f.
It is not permisssible to switch the fan on and off as a function of the temperature in the electrical enclosure.

Please contact KIMO HVAC if it is desired that the cooling fan should only run when there is a cooling requirement.

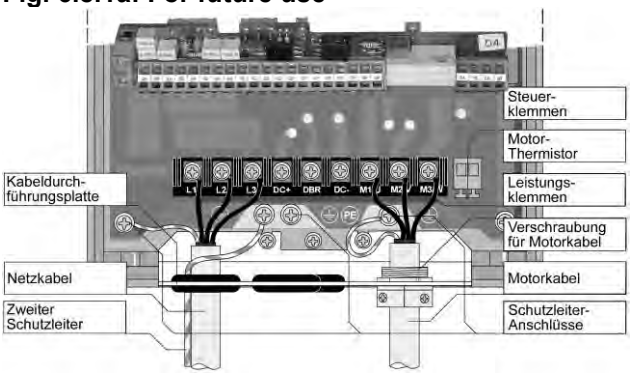
6.8 Terminals

6.8.1 Power terminals

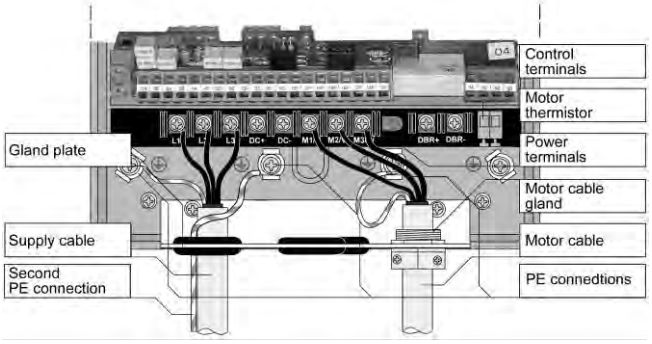
The power connections of the ***FrigoPack*** Refrigeration Inverter are shown in Fig. 6.8.1.

When installing and connecting-up the power connections, it is important that the appropriate information in the ***MotorMaster*** Product manual is carefully observed. Important information concerning EMC-correct wiring is also provided in the appropriate chapters.

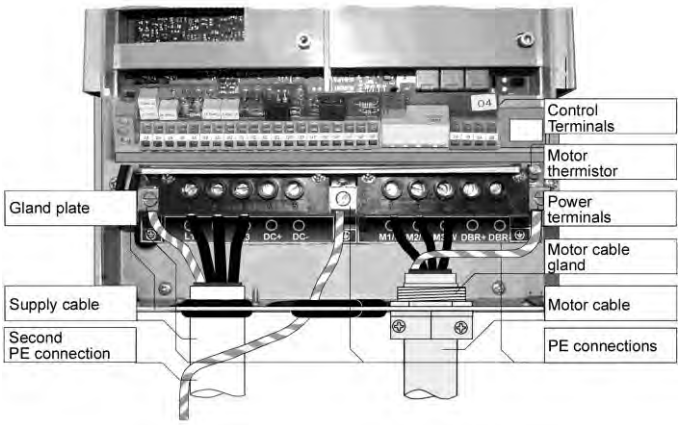
Fig. 6.8.1a: For future use



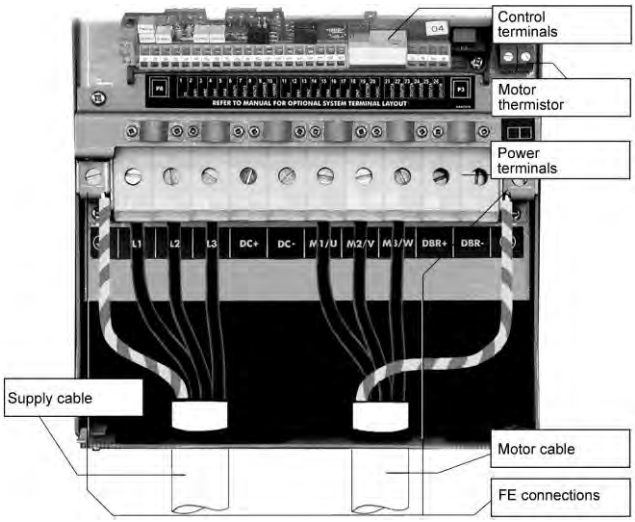
6EP0
Fig. 6.8.1b: *FP* 2.2/4.0/6.0 FEP



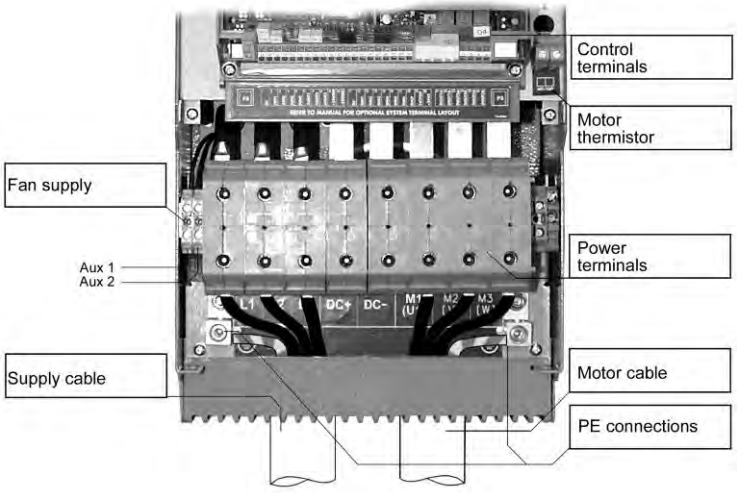
6FP0
Fig. 6.8.1c: *FP* 5.5/7.5...15FEP



6GP0
Fig. 6.8.1d: *FP* 18.5...30FEP



6HP0
Fig. 6.8.1e: *FP* 37...45FEP



6IP0
Fig. 6.8.1f: *FP* 55...90FEP

Fig. 6.8.1: Power connections of the *FrigoPack* Refrigeration Inverter

Terminal / Designation X1:	Signal / Function	Explanation	Further information
PE, PE	***FP* …30FEP-EMC**: Protective earth connections (both to be earthed)	- Observe all safety and EMC requirements	7.7.1
PE	***FP* 37…FEP-EMC**: Protective earth connection		
L1 L2/N L3	Three phases of voltage supply	- Ensure that Supply voltage agrees with data on ***MotorMaster*** name plate	
DC+ DC-		- Do not use otherwise risk of damage to ***FrigoPack***	
M1/U M2/V M3/W	Compressor motor	- Variable-speed Compressor via safety contactor	7.7.1/2
PE	Protective earth connection to compressor motor		
DBR DBR+ DBR-		- Do not use otherwise risk of damage to ***FrigoPack***	
AUX1 AUX2	Only with: ***FP* 55...FEP-EMC**: 2AC 230 supply for equipment fan	- Supply externally	6.8.4

Tab. 6.8.1a: Power connections

The suitability of the supply voltage must be verified before connecting the ***FrigoPack*** Refrigeration Inverter to the supply, see following table.

Type	***FrigoPack* FEP-EMC**	***FrigoPack* FEP/T230-EMC**
Supply voltage	3AC 400...460 V; 50/60 Hz	3AC 220…240 V; 50/60 Hz
Motor voltage	3AC 0…400/460 V; 0…60 Hz	3AC 0...230 V; 0...60 Hz
	3AC 0…400 V; 0…87 Hz	-

Tab. 6.8.1b: *FrigoPack and voltages*

FrigoPack Refrigeration Inverters are designed for use on a 3AC 400...460V (or 3AC 230 V) supply from the public power supply.

The appropriate standards and regulations must be carefully observed regarding earthing and the use of residual-current operated circuit breakers. It is important to note that using EMC filters and screened motor cables increased leakage currents of > 3.5 mA with respect to PE can be expected. This means that it is necessary to provide increased or double earthing.

The residual-current-operated circuit-breakers used must also trip with DC fault currents (universal current-sensitive residual-current-operated circuit-breaker), and they must be able to handle the inrush current when the filter and cable capacitances are charged without tripping.

6.8.2 Terminals for motor protection

The two terminals MOT/TEMP are provided for connection to the motor protection circuit.

These terminals are indicated as "Motor thermistor" in Fig. 6.8.1. Refer to 6.2 for more details.

6.8.3 Terminals for control functions

Table 6.8.3 shows the connections to the digital inputs and outputs as well as the connections for the suction and discharge pressure sensors.

0.2...0.75 mm² insulated wire should be used for the control circuit connections. The control connections have cage clamp terminals which allow connections to be quickly made. Fig. 7.7.3 shows how to use these terminals.

The screen of cables with analog signals (e.g. pressure sensor cables) should only be connected to earth at the ***FrigoPack*** end in order to prevent earth loops.

Terminal / Designation		Signal / Function	Explanation	Further information
1	0 V	Ground for analog signals	- Use green terminal	
2A - 2B	**AIN1**	**Analog Input from pressure transducer for Suction Pressure Po (LP)** **0 mA: Fault** **4 mA: -0.5 bar** **20 mA: +7.0 bar**	**- Suction pressure Po (LP), must be used** **Suitable pressure transducer:** **- A REFR-P-TRANSD-LP7** **- Connections::** **- 1-->2A;2-->2B**	**7.7.4**
3A - 3B	**AIN2**	**Analog Input from pressure transducer for Discharge / Condensing Pressure Pc(HP)** **0 mA: Fault** **4 mA: 0.0 bar** **20 mA: 25.0 bar**	**- Discharge / condens. pressure Pc (HP), optional use** **- Suitable pressure transducer:** **- A REFR-P-TRANSD-HP25** **- Connections:** **- 1-->3A;2-->3B**	**7.7.4**
4A - 4B	***AIN3***	***Analog Input from temperature transducer for Exhaust-Gas Temperature (PT1000)***	***- Exhaust-gas Temperature, optional use*** ***- Bridge when not used***	***5.3, 7.7.5***
5 - 5G	***AIN4***	***Analog input for External Setpoint / Actuating value:*** ***0 V: 0.0%*** ***+10 V: 100.0%***	***- External setpoint / actuating value required for operation with external controller*** ***- Use screened cable***	***5.2.3/4***
6- 6G	**AOUT1**	**Analog Output (5 mA max. load)** **0 V: 0.0% Actuating value** **+10 V: 100.0% Actuating value** **Digital Output with ext. special relay:** **Open: Not activated** **Closed: Activated**	**- Depending on setting 30:AOUT1 FUNCTN:** **- VsF Condenser fan: Actuating Value /** **- VsC: Measured speed /** **- Warning** **- Only use special relay A RELAY-DC12V (available as accessory)**	**7.7.3**
7A - 7B	**AOUT2**	**Analog Output usually used with internal relay to activate FsC1** **Open: Not activated** **Closed: Activated**	**- Activate FsC1 Fixed-speed Compressor 1** **- Max contact load: AC 230 V, 250 VA**	**7.7.3**
8A - 8B	**AOUT3**	**Analog Output usually used with internal relay to activate FsC3** **Open: Not activated** **Closed: Activated**	**- Depending on setting 31:AOUT3 FUNCTN:** **- Activate FsC3 Fixed-speed Compressor 3 /** **- Warning /** **- VsC Capacity Control** **- Max contact load: AC 230 V, 250 VA**	**7.7.3**
9	+10 V REF	Internal +10 V reference	- Not available	
10	-10 V REF	Internal -10 V reference	- Not available	
11	0 V	Ground for digital inputs	- Not available	
12P - 12	**DIN1**	**Digital input for Enable (Start)** **0 V: Stop** **+24 V: Enable**	**- Enable / Start**	**5.2.1-4, 7.7.3**
13P - 13	***DIN2***	***Digital Input to force to Lubrication Speed*** ***0 V: Normal*** ***+24 V: Lubrication speed***	***- Force lubrication speed*** ***- Optional use*** ***- Requires external timer***	***5.3, 7.7.3***
14P - 14	***DIN3***	***Digital Input to activate Setpoint / Limit Po2*** ***0 V: No action*** ***+24 V: Activate Setpoint / Limit Value Po2***	***- Setpoint / Limit selection Po*** ***- Optional use*** ***- Connect to DIN4 for normal selection***	***5.2.2/4, 7.7.3***
15P - 15	***DIN4***	***Digital Input to activate Setpoint / Limit Po1 (inverted)*** ***0 V: Activate Setpoint / Limit Value Po1*** ***+24 V: No action***	***- Setpoint / Limit selection (inverted) Po*** ***- Optional use*** ***- Connect to DIN3 for normal selection***	***5.2.2/4, 7.7.3***
16P - 16	***DIN5***	***Digital Input to activate Setpoint Pc2*** ***0 V: No action*** ***+24 V: Activate Setpoint / Limit Value Pc2***	***- Pc Setpoint selection*** ***- Optional use***	***5.3, 7.7.3***
17P - 17	***DIN6***	***Digital Input to activate VsC continuous operation*** ***0 V: Normal*** ***+24 V: Activate Continuous Operation***	***- VsC continuous operation*** ***- Optional use*** ***- Prevents VsC from stopping provided that suction pressure is not less than 0.2 bar***	***5.3, 7.7.3***
18P - 18	***DIN7***	***Digital Input to enable Emergency Control*** ***0 V: No Emergency Control*** ***+24 V: Activate Emergency Control***	***- Emergency operation (Operation with a defect inverter or compressor)*** ***- Optional use***	***5.3, 7.7.3***
19P - 19	**DIN8**	**Digital Input to monitor Safety Circuit of the VsC compressor** **0 V: External fault** **+24 V: Normal (no fault)**	**- Safety circuit OK** **- Must be used** **- Interrupt if there is a fault** **- (Required to stop inverter operation)**	**5.4, 7.7.3**
20	+24 V	Supply for contacts for digital inputs and pressure transducers	- Not available	

21 - 22	**DOUT1**	**Relay Output "Ready" (without fault)** **Open: No supply, fault or alarm** **Closed: Ready (no fault)**	**- Ready to operate** **- Max contact load: AC 230 V, 250 VA**	**7.7.3**
23 - 24	**DOUT2**	**Relay Output "Operating"** **Open: VsC: Inhibited / Not operating** **Closed: VsC: Starting / Operating**	**- "Operating" to control auxiliaries such as: Crankcase heater, Condenser fan, Start unloader** **- Max contact load: AC 230 V, 250 VA**	**7.7.3**
25 - 26	**DOUT3**	**Relay Output to activate FsC2** **Open: Not activated** **Closed: Activated**	**- Activate FsC2 Fixed-speed Compressor 2** **- Max contact load: AC 230 V, 250 VA**	**7.7.3**

VsC: Variable-speed Compressor (Inverter operation) **VsF:** Variable-speed fans (condenser)
FsC Fixed-speed Compressor

Tab. 6.8.3: Control connections

6.8.4 Terminals for the fan supply with *FP* 55...90FEP-EMC

With ***FP* 55...75FEP-EMC** the terminals for the fan supply are to the direct left of the power terminals, see Fig. 6.8.1f.

7 MOUNTING AND INSTALLING

7.1 Equipment unpacking

Check the following before mounting or storing the ***FrigoPack*** Refrigeration Inverter:

- Sign of transit damage
- The type code and ratings on the name plate conform to the compressor requirement (refer to Section 2.1 - **KIMO COMPRESSOR CROSS-REFERENCE LIST** for more information).

If the unit is not being installed immediately, store the unit in a well-ventilated place away from high temperatures, humidity, dust or metal pieces.

Refer to Chapter 12 - SERVICE for information on returning damaged equipment.

7.2 Electrical enclosure

FrigoPack kits are intended for installation in an electrical enclosure. This enclosure must be selected to provide:

- Adequate protection, to at least IP54
- Adequate cooling to limit internal temperature to 40 °C max
- If filter fans are used then the required air flow (m³/h) must be carefully designed to provide adequate cooling! The air flow required depends on:
  - Compressor used
  - ***FrigoPack*** F Refrigeration Inverter used
  - ***FrigoPack*** S Soft Starter used

  The **KIMO COMPRESSOR CROSS-REFERENCE LIST** provides useful data to select suitable filter fans.
- Thermostatically controlled heating arrangement to protect against:
  - Temperatures lower than 0° C
  - Condensation if low-temperature high-humidity can occur
- Use of a galvanized mounting panel to provide good EMC contact of equipment and cable screens
- Suitable measures to prevent aggressive or salt air from entering enclosure.

The enclosure should be preferably installed in a clean dry room as close as possible to the compressors.

Should the enclosure be mounted outdoors, then the following additional precautions are required:

- Separate outer cover to prevent direct contact with sun or rain
- Arrangement to prevent the internal relative humidity from exceeding 85 %.

7.3 Wall mounting

If the place of installation is clean, free from aggressive or salt air and moisture-free, then the ***FrigoPack*** Refrigeration Inverter can be wall-mounted outside of the electrical enclosure.

The following accessories must be used:

- Top cover to provide protection to IP40
- Gland box to cover terminals of external EMC filter
- Care must be taken that all electrical connections are suitably protected to the relevant safety standards.

7.4 Dimensions, spacing for cooling

Table 7.4 shows the dimensions of each ***FrigoPack*** together with EMC filter if appropriate.

The indicated spacing for cooling (see Fig. 7.4) must be provided for in the electrical enclosure.

MotorMaster	Dimensions [mm]			Cooling space [mm]				Cooling Air required [m^3/h] *
	Height	Width	Depth	Above	Below	L/R	Front	
***FP* 2.2FEP-EMC**	233	177	181	60	60	15	15	80 *
***FP* 4.0FEP-EMC**								
***FP* 6.0FEP-EMC**	233	177 (+) 60	181					
***FP* 7.5FEP-EMC**	415	201 (+) 55	208 + 55	60	60	15	15	180 *
***FP* 11FEP-EMC**								
***FP* 15FEP-EMC**								
***FP* 18.5FEP-EMC**	515	252 (+) 70	245 + 70	60	60	15	25	340 *
***FP* 22FEP-EMC**								
***FP* 30FEP-EMC**								
***FP* 37FEP-EMC**	715	257 (+) 95	310 + 95	60	60	0	25	400 *
***FP* 45FEP-EMC**								
***FP* 55FEP-EMC**	720	257 (+) 110	355 + 110	60	60	0	25	460
***FP* 75FEP-EMC**								
***FP* 90FEP-EMC**								

EMC filter:

+: Additional depth when installed as "footprint" filter

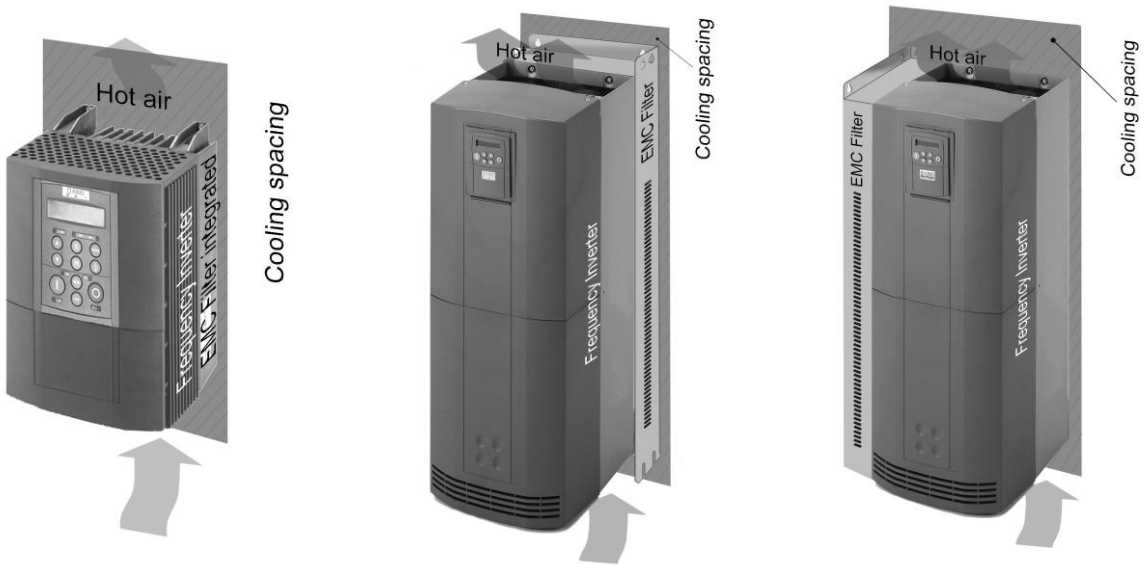
(+): Additional width when installed as "book style" filter.

* Approximate value. Refer to attachment of **KIMO COMPRESSOR CROSS-REFERENCE LIST** for values for each compressor.

FrigoPack fan can be used as follows for enclosure cooling:

- Air entry to enclosure through large-area air filters (e.g. RITTAL) in the front panel of the enclosure
- Air exit through top of enclosure using duct kit (accessory).

Tab. 7.4: ***FrigoPack* dimensions and cooling spacings**



71P0 72P0 73P0

Fig. 7.4: ***FrigoPack* air clearance for cooling**

7.5 Mounting

Refer to ***MotorMaster*** Product Manual **PMM-FEP**.

7.6 Outline drawings

Refer to ***MotorMaster*** Product Manual **PMM-FEP**.

7.7 Connections

The system must be wired with great care. This is to ensure that ***FrigoPack*** operates reliably under all operating conditions.

7.7.1 Power section in electrical enclosure

- **Connections:**
  The wiring diagrams in section 6.1 show the power connection of the ***FrigoPack*** system and the Variable-speed Compressor (**VsC**) and also for controlling 1...3 Fixed-speed Compressors (**FsC**). The connection instructions 1)...8) in Figs. 6.1a...c must be adhered to:

- **Earthing:**
  - The mounting plate of the electrical enclosure must be connected to the building earth with at least 16 mm² independent to the earth in the supply cable. This connection should be as short as possible
  - The compressor mounting frame must be connected to the mounting plate of the electrical enclosure with at least 16 mm². This connection should be as short as possible.

- **Supply input:**
  Recommendations for
  - Supply fuses/circuit breaker
  - Cross section of supply cable depending on the type of installation
  - Supply choke (accessory)

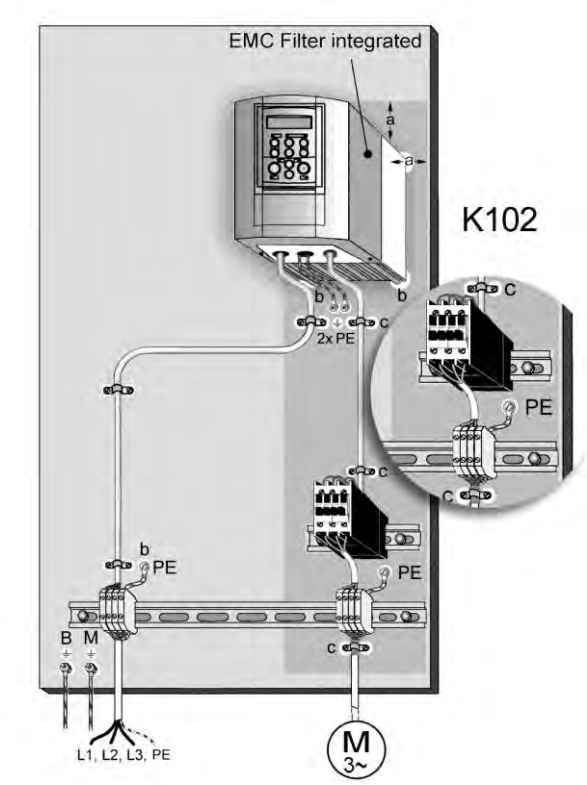
  depending on each compressor are included in the **KIMO COMPRESSOR CROSS-REFERENCE LIST**.
  If an external EMC filter is used:
  - Mount EMC filter as close as possible to ***FrigoPack*** Refrigeration Inverter
  - Keep wiring between EMC filter and ***FrigoPack*** Refrigeration Inverter as short as possible.

- **Safety contactor, bypass contactor**
  For EMC reasons the output safety contactor should be mounted as near as possible (i.e. several cm) to the terminals for the screened cable to the compressor motor.
  The motor cable can often be connected directly to the terminals of the safety contactor.

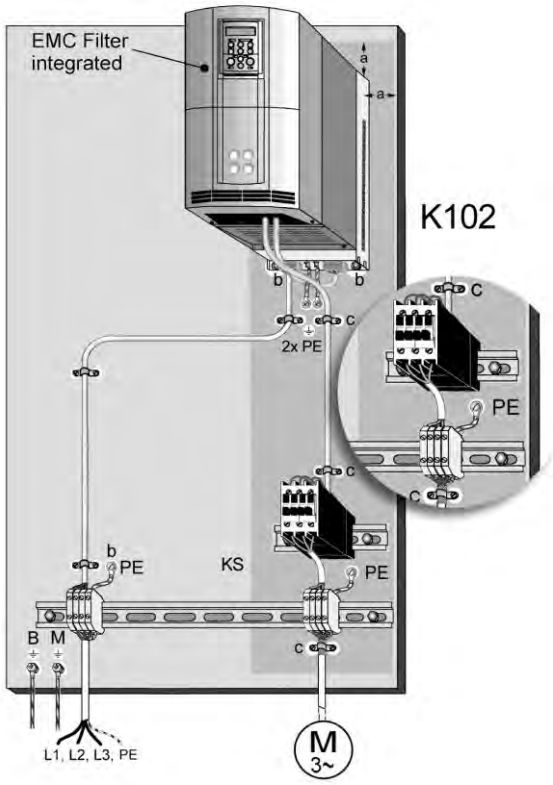
  The ***FrigoPack*** Refrigeration Inverter can be destroyed if power is fed to the output terminals. If a bypass circuit is provided for emergency operation of the compressor without the ***FrigoPack*** Refrigeration Inverter, then all power connections at the ***FrigoPack*** Refrigeration Inverter output must be disconnected using a separate safety/bypass contactor. This safety/bypass contactor should also be mounted as close as possible (i.e. several cm) to the terminals for the screened cable to the compressor motor. The safety contactor and the bypass contactors should also be mechanically interlocked.

- **Output to terminals for compressor motor:**
  - Use screened cable (**copper braid**, steel reinforced cable is not suitable) for motor cable inside the electrical enclosure
  - Connect screen at both ends with large-area bonding to the mounting plate
  - Other cables should not be run within the "EMC hot area".
  - Make sure that there are no common cable runs in cable channels!
  - If other cables have to cross the motor cable, then this should be only at an angle of 90° to the motor cable (to reduce interference coupling)
  - The terminals for the connection to the external motor cable should be mounted away from other terminals.

- **Layout in the enclosure**
  Fig. 7.7.1 indicates important considerations for mounting the equipment and routing the power wiring. Pay careful attention to details a...K102.



74P0



75P0

a 0.25 m spacing to adjoining equipment, avoid "shaded" EMC hot areas, especially important with field-sensitive equipment and other cables

b Contact areas between metallic mounting panel and the ***FrigoPack*** Refrigeration Inverter, EMC filter, PE earthing bar, screens etc. to be free of paint

c Cable screen clamped to contact area on mounting panel

PE PE Protective-earth cables:
- PE earth core of supply cable
- B: Cable to building earth
- M: Cable to compressor mounting frame

K102: Safety contactor.

Fig. 7.7.1: Arrangement of equipment and rating power cables

7.7.2 Compressor motor

- **Cable to compressor motor:**
  - Screened cable (copper screened or cable laid in a steel conduit) must be used between the electrical enclosure and the compressor motor. The protective earth conductor should be part of the motor cable
  - The screen at the enclosure end must be connected to the mounting plate with large-area bonding
  - The screen of the compressor motor must be connected to metal housing with large-area bonding
  - Other installation cables should have at least 0,25 cm spacing to the motor cable. If there are any long parallel runs (>10 m) then the spacing should be increased. Recommendation:

    Spacing $\geq \frac{l\,[m]}{10}$ x 0,25 m

    Permissible length of screened motor cable:

FrigoPack /	**6.0**	**2.2/4.0/5.5/7.5...90**
MotorMaster:	**FEP**	**FEP**
Length:	25 m	50 m

    These cable lengths are only valid if all previous recommendations have been applied with great care. Please contact KIMO Refrigeration HVAC if longer cable lengths are required.

- **Protection of compressor motor**

  Refer to Section 6.2.

7.7.3 Control circuit

The connection to the control section depends on the mode of operation, see section 5. The terminal lists in Table 6.8.3 give further information.

All contactor and relay coils should have RC suppressors fitted. Suitable suppressors are available as accessories from the suppliers of switchgear.

Wire to cage-clamp terminals as follows:
- Prepare wire ends
  - strip to 5...6 mm
  - ferrules are not required, but can be used
- Insert a flat-bladed (size 3.5 mm) screw driver inside the smaller hole of the cage-clamp terminal
- Lever screwdriver keeping it firmly pressed into the hole.
  The cage will open.
- Insert wire into cage keeping the screwdriver in position.
- Remove screwdriver. The terminal will now provide the correct clamping force for a secure connection

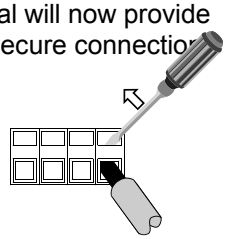


Fig. 7.7.3: Wiring with screwless cage-clamp terminals

7.7.4 Pressure transducers

The connection diagrams in Section 5.2.1 ... 4 show the connections to the pressure tranducer(s).

Only use pressure sensors approved by KIMO (Huba Control type, available as accessory), see Section 3.3.

The following must be observed when connecting:

- Install cable separate from motor cable (spacing to instructions in Section 7.7.1 must be adhered to)
- Use screened cable with cable lengths greater than 10 m (connect screen to earth at ***FrigoPack*** end only to avoid earth loops)
- Take special care with wiring and check before powering up. With correct connection the monitoring LED near the input terminals will light at medium intensity.

7.7.5 Temperature transducer

FrigoPack uses two-wire PT1000 temperature transducers for temperature measurements. A PT1000 temperature transducer in the form of a 6 mm diameter, cylindrical probe is available as an accessory, see Section 3.3.

For more exacting requirements standard PT1000 probes may be used.

7.8 EMC screening

The EMC regulations must be observed when operating the AC drive inverter from the public power supply. Further information on EMC compliant installation (e.g. ground connections, using screened cables) can be referred to in the ***MotorMaster*** Product Manual.

For the following reasons it is very important to adhere to the following EMC recommendations:

- Conformity to the EMC-DIRECTIVE (within the EEC)
- To prevent other equipment from being interfered with
- To prevent any interference with measurement cables, this could degrade the control performance.

The use of screened cable is very important for an EMC compliant electrical installation. Only screened cables with **copper braid** are suitable; steel reinforced cable is not suitable.

Fig. 7.8 shows the basic rules of connection of screen of the mounting plate. Ensure that there is a large area bonding (e.g. by using metal cable clamps).

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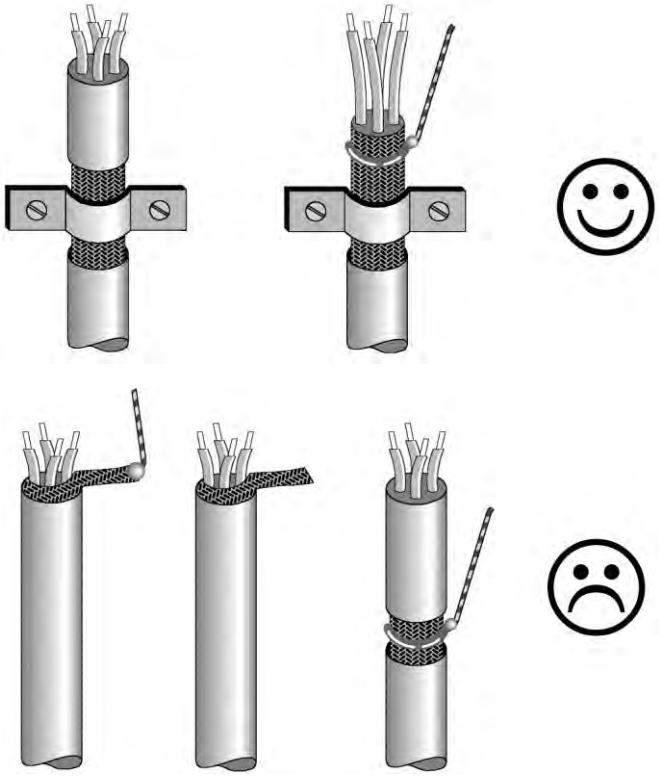

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Fig. 7.8: Large area bonding of cable screen to mounting plate

Unscreened cables in steel conduit may alternatively be used outside of the electrical enclosure.

8 COMMISSIONING, SETTING UP

FrigoPack Refrigeration Inverters are supplied with pre-installed ***FrigoSoft*** software.
NEVER reset the factory default settings as described in the ***MotorMaster*** Product Manual otherwise the refrigeration functionality will be lost.
Please contact your supplier if problems are encountered (refer to section 12).

The combined Refrigeration / A/C Software

***FrigoSoft*24.2-1x (CONFIG: FS 2.4.2-1x)**

is preloaded as standard.

To select other software configurations refer to Section 8.10.

The language of the Programming Pad indicated **bold** in the following list:
ENGLISH, DEUTSCH, FRANCAIS, ESPANOL, ITALIANO, SVENSK, POLSKI, PORTUGUES
is factory preset.

To select other languages in this list refer to Section 8.11.

8.1 Modifying operating parameters with the Programming Pad

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Fig. 8.1: Programming Pad

Note:
Keys L/R , ◀▶ , I , O are for LOCAL MODE. See Section 8.13.
Key JOG has no function.

ESCAPE
The ESCAPE key allows the user to revert to the preceding menu level or leave the parameter modification mode. Also any displayed trip message will disappear on pressing this key. However the latched trip itself will not be reset, see O key.

MENU
This menu key selects the next lower menu or function. If an adjustable parameter has already been selected, then pressing M again will select the enter mode (indicated by arrow to the left of lower display line).

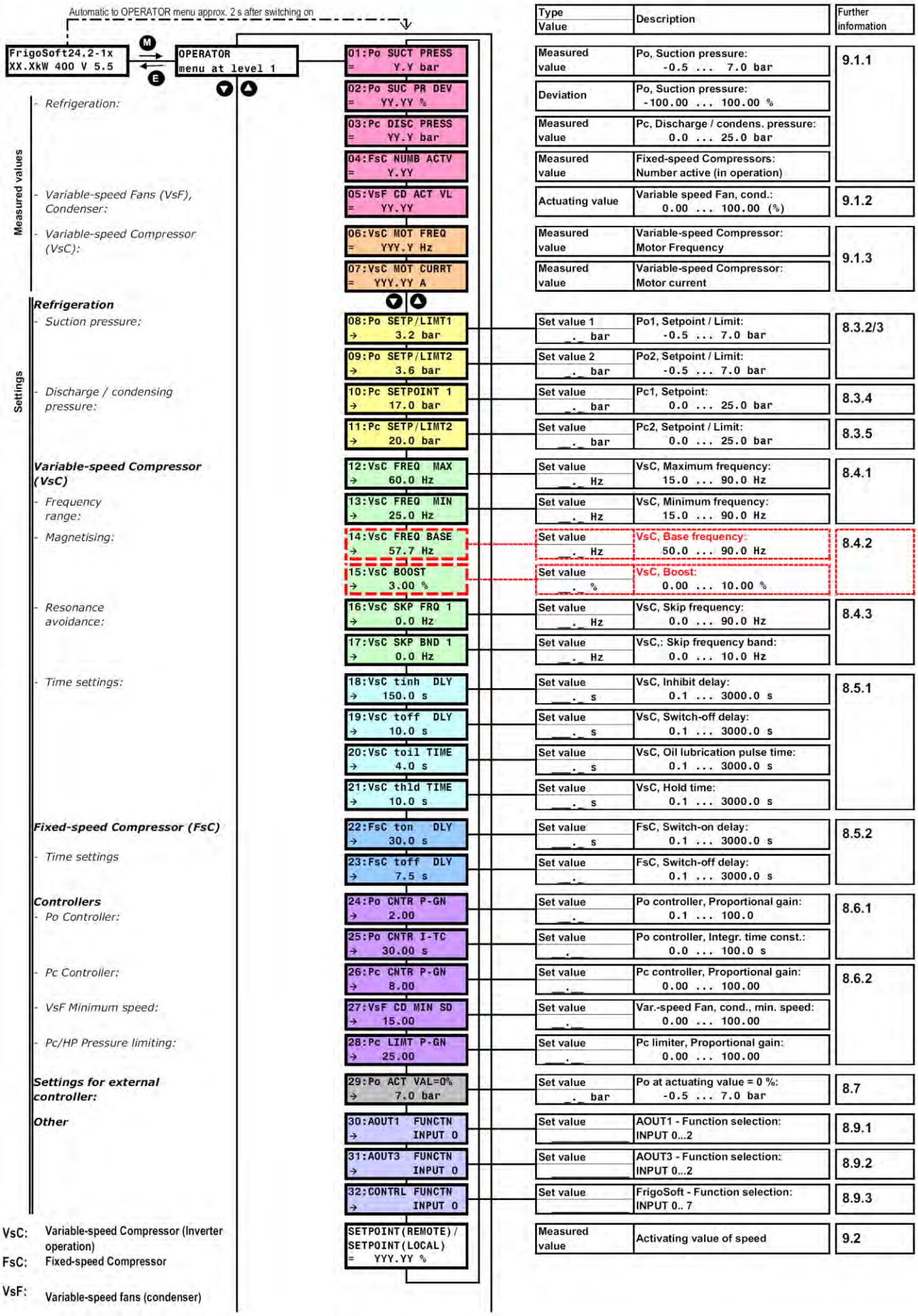
UP / DOWN
These keys provide forward / backward movement to explore the options available in the selected menu level. If an adjustable parameter is already in the enter mode (indicated by arrow to the left of lower display line), then the present value can be increased / decreased.

PROGRAMMING
This key has the following functions:
- Toggles between the last position in the **OPERATOR** menu and the last position in the other menus
- Provides simple direct means of saving parameters by pressing for at least 2 s.

8.2 Menu OPERATOR

The necessary operating parameters, such as pressure setpoint, maximum and minimum frequency etc. are set in the menu **OPERATOR**.

This menu is automatically displayed after power-on. Refer to the following overview or separate attachment for more information.



Type / Value	Description	Further information
Measured value	Po, Suction pressure: -0.5 ... 7.0 bar	9.1.1
Deviation	Po, Suction pressure: -100.00 ... 100.00 %	
Measured value	Pc, Discharge / condens. pressure: 0.0 ... 25.0 bar	
Measured value	Fixed-speed Compressors: Number active (in operation)	
Actuating value	Variable speed Fan, cond.: 0.00 ... 100.00 (%)	9.1.2
Measured value	Variable-speed Compressor: Motor Frequency	9.1.3
Measured value	Variable-speed Compressor: Motor current	
Set value 1 ___._ bar	Po1, Setpoint / Limit: -0.5 ... 7.0 bar	8.3.2/3
Set value 2 ___._ bar	Po2, Setpoint / Limit: -0.5 ... 7.0 bar	
Set value ___._ bar	Pc1, Setpoint: 0.0 ... 25.0 bar	8.3.4
Set value ___._ bar	Pc2, Setpoint / Limit: 0.0 ... 25.0 bar	8.3.5
Set value ___._ Hz	VsC, Maximum frequency: 15.0 ... 90.0 Hz	8.4.1
Set value ___._ Hz	VsC, Minimum frequency: 15.0 ... 90.0 Hz	
Set value ___._ Hz	VsC, Base frequency: 50.0 ... 90.0 Hz	8.4.2
Set value ___._ %	VsC, Boost: 0.00 ... 10.00 %	
Set value ___._ Hz	VsC, Skip frequency: 0.0 ... 90.0 Hz	8.4.3
Set value ___._ Hz	VsC,: Skip frequency band: 0.0 ... 10.0 Hz	
Set value ___._ s	VsC, Inhibit delay: 0.1 ... 3000.0 s	8.5.1
Set value ___._ s	VsC, Switch-off delay: 0.1 ... 3000.0 s	
Set value ___._ s	VsC, Oil lubrication pulse time: 0.1 ... 3000.0 s	
Set value ___._ s	VsC, Hold time: 0.1 ... 3000.0 s	
Set value ___._ s	FsC, Switch-on delay: 0.1 ... 3000.0 s	8.5.2
Set value ___._	FsC, Switch-off delay: 0.1 ... 3000.0 s	
Set value ___._	Po controller, Proportional gain: 0.1 ... 100.0	8.6.1
Set value ___._	Po controller, Integr. time const.: 0.0 ... 100.0 s	
Set value ___._	Pc controller, Proportional gain: 0.00 ... 100.00	8.6.2
Set value ___._	Var.-speed Fan, cond., min. speed: 0.00 ... 100.00	
Set value ___._	Pc limiter, Proportional gain: 0.00 ... 100.00	
Set value _._ bar	Po at actuating value = 0 %: -0.5 ... 7.0 bar	8.7
Set value	AOUT1 - Function selection: INPUT 0...2	8.9.1
Set value	AOUT3 - Function selection: INPUT 0...2	8.9.2
Set value	FrigoSoft - Function selection: INPUT 0.. 7	8.9.3
Measured value	Activating value of speed	9.2

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Tab. 8.2: Arrangement of *MotorMaster* parameters in the OPERATOR menu

8.3 Settings, Refrigeration

8.3.1 General

The pressure and the associated evaporation and condensing temperatures for commonly used refrigerants is shown in Table 8.3.1.

8.3.2 Refrigeration: Setpoints for Suction Pressure

		Range from:	to:	Factory setting:
Setpoint 1 (Main setpoint):	08:Po SETP/LIMT1 → 3.2 bar	-0.5 bar	+7.0 bar	3.2 bar
Setpoint 2 (Auxiliary setpoint):	09:Po SETP/LIMT2 → 3.6 bar	-0.5 bar	+7.0 bar	3.6 bar

Making a change:

1. Select parameter **08:Po SETP/LIMT1** / **09:Po SETP/LIMT2** in the **OPERATOR** menu using keys ▲ or ▼ .
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

8.3.3 A/C, heat pumps: Limits of Suction Pressure

Identical to Section 8.3.2.

8.3.4 Setpoint for condensing pressure

		Range from:	to:	Factory setting:
Setpoint:	10:Pc SETPOINT 1 → 17.0 bar	0.0 bar	25.0 bar	17.0 bar

Making a change:

1. Select parameter **10:Pc SETPOINT 1** in the **OPERATOR** menu using keys ▲ or ▼ .
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

8.3.5 Second higher Setpoint of Condensing Pressure, Limit of Discharge Pressure

Note:
The limiting value of High-Pressure Ph is 2.5 bar higher than the adjustable setpoint of Condensing Pressure Pc.

		Range from:	to:	Factory setting:
Setpoint, Limit Value:	11:Pc SETP/LIMT2 → 20.0 bar	0.0 bar	25.0 bar	20.0 bar

Making a change:

1. Select parameter **11:Pc SETP/LIMT2** in the **OPERATOR** menu using keys ▲ or ▼ .
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

ND-Sensor LP sensor		Druck Pressure		R404A		R507		R407C		R22		R134a		HD-Sensor HP sensor	
[%]	[mA]	[bar]	[bara]	LP[°C]	HP[°C]	LP[°C]	HP[°C]	LP[°C]	HP[°C]	LP[°C]	HP[°C]	LP[°C]	HP[°C]	[%]	[mA]
0,00%	***4,00***	**-0,50**	**0,51**	**-59,1**		**-59,5**		**-49,7**		**-54,5**		**-40,1**			
1,33%	*4,21*	-0,40	0,61	-55,8		-56,3		-46,4		-51,1		-36,6			
4,00%	*4,64*	-0,20	0,81	-50,3		-50,9		-40,9		-45,5		-30,8			
6,67%	***5,07***	**0,00**	**1,01**	**-45,9**	**-45,9**	**-46,5**	**-46,5**	**-36,5**	**-36,5**	**-40,9**	**-40,9**	**-26,1**	**-26,1**	**0,00%**	***4,00***
9,33%	*5,49*	0,20	1,21	-42,0	-42,0	-42,7	-42,7	-32,6	-32,6	-36,9	-36,9	-22,0	-22,0	0,80%	*4,13*
12,00%	*5,92*	0,40	1,41	-38,6	-38,6	-39,4	-39,4	-29,3	-29,3	-33,5	-33,5	-18,5	-18,5	1,60%	*4,26*
14,67%	*6,35*	0,60	1,61	-35,6	-35,6	-36,4	-36,4	-26,3	-26,3	-30,4	-30,4	-15,3	-15,3	2,40%	*4,38*
17,33%	*6,77*	0,80	1,81	-32,9	-32,9	-33,7	-33,7	-23,6	-23,6	-27,6	-27,6	-12,4	-12,4	3,20%	*4,51*
20,00%	***7,20***	**1,00**	**2,01**	**-30,4**	**-30,4**	**-31,2**	**-31,2**	**-21,1**	**-21,1**	**-25,0**	**-25,0**	**-9,8**	**-9,8**	**4,00%**	***4,64***
22,67%	*7,63*	1,20	2,21	-28,1	-28,1	-28,9	-28,9	-18,9	-18,9	-22,6	-22,6	-7,4	-7,4	4,80%	*4,77*
25,33%	*8,05*	1,40	2,41	-25,9	-25,9	-26,7	-26,7	-16,7	-16,7	-20,4	-20,4	-5,1	-5,1	5,60%	*4,90*
28,00%	*8,48*	1,60	2,61	-23,9	-23,9	-24,7	-24,7	-14,7	-14,7	-18,3	-18,3	-3,0	-3,0	6,40%	*5,02*
30,67%	*8,91*	1,80	2,81	-21,9	-21,9	-22,8	-22,8	-12,8	-12,8	-16,3	-16,3	-1,0	-1,0	7,20%	*5,15*
33,33%	***9,33***	**2,00**	**3,01**	**-20,1**	**-20,1**	**-21,0**	**-21,0**	**-11,1**	**-11,1**	**-14,5**	**-14,5**	**0,9**	**0,9**	**8,00%**	***5,28***
36,00%	*9,76*	2,20	3,21	-18,4	-18,4	-19,3	-19,3	-9,4	-9,4	-12,7	-12,7	2,7	2,7	8,80%	*5,41*
38,67%	*10,19*	2,40	3,41	-16,8	-16,8	-17,6	-17,6	-7,8	-7,8	-11,0	-11,0	4,5	4,5	9,60%	*5,54*
41,33%	*10,61*	2,60	3,61	-15,2	-15,2	-16,1	-16,1	-6,2	-6,2	-9,4	-9,4	6,1	6,1	10,40%	*5,66*
44,00%	*11,04*	2,80	3,81	-13,7	-13,7	-14,5	-14,5	-4,7	-4,7	-7,8	-7,8	7,7	7,7	11,20%	*5,79*
46,67%	***11,47***	**3,00**	**4,01**	**-12,2**	**-12,2**	**-13,1**	**-13,1**	**-3,3**	**-3,3**	**-6,4**	**-6,4**	**9,2**	**9,2**	**12,00%**	***5,92***
49,33%	*11,89*	3,20	4,21	-10,8	-10,8	-11,7	-11,7	-2,0	-2,0	-4,9	-4,9	10,6	10,6	12,80%	*6,05*
52,00%	*12,32*	3,40	4,41	-9,5	-9,5	-10,4	-10,4	-0,7	-0,7	-3,5	-3,5	12,0	12,0	13,60%	*6,18*
54,67%	*12,75*	3,60	4,61	-8,2	-8,2	-9,1	-9,1	0,6	0,6	-2,2	-2,2	13,4	13,4	14,40%	*6,30*
57,33%	*13,17*	3,80	4,81	-6,9	-6,9	-7,8	-7,8	1,8	1,8	-0,9	-0,9	14,7	14,7	15,20%	*6,43*
60,00%	***13,60***	**4,00**	**5,01**	**-5,7**	**-5,7**	**-6,6**	**-6,6**	**3,0**	**3,0**	**0,3**	**0,3**	**16,0**	**16,0**	**16,00%**	***6,56***
62,67%	*14,03*	4,20	5,21	-4,5	-4,5	-5,4	-5,4	4,2	4,2	1,6	1,6	17,2	17,2	16,80%	*6,69*
65,33%	*14,45*	4,40	5,41	-3,4	-3,4	-4,3	-4,3	5,3	5,3	2,7	2,7	18,4	18,4	17,60%	*6,82*
68,00%	*14,88*	4,60	5,61	-2,2	-2,2	-3,1	-3,1	6,4	6,4	3,9	3,9	19,5	19,5	18,40%	*6,94*
70,67%	*15,31*	4,80	5,81	-1,1	-1,1	-2,0	-2,0	7,4	7,4	5,0	5,0	20,7	20,7	19,20%	*7,07*
73,33%	***15,73***	**5,00**	**6,01**	**-0,1**	**-0,1**	**-1,0**	**-1,0**	**8,5**	**8,5**	**6,1**	**6,1**	**21,7**	**21,7**	**20,00%**	***7,20***
76,00%	*16,16*	5,20	6,21	1,0	1,0	0,1	0,1	9,5	9,5	7,1	7,1	22,8	22,8	20,80%	*7,33*
78,67%	*16,59*	5,40	6,41	2,0	2,0	1,1	1,1	10,4	10,4	8,2	8,2	23,9	23,9	21,60%	*7,46*
81,33%	*17,01*	5,60	6,61	3,0	3,0	2,1	2,1	11,4	11,4	9,2	9,2	24,9	24,9	22,40%	*7,58*
84,00%	*17,44*	5,80	6,81	3,9	3,9	3,0	3,0	12,3	12,3	10,2	10,2	25,9	25,9	23,20%	*7,71*
86,67%	***17,87***	**6,00**	**7,01**	**4,9**	**4,9**	**4,0**	**4,0**	**13,2**	**13,2**	**11,1**	**11,1**	**26,8**	**26,8**	**24,00%**	***7,84***
89,33%	*18,29*	6,20	7,21	5,8	5,8	4,9	4,9	14,1	14,1	12,1	12,1	27,8	27,8	24,80%	*7,97*
92,00%	*18,72*	6,40	7,41	6,7	6,7	5,8	5,8	15,0	15,0	13,0	13,0	28,7	28,7	25,60%	*8,10*
94,67%	*19,15*	6,60	7,61	7,6	7,6	6,7	6,7	15,8	15,8	13,9	13,9	29,6	29,6	26,40%	*8,22*
97,33%	*19,57*	6,80	7,81	8,5	8,5	7,5	7,5	16,7	16,7	14,8	14,8	30,5	30,5	27,20%	*8,35*
100,00%	***20,00***	**7,00**	**8,01**	**9,3**	**9,3**	**8,4**	**8,4**	**17,5**	**17,5**	**15,7**	**15,7**	**31,4**	**31,4**	**28,00%**	***8,48***
		7,50	8,51		11,4		10,5		19,5		17,8		33,5	30,00%	*8,80*
		8,00	**9,01**		**13,3**		**12,4**		**21,4**		**19,8**		**35,6**	**32,00%**	***9,12***
		8,50	9,51		15,2		14,3		23,2		21,7		37,5	34,00%	*9,44*
		9,00	**10,01**		**17,1**		**16,1**		**25,0**		**23,6**		**39,4**	**36,00%**	***9,76***
		9,50	10,51		18,8		17,9		26,7		25,4		41,2	38,00%	*10,08*
		10,00	**11,01**		**20,5**		**19,6**		**28,3**		**27,1**		**42,9**	**40,00%**	***10,40***
		10,50	11,51		22,1		21,2		29,8		28,8		44,6	42,00%	*10,72*
		11,00	**12,01**		**23,7**		**22,8**		**31,4**		**30,4**		**46,2**	**44,00%**	***11,04***
		11,50	12,51		25,3		24,3		32,8		32,0		47,8	46,00%	*11,36*
		12,00	**13,01**		**26,7**		**25,8**		**34,3**		**33,5**		**49,3**	**48,00%**	***11,68***
		12,50	13,51		28,2		27,3		35,6		35,0		50,7	50,00%	*12,00*
		13,00	**14,01**		**29,6**		**28,7**		**37,0**		**36,4**		**52,2**	**52,00%**	***12,32***
		13,50	14,51		31,0		30,0		38,3		37,8		53,6	54,00%	*12,64*
		14,00	**15,01**		**32,3**		**31,3**		**39,6**		**39,2**		**54,9**	**56,00%**	***12,96***
		14,50	15,51		33,6		32,6		40,8		40,5		56,3	58,00%	*13,28*
		15,00	**16,01**		**34,9**		**33,9**		**42,0**		**41,8**		**57,6**	**60,00%**	***13,60***
		15,50	16,51		36,1		35,1		43,2		43,1		58,8	62,00%	*13,92*
		16,00	**17,01**		**37,3**		**36,3**		**44,4**		**44,4**		**60,1**	**64,00%**	***14,24***
		16,50	17,51		38,5		37,5		45,5		45,6		61,3	66,00%	*14,56*
		17,00	**18,01**		**39,7**		**38,7**		**46,6**		**46,8**		**62,4**	**68,00%**	***14,88***
		17,50	18,51		40,8		39,8		47,7		47,9		63,6	70,00%	*15,20*
		18,00	**19,01**		**41,9**		**40,9**		**48,8**		**49,1**		**64,7**	**72,00%**	***15,52***
		18,50	19,51		43,0		42,0		49,8		50,2		65,8	74,00%	*15,84*
		19,00	**20,01**		**44,1**		**43,0**		**50,8**		**51,3**		**66,9**	**76,00%**	***16,16***
		19,50	20,51		45,1		44,1		51,8		52,4		68,0	78,00%	*16,48*
		20,00	**21,01**		**46,2**		**45,1**		**52,8**		**53,4**		**69,0**	**80,00%**	***16,80***
		20,50	21,51		47,2		46,1		53,8		54,5		70,1	82,00%	*17,12*
		21,00	**22,01**		**48,2**		**47,1**		**54,7**		**55,5**		**71,1**	**84,00%**	***17,44***
		21,50	22,51		49,2		48,1		55,7		56,5		72,1	86,00%	*17,76*
		22,00	**23,01**		**50,1**		**49,0**		**56,6**		**57,5**		**73,0**	**88,00%**	***18,08***
		22,50	23,51		51,1		49,9		57,5		58,5		74,0	90,00%	*18,40*
		23,00	**24,01**		**52,0**		**50,8**		**58,4**		**59,4**		**75,0**	**92,00%**	***18,72***
		23,50	24,51		52,9		51,8		59,3		60,4		75,9	94,00%	*19,04*
		24,00	**25,01**		**53,8**		**52,6**		**60,1**		**61,3**		**76,8**	**96,00%**	***19,36***
		24,50	25,51		54,7		53,5		61,0		62,2		77,7	98,00%	*19,68*
		25,00	**26,01**		**55,6**		**54,4**		**61,8**		**63,1**		**78,6**	**100,00%**	***20,00***

Tab. 8.3.1: Pressure and the associated evaporation and condensing temperatures for commonly used refrigerants

8.4 Settings, Variable-speed Compressor

Before changing the pre-set frequencies, the permissible minimum and maximum frequencies must be determined. If a compressor is operated outside this range then this can result in death, severe bodily injury and/or significant damage.

8.4.1 Range of frequency

		Range from:	to:	Factory setting:
Maximum frequency:	12:VsC FREQ MAX → 60.0 Hz	15.0 Hz	90.0 Hz	60.0 Hz
Minimum frequency:	13:VsC FREQ MIN → 25.0 Hz	15.0 Hz	90.0 Hz	25.0 Hz

Making a change:

1. Select parameter **12:VsC FREQ MAX** / **13:VsC FREQ MIN** in the **OPERATOR** menu using keys ▲ or ▼.
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

8.4.2 Magnetisation (password protected)

		Range from:	to:	Factory setting:
Base frequency (operation):	14:VsC FREQ BASE → 55.0 Hz	15.0 Hz	90.0 Hz	55.0 Hz
Boost (starting):	15:VsC BOOST → 2.5 %	0.0 %	10.0 %	Depending on rated power

Making a change:

1. Select parameter **14:VsC FREQ BASE** / **15:VsC BOOST** in the **OPERATOR** menu using keys ▲ or ▼.
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

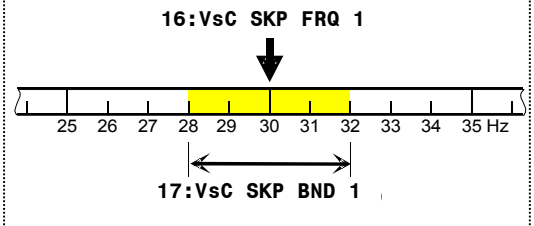
8.4.3 Resonance avoidance

		Range from:	to:	Factory setting:
Skip frequency:	16:VsC SKP FRQ 1 → 0.0 Hz	0.0 Hz	100.0 Hz	0.0 Hz
Skip frequency band:	17:VsC SKP BND 1 → 0.0 Hz	0.0 Hz	10.0 Hz	0.0 Hz

Making a change:

1. Select parameter **16:VsC SKP FRQ 1** / **17:VsC SKP BND 1** in the **OPERATOR** menu using keys ▲ or ▼.
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

Example:



16:VsC SKP FRQ 1 = 30.0 Hz
17:VsC SKP BND 1 = 4.0 Hz

8.5 Settings, Time

In order that the compressor is adequately lubricated, the compressor must not be switched on and off too frequently. This is the reason adjustable timers have been incorporated in the ***FrigoSoft*** software. The adjustable timers delay the ON and OFF switching of the **VsC** and **FsC** compressors. The range of adjustment is 0.0 ... 3,000.0 s.

The optimum set times should be determined when commissioning the system and depends on the lowest cooling requirement. If the ON/OFF delays are set too long, then there is a risk that the actual value of pressure will deviate too significantly from the setpoint and more significant temperature fluctuations will occur in the refrigeration circuit.

8.5.1 Variable-speed Compressor (VsC)

		Range from:	to:	Factory setting:
Inhibit delay:	18:VsC tinh DLY → 150.0 s	0.0 s	3000.0	Depending on rated power
Stop delay:	19:VsC toff DLY → 10.0 s	0.0 s	3000.0	10.0 s
Oil lubrication pulse time:	20:VsC toil TIME → 4.0 s	0.0 s	3000.0	4.0 s
Hold time:	21:VsC thld TIME → 10.0 s	0.0 s	3000.0	Depending on rated power

Making a change:

1. Select parameter **18:VsC tinh DLY** / **19:VsC toff DLY** / **20:VsC toil TIME** / **21:VsC thld TIME** in the **OPERATOR** menu using keys ▲ or ▼ .
2. Press the Ⓜ key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the Ⓔ key to leave the changing mode.

8.5.2 Fixed-speed Compressor (FsC)

		Range from:	to:	Factory setting:
Start delay:	22:FsC ton DLY → 20.0 s	0.0 s	3000.0	Depending on rated power
Stop delay:	23:FsC toff DLY → 5.0 s	0.0 s	3000.0	Depending on rated power

Making a change:

1. Select parameter **22:FsC ton DLY** / **23:FsC toff DLY** in the **OPERATOR** menu using keys ▲ or ▼ .
2. Press the Ⓜ key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the Ⓔ key to leave the changing mode.

8.6 Controller and limiter settings

8.6.1 Po controller

		Range from:	to:	Factory setting:
Proportional gain:	24:Po CNTR P-GN → 3.0	0.0	100.0	Depending on rated power
Integral time constant:	25:Po CNTR I-TC → 20.0 s	0.0 s	100.0 s	Depending on rated power

Making a change:

1. Select parameter **24:Po CNTR P-GN** / **25:Po CNTR I-TC** in the **OPERATOR** menu using keys ▲ or ▼ .
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

8.6.2 Pc controller / limiter

		Range from:	to:	Factory setting:
Proportional gain:	26:Pc CNTR P-GN → 8.0	0.0	100.0	8.0
Condenser fan, minimum speed:	27:VsF CD MIN SD → 15.0 %	0.0 %	100.0 %	15.0 %
Proportional gain:	28:Pc LIMT P-GN → 10.0	0.0	100.0	10.0

Making a change:

1. Select parameter **26:Pc CNTR P-GN** / **27:VsF CD MIN SD** / **28:Pc LIMT P-GN** in the **OPERATOR** menu using keys ▲ or ▼ .
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

8.7 Settings: A/C with ext. Controller

		Range from:	to:	Factory setting:
Suction pressure at minimum actuating value:	29:Po ACT VAL=0% → 7.0 bar	-0.5 bar	7.0 bar	7.0 bar

Making a change:

1. Select parameter **29:Po ACT VAL=0%** in the **OPERATOR** menu using keys ▲ or ▼ .
2. Press the M key to select the changing mode
3. Enter the new value using the ▲ or ▼ keys.
4. Confirm new value using the E key to leave the changing mode.

8.8 Other settings

8.8.1 Function selection 30:AOUT1 FUNCTN

Setting	Function	Connection
• **INPUT 0**:	Control of condenser fan	0 ... +10 V / 5 mA
• **INPUT 1**:	Warning: - High-pressure limiting	Only with special relay **A RELAY-DC12V**, see Section 3.3.
• **INPUT 2**:	Frequency / Speed of the **VsC**	0 ... +10 V / 5 mA

8.8.2 Function selection 31:AOUT3 FUNCTN

Setting	Function	Connection
• **INPUT 0**:	Control of **FsC3**	Only with special relay **A RELAY-DC12V**, see Section 3.3.
• **INPUT 1**:	Warning: - High-pressure limiting	Only with special relay **A RELAY-DC12V**, see Section 3.3.
• **INPUT 2**:	Control of **VsC**, Capacity Control	Refer to Section 6.5.3.

8.8.3 Function selection 32:CONTRL FUNCTN

Setting	Internal Setpoints Po1 / Po2	External setpoint / activating value AIN4	Fixed test setpoint	Explanation
• **INPUT 0**	●			Mode: 1,2 (Factory setting)
• **INPUT 1**		●		Mode: 3,4
• **INPUT 2**			4.0 bar	Installation test
• **INPUT 3**			3.0 bar	
• **INPUT 4**			2.0 bar	
• **INPUT 5**			1.0 bar	
• **INPUT 6**			0.5 bar	
• **INPUT 7**			0.0 bar	

8.9 Setting-up recommendations

Settings		Refrigeration A/C installation			
		Small	**Medium**	**Large**	**Very large**
Variable-speed Compressor, Time settings	**18:VsC tinh DLY**	100.0 s	150.0 s	240.0 s	300.0 s
Fixed-speed Compressor, Time settings	**22:FsC ton DLY**	20.0 s	30.0 s	60.0 s	100.0 s
	23:FsC toff DLY	5.0 s	7.5 s	15.0 s	21.0 s
Compressor pack, Time settings	**24:Po CNTR P-GN**	3.0	3.0	2.0	2.0
	25:Po CNTR I-TC	20.0 s	30.0 s	45.0 s	60.0 s
Typical installation characteristics	Pipe volume	- Small	- Medium	- Large	- Very large
	Pipe runs	- Short	- Medium	- Long	- Very long
	Refrigerant volume	- Low	- Medium	- High	- Very high
Typical ***FrigoPack***s		***FP* ...6.0FEP-EMC**	***FP* 7.5…30FEP-EMC**	***FP* 30...90FEP-EMC**	***FP* 30...90FEP-EMC**

8.10 Software configurations

8.10.1 Available software configurations

- Active configuration: **APPLICATION**
- Programming Pad: **OP STATION**
- ***FrigoSoft 2.3-German (old version):*** **FS 2.3.1-1x**
- ***FrigoSoft 2.3-English (old version):*** **FS 2.3.2-1x**
- ***FrigoSoft 2.4-German:*** **FS_2.4.1-1x**
- ***FrigoSoft 2.4-English:*** **FS_2.4.2-1x**
- ***FrigoSoft 2.4-French:*** **FS_2.4.3-1x**
- ***FrigoSoft 2.4-Italian:*** **FS_2.4.5-1x**
- ***FrigoSoft 2.4-Dutch:*** **FS_2.4.8-1x**
- ***FrigoLON 2.4-German:*** **FL_2.4.1-1x**

8.10.2 Loading other software configurations

Go through the following steps taking great care:

- **Establish password by contacting supplier and keep ready for following use.**
- **Select ADVANCED level of access:**

1. Press following key sequence E E M ▼ ▼ M to select following entry:	**VIEW LEVEL OPERATOR**	should be displayed
2. Press key M :	**ENTER PASSWORD**	should be displayed
3. Use keys M, ▲ and ▼ to enter password and confirm with key E :	**VIEW LEVEL OPERATOR**	should be displayed again
4. Use keys ▼ and ▲ to select the following view level:	**VIEW LEVEL ADVANCED**	
5. Press key E 2x to confirm:	**QUICK SETUP**	should be displayed

- **Loading other software configuration**

1. Press key ▼ 2x to select following menu:	**SYSTEM**	
2. Press key M :	**SAVE CONFIG**	should be displayed
3. Press key ▼ :	**RESTORE CONFIG**	should be displayed
4. Press key M :	**RESTORE CONFIG APPLICATION**	should be displayed
5. Press key ▼ until required configuration is displayed.	Valid configurations are: **APPLICATION** **FS_2.4.1-1x** **FS_2.4.8-1x** **OP STATION** **FS_2.4.2-1x** **FL_2.4.1-1x** **FS 2.3.1-1x** **FS_2.4.3-1x** **FS 2.3.2-1x** **FS_2.4.5-1x**	
6. Press key M to activate:	**UP TO CONFIRM**	should be displayed
7. Press key ▲ to confirm:	**RESTORE CONFIG COMPLETE**	should be momentarily displayed
8. Press following key sequence E E M M to return to **OPERATOR** menu.		

- **Store software configuration**

1. Press key Prog for approx. 3 s until the following entry appears:	**SYSTEM**	should be displayed
Now release key:	**SAVE CONFIG**	should be displayed
2. Press key M to activate:	**SAVE CONFIG APPLICATION**	should be displayed
3. Press key M to activate:	**UP TO CONFIRM**	should be displayed
4. Press key ▲ to confirm:	**SAVE CONFIG SAVING**	and
	SAVE CONFIG COMPLETE	should be momentarily displayed
5. Press key E 3x:	**PASSWORD LOCKED**	should be momentarily displayed
6. Press key M 2x to return to **OPERATOR** menu.		

8.11 Changing the language of the Programming Pad

Go through the following steps taking great care:

- **Establish password by contacting supplier and keep ready for following use.**
- **Select ADVANCED level of access:**

1. Press following key sequence E E M ▼ ▼ M to select following entry:	**VIEW LEVEL OPERATOR**	should be displayed
2. Press key M :	**ENTER PASSWORD**	should be displayed
3. Use keys M, ▲ and ▼ to enter password and confirm with key E :	**VIEW LEVEL OPERATOR**	should be displayed again
4. Use keys ▼ and ▲ to select the following view level:	**VIEW LEVEL ADVANCED**	
5. Press key E 2x to confirm:	**QUICK SETUP**	should be displayed

- **Select other language:**

1. Press key ▼ 2x to select following menu:	**SYSTEM**	
2. Press key M :	**SAVE CONFIG**	should be displayed
3. Press key ▲ :	**LANGUAGE**	should be displayed
4. Press key M 2x:	**LANGUAGE ENGLISH**	should be displayed
5. Press key ▼ until required configuration is displayed.	Valid configurations are: **ENGLISH** **ITALIANO** **DEUTSCH** **SVENSK** **FRANCAIS** **POLSKI** **ESPANOL** **PORTUGUES**	
6. Press key E to confirm:	**LANGUAGE COMPLETE**	should be momentarily displayed
7. Press key E 2x:	**SYSTEM**	should be displayed

- **Revert to OPERATOR level of access:**

1. Press key ▲ 2x to select following menu:	**QUICK SETUP**	
2. Press following key sequence M ▲ :	**VIEW LEVEL ADVANCED**	should be displayed
3. Press key M to enter change mode.		
4. Use keys ▼ and ▲ to select the following view level:	**VIEW LEVEL OPERATOR**	
5. Press key E 2x to confirm:	**QUICK SETUP**	should be displayed
6. Press key E 2x:	**PASSWORD LOCKED**	should be momentarily displayed
7. Press key M 2x to return to **OPERATOR** menu.		

8.12 Storing software modifications

Software modifications may only be made after referring to and following the instructions of KIMO RHVAC.

Go through the following steps taking great care:

- **Establish password by contacting supplier and keep ready for following use.**
- **Select ADVANCED level of access:**

1. Press following key sequence E E M ▼ ▼ M to select following entry:	**VIEW LEVEL OPERATOR**	should be displayed
2. Press key M :	**ENTER PASSWORD**	should be displayed
3. Use keys M, ▲ and ▼ to enter password and confirm with key E :	**VIEW LEVEL OPERATOR**	should be displayed again
4. Use keys ▼ and ▲ to select the following view level:	**VIEW LEVEL ADVANCED**	
5. Press key E 2x to confirm:	**QUICK SETUP**	should be displayed

- **Make software modifications following instructions of KIMO RHVAC**
- **Revert to OPERATOR level of access:**

1. Press key ▲ 2x to select following menu:	**QUICK SETUP**	
2. Press following key sequence M ▲ :	**VIEW LEVEL ADVANCED**	should be displayed
3. Press key M to enter change mode.		
4. Use keys ▼ and ▲ to select the following view level:	**VIEW LEVEL OPERATOR**	
5. Press key E 2x to confirm:	**QUICK SETUP**	should be displayed

- **Store software configuration**

1. Press key Prog for approx. 3 s until the following entry appears:	**SYSTEM**	should be displayed
Now release key:	**SAVE CONFIG**	should be displayed
2. Press key M to activate:	**SAVE CONFIG APPLICATION**	should be displayed
3. Press key M to activate:	**UP TO CONFIRM**	should be displayed
4. Press key ▲ to confirm:	**SAVE CONFIG SAVING**	and
	SAVE CONFIG COMPLETE	should be momentarily displayed
5. Press key E 3x:	**PASSWORD LOCKED**	should be momentarily displayed
6. Press key M 2x to return to **OPERATOR** menu.		

8.13 Installation test, system charging - Special manual mode (LOCAL)

The ***FrigoSoft*** software can be disabled to commission or function test the ***FrigoPack*** Refrigeration Inverter. The drive inverter is then only controlled from the Programming Pad of ***FrigoPack***. To prevent inadvertent operation this special manual mode is not available for a remotely mounted Programming Pad.

Activation:	- Deactivate control input DIN1 at terminal 7. - Press key **'L/R'** on the Programming Pad.
Verification:	- LEDs 'SEQ' und 'REF' must light. "**SETPOINT(LOCAL)**" must be displayed.
Check direction of rotation:	- LED ► must light. If not then press key .
Verify setpoint and modify if necessary	- The effective setpoint is the set value in % multiplied with the maximum speed in Hz. - The speed setpoint can be adjusted using the arrow keys after entering a password. - Set to value corresponding to the minimum permissible speed as advised by the compressor manufacturer.
Starting and stopping:	- Pressing the **'I'** (RUN) and **'O'** (STOP) keys will start and stop the Variable-speed Compressor (**VsC**).
Back to normal operation:	- Press key **'L/R'** on the Programming Pad.
Verification:	- LEDs 'SEQ' und 'REF' must not light. - "**SETPOINT(LOCAL)**" must not be displayed.

CAUTION:

In the LOCAL mode the timed restart inhibit is not active ! The compressor can be damaged by frequent starting and stopping.

Also the permissible minimum and maximum frequencies of the compressor must be adhered to.
Never forget to revert back to normal operation before leaving the installation.

9 MEASURED VALUES, OPERATING STATES

9.1 Menu OPERATOR

The measurement values are at the top of the **OPERATOR** menu, see Table 8.2.

9.1.1 Refrigeration

Suction pressure in bar:

```
01:Po SUCT PRESS
=      Y.Y bar
```

Range from:	to:	Measured value:
-0.5 bar	7.0 bar	Y.Y bar

Suction pressure deviation in %:

```
02:Po SUC PR DEV
=    YYY.YY %
```

Range from:	to:	Measured value:
0.00 %	100.00 %	YYY.YY %

Discharge pressure in bar:

```
03:Pc DISC PRESS
=     YY.Y bar
```

Range from:	to:	Measured value:
0.0 bar	25.0 bar	YY.Y bar

The second higher setpoint of Condensing Pressure will be indicated if a transducer for high pressure is not used, see 8.3.5.

Fixed-speed Compressors:

```
04:FsC NUMB ACTV
=     YY.YY
```

Range from:	to:	Measured value:
0.00	3.00	YY.YY

Number active (in operation)

9.1.2 Variable-speed Compressor (VsC)

Motor frequency:

```
06:VsC MOT FREQ
=     YY.YY Hz
```

Range from:	to:	Measured value:
0.00 Hz	90.00 Hz	YY.YY Hz

Motor current:

```
07:VsC MOT CURRT
=    YYY.YY A
```

Range from:	to:	Measured value:
0.00 A		YYY.YY A

Active setpoint:

```
SETPOINT(REMOTE)/
SETPOINT(LOCAL)
=    YYY.YY %
```

Range from:	to:	Measured value:
0.00 %	100.00 %	YYY.YY %

For diagnostic use

9.1.3 Condenser

Fan:

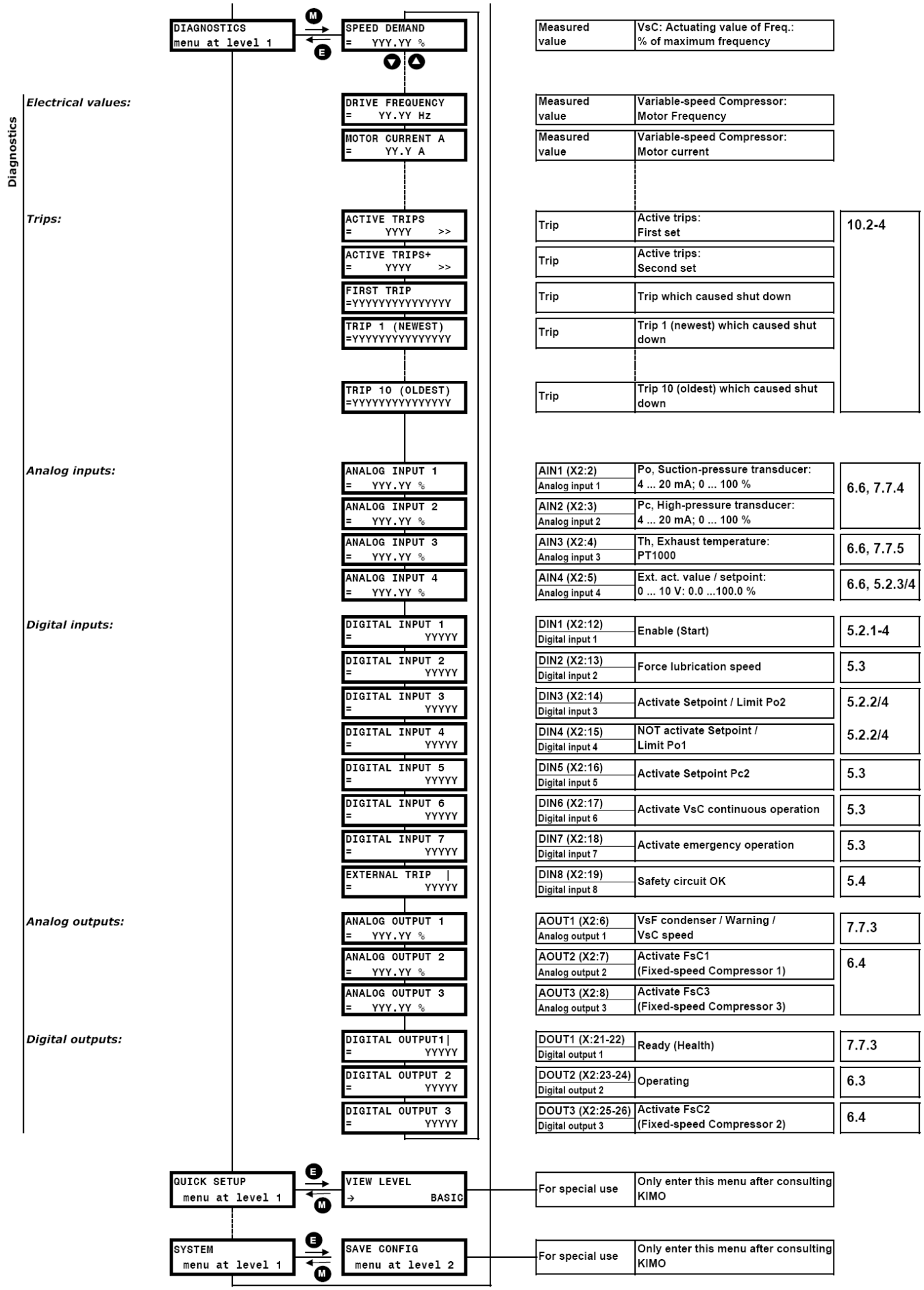
```
05:VsF CD ACT VL
=    YYY.YY %
```

Range from:	to:	Measured value:
0.00 %	100.00 %	YYY.YY %

Actuating value

9.2 Menu DIAGNOSIS

Refer to the following overview or separate attachment.



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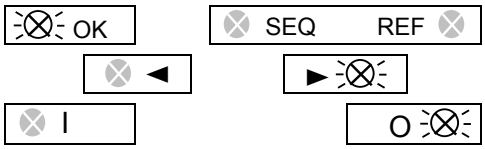
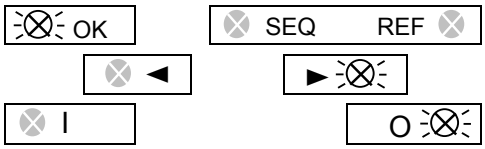
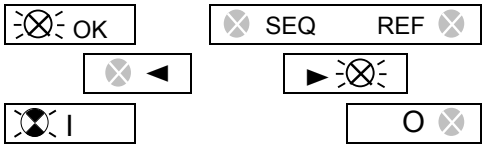
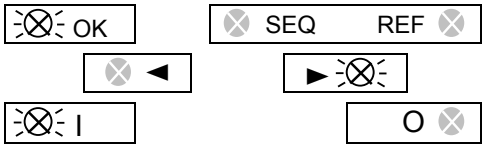
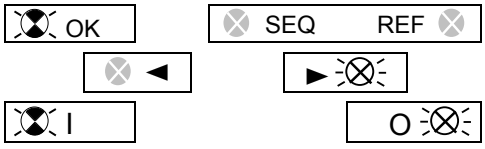
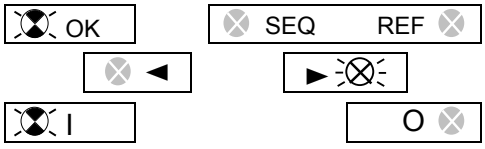
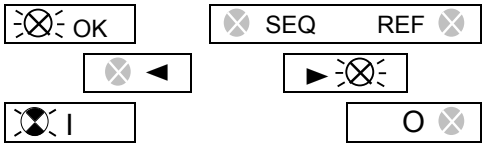
Tab. 9: Arrangement of *MotorMaster* parameters in the DIAGNOSIS menu

9.3 Operating status

LEDs: Dark / Flashes / Lights	Control state	Explanation
	0: START DISABLED Switch-on disabled (inhibited)	Possible causes: - Stopped with red key '0' - Auto-restart-control was not able to clear fault and restart the Variable-speed Compressor (**VsC**) - Variable-speed Compressor (**VsC**) faulty - Power section of ***FrigoPack*** faulty Remedies: - Remove cause of fault. - Press green key '1' for at least 10 s
	1: START ENABLED Switch-on possible but not yet happened	Possible causes: - Enable (Start) DIN1 not activated - Suction Pressure Po below setpoint - Inhibit delay still active Remedies: - Verify that DIN1 Enable (Start) is activated - Investigate other possible causes.
	3: READY Starting phase	State: - Normal start-up delay to allow for start unloading (approx. 4 s)
	4: ENABLED Normal controlled operation	State: - Variable-speed Compressor (**VsC**) operates with speed control
	7: TRIPPED ***FrigoPack*** in a fault condition	Possible causes: - Fault in the safety circuit (Input DIN8 not activated) - Compressor motor too hot (check input MOT/TEMP) ***FrigoPack*** itself has a fault Remedies: - Investigate cause of fault.
	7: TRIPPED ***FrigoPack*** in a fault condition, Auto-Restart-Control operating	State: - ***FrigoPack*** will attempt to restart after a time delay.
	8: RESTART PENDING ***FrigoPack*** in a fault condition, Auto-Restart-Control operating	Cause: - Red key '0' has been pressed - ***FrigoPack*** will attempt to restart after a time delay.

10 TRIPS, DIAGNOSIS, FAULT FINDING

10.1 Configuration Overview

The following CONFIGURATION OVERVIEW with PROBLEM REPORT is intended to:

- Provide a record for set-up data for future service work
- Provide a means of documenting and communicating all relevant data should the advice/assistance of KIMO be necessary.
  In this case, please also use the checklist with additional data. Please take time to complete all relevant parts of this report!

Application:

Type:	_____	Refrigerant:	_____
Compressor:	_____	Manufacturer:	_____

FrigoPack* F / *MotorMaster:

Type:	_____	Serial no.:	_____

FrigoPack* S / *SoftCompact*, *LEKTROMIK:

Type:	_____	Serial no.:	_____

Commissioning data:

Installation:	_____	Customer:	_____
Installer:	_____	Agent:	_____
Commissioning data:	_____	Responsible:	_____

10.2 Fault finding

Most problems can usually be solved by referring to the **TROUBLE SHOOTING LIST**, see section 10.4.

In addition the KIMO local agent will usually be able to assist.

If there are any problems which cannot be solved with the assistance of the local agent then the KIMO applications service will be pleased to provide back-up support.

In this case it is necessary that full completed information on the installation and on the problem is communicated to KIMO by filling out the following forms:

- **CONFIGURATION OVERVIEW / PROBLEM REPORT**
- **CHECK LIST AND ADDITIONAL DATA FOR PROBLEM REPORT.**

These forms are in the following section 10.3.

10.3 CONFIGURATION OVERVIEW / PROBLEM REPORT

FrigoPack FEP-12: CONFIGURATION OVERVIEW / PROBLEM REPORT (Put cross in box where appropriate) FS 2.4.2-1x

Application	Refrigeration ☐	No. of cooling outlets ____	Air Conditioning ☐	Condenser ☐	Other ____				
Refrigerant	R404A ☐	R407C ☐	R134a ☐	Total refrig. Power ____ [kW]	Other ____				
	R507A ☐	R22 ☐	R ____		____				
Compressor 1	Piston ☐	No. of cylinders ____	Scroll ☐	Screw ☐	Other ____				
	Start unloader ☐	Part Winding ☐	Variable speed ☐	OR Fixed speed ☐	No. of compressors ____				
	Capacity control ____ [%]	____ [%]	____ [%]	____ [%]					
	Manufacturer ____		Model ____		Anything special ____				
Compressor 2	Piston ☐	No. of cylinders ____	Scroll ☐	Screw ☐	Other ____				
	Start unloader ☐	Part Winding ☐	Variable speed ☐	OR Fixed speed ☐	No. of compressors ____				
	Capacity control ____ [%]	____ [%]	____ [%]	____ [%]					
	Manufacturer ____		Model ____		Anything special ____				
Operating point	Suction pressure ____	High (discharge) pressure ____	Pascal/ ☐ bar/ ☐ lb/in² ☐ gauge/ ☐ absolute ☐	Suction gas temperature ____ [°C]	Discharge gas temperature ____ [°C]	Motor current ____ [A]			
Start up	Suction pressure ____	High (discharge) pressure ____		Anything special ____		Motor current ____ [A]			

FrigoPack Speed variator	**FrigoPack/MotorMaster** Type FP/MM Serial number ____	**Pressure sensors** Suction pressure ____ Discharge pressure ____	**FrigoSoft refrigeration/ A/C software** Version ____ Mode ____
FrigoPack Soft Starter	**FrigoPack/SoftCompact, LEKTROMIK/SoftPower** Type FP/SC/LEK Serial number ____	**Switching times of compressor pack** Variable-speed compressor (VsC) t_{ON} ____ [s] t_{PERIOD} ____ [s] Fixed speed compressor(s) (FsCs) t_{ON} ____ [s] t_{PERIOD} ____ [s]	

Report

List of adjustable parameters in OPERATOR menu
FrigoPack FEP-12 / *FrigoSoft* 2.4

08:Po SETP/LIMT1	3.2 bar	____ [bar]
09:Po SETP/LIMT2	3.6 bar	____ [bar]
10:Pc SETPOINT 1	17.0 bar	____ [bar]
11:Pc SETP/LIMT2	20.0 bar	____ [bar]
12:VsC FREQ MAX	25.0 Hz	____ [Hz]
13:VsC FREQ MIN	60.0 Hz	____ [Hz]
14:VsC FREQ BASE	55.0 Hz	____ [Hz]
15:VsC BOOST	.00 %	____ [%]
16:VsC SKP FRQ 1	0.0 Hz	____ [Hz]
17:VsC SKP BND 1	0.0 Hz	____ [Hz]
18:VsC tinh DLY	.0 s	____ [s]
19:VsC toff DLY	10.0 s	____ [s]
20:VsC toil TIME	4.0 s	____ [s]
21:VsC thld TIME	10.0 s	____ [s]
22:FsC ton DLY	.0 s	____ [s]
23:FsC toff DLY	.0 s	____ [s]
24:Po CNTR P-GN	.00	____
25:Po CNTR I-TC	.0 s	____ [s]
26:Pc CNTR P-GN	8.00	____
27:VsF CD MIN SD	15.00	____ [%]
28:Pc LIMT P-GN	25.00	____
29:Po ACT VAL=0%	7.0 bar	____ [bar]
30:AOUT1 FUNCTN	INPUT 0	____
31:AOUT3 FUNCTN	INPUT 0	____
32:CONTRL FUNCTN	INPUT 0	____

TRIP HISTORY

TRIP 1 (NEWEST) 2 3 4 5
6 7 8 9 10 (OLDEST)

Manufacturer	Agent / Partner	Customer	Installation
KIMO Refrigeration HVAC Ltd Huettendorfer Weg 60, D-90768 Fürth Germany Tel.: +49 911-8018778 Fax: +49 911-9976118 E-Mail: applications@frigokimo.com Internet: www.frigokimo.com			Name: Date:

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FrigoPack FEP-12: CHECKLIST AND ADDITIONAL DATA FOR PROBLEM REPORT

FS 2.4.2-1x

KIMO Problem Code		Part of installation	Checklist of questions for PROBLEM REPORT	Explanation	Terminals	Answer/ Confirmation
ES		Electrical: - **Einspeisung**	• Are there any known power supply interruptions ? • Do these power supply interruptions occur at the same time each day ? • By what amount does the supply voltage vary ?	- Indicate approx. times - Indicate min. and max. voltages		Yes☐ No☐ Yes☐ No☐ When: _____ _____ Min.: _____ [V] Max.: _____ [V]
EI		- **Installation**	• Motor cable: Approx. Length ? • Motor cable: Type of screen ? • Motor cable: Screen connected to mounting plate? • Motor cable: Screen connected to metal motor housing ? • Is a galvanised mounting plate used in the electrical enclosure ? • Is a motor filter used between the MotorMaster and the compressor motor ?	- Copper braid ?, Steel braid ?, - Steel conduit ?, none ? - Recommendations: - Contact with large surface area - Make sure no "pig tails" - If yes, indicate KIMO product code		_____ Cu brd.☐ Fe brd.☐ Fe cond.☐ None☐ Yes☐ No☐ Yes☐ No☐ Yes☐ No☐ Pr. Cde: _____
MT		**Compressor motor**	• Have motor currents been entered into the PROBLEM REPORT ?	- Operating point - Start up		Yes☐ No☐ Yes☐ No☐
MM MM	CI	*FrigoPack* : - **Control and sensor inputs**	• Protective Earth of FrigoPack connected to mounting plate (two separate short connections) ? • Is the DC P24 control voltage present ? • Connection of PTC motor protection ? • Safety circuit OK ? • Enable signal present ? • *External setpoint or actuating signal present ?* * • Signal from suction-pressure transducer present ? • *Signal from high-pressure transducer present ?* * • *Signal from exhaust temperature transducer present (link if not used) ?* * • * If used	- Terminal: - Terminal: - Without processing - Direct processing of motor thermistors - Processing an external thermistor relay - Terminal: - Terminals for measuring: - Terminals for measuring: - *Terminals for measuring:* - Terminals for measuring: - *Terminals for measuring:* - *Terminals for measuring:* - *Link terminals:* - Terminal for measuring: - Measured against green terminal:	**2x PE** **15P - GN** **MOT/TEMP** **19 - GN** **12 - GN** ***5 - GN*** **2B - GN** ***3B - GN*** ***4B - GN*** ***4A - 4B***	Yes☐ No☐ Yes☐ No☐ Linked ☐ Direkt ☐ Relay ☐ Yes☐ No☐ Yes☐ No☐ _____ *[V]* _____ [V] _____ *[V]* _____ *[V]* Yes☐ No☐
MM	PS	- **Power section**	• Reserved for future use			
MM	CA	- **Control assembly**	• Reserved for future use			
MM	CS	- **Control settings, parameter**	• Operating Mode LOCAL (Programming Pad: LEDs SEQ + REF light) ? • Refrigeration / cooling parameters set ?	- Not suitable for normal operation, only use for commissioning: - The following parameters must be set: **08:, 09:, 10:, 11:**		Yes☐ No☐ Yes☐ No☐ Yes☐ No☐
RI	AP	Refrigeration: - **Application**	• Required Refrigeration Power entered into PROBLEM REPORT ? • Number of cooling outputs entered into the PROBLEM REPORT ? • Operating pressure and temperatures entered into PROBLEM REPORT ? • On/Off times of compressor pack entered into PROBLEM REPORT ?	- Operating point - At start up - Enter variable and fixed speed compressor times separately		Yes☐ No☐ Yes☐ No☐ Yes☐ No☐ Yes☐ No☐ Yes☐ No☐
RI	IN	- **Installation**	• Reserved for future use	- tbd		
RI	PS	- **Pressure transducers**	• Approx. cable length • Type of screen • Screen NOT connected at sensor end ? • Screen connected to mounting plate of electricial enclosure ? • Are measured pressures stable ?	- Copper braid ?, Steel braid ?, - Steel conduit ?, none ? - Large area contact, no pig tails - Indicate range of variation within 30 s		_____ [m] Cu brd.☐ Fe brd.☐ Fe cond.☐ None☐ Yes☐ No☐ Yes☐ No☐ Yes☐ No☐ Po/LP ____ Pc/HP ____ [bar]
RI	RC	- **Refrigeration compressor**	• Oil present ? • Basic data entered into PROBLEM REPORT ?			Yes☐ No☐ Yes☐ No☐

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10.4 TROUBLE SHOOTING LIST

KIMO problem code	PROBLEM	POSSIBLE CAUSE	Hints for fault finding	REMEDIES

Available soon,
please contact KIMO RHVAC if necessary.

11 EC DIRECTIVES, THE CE MARK, UL, CSA

Refer to ***MotorMaster*** Product Manual PMM-**FEP**.

12 SERVICE

12.1 Application Service for refrigeration / air conditioning

FrigoPack with ***FrigoSoft*** refrigeration software allow many special solutions to be quickly implemented at a favourable cost, as various application solutions are already pre-configured in the software.

Should you have an application which cannot be catered for by our standard ***FrigoPack*** then please contact your supplier or KIMO RHVAC.

12.2 Training

Training for ***FrigoPack*** systems in refrigeration technology is available on request.

12.3 Maintenance

FrigoPack Refrigeration Inverters are practically free of maintenance. However the following should be periodically inspected:
Cooling system:
- Are all fans in operation ?
- Are cooling filters of the enclosure free from obstructions or dust build-up ?
- Can cooling air circulate freely and is adequate enclosure cooling is available ?

Mounting, terminals:
- Is the ***FrigoPack*** Refrigeration Inverter securely mounted ?
- Are all wires securely clamped ?

12.4 Warranty

This piece of equipment is warranted against defects in design materials and workmanship for a period of 24 months from the date of delivery as detailed in the general terms of supply and payment of the ZVEI (Federation of the German Electrical Industry).

12.5 Disposal

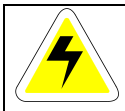
During transport, our products are protected by suitable packaging as far as necessary. The packaging consists entirely of environmentally compatible material that should be taken for central disposal as valuable secondary raw materials.

Contact the relevant Local Authority Department to obtain information on disposal facilities including disposal of old equipment.

13 REPAIR

The ***FrigoPack*** Refrigeration Inverter must not be repaired by the user.

If repair is necessary return the unit to your supplier.



WARNINGS

Ensure isolation to the voltage supply before disconnecting the ***MotorMaster*** Refrigeration Inverter. Ensure that there is no voltage at terminals L1, L2, L3 or L1, N.

Wait for at least 3 minutes for the d.c. link terminals (DC+ & DC-) to discharge to safe voltage levels (<50 V) before removing the terminal cover. Failure to do so constitutes a potentially lethal electrical shock hazard.

13.1 Returned equipment

The following procedure is recommended in the unlikely event of a fault which necessitates return of the equipment to your supplier:

- Contact your supplier to arrange return of the controller and keep the following information ready for reference:
  - Type of equipment
  - Serial number
- The return, repair or replacement procedure must be agreed with your supplier before returning equipment
- The EMC filter must not usually be returned
- Send the following information with the return:
  - Detailed fault report
  - Copy of Configuration Overview, see 10.1

  This will help shorten the repair time and reduce the repair cost
- The original packing material should be used for returns
- If the original packing is no longer available, then return the equipment with packing which is environmentally suitable, recyclable and provides ample transport protection. When using polystyrene chips or equivalent as a packing material, the equipment must first be sealed in a polythene bag or similar, to prevent ingress of the packing material. The equipment will be returned with an original-type packing which will be charged at self-cost price.

13.2 Saving application data before returning equipment

Although the ***MotorMaster*** Refrigeration Inverter retains parameter settings during power down, it is recommended that the Programming Pad is also used to record the valid settings. This is however possible if the ***MotorMaster*** microprocessor control is still functional. Establish password by contacting supplier and keep ready for following use. Use the SYSTEM |SAVE CONFIG | ENTER PASSWORD | OP STATION function (see Chapter 5 of the ***MotorMaster*** Product Manual) to perform the parameter save to Programming Pad.

14 ACCESSORIES

An overview over available accessories is in section 3.3.

For more details refer to valid Price list for Refrigeration and Air conditioning.

15 ORDERING INFORMATION

Refer to valid Price list for Refrigeration and Air conditioning.

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