◐ KIMO ®

Refrigeration HVAC

Product Manual

FrigoPack FP 2.2…90FEP-EMC-11

Multi-stage compressor packs with up to 4 compressors

FrigoSoft 2.3

Valid for:		
FREQUENCY INVERTER:	*MotorMaster* FEP	**at or above Firmware 5.6**
KIMO COMPRESSOR CROSS-REFERENCE LIST	CCP-0403 / CCS-0403 / CCT-0403	
Refrigeration and A/C Software	*FrigoSoft* MM-CP-RA/2.3 (**ab Version 1d**) **Display:** *FrigoSoft*23.2-1d CONFIG: FS 2.3.2-1d	

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

KIMO Refrigeration HVAC

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Contents

INPORTANT INFORMATION

Scope of this Product Manual

This product manual describes the operation of *FrigoPack* / *MotorMaster* Frequency Inverters.

It is not intended that this product manual describes the function of the apparatus or system into which the *FrigoPack* / *MotorMaster* Frequency 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* / *MotorMaster* Frequency 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* Frequency 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 $\hat{=}$ 4...20 mA
- Discharge pressure: - 0,0 ... 25,0 bar $\hat{=}$ 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 *MotorMaster* Frequency Inverter
CCP-0403 / CCS-0403 / CCT-0403 **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.

Air conditioning:
- 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 min-1. 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 compresser when a set limit of discharge pressure is reached
  - 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.

Installation test, system charging:

- Pressure senser 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)
- Suction pressure setpoint
- 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.

2   REFRIGERATION COMPRESSORS

2.1   KIMO COMPRESSOR CROSS-REFERENCE LIST

The **KIMO COMPRESSOR CROSS-REFERENCE LIST** list between *FrigoPack* Frequency 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 FP variable-frequency 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 *MotorMaster* Frequency 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:

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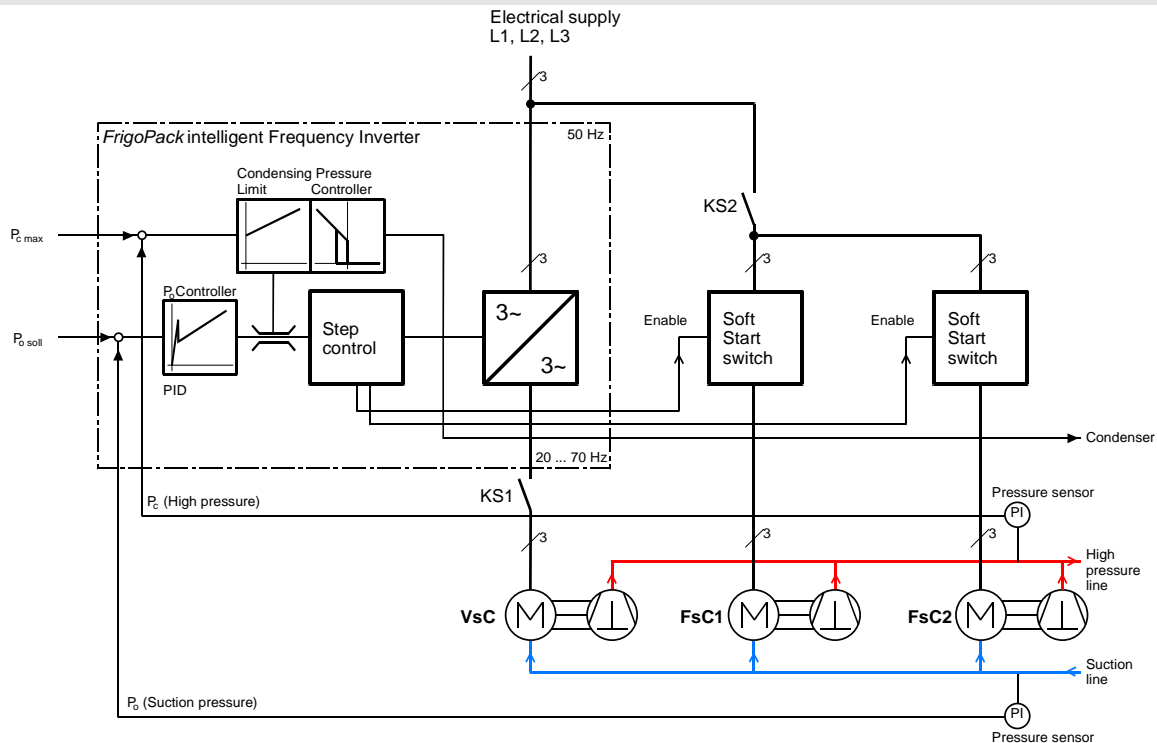
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Fig. 3.1:   Block diagram of the closed-loop refrigeration control
(Po: Evaporating pressure, Pc: Condensing pressure, **Vsc**: Variable-speed compressor, **FsC**: Fixed-speed Compressor)

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.

A block diagram of the closed-loop control and common system control are shown in Fig. 3.1.

With A/C or heat pump operation this structure is modified as follows:
- An actuating value from an external temperature controller controls the speed of the **VsC** directly (without Po controller)
- The measured suction pressure Po limits the suction pressure by modifiying the speed of the **VsC**.

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 *MotorMaster* 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 of 10 min. 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 *MotorMaster* 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.

3.2   *FrigoPack* kits

FrigoPack kits consisting of:

- **MotorMaster** Frequency Inverter
- **SoftCompact** / **LEKTROMIK** soft starter
- associated options and accessories.

are intended for installation in an electrical enclosure.

Table 3.2 shows the equipment and parts included in *FrigoPack* kit.

FrigoPack	Main piece of equipment	A RELAY-DC24V	A RELAY-DC12V	Footprint/external EMC filter	Programming pad	Glands for screened EMC-conform motor cable	FrigoSoft refrig.-Software	Supply chokes
	Frequency inverter							
FP 2.2FEP-EMC-11	MM 2.2FECP-EMC	-	-	-	1	A MOT-GLAND-M20/PG16	FS MM-CP-RA/2.2	-
FP 4.0FEP-EMC-11	MM 4.0FECP-EMC	-	-		1	A MOT-GLAND-M20/PG16	FS MM-CP-RA/2.2	-
FP 6.0FEP-EMC-11	MM 6.0FECPM-emc	-	-	MM A-FM-7.5EE	1	A MOT-GLAND-M20/PG16	FS MM-CP-RA/2.2	-
FP 5.5FEP-EMC-11	MM 5.5FECP	-	-	MM A-11EU	1	A MOT-GLAND-M20/PG16	FS MM-CP-RA/2.2	-
FP 7.5FEP-EMC-11	MM 7.5FECP	-	-	MM A-11EU	1	A MOT-GLAND-M25/PG21	FS MM-CP-RA/2.2	-
FP 11FEP-EMC-11	MM 11FECP	-	-	MM A-11EU	1	A MOT-GLAND-M25/PG21	FS MM-CP-RA/2.2	-
FP 15FEP-EMC-11	MM 15FECPM	-	-	MM A-15EU	1	A MOT-GLAND-M32/PG29	FS MM-CP-RA/2.2	-
FP 18.5FEP-EMC-11	MM 18.5FEP	-	-	MM A-22EU	1	A MOT-GLAND-M32/PG29	FS MM-CP-RA/2.2	-
FP 22FEP-EMC-11	MM 22FEP	-	-	MM A-22EU	1	A MOT-GLAND-M32/PG29	FS MM-CP-RA/2.2	-
FP 30FEP-EMC-11	MM 30FEPM	-	-	MM A-30EU	1	A MOT-GLAND-M40/PG36	FS MM-CP-RA/2.2	-
FP 37FEP-EMC-11	MM 37FEP	-	-	MM A-45EU	1	A MOT-GLAND-M40/PG36	FS MM-CP-RA/2.2	-
FP 45FEP-EMC-11	MM 45FEP	-	-	MM A-45EU	1	A MOT-GLAND-M40/PG36	FS MM-CP-RA/2.2	-
FP 55FEP-EMC-11	MM 55FEP	-	-	MM A-90EU	1		FS MM-CP-RA/2.2	-
FP 75FEP-EMC-11	MM 75FEP	-	-	MM A-90EU	1		FS MM-CP-RA/2.2	-
FP 90FEP-EMC-11	MM 90FEP	-	-	MM A-90EU	1		FS MM-CP-RA/2.2	-
FP 110FEP-emc-11	MM 110FEP	-	-	A 110EEC3+260	1		FS MM-CP-RA/2.2	A 132NE3+260
FP 132FEP-emc-11	MM 132FEP	-	-	A 132EEC3+336	1		FS MM-CP-RA/2.2	A 132NE3+260
FP 160FEP-emc-11	MM 160FEP	-	-	A 160EEC3+420	1		FS MM-CP-RA/2.2	A 160NE3+320
FP 200FEP-emc-11	MM 200FEP	-	-	A 315EEC3+630	1		FS MM-CP-RA/2.2	2x A 132NE3+260
FP 250FEP-emc-11	MM 250FEP	-	-	A 315EEC3+630	1		FS MM-CP-RA/2.2	2x A 132NE3+260
FP 315FEP-emc-11	MM 315FEP	-	-	A 315EEC3+630	1		FS MM-CP-RA/2.2	2x A 160NE3+320
FP 2.2FEP/S230-EMC-11	MM 4.0FECP/T230-EMC	-	-		1	A MOT-GLAND-M20/PG16	FS MM-CP-RA/2.2	-
FP 4.0FEP/T230-EMC-11	MM 4.0FECP/T230-EMC	-	-		1	A MOT-GLAND-M20/PG16	FS MM-CP-RA/2.2	
FP 7.5FEP/T230-EMC-11	MM 7.5FECPM/T230	-	-	MM A-15EU	1	A MOT-GLAND-M25/PG21	FS MM-CP-RA/2.2	-
FP 11FEP/T230-EMC-11	MM 11FEPM/T230	-	-	MM A-22EU	1	A MOT-GLAND-M32/PG29	FS MM-CP-RA/2.2	-
FP 18.5FEP/T230-EMC-11	MM 18.5FEPM/T230	-	-	MM A-30EU	1	A MOT-GLAND-M40/PG36	FS MM-CP-RA/2.2	-
FP 22FEP/T230-EMC-11	MM 22FEPM/T230	-	-	MM A-45EU	1	A MOT-GLAND-M40/PG36	FS MM-CP-RA/2.2	-
FP 30FEP/T230-EMC-11	MM 30FEPM/T230	-	-	MM A-45EU	1		FS MM-CP-RA/2.2	-
FP 45FEP/T230-EMC-11	MM 45FEPM/T230	-	-	MM A-90EU	1		FS MM-CP-RA/2.2	-
FP 2.2SM2/T400-16	SC 2.2SM2/T400-16	-	-	-		-		-
FP 5.5SM2/T400-16	SC 5.5SM2/T400-16	-	-	-		-		-
	Soft starter	**Strombegrenzung**						
FP 4.0SE3-26	L 4S2-26	LS-I2-26	SP A-EE/S230			-		-
FP 11SE3-26	L 11S2-26	LS-I2-26	SP A-EE/S230			-		-
FP 22SE3-26	L 22S2-26	LS-I2-26	SP A-EE/S230			-		-
FP 37SE3-26	L 37S2-26	LS-I2-26	SP A-EE/S230			-		-
FP 75SE3-26	L 75S2-26	LS-150I1-26	SP A-EE/S230			-		-
FP 160SE3-26	L 160S2-26	LS-750I1-26	SP A-EE/S230			-		-
FP 250S2-26	L 250S2-26	LS-750I1-26	SP A-EE/S230			-		-
FP 400S2-26	L 400S2-26	LS-750I1-26	SP A-EE/S230			-		-
FP 3.0SM2/T230-16	SC 3.0SM2/T230-16	-	-	-		-		-

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Tab. 3.2:   *FrigoPack*: Equipment and parts

3.2.1   *MotorMaster Frequency 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
- Fulfills the requirements of electrical supply companies.

3.3   Overview of available accessories

- **Pressure sensors and suitable parts:**
  We recommend that only two-wire pressure sensors approved by KIMO (Huba Control type) are used:

  - A REFR-P-SENSOR-LP7+PL:
    Suction pressure within the range -0.5...+7.0 bar

  - A REFR-P-SENSOR-HP25+PL:
    Discharge pressure within the range 0.0...+25.0 bar.

  Best performance is achieved if the pressure sensors are supplied from the +24 V control supply of the *FrigoPack* / *MotorMaster* Frequency Inverter, see connection suggestions in Section 7.

  The cable connection must be screened and routed well away from the screened supply cables to the **VsC** compressor motor.

  We recommend that the following special filter option is used:
  - A REFR-P-SENSOR-**FI**LT:
    Filter for KIMO pressure sensors.

  Control performance will be improved and susceptability to interference substantially reduced. This results in an overall cost saving as screened cables are not necessay.

- **Output relays for the control of more than 2 fixed-speed compressors:**
  Additional special relays with extremely low current drain and integrated free-wheeling diode must be connected to the analog outputs:

  - A RELAY-DC12V

  The rating of the output contact is AC 250 V, 8A, 500 VA.

- **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:
  - *MotorMaster* 6.0FEP: $\geq$ 25 m
  - *MotorMaster* 2.2/4.0/5.5...90FEP: $\geq$ 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.

- **Autotransformers:**
  Autotransformers are required for operation at special supply voltages.

  Also the output power of *FrigoPack* can be increaseby up to 10 % when used with 3AC 400 V supplies.

Important
  KIMO can assist only any installation or comissioning 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.

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.

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

Air conditioning (A/C):

A/C - Mode 4:
- Operation with external actuating value of refrigeration capacity (via analog input)
- For operation with an external temperature controller

Installation test, system charging:

- Special manual mode (LOCAL).

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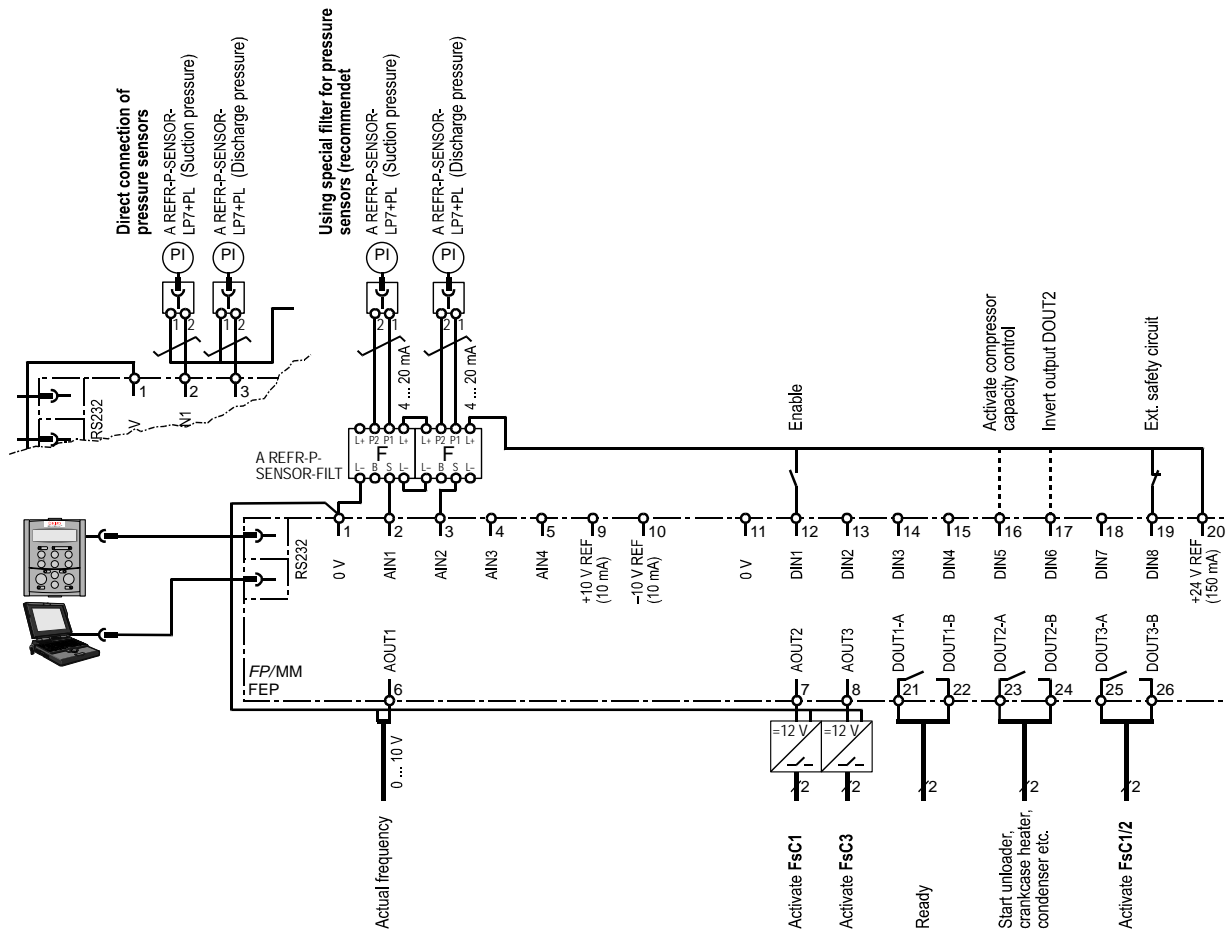
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Fig. 5.2.1: Connection for operation with internal adjustable setpoint for suction pressure

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-SENSOR-FILT (Accessory).
Accessories	- Pressure sensor A REFR-P-SENSOR-LP7+PL: Suction pressure in the range -0.5...+7.0 bar
	- Pressure sensor A REFR-P-SENSOR-HP25+PL: High pressure in the range 0.0...+25.0 bar
	- Filter module(s) A REFR-P-SENSOR-FILT for pressure sensors
	- Output relays A RELAY-DC12V.

Settings:
- Setpoint
- Modify value for each refrigerant
- Suction pressure, Setpoint: 08: Po SUC PRES 1

	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

- Condensing pressure, Setpoint: 11: Pc CND PR SPT

	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

- Limit:
- Discharge-pressure limit: 10: Pc DIS PR LMT

	R404A	R507	R407C	R22	R134a
- Factory set value: 20.0 bar, Corresponding tc:	+46.2 °C	+45.1 °C	+52.8 °C	+53.4 °C	+69.0 °C

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

- Other:
- Refer to section 8.

5.2.2 Mode 2: Refrigeration - Operation with two internal adjustable setpoints of suction pressure
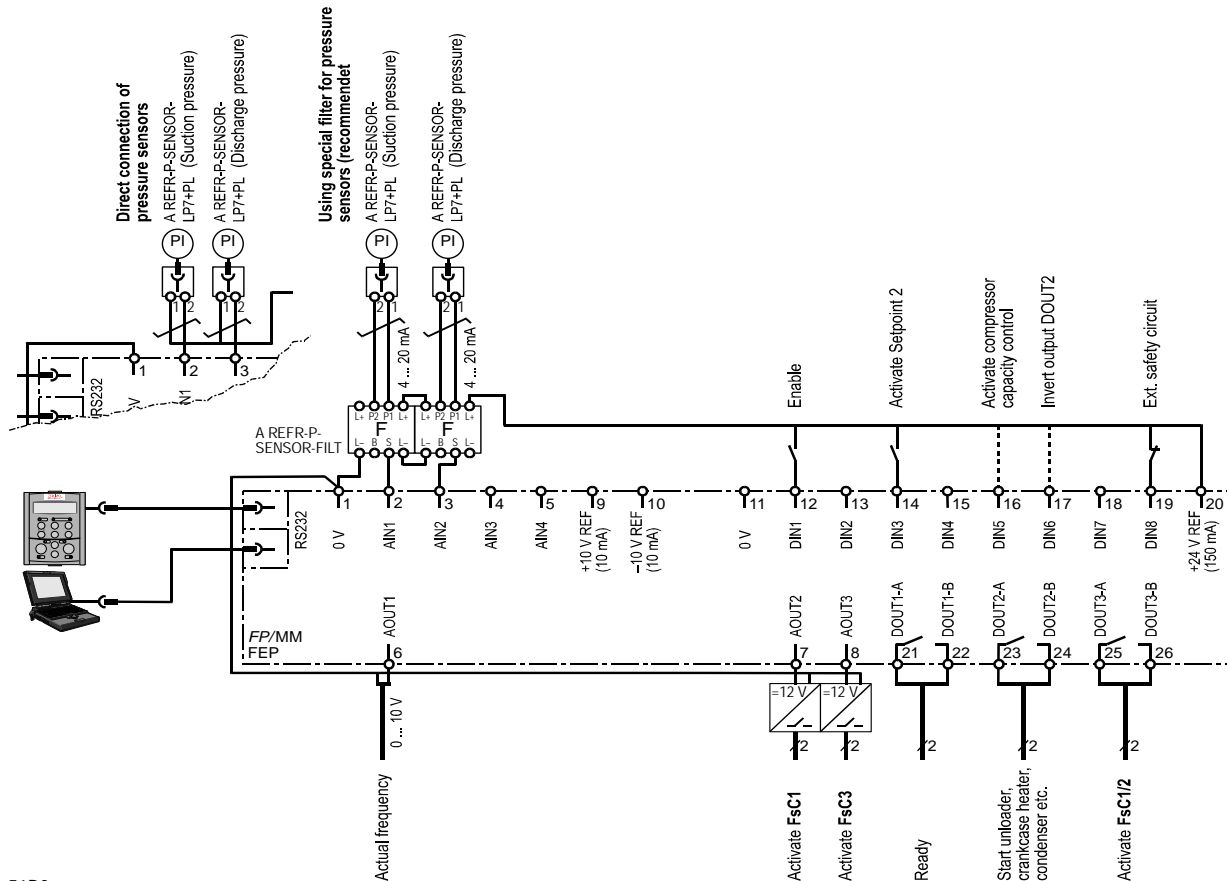
51P2

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
- Fixed-speed Compressor (**FsC**) activated when refrigeration power of Variable-speed Compressor (**VsC**) is not sufficient
- High pressure limiting with A REFR-P-SENSOR-FILT (Accessory).

Accessories:
- Pressure sensor A REFR-P-SENSOR-LP7+PL: Suction pressure in the range -0.5...+7.0 bar
- Pressure sensor A REFR-P-SENSOR-HP25+PL: High pressure in the range 0.0...+25.0 bar
- Filter module(s) A REFR-P-SENSOR-FILT for pressure sensors.
- Output relays A RELAY-DC12V.

Settings:
- Modify values for each refrigerant

- Setpoints:
- Suction pressure, Setpoint 1 (main setpoint): `08: Po SUC PRES 1`

		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 SUC PRES 2`

		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

- Condensing pressure, Setpoint: `11: Pc CND PR SPT`

		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

- Limit:
- Discharge-pressure limit: `10: Pc DIS PR LMT`

		R404A	R507	R407C	R22	R134a
Factory set value: 20.0 bar,						
Corresponding tc:		+46.2 °C	+45.1 °C	+52.8 °C	+53.4 °C	+69.0 °C

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

- Other:
- Refer to section 8.

5.2.3 Mode 3: Refrigeration - Operation with external setpoint control of suction pressure
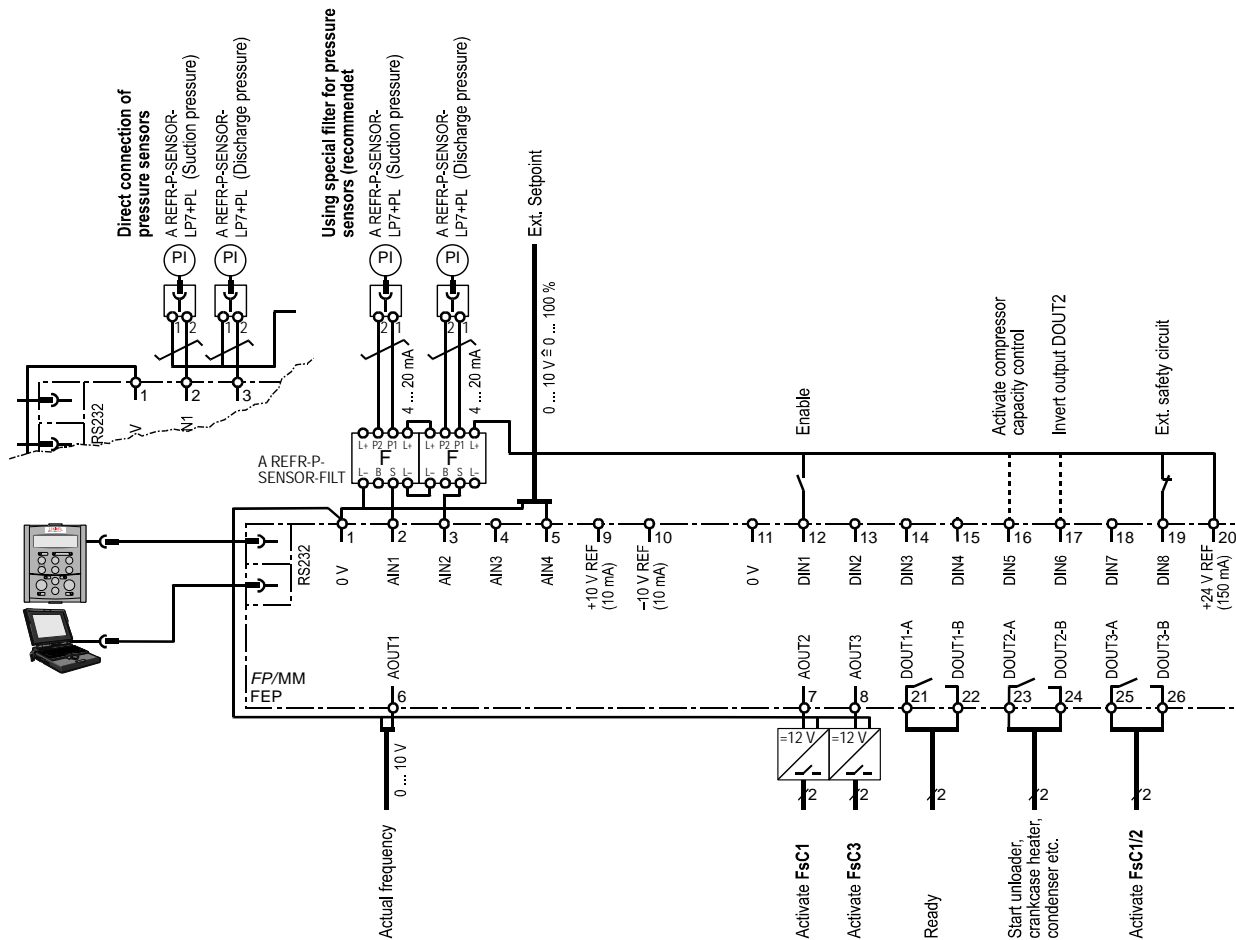
51P3

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-SENSOR-FILT (Accessory).
Accessories:	- Pressure sensor A REFR-P-SENSOR-LP7+PL: Suction pressure in the range -0.5...+7.0 bar
	- Pressure sensor A REFR-P-SENSOR-HP25+PL: High pressure in the range 0.0...+25.0 bar
	- Filter module(s) A REFR-P-SENSOR-FILT for pressure sensors.
	- Output relays A RELAY-DC12V.
Settings:	- Modify value for each refrigerant
- External setpoint:	- Only available if DIN4 is activated
	- 0...10 V $\triangleq$ 0...100 % $\triangleq$ P_o = -0.5...+7.0 bar

- Setpoint:
- Condensing pressure, Setpoint: `11: Pc CND PR SPT`

	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

- Limit:
- Discharge-pressure limit: `10: Pc DIS PR LMT`

	R404A	R507	R407C	R22	R134a
- Factory set value: 20.0 bar, Corresponding tc:	+46.2 °C	+45.1 °C	+52.8 °C	+53.4 °C	+69.0 °C

- 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 - Operation with actuating value from external controller
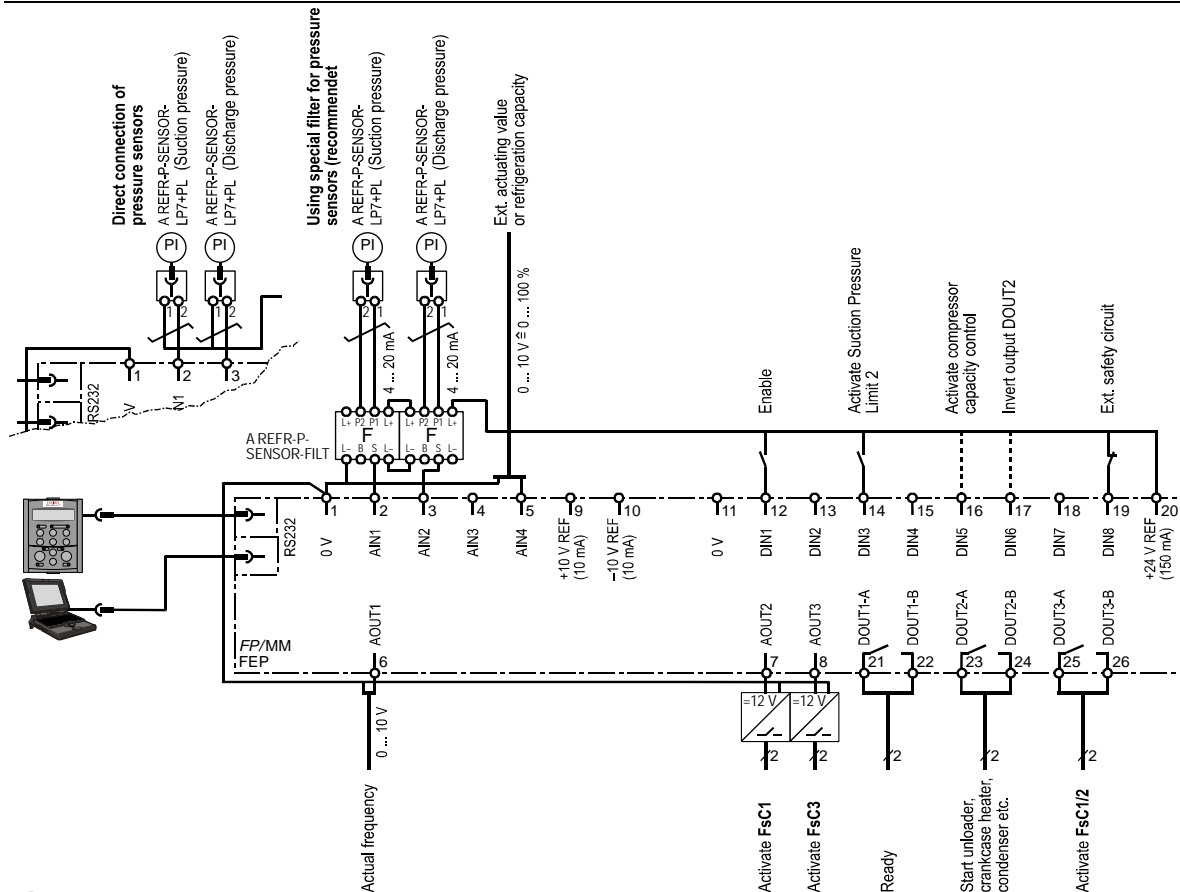
51P4

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)
	-	Digital closed-loop 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-SENSOR-FILT (Accessory).
Accessories:	-	Pressure sensor A REFR-P-SENSOR-LP7+PL: Suction pressure in the range -0.5...+7.0 bar
	-	Pressure sensor A REFR-P-SENSOR-HP25+PL: High pressure in the range 0.0...+25.0 bar
	-	Filter module(s) A REFR-P-SENSOR-FILT for pressure sensors.
	-	Output relays A RELAY-DC12V.
Settings:	-	Modify values for each refrigerant

- Limits:

- Suction pressure, Limit value 1 (main value):   `08: Po SUC PRES 1`

	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, Limit value 2 (auxiliary value):   `09: Po SUC PRES 2`

	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

- Discharge-pressure limit: `10: Pc DIS PR LMT`

	R404A	R507	R407C	R22	R134a
- Factory set value: 20.0 bar, Corresponding tc:	+46.2 °C	+45.1 °C	+52.8 °C	+53.4 °C	+69.0 °C

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

- Other: - Refer to section 8.

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

The *FrigoSoft* program can be disabled to commission or function test the frequency inverter. The drive inverter is then only controlled from the Programming Pad.

Activation: Deactivate control input DIN1 at terminal 7.
                         Press key L/R on the Programming Pad.

As soon as the function has been activated, the "SETPOINT(LOCAL)" message is displayed. The speed setpoint can be adjusted using the arrow keys. Pressing the **'I'** (RUN) and **'O'** (STOP) keys will start and stop the Variable-speed Compressor (**VsC**).

In addition to this function, there is also the JOG mode. The Variable-speed Compressor (**VsC**) motor is fed with 30 Hz as long as the **'JOG'** key is pressed.

⚠ **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.**

6 CONNECTIONS, INTERFACES

6.1 Wiring diagrams

6.1.1 Power section
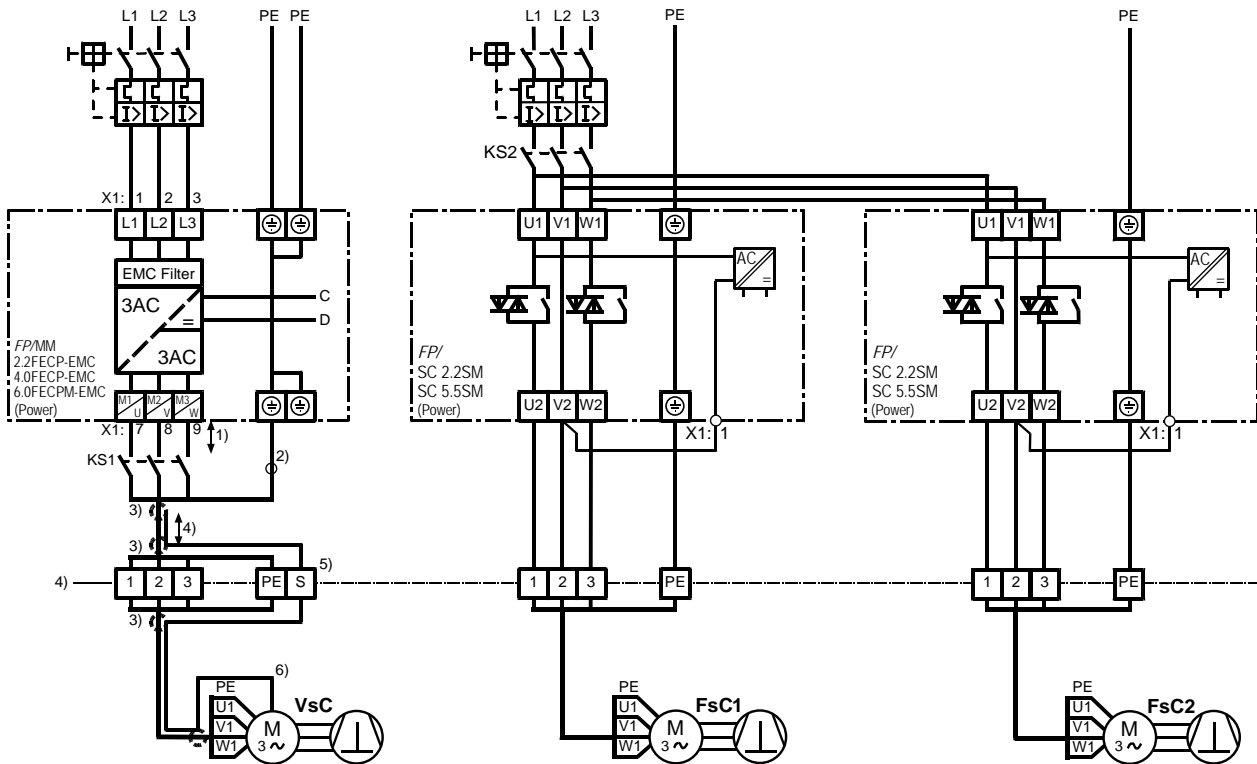
61P2

1) Keep the connection cable as short as possible

2) Terminal for PE of internal screened motor cable in addition to large-area electrical bonding to mounting panel

3) Screen with large-area bonding to mounting panel

4) Screened motor cable inside the electrical enclosure (ensure adequate spacing to electrical equipment and cables, see Fig. 7.6.1)

5) Terminal for screen of external motor cable (in addition to large-area electrical bonding to the mounting plate as in 3)

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

Fig. 6.1.1a: *FrigoPack* **2.2/4.0/6.0 FEP - Principal diagram of power wiring**
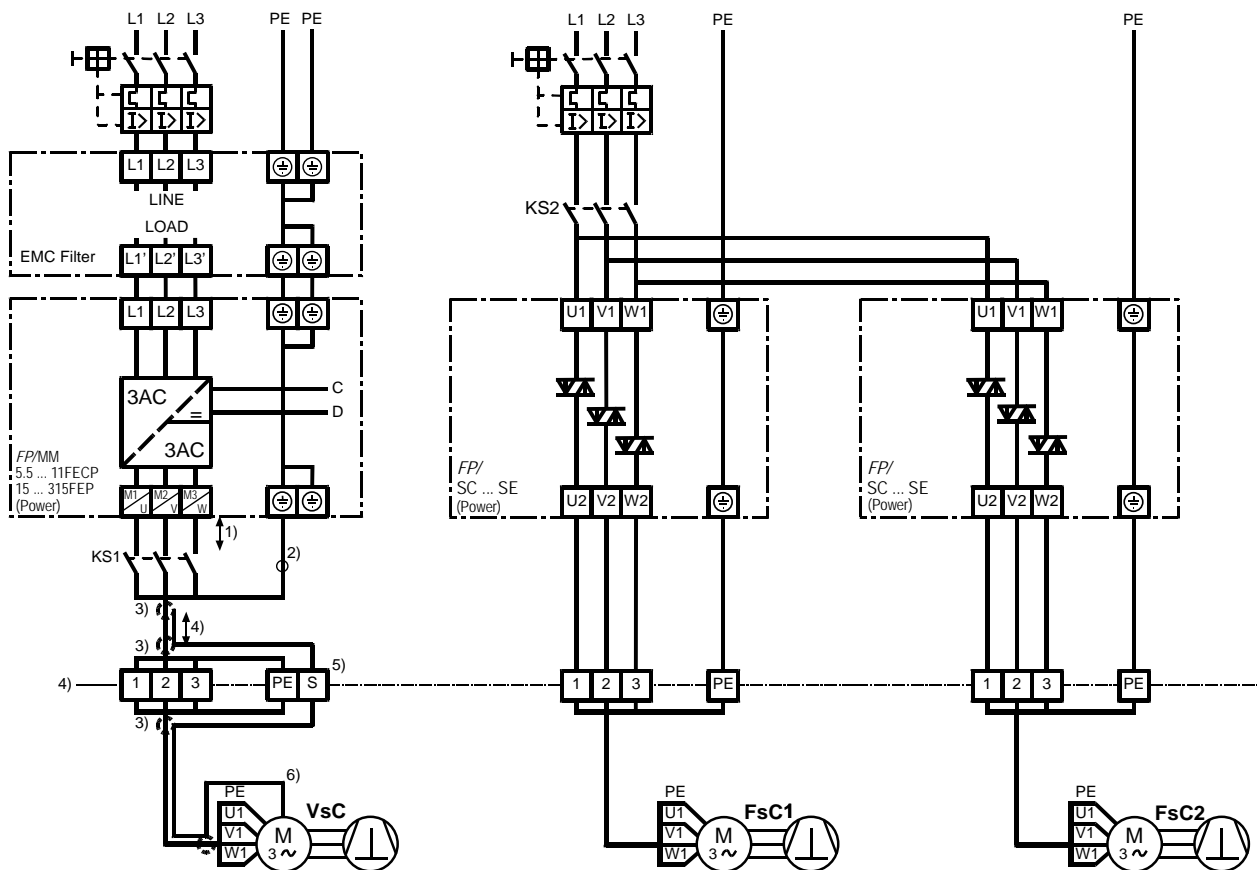
62P2

1) Keep the connection cable as short as possible

2) Terminal for PE of internal screened motor cable in addition to large-area electrical bonding to mounting panel

3) Screen with large-area bonding to mounting panel

4) Screened motor cable inside the electrical enclosure (ensure adequate spacing to electrical equipment and cables, see Fig. 7.6.1)

5) Terminal for screen of external motor cable (in addition to large-area electrical bonding to the mounting plate as in 3)

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

Fig. 6.1.1b: *FrigoPack* 5.5/7.5...90 FEP - Principal diagram of power wiring

6.1.2   Motor protection

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

1) Without processing by *FrigoPack*:
   - Thermistor protection is processed in external safety circuit, these two terminals must be linked.

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

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

6.1.3 Control section

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

It is recommended that a relay contact from the external safety circuit is connected to terminal DIN8 (terminal 19). A fault in the safety circuit (such as a pressure cut out) will be registered in the trip stack. The auto-retart logic will attempt to rest this trip after a set delay time (see 3.1).

The relay output DOUT2 is provided to control the following auxiliary equipment:
- Start unloader
- Condenser fan
- Crankcase heater
- Oil pump.

A circuit suggestion for the control of the crankcase heater alone is shown in Fig 6.1.3a.

An alternative circuit sugggestion for the control of various auxiliary equipment is shown in Fig. 6.1.3b
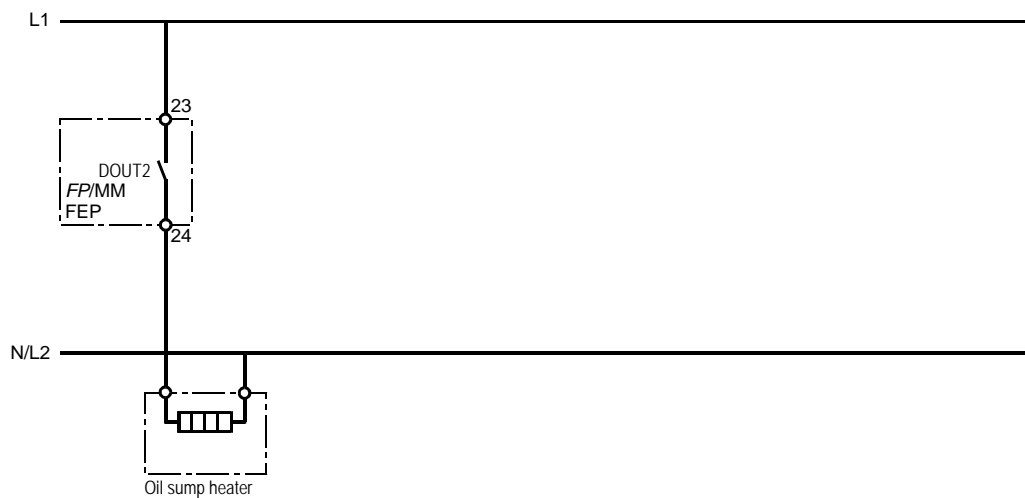
63P0
Fig. 6.1.3a: Direct control of oil sump heater
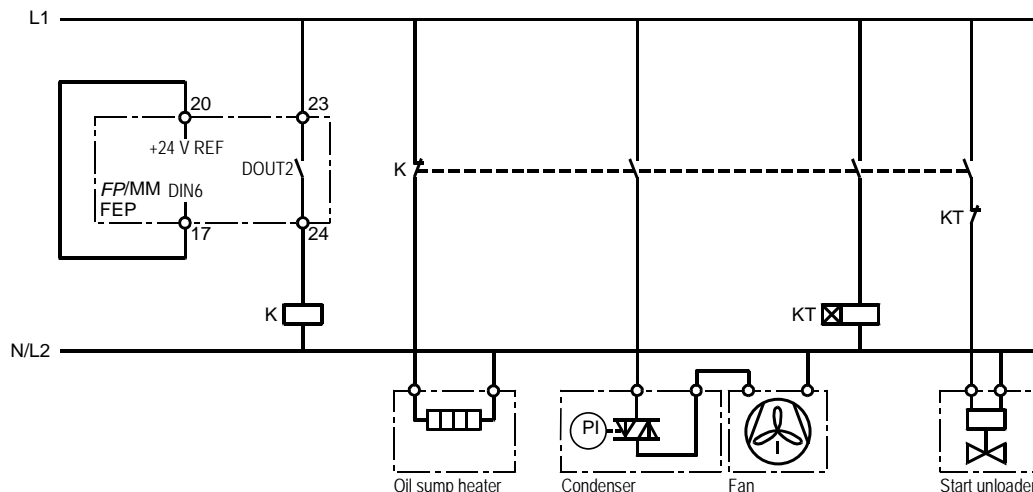
64P02
Fig. 6.1.3b: Control of various auxiliary equipment

6.1.4   Variable-speed Compressors (VsC)

The following responsabilities are taken into consideration:

- Normal ON / OFF switching: - ***FrigoPack / MotorMaster.***
- Speed variation:

- Thermal protection of compressor motor: - See 6.1.3.

- Safety functions such as pressure switches: - Compressor safety circuit

    - Safety contactor between **MotorMaster** and the compressor motor

    - If there is a fault, open circuit to DIN8 (terminal 19) of **MotorMaster** immediately (e.g. using an auxiliary contact of the safety contactor).

6.1.5   Fixed-speed Compressors (VsC) without Capacity Control

The following responsabilities are taken into consideration:

• Normal ON / OFF switching of fixed-speed stages in accordance with demand:	- *FrigoPack / MotorMaster.*
• Safety functions such as pressure switches:	- Compressor safety circuit
• Thermal protection of compressor motor:	- Compressor contactors serve also for protection.

The control and the connection of the compressor control to the *FrigoPack* control outputs depends on the number of Fixed-speed Compressors (**FsC**s), see Fig. 6.1.5.1. Only special relays from KIMO are suitable for connection to the outputs AOUT2 and AOUT3, see Section 3.3.

The operations with an independent step controller is **<u>NOT</u>** permissible.
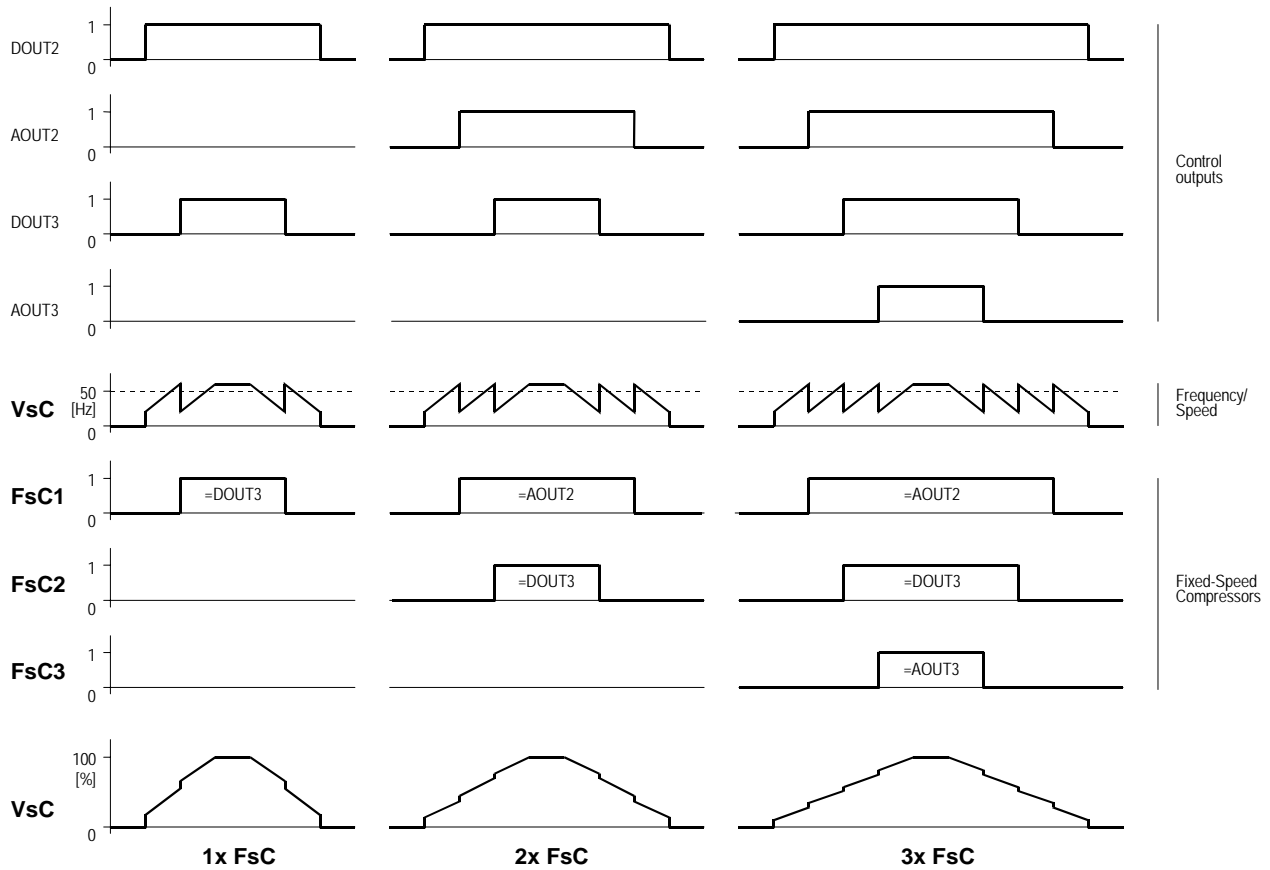
65P0
Fig. 6.1.5a: Control of Fixed-speed Compressors (FsC)
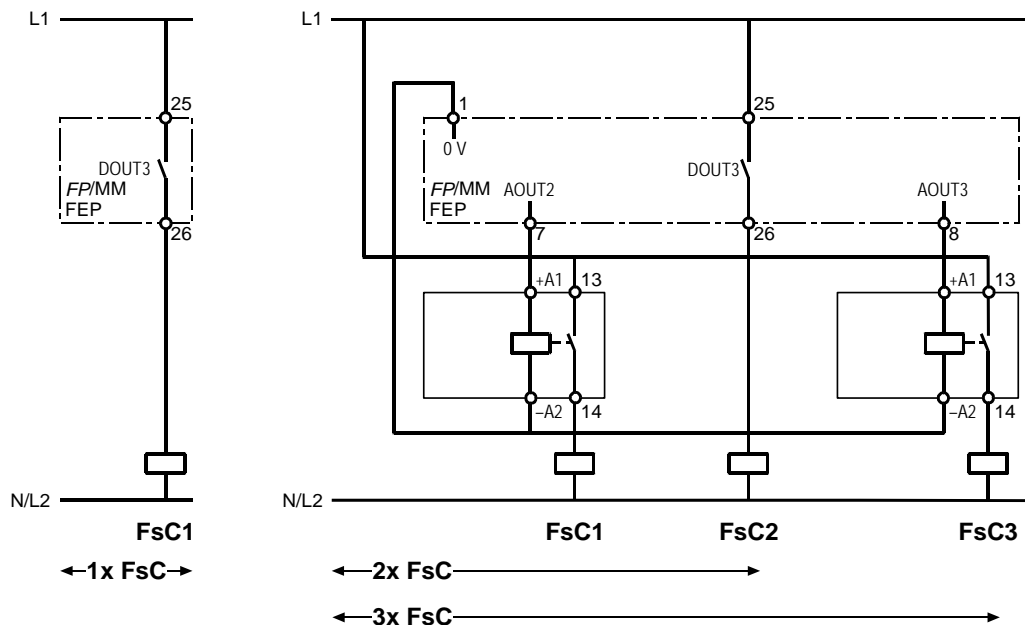
66P0
Fig. 6.1.5b: Connection of Fixed-speed Compressors (FsC)

6.1.6 Fixed-speed Compressors (FsC) with capacity control

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

- **FsC: 2/4**, 4 cylinders: - Operation with 0 / 50 / 100 % power

- **FsC: 2/4/6**, 6 cylinders: - Operation with 0 / 33 / 67 / 100 % power.

The following responsabilities are taken into consideration:

- Normal ON / OFF switching,   - *FrigoPack / MotorMaster.*
  Capacity control (cylinder bank off-loading):

- Safety functions such as pressure switches,   - Compressor safety circuit
  Thermal protection of compressor motors:

    - Compressor contactors serve also for protection.

The control and connection of the compressor control to the *FrigoPack* control outputs is shown in Fig. 6.1.6a and 6.1.6b. Only special relays from KIMO are suitable for connection to the outputs AOUT2 and AOUT3, see Section 3.3.

The operations with an independent step controller is **NOT** permissible.
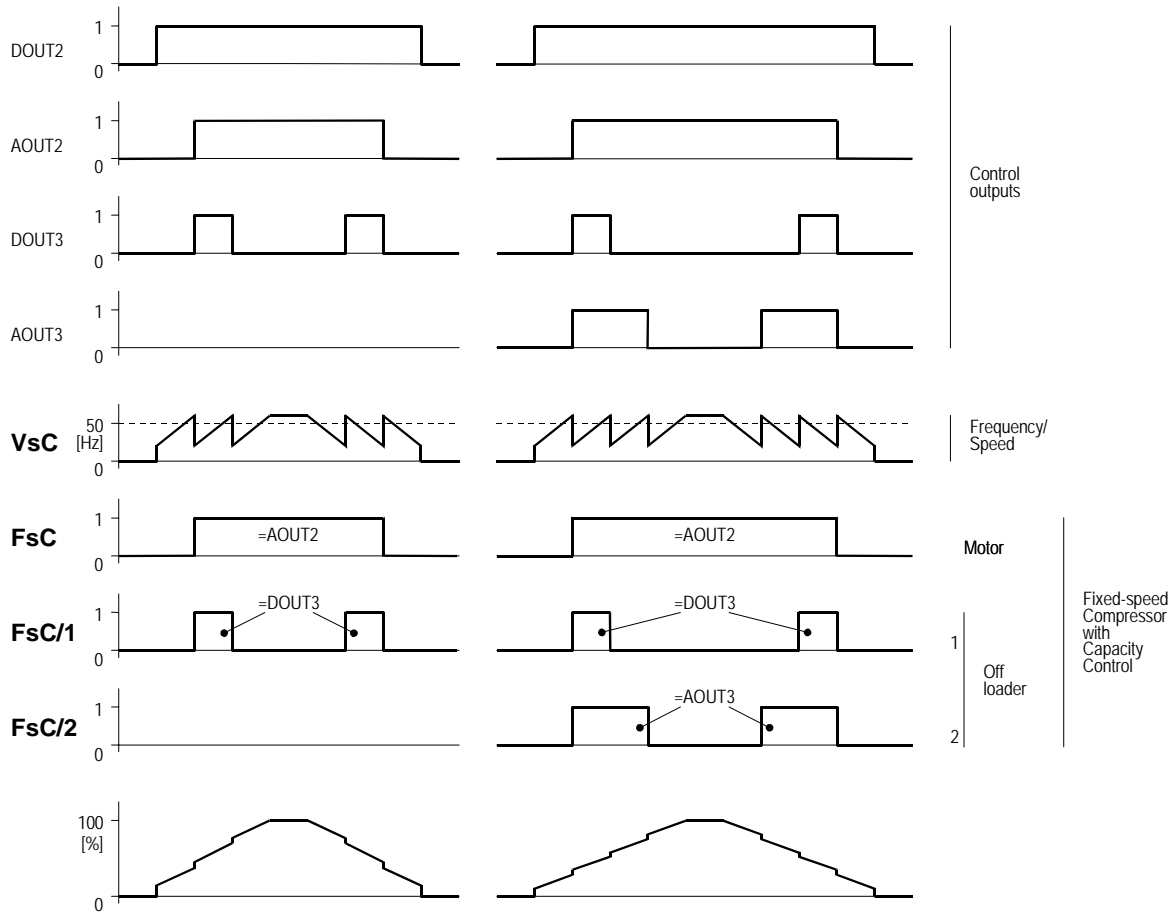
67P0

Fig. 6.1.6a: Control of Fixed-speed Compressor (FsC) with capacity control

68P0

Fig. 6.1.6b: Connection of Fixed-speed Compressors (FsC) with capacity control

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

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

- **VsC**: 4 cylinders:
  - Operation with 0 / 50 / 100 % power together with variable-speed operation

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

The large range of control when using only two compressors is a particular advantage of this arrangment.

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 of the compressor control to the *FrigoPack* control outputs is shown in Fig. 6.1.7a and 6.1.7b. Only special relays from KIMO are suitable for connection to the outputs AOUT2 and AOUT3, see Section 3.3.

The operations with an independent step controller is **NOT** permissible.
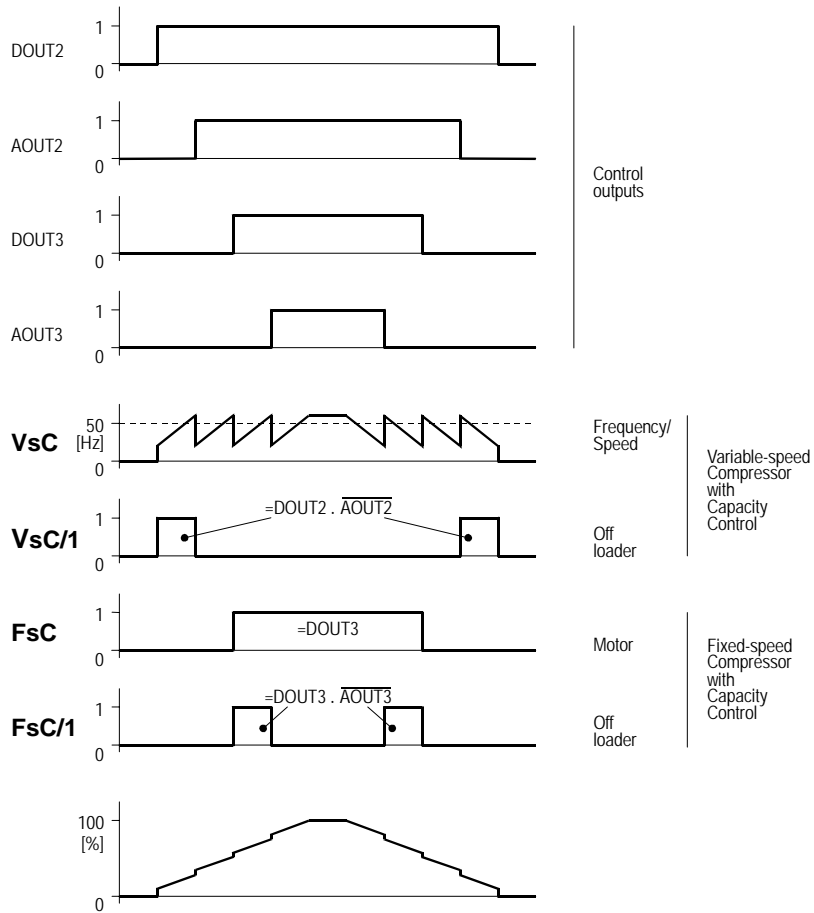
69P0

Fig. 6.1.7a: Control of Variable-speed and Fixed-speed Compressors (VsC and FsC), both with capacity control
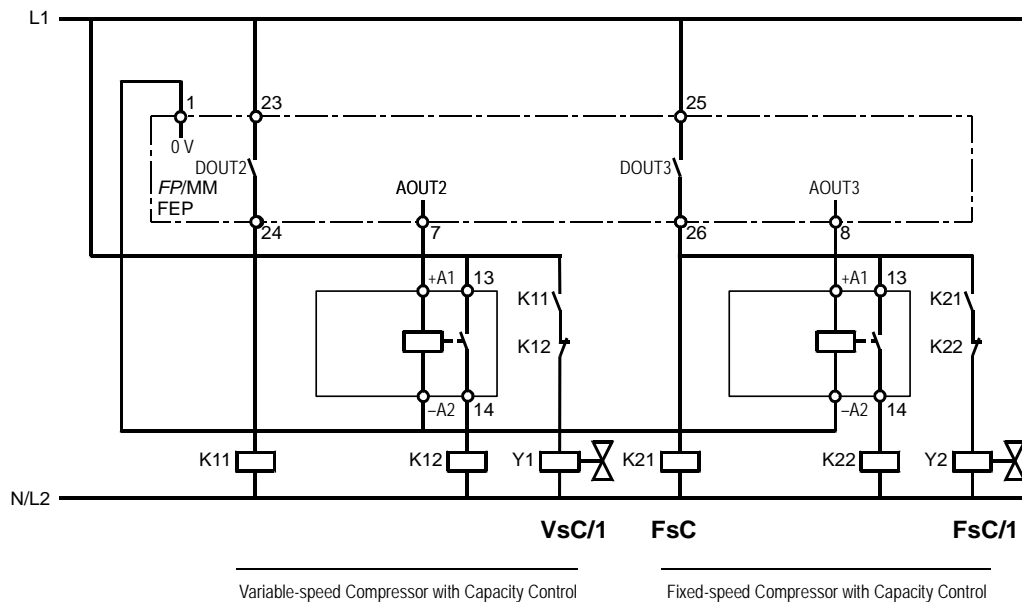
6AP0

Fig. 6.1.7b: Connection of Variable-speed and Fixed-speed Compressors (VsC and FsC), both with capacity control

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

The use of the following compressors is possible:

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

The large range of control when using only two compressors is a particular advantage of this arrangment.

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.
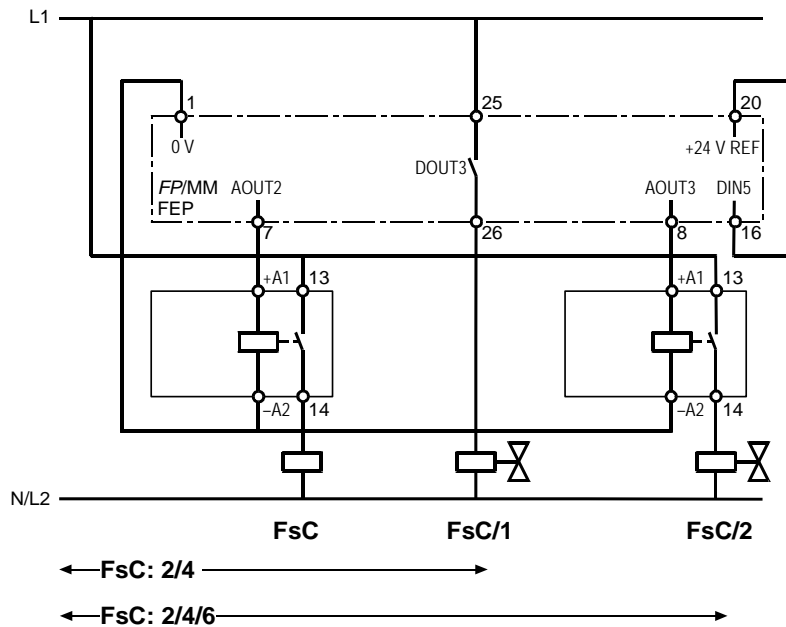
The control and connection of the compressor control to the *FrigoPack* control outputs is shown in Fig. 6.1.7a and 6.1.7b. Only special relays from KIMO are suitable for connection to the outputs AOUT2 and AOUT3, see Section 3.3.

The operations with an independent step controller is **NOT** permissible.

6.1.9 Emergency control

Emergency control of the Fixed-speed Compressors (**FsC**) is possible with the following faults:

- Fault in power section of *FrigoPack*
- Fault with Variable-speed Compressor (**VsC**)
- Other fault(s)

Emergency operation can be enabled by activating the digital input DIN7 when there is a fault. Do not activate digital input DIN7 during normal operation otherwise the *FrigoPack* control performance will be impaired.
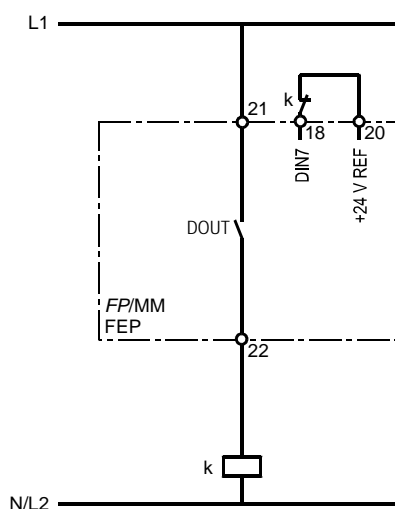
6DP0
Fig. 6.1.9:   Activating Emergency Control
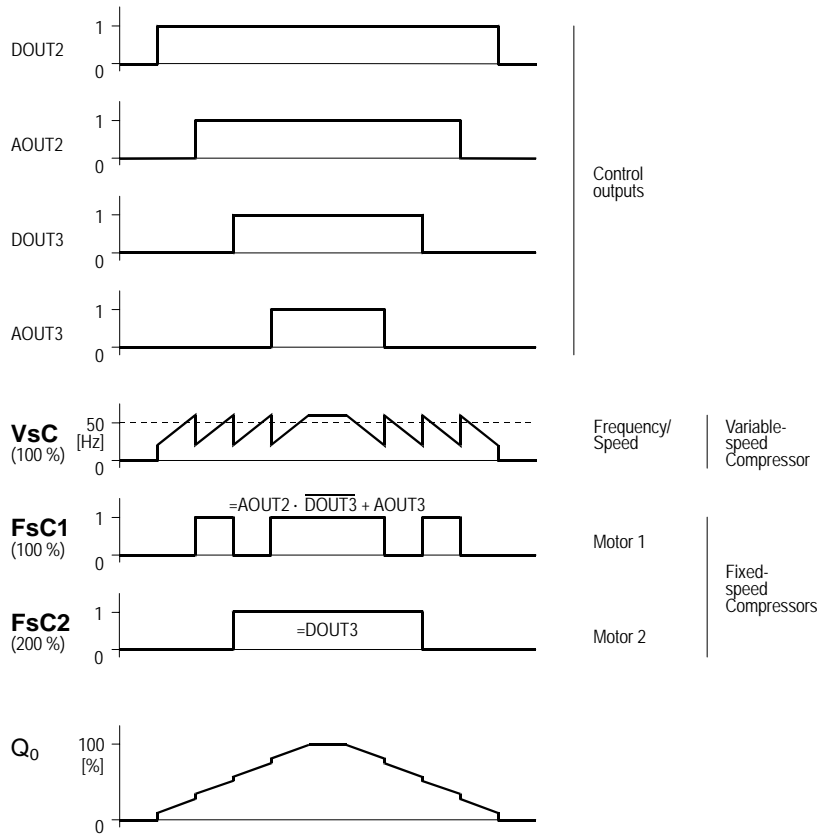
6BP0

Fig. 6.1.8a: Control of Variable-speed Compressor (VsC) and two Fixed-speed Compressors (FsCs) with unsymmetrical powers
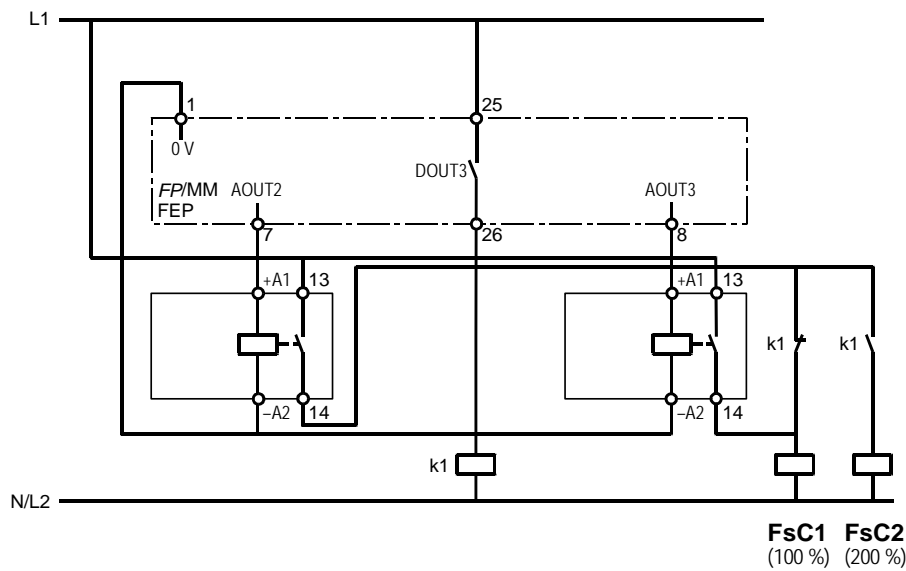
6CP0

Fig. 6.1.8b: Connection of Variable-speed and Fixed-speed Compressors (VsC and FsC) with unsymmetrical powers

6.2 Terminals

6.2.1 Power terminals

The power connections of the *MotorMaster* Frequency Inverter are shown in Fig. 6.2.1..

When installing and connecting-up the power connections, it is important that the appropriate

information in the *MotorMaster* Product manual are carefully observed. Important information concerning EMC-correct wiring is also provided in the appropriate chapters.
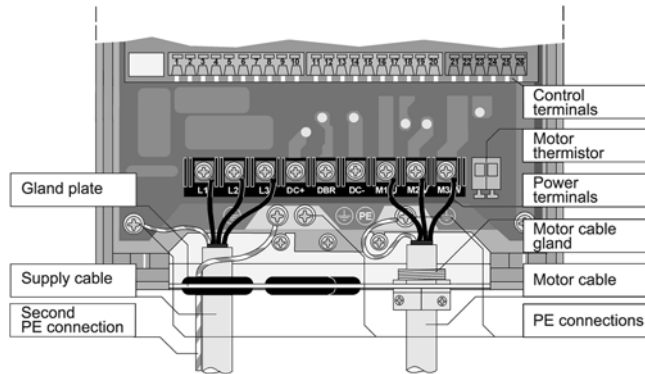
6EP0
Fig. 6.2.1b: MM 2.2/4.0/6.0 FEP
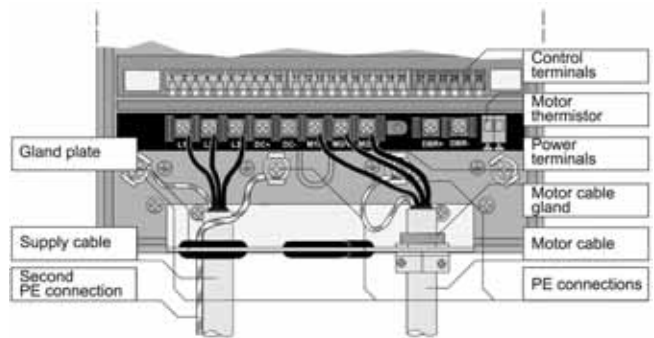
6FP0
Fig. 6.2.1c: MM 5.5/7.5...15FEP(M)
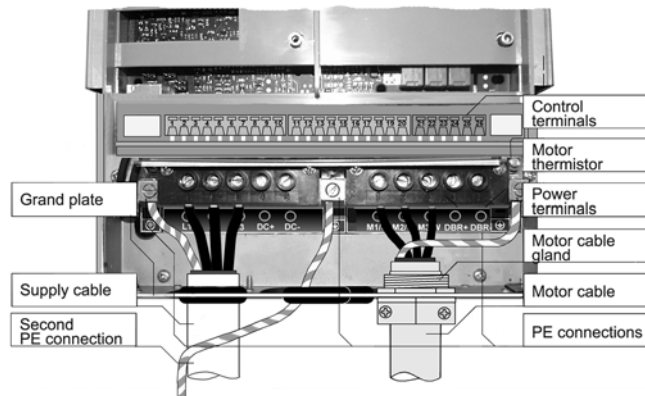
6GP0
Fig. 6.2.1d: MM 18.5...30FEP(M)
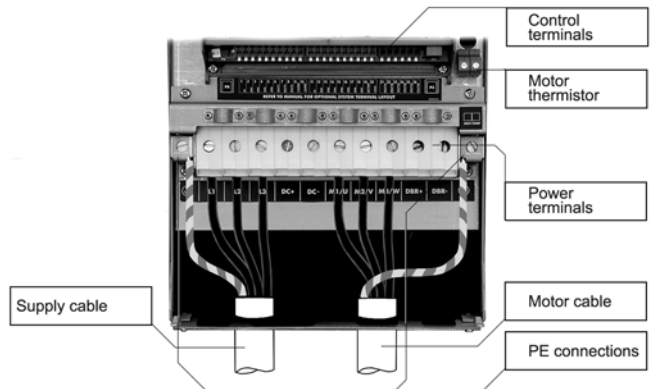
6HP0
Fig. 6.2.1e: MM 37...45FEP
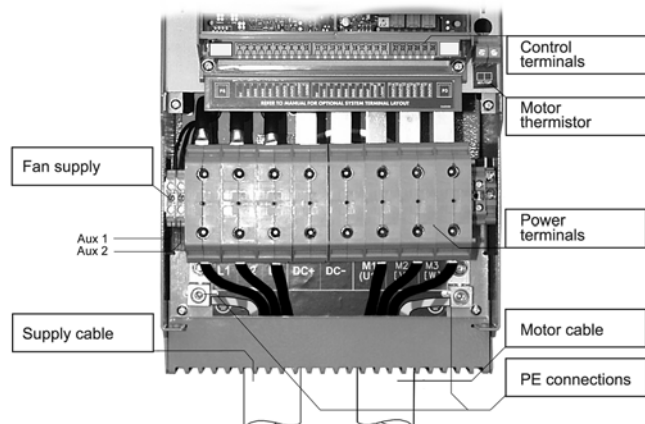
6IP0
Fig. 6.2.1f: MM 55...90FEP

Fig. 6.2.1:   Power connections of the *MotorMaster* Frequency Inverter

Terminal / Designation X1:	Signal / Function	Explanation	Further information
PE, PE	*FP* …30FEP-EMV: Protective earth connection of voltage supply (both to be earthed)	- Observe all safety and EMC requirements	7.6.1
PE	*FP* 37…FEP-EMC: Protective earth connection of voltage supply		
L1 L2/N L3	Three phases of voltage supply	- Ensure that Supply voltage agrees with data on *MotorMaster* name plate	7.6.1
DC+ DC-		- Do not use otherwise risk of damage to *FrigoPack* / *MotorMaster*	
M1/U M2/V M3/W	Compressor motor (via safety contactor)		7.6.1
PE	Protective earth connection to compressor motor		7.6.1
DBR DBR+ DBR-		- Do not use otherwise risk of damage to *FrigoPack* / *MotorMaster*	
AUX1 AUX2	FP 55...FEP-EMC only: 2AC 230 supply for equipment fan	- Supply from control transformer	7.6.1

Tab. 6.2.1.1: Power connections

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

Type	*FrigoPack* / *MotorMaster* FEP-EMC	*FrigoPack* / *MotorMaster* 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. 6.2.1.2: *FrigoPack* and voltages

FrigoPack / *MotorMaster* Frequency 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 an 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.

6.2.2   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. 6.2.1. Refer to 6.1.2 for more details.

6.2.3   Terminals for control functions

Table 6.2.3 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. 7.6.3 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 *MotorMaster* end in order to prevent earth loops.

Terminal / Designation		Signal / Function	Explanation	Further information
1	0 V	Ground for analog signals	- Ground for special relays on terminals 7 and 8 - A REFR-P-SENSOR-**FI**LT, terminal L- (if used) - Do not use for other purposes !!	7.6.4

2	AIN1	Analog input from Pressure Sensor for suction pressure:
		  0 mA: Fault
		  4 mA: -0.5 bar
		20 mA: +7.0 bar
			- A REFR-P-SENSOR-**FI**LT, Terminal: S (if used)
			
			- A REFR-P-SENSOR-LP7, terminal: 2
				7.6.4

3	AIN2	Analog input from Pressure Sensor for discharge pressure:
		  0 mA: Fault
		  4 mA: 0.0 bar
		20 mA: 25.0 bar
			- A REFR-P-SENSOR-**FI**LT, Terminal: S (if used)
			
			- A REFR-P-SENSOR-HP25, terminal: 2
				7.6.4

4	AIN3	Analog input	- Do not use	
5	AIN4	Analog input for external setpoint/act. value: 0 V: -0,5 bar +10 V: +7,0 bar	- Use screened cable	7.6.3

6	AOUT1	Analog output (5 mA max. load):
		  0 V: 0 % f_{max} / Actuating value
		+10 V: 100 % f_{max} / Actuating value
			- **VsC**: Measured speed
			  Condenser fan, actuating value
			- Digital output with special relay:
				7.6.3

7	AOUT2	Digital output usually used to activate **FsC1**:
		Open: Not activated
		Closed: Activated
			- Only available when used with special relay
			  A RELAY-DC24V
			  (available as accessory)
				7.6.3

8	AOUT3	Analog output (5 mA max. load):
		Actuating value Condenser fan, actuating value
		Digital output with special relay: Open:
			- Not activated
			  A RELAY-DC24V
			  Closed:)
				7.6.3

9	+10 V REF	Internal +10 V reference	- Do not use	
10	-10 V REF	Internal -10 V reference	- Do not use	
11	0 V	Ground for digital inputs	- Short connection to mounting plate	
12	DIN1	Digital input for Enable: 0 V: Stop +24 V: Enable	- Enable / Start	7.6.3
13	DIN2	Digital input	- Do not use	
14	DIN3	Digital input to activate Po Setpoint / Limit 2: 0 V: Normal (Setpoint / Limit 1) +24 V: Activate Setpoint / Limit 2	- Po Setpoint / Limit selection	7.6.3
15	DIN4	Digital input	- Do not use	7.63
16	DIN5	Digital input to activate capacity control: 0 V: Normal +24 V: Capacity control activated	- Operation with capacity control	7.63
17	DIN6	Digital input to inverse output DOUT2: 0 V: Normal +24 V: Invert output DOUT2	- Invert output DOUT2	7.63
18	DIN7	Digital input for emergency control: 0 V: Normal +24 V: Activate for emergency control	- Only activate if there is a fault	

19	DIN8	Digital input for external safety circuit:
		  0 V: External fault
		+24 V: Normal (no fault)
			- External safety circuit is interrupted if there is a fault
			  (e.g. auxiliary contact of safety contactor)
				7.63

20	+24 V	Supply for contacts for digital inputs and pressure sensors	- A REFR-P-SENSOR-**FI**LT, Terminal: L+ (if used) / A REFR-P-SENSOR LP7, Terminal: 1	
21	DOUT1-A	Digital output "Ready": Open: No supply, fault or alarm	- Health, OK	7.63
22	DOUT1-B	Closed: Normal (no fault)	- Isolated relay contact	
23	DOUT2-A	Digital output used for: - Start unloader	- Auxiliaries	7.63
24	DOUT2-B	- Crankcase heater - Condenser etc.: Open: Not activated Closed: Activated	- Isolated relay contact	
25	DOUT3-A	Digital output usually used to activate **FsC1/2**:	- Activation of **FsC1/2**	7.63
26	DOUT3-B	Open: Not activated Closed: Activated	- Isolated relay contact	

Tab. 6.2.3:   Control connections

FsC: Fixed-speed compressor
VsC: Variable-speed compressor (Inverter operation)

7 MOUNTING AND INSTALLING

7.1 Equipment unpacking

Check the following before mounting or storing the *FrigoPack* / *MotorMaster* Frequency Inverter:

- Sign of transit damage

- The type code and ratings on the name plate conform to the requirement (refer to Chapter 2 - PRODUCT OVERVIEW 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, wall mounting

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 Frequency 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 %.

If the place of installation is clean, free from aggressive or salt air and moisture-free, then *MotorMaster* Frequency Inverter of *FrigoPack* F can be wall-mounted outside of the electrical enclosure. In this case the recommended to cover must be used to provide the protection class (see accessories). Care must be taken that all electrical connections are suitably protected to the relevant safety standards.

7.3 Dimensions, spacing for cooling

Table 7.3 shows the dimensions of each *FrigoPack*
together with EMC filter if appropriate. The indicated
spacing for cooling (see Fig. 7.3) must be provided for
in the electrical enclosure.

MotorMaster	Dimensions [mm]			Cooling space [mm]				Air flow required [mm³/h] *
	Height	Width	Depth	Above	Below	L/R	Front	
FP 2.2FEP-EMC	233	177	181	55	65	15	15	40 *
FP 4.0FEP-EMC				60	60	15	15	80 *
FP 6.0FEP-emc								
FP 5.5FEP-EMC	415	201	263	60	60	15	15	180 *
FP 7.5FEP-EMC								
FP 11FEP-EMC								
FP 15FEP								
FP 18.5FEP	515	252	319	60	60	15	25	340 *
FP 22FEP								
FP 30FEP								
FP 37FEP	715	257	407	60	60	0	25	400 *
FP 45FEP								
FP 55FEP	720	257	355	60	60	0	25	460 (built-in fan)
FP 75FEP								
FP 90FEP								

Tab. 7.3:   *FrigoPack* dimensions and cooling spacings

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

7AP0

7BP0

Fig. 7.3:   **Cooling space**

7.4 Mounting

Refer to *MotorMaster* Product Manual PMM-FEP

7.5 Outline drawings

Refer to *MotorMaster* Product Manual PMM-FEP

7.6 Connections

It must be ensured that the system is carefully connected because only then can the *FrigoPack* system operate disturbance and fault-free.

7.6.1 Power section in electrical enclosure

- **Connections:**
  The wiring diagrams in section 6.1.1 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)...6) in Figs. Fig. 6.1.1a and 6.1.1b 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 *MotorMaster* Frequency Inverter
  - Keep wiring between EMC filter and *MotorMaster* Frequency 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 output of *MotorMaster* Frequency Inverter.

The *FrigoPack* / *MotorMaster* can be destroyed if power is fed to the output terminals. If bypass circuit is provided for emergency operation of the compressor without AC drive inverter, then all power connections at the *FrigoPack* / *MotorMaster* output must be disconnected using a separate contactor. Bypass contactors should also be mounted as close as possible (i.e. several cm) to the output of the *MotorMaster* Frequency Inverter. 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. 7.6.1 indicates important considerations for mounting the equipment and routing the power wiring. Pay careful attention to details a...SK.
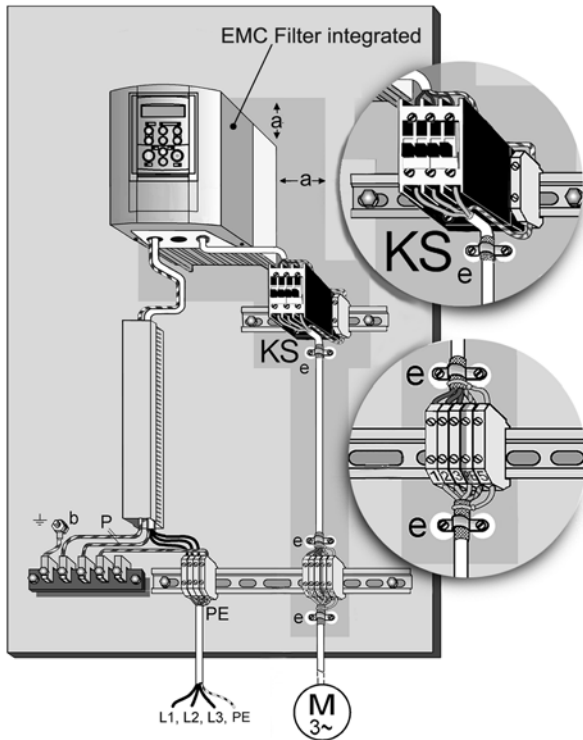
7CP0
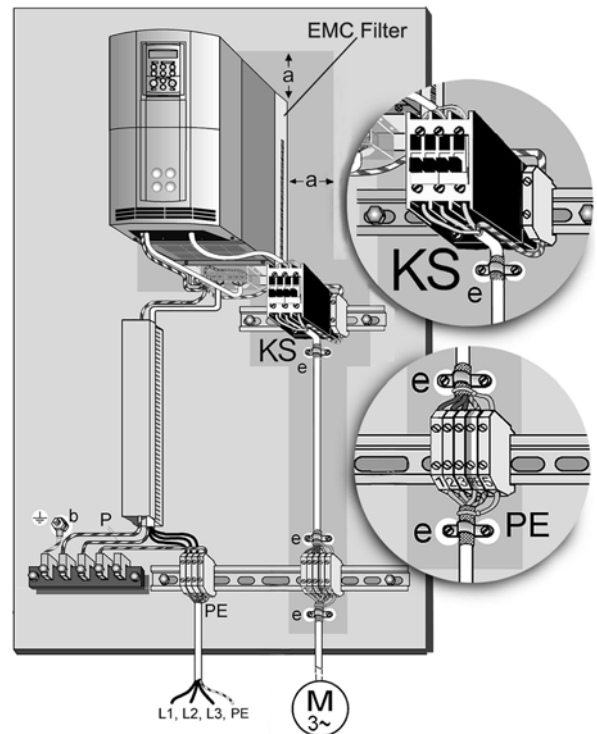
7DP0

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 *MotorMaster* Frequency Inverter, EMC filter, PE earthing bar, screens etc. to be free of paint

e   Cable screen clamped to contact area on mounting panel

P   Protective-earth cables:
2 separate parallel earth cables each to wiring regulations

KS   Safety contactor.

Fig. 7.6.1:   Arrangement of equipment and rating power cables

7.6.2   Compressor motor

- **Cable to compressor motor:**
  - Screened cable (copper screened or cable layed 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 $\geq \dfrac{l\,[m]}{10}$ 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 6.1.2.

7.6.3 Control circuit

The connection to the control section depends on the mode of operation, see section 5. The terminal lists in Table 6.2.2 give further information.

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

If external controllers or field bus systems are connected to *FrigoPack* then it is recommended that the 0 V ground of the *MotorMaster* control (terminal 11) is earthed to the galvanised mounting plate. This connection should be as short as possible.

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
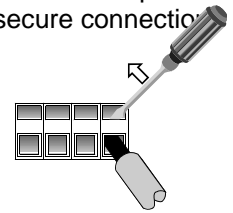
Fig. 7.6.3:   Wiring with screwless cage-clamp terminals

7.6.4 Pressure sensors

The connection diagrams in Section 5 and Fig 7.6.4 show the connections to the pressure sensor(s).

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

The pressure sensors may be wired without any special precautions if the special filters for pressure sensors are used (accessory).

The following must be observed with the direct connection without using the special filter:
- Install cable separate from motor cable (spacing to instructions in Section 7.6.1 must be adhered to)
- Use screened cable(connect screen to earth at *MotorMaster* end only to avoid earth loops)
- Take special care with wiring and check before powering up. Take particular care to avoid short circuits, earth faults (otherwise danger that the control assembly of *MotorMaster* may be damaged beyond repair).
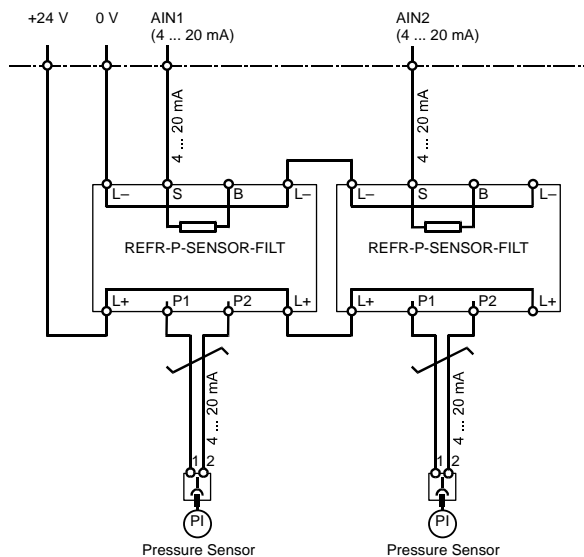
7FP0
a: Using special filter for pressure sensors
   (recommended)

Fig. 7.6.4:   Connection of the pressure sensors
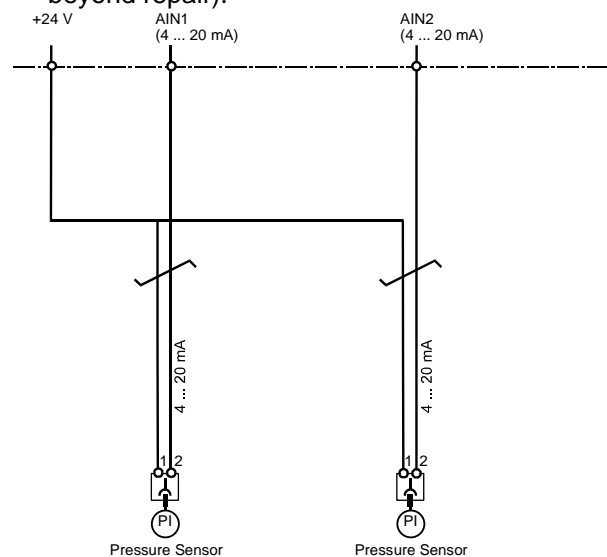
7GP2
b: Connection of the pressure sensors
   (careful attention to installation required)

7.7   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. 7.7 shows the basic rules of connection to screen to the mounting plate. Ensure that there is a large area bonding (e.g. by using metal cable clamps).
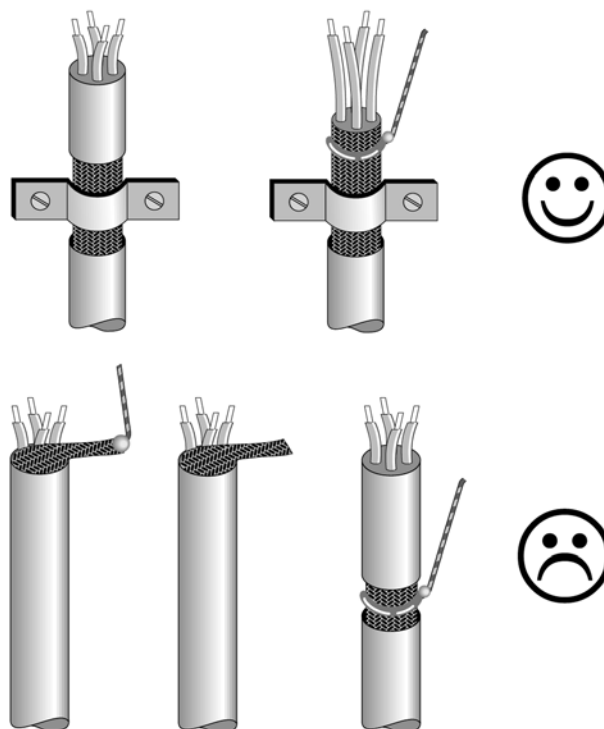
7HP0

7IP0

Fig. 7.7:   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* / *MotorMaster* is supplied with pre-installed refrigeration software.
Please contact the Application Service department if problems are encountered (refer to section 12).

The combined Refrigeration / A/C Software

   *FrigoSoft*23.2-1x (CONFIG: FS 2.3.2-1x)

is preloaded as standard.

To select other software configurations refer to Sections 8.11 and 8.12.

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 8.13.

8.1 Modifying operating parameters with the Programming Pad

Fig. 8.1: Programming Pad

Note:

Keys 🔘, 🔘, 🔘 are for LOCAL MODE. See Section 5.2.5.

Key ◆ 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 🔘 key.

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

UP / DOWN
These keys provides 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, minimum and maximum frequency etc. are set in the menu **OPERATOR**.

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

Automatic to OPERATOR menu approx. 2 s after switching on.

```
FrigoSoft23.2 11      OPERATOR           01:Po SUCT PRESS
XX.XkW 400 V 5.5      menu at level 1    =      Y.Y bar
```

Parameter	Type / Value	Description	Further information
01:Po SUCT PRESS = Y.Y bar	Measured value	Po, Suction pressure: -0.5 bar ... 7.0 bar	9.1
02:Po SUC PR DEV = 00.0 %	Error	Po, Suction pressure: -100.00 ... 100.00 %	
03:Pc DISC PRESS = YY.Y bar	Measured value	Pc, Discharge / condens. pressure: 0.0 bar ... 25.0 bar	
04:FsC NUMB ACTV = Y.YY	Actuating value	Fixed-speed Compressors: Number active (in operation)	
05:VsC MOT FREQ = YY.YY Hz	Measured value	Variable-speed Compressor: Motor Frequency	9.2
06:VsC MOT CURRT = YYY.Y A	Measured value	Variable-speed Compressor: Motor current	
07:CD FN ACT VAL = YYY.YY %	Actuating value	Condenser fan, actuating value: 0.00 ... 100.00 %	9.3
08:Po SUC PRES 1 → 3.2 bar	Setpoint 1 _._ bar	Po, Suction pressure: -0.5 ... 7.0 bar	8.3.2/3
09:Po SUC PRES 2 → 3.6 bar	Setpoint 2 _._ bar	Po, Suction pressure: -0.5 ... 7.0 bar	
10:Pc DIS PR LMT → 20.0 bar	Limit value _._ bar	Pc, Discharge pressure: 0.0 ... 25.0 bar	8.3.4
11:Pc CND PR SPT → 17.0 bar	Setpoint __._ bar	Pc, Condensing pressure: 0.0 ... 25.0 bar	8.3.5
12:VsC FREQ MIN → 25.0 Hz	Set value __._ Hz	VsC, Minimum frequency: 15.0 ... 90.0 Hz	8.4.1
13:VsC FREQ MAX → 60.0 Hz	Set value __._ Hz	VsC, Maximum frequency: 15.0 ... 90.0 Hz	
14:VsC FREQ BASE → 57.7 Hz	Set value _._ Hz	VsC, Base frequency (Password): 15.0 ... 90.0 Hz	8.4.2
15:VsC BOOST → 3.0 %	Set value _._ %	VsC, Boost (Password): 0.0 ... 5.0 %	
16:VsC SKP FRQ 1 → 0.0 Hz	Set value __._ Hz	VsC, Skip frequency: 0.0 ... 90.0 Hz	8.4.3
17:VsC SKP BND 1 → 0.0 Hz	Set value __._ Hz	VsC,: Skip frequency band: 0.0 ... 10.0 Hz	
18:VsC tinh DLY → 180.0 s	Set value __._ s	VsC, Inhibit delay: 0.1 ... 3000.0 s	8.5.1
19:VsC toff DLY → 0.1 s	Set value _._ s	VsC, Switch-off delay: 0.1 ... 3000.0 s	
20:VsC toil DLY → 4.0 s	Set value __._ s	VsC, Oil lubrication pulse time: 0.1 ... 3000.0 s	
21:FsC ton DLY → 20.0 s	Set value _._ s	FsC, Switch-on delay: 0.1 ... 3000.0 s	8.5.2
22:FsC toff DLY → 5.0 s	Set value _._ s	FsC, Switch-off delay: 0.1 ... 3000.0 s	
23:Po CNTR P-GN → 3.0	Set value __._ s	Po controller, Proportional gain: 0.0 ... 100.0	8.6.1
24:Po CNTR I-TC → 20.0 s	Set value _._	Po controller, Integr. time const.: 0.1 ... 100.0 s	
25:Pc LIMT P-GN → 10.00	Set value __.__	Pc limiter, Proportional gain: 0.00 ... 100.00	8.6.2
26:Pc CNTR P-GN → 8.00	Set value _.__	Pc controller, Proportional gain: 0.00 ... 100.00	8.7
27:Pc CNTR I-GN → 0.00	Set value __._ bar	Pc controller, Integral gain: 0.00 ... 100.00	
28:CD FN MIN SPD → 15.0	Set value _.__	Condenser fan, Min. speed: 0.00 ... 100.00 (%)	
29:ACT VAL Po=0% → 7.0 bar	Set value _._ bar	Po at actuating value = 0 %: -0.5 ... 7.0 bar	8.8
30:AOUT1 FUNCTN → INPUT 0	Set value	AOUT1 - Function selection: INPUT 0 ... INPUT 2	8.9
31:AOUT3 FUNCTN → INPUT 0	Set value	AOUT3 - Function selection: INPUT 0 ... INPUT 1	
32:CONTRL FUNCTN → 0000	Set value	FrigoSoft - Function selection: 0000 ... 003F	
SETPOINT(REMOTE) / SETPOINT(LOCAL) = YYY.YY %	Measured value	Activating value of speed	9.2

Menu structure labels (left column):

Measured values:
- Refrigeration:
- Variable-speed Compressor:
- Condenser fan:

Settings, Refrigeration:
- Suction pressure:
- Discharge pressure:
- Condensing pressure:

Settings, Variable-speed Compressor:
- Range of frequency:
- Magnetising:
- Resonance avoidance:
- Time settings:

Settings, Fixed-speed Compressors:
- Time settings:

Settings, Compressor pack/rack:
- Po Controller:
- Pc Limiter:

Settings, Condenser:
- Pc Controller:
- Minimum speed:

Settings: A/C with ext. Controller:

Settings, Other:

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 SUC PRES 1 → 3.2 bar	-0.5 bar	+7.0 bar	3.2 bar
Setpoint 2 (Auxiliary setpoint):	09: Po SUC PRES 2 → 3.6 bar	-0.5 bar	+7.0 bar	3.6 bar

Making a change:
1. Select parameter 08: Po SUC PRES 1 / 09: Po SUC PRES 2 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.

8.3.3   Air conditioning: Limits of Suction Pressure

		Range from:	to:	Factory setting:
Limit value 1 (Hauptwert):	08: Po SUC PRES 1 → 3.2 bar	-0.5 bar	+7.0 bar	3.2 bar
Begrenzungswert 2 (Hilfswert):	09: Po SUC PRES 2 → 3.6 bar	-0.5 bar	+7.0 bar	3.6 bar

Making a change: Identical to Section 8.3.2.

8.3.4   Limit of Discharge Pressure

		Range from:	to:	Factory setting:
Limit value:	10: Pc DIS PR LMT → 20.0 bar	0.0 bar	25.0 bar	20.0 bar

Making a change:
1. Select parameter 10: Pc DIS PR LMT 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.

8.3.5   Setpoint for condensing pressure

		Range from:	to:	Factory setting:
Setpoint:	11: Pc CND PR SPT → 17.0 bar	0.0 bar	25.0 bar	17.0 bar

Making a change:
1. Select parameter 11: Pc CND PR SPT 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.

ND-Sensor / LP sensor [%]	[mA]	Druck / Pressure [bar]	[bara]	R404A LP[°C]	HP[°C]	R507 LP[°C]	HP[°C]	R407C LP[°C]	HP[°C]	R22 LP[°C]	HP[°C]	R134a LP[°C]	HP[°C]	HD-Sensor / HP sensor [%]	[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:
Minimum frequency:	`12: VsC FREQ MIN` `→ 25.0 Hz`	15.0 Hz	90.0 Hz	25.0 Hz
Maximum frequency:	`13: VsC FREQ MAX` `→ 60.0 Hz`	15.0 Hz	90.0 Hz	60.0 Hz

Making a change:
1. Select parameter **12: VsC FREQ MIN** / **13: VsC FREQ MAX** 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.

8.4.2 Magnetisation (password protected)

		Range from:	to:	Factory setting:
Base frequency (operation):	`14: VsC FREQ BASE` `→ 57.7 Hz`	15.0 Hz	90.0 Hz	57.7 Hz
Boost (starting):	`15: VsC BOOST` `→ 3.0 %`	0.0 %	5.0 %	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 Ⓜ 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.

8.4.3 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 Ⓜ 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.

Example:

16: VsC SKP FRQ 1 = 30.0 Hz
17: VsC SKP BND 1 = 4.0 Hz
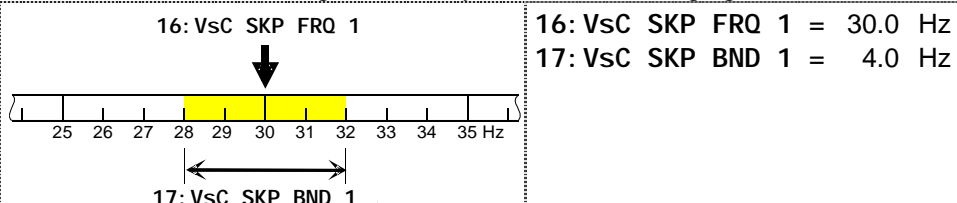
8.5   Settings,Time

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 Frigo Soft 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 → 180.0 s	0.0 s	3000.0	180.0 s
Stop delay:	19:VsC toff DLY → 0.0 s	0.0 s	3000.0	0.0 s
Oil lubrication pulse time:	20:VsC toil DLY → 4.0 s	0.0 s	3000.0	4.0 s

Making a change:

    1. Select parameter **18:VsC tinh DLY** / **19:VsC toff DLY** / **20:VsC toil DLY**
       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.

8.5.2   Fixed-speed Compressor (FsC)

		Range from:	**to:**	**Factory setting:**
Start delay:	21:FsC ton DLY → 20.0 s	0.0 s	3000.0	20.0 s
Stop delay:	22:FsC toff DLY → 5.0 s	0.0 s	3000.0	5.0 s

Making a change:

    1. Select parameter **21:FsC ton   DLY** / **22:FsC toff DLY**
       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 Settings, Compressor pack/rack

8.6.1 Po controller / limiter, P gain and I time constant

		Range from:	to:	Factory setting:
Proportional gain:	`23: Po CNTR P-GN` `→      3.0`	0.0	100.0	3.0
Integral time constant:	`24: Po CNTR I-TC` `→     20.0 s`	0.0 s	100.0 s	20.0 s

Making a change:

1. Select parameter `23: Po CNTR P-GN` / `24: Po CNTR I-TC`
   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.

8.6.2 Pc limiter, P gain

		Range from:	to:	Factory setting:
Proportional gain:	`25: Pc LIMT P-GN` `→     10.0`	0.0	100.0	10.0

Making a change:

1. Select parameter `25: Pc LIMT P-GN`
   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.

8.7 Settings, Condenser pressure (please refer to KIMO)

		Range from:	to:	Factory setting:
Proportional gain:	`26: Pc CNTR P-GN` `→      8.0`	0.0	100.0	8.0
Integral time constant:	`27: Pc CNTR I-GN` `→      0.0`	0.0	100.0	0.0
Condenser fan, minimum speed:	`28: CD FN MIN SPD` `→     15.0 %`	0.0 %	100.0 %	15.0 %

Making a change:

1. Select parameter `26: Pc CNTR P-GN` / `27: Pc CNTR I-GN` / `28: CD FN MIN SPD`
   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.

8.8   Settings: A/C with ext. Controller

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

Making a change:

1. Select parameter **29: ACT VAL Po=0%**
   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.

8.9   Other settings

8.9.1   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 - Low-pressure limiting (A/C only)	Only with special relay A RELAY-DC12V, see Section 3.3.
• **INPUT 2:**	Frequency / Speed of the **VsC**	0 ... +10 V / 5 mA

8.9.2   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 - Low-pressure limiting (A/C only)	Only with special relay A RELAY-DC12V, see Section 3.3.

8.9.3   Function selection 32: CONTRL FUNCTN

Setting	Energy saving	High-pressure sensor: Monitoring	Type of control		Setpoint / Actuating value		
			A/C	Suction pressure	Test (+0.5 bar)	Extern	Internal 1/2
* 00X0:				●			●
* 00X1:				●		●	
* 00X2:			●			●	
* 00X3:				●	●		
* 00X4:		●		●			●
* 00X5:		●		●		●	
* 00X6:		●	●			●	
* 00X7:		●		●	●		
* 000X:							
* 001X:	●						
X: any	* Please refer to KIMO before use						

8.10 Setting-up recommendations

Settings		Refrigeration A/C installation		
		Small	Medium	Large
Variable-speed Compressor, Time settings:	`18:VsC tinh DLY`	180.0 s	180.0 s	180.0 s
	`19:VsC toff DLY`	0.0 s	0.0 s	0.0 s
Fixed-speed Compressor, Time settings:	`21:FsC ton DLY`	20.0 s	40,0 s	120.0 s
	`22:FsC toff DLY`	5.0 s	10.0 s	15.0 s
Compressor pack, Time settings:	`23:Po CNTR P-GN`	3.0	1.5	0.5
	`24:Po CNTR I-TC`	20.0 s	30.0 s	45.0 s
	`25:Pc LIMT P-GN`	10.0	10.0	10.0
Typical *FrigoPack*s:		*FP* ...5.5FEP-EMC	*FP* 5.5…30FEP-EMC	*FP* 30...90FEP-EMC
Typical installation characteristics:	Pipe volume:	- Small	- Medium	- Large
	Pipe runs:	- Short	- Medium	- Long
	Refrigerant volume:	- Low	- Medium	- High

8.11 Available software configurations

- Active configuration: `APPLICATION`
- Programming Pad: `OP STATION`
- *FrigoSoft* 2.2-German (old version):   `FS 2.2.1-1x`
- *FrigoSoft* 2.2-**English** (old version):   `FS 2.2.2-1x`
- *FrigoSoft* 2.3-German: `FS 2.3.1-1x`
- *FrigoSoft* 2.3-**English**:   `FS 2.3.2-1x`
- *FrigoSoft* 2.3-French: `FS 2.3.3-1x`
- *FrigoSoft* 2.3-Italian: `FS 2.3.5-1x`
- *FrigoSoft* 2.3-Dutch/Flemish: `FS 2.3.8-1x`
- *FrigoLON* 2.3-German: `FL 2.3.1-1x`

8.12 Loading other software configurations

Go through the following steps taking great care:

- **Establish password by contacting supplier and keep ready for following use.**

- **Changing 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 2.3.1-1x FS 2.3.8-1x OP STATION FS 2.3.2-1x FL 2.3.1-1x FS 2.2.1-1x FS 2.3.3-1x FS 2.2.2-1x FS 2.3.5-1x	
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.		

8.13 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.**

- **Changing 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 momantarily 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 momantarily displayed
7. Press key **M** 2x to return to **OPERATOR** menu.		

9   MEASURED VALUES

The measurement values are at the top of the **DIAGNOSIS** menu, see Table 9.

9.1   Refrigeration

		Range from:	to:	Measured value:
Suction pressure in bar:	`01:Po SUCT PRESS` `=      Y.Y bar`	`-0.5 bar`	`7.0 bar`	`Y.Y bar`
Suction pressure deviation in %:	`02:Po SUC PR DEV` `=    YYY.YY %`	`0.00 %` Only with refrigeration	`100.00 %`	`YYY.YY %`
Discharge pressure in bar:	`03:Pc DISC PRESS` `=     YY.Y bar`	`0.0 bar`	`25.0 bar`	`YY.Y bar`
Fixed-speed Compressors:	`04:FsC NUMB ACTV` `=    YY.YY`	`0.00` Number active (in operation)	`2.00`	`YY.YY`

9.2   Variable-speed Compressor (VsC)

		Range from:	to:	Measured value:
Motor frequency:	`05:VsC MOT FREQ` `=    YY.YY Hz`	`0.00 Hz`	`90.00 Hz`	`YY.YY Hz`
Motor current:	`06:VsC MOT CURRT` `=   YYY.YY A`	`0.00 A`		`YYY.YY A`

Active setpoint:	`SETPOINT(REMOTE)`
	`/`
	`SETPOINT(LOCAL)`
	`=   YYY.YY %`
		`0.00 %`
		
		For **diagnosis** use
			`100.00 %`	`YYY.YY %`

9.3   Condenser

		Range from:	to:	Measured value:
Fan::	`07:CD FN ACT VAL` `=   YYY.YY A`	`0.00 %` Motor current:	`100.00 %`	`YYY.YY %`

9.4   Menu **DIAGNOSIS**

Refer to the following overview or separate attachment.

DIAGNOSTIC menu at level 1	SPEED DEMAND = YYYY.YY %	Measured value	Activating value of speed

Electrical values:

DRIVE FREQUENCY = YY.YY Hz	Measured value	Variable-speed Compressor: Motor Frequency
MOTOR CURRENT A = YY.Y A	Measured value	Variable-speed Compressor: Motor current

Trips:

ACTIVE TRIPS = YYYY >>	Trip	Active trips: First set	10.2-4
ACTIVE TRIPS* = YYYY >>	Trip	Active trips: Second set	10.2-4
FIRST TRIP =YYYYYYYYYYYYYYYY	Trip	Trip which caused shut down	10.2-4
TRIP 1 (NEWEST) =YYYYYYYYYYYYYYYY	Trip	Trip 1 (newest) which caused shut down	10.2-4
TRIP 10 (OLDEST) =YYYYYYYYYYYYYYYY	Trip	Trip 10 (oldest) which caused shut down	10.2-4

Analog inputs:

ANALOGUE INPUT 1 = YYY.YY %	AIN1 (X2:2) Analog input 1	Po, Suction pressure sensor: 0.00 %: -0.5 bar; 100.00 %: 7.0 bar	7.6.4
ANALOGUE INPUT 2 = YYY.YY %	AIN2 (X2:3) Analog input 2	Pc, High pressure sensor: 0.00 %: 0.0 bar; 100.00 %: 25.0 bar	7.6.4
ANALOGUE INPUT 3 = YYY.YY %	AIN3 (X2:4) Analog input 3	Not used	
ANALOGUE INPUT 4 = YYY.YY %	AIN4 (X2:5) Analog input 4	Po, Ext. setpoint: 0.00 %: -0.5 bar; 100.00 %: 7.0 bar	5.2.3

Digital inputs:

DIGITAL INPUT 1 = YYYYY	DIN1 (X2:12) Digital input 1	Enable (start/run)	5.2.1-3
DIGITAL INPUT 2 = YYYYY	DIN2 (X2:13) Digital input 2	Not used	
DIGITAL INPUT 3 = YYYYY	DIN3 (X2:14) Digital input 3	Activate setpoint 2	5.2.2
DIGITAL INPUT 4 = YYYYY	DIN4 (X2:15) Digital input 4	Not used	
DIGITAL INPUT 5 = YYYYY	DIN5 (X2:16) Digital input 5	Activate compressor capacity control	6.1.6
DIGITAL INPUT 6 = YYYYY	DIN6 (X2:17) Digital input 6	Invert output DOUT2	6.1.3
DIGITAL INPUT 7 = YYYYY	DIN7 (X2:18) Digital input 7	For emergency control	6.1.9
EXTERNAL TRIP = YYYYY	DIN8 (X2:19) Digital input 8	External safety circuit	6.1.3

Analog outputs:

ANALOG OUTPUT 1 = YYY.YY %	AOUT1 (X2:6) Analog output 1	VsC: Actual speed / Conden. fan, actuat. value / Warning	5.2.1-3
ANALOG OUTPUT 2 = YYY.YY %	AOUT2 (X2:7) Analog output 2	Fixed-speed compressor 1: Activate with 2 or 3 FsC stages	6.1.5-7
ANALOG OUTPUT 3 = YYY.YY %	AOUT3 (X2:8) Analog output 3	Fixed-speed compressor 3 / Conden. fan, actuat. value / Warning	6.1.5-7

Digital outputs:

DIGITAL OUTPUT 1 = YYYYY	DOUT1 (X21:22) Digital output 1	Ready (without trip)	5.2.1-3
DIGITAL OUTPUT 2 = YYYYY	DOUT2 (X22:23) Digital output 2	VsC in operation: Start unloader, crankcase heater, condenser etc.	6.1.3
DIGITAL OUTPUT 3 = YYYYY	DOUT3 (X24:25) Digital output 3	Fixed-speed compressor 1(or 2): Activate with 1(2 or 3) FsC stages	6.1.5-7

QUICK SETUP menu at level 1	VIEW LEVEL → BASIC	For special use	Only enter this menu after consulting KIMO
SYSTEM menu at level 1	SAVE CONFIG menu at level 2	For special use	Only enter this menu after consulting KIMO

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

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For future use.

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: CONFIGURATION OVERVIEW / PROBLEM REPORT (Put cross in box where appropriate)

Application	Refrigeration ☐	No. of cooling outlets ___	Air Conditioning ☐	Condenser ☐	Other _____

Refrigerant	R404A........☐ R507A........☐	R407C........☐ R22..........☐	R134a........☐ R............	Total refrig. Power ___ [kW]	Other _____

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 ☐	Suction gas temperature ___ [°C]	Discharge gas temperature ___ [°C]	Motor current ___ [A]
Start up	Suction pressure ___	High (discharge) pressure ___	gauge/ ☐ absolute ☐	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 P (Version 11) / FrigoSoft 2.3

Parameter	Value	Unit
08:Po SUC PRES 1	3.2 bar ___	[bar]
09:Po SUC PRES 2	3.6 bar ___	[bar]
10:Pc DIS PR LMT	20.0 bar ___	[bar]
11:Pc CND PR SPT	17.0 bar ___	[bar]
12:VsC FREQ MIN	25.0 Hz ___	[Hz]
13:VsC FREQ MAX	60.0 Hz ___	[Hz]
14:VsC FREQ BASE	57.7 Hz ___	[Hz]
15:VsC BOOST	5.0 % ___	[%]
16:VsC SKP FRQ 1	0.0 Hz ___	[Hz]
17:VsC SKP BND 1	0.0 Hz ___	[Hz]
18:VsC tinh DLY	180.0 s ___	[s]
19:VsC toff DLY	0.0 s ___	[s]
20:VsC toil DLY	5.0 s ___	[s]
21:FsC ton DLY	20.0 s ___	[s]
22:FsC toff DLY	5.0 s ___	[s]
23:Po CNTR P-GN	3.0 ___	
24:Po CNTR I-TC	20.00 s ___	[s]
25:Pc LIMT P-GN	10.00 ___	
26:Pc CNTR P-GN	8.00 ___	
27:Pc CNTR I-GN	0.00 ___	
28:CD FN MIN SPD	15.00 % ___	[%]
29:ACT VAL Po=0%	7.0 bar ___	[bar]
30:AOUT1 FUNCTN	INPUT 0 ___	
31:AOUT3 FUNCTN	INPUT 0 ___	
32:CONTRL FUNCTN	0000 ___	

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

Manufacturer	Agent	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:

FrigoPack: CHECKLIST AND ADDITIONAL DATA FOR PROBLEM REPORT

KIMO Problem Code	Part of installation	Checklist of questions for PROBLEM REPORT	Explanation	FE (MM5)	FE (MM6)	FE (MM35V)	FEP (MM FEP)	Answer/Confirmation
ES	Electrical: - Einspeisung	• Are there any known power supply interruptions ?						Yes ☐ No ☐ Yes ☐ No ☐
		• Do these power supply interruptions occur at the same time each day ?	- Indicate approx. times					When: _____ _____
		• By what amount does the supply voltage vary ?	- Indicate min. and max. voltages					Min.: _____ [V] Max.: _____ [V]
EI	- Installation	• Motor cable: Approx. Length ?						_____ [m]
		• Motor cable: Type of screen ?	- Copper braid ?, Steel braid ?, - Steel conduit ?, none ?					Cu brd ☐ Fe brd ☐ Fe cond ☐ None ☐
		• Motor cable: Screen connected to mounting plate?	- Recommendations: - Contact with large surface area					Yes ☐ No ☐
		• Motor cable: Screen connected to metal motor housing ?	- Make sure no "pig tails"					Yes ☐ No ☐
		• Is a galvanised mounting plate used in the electrical enclosure ?						Yes ☐ No ☐
		• Is a motor filter used between the MotorMaster and the compressor motor ?	- If yes, indicate KIMO product code					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	MotorMaster: - Control and sensor inputs	• Ground of MotorMaster control connected to central earth ?	- Terminal:				1 + 11	Yes ☐ No ☐
		• Is the DC P24 control voltage present ?	- Terminal:				20 - 11	Yes ☐ No ☐
		• Connection of PTC motor protection ?	- Direct to MotorMaster (MM)/ through relay (e.g. Kriwan)					MM ☐ Relay ☐
			- Terminal:				MOT/	Yes ☐ No ☐
		• External safety circuit OK ?	- Terminal:				19 - 11	Yes ☐ No ☐
		• Enable signal present ?	- Terminal:				12 - 11	Yes ☐ No ☐
		• Signal from suction-pressure sensor present ?	- Terminal:				2 - 1	_____ [V]
		• Signal from high-pressure sensor present ?	- Terminal:				3 - 1	_____ [V]
			- Terminal to be measured: - Measured against:	Underlined Not underlined				
MM PS	- Power section	• Reserved for future use						
MM CA	- Control assembly	• Reserved for future use						
MM CS	- Control settings, parameter	• DIL switches correctly set ?	- Only relevant for following types:	X	X	X		Yes ☐ No ☐
		• Operating Mode LOCAL ?	- FL: Wie feststellen ??					Yes ☐ No ☐
		• At limit values ?	- FL: Wie feststellen ??					Yes ☐ No ☐
RI AP	Refrigeration: - Application	• Required Refrigeration Power entered into PROBLEM REPORT ?						Yes ☐ No ☐
		• Number of cooling outputs entered into the PROBLEM REPORT ?						Yes ☐ No ☐
		• Operating pressure and temperatures entered into PROBLEM REPORT ?	- Operating point - At start up					Yes ☐ No ☐ Yes ☐ No ☐
		• On/Off times of compressor pack entered into PROBLEM REPORT ?	- Enter variable and fixed speed compressor times separately					Yes ☐ No ☐
RI IN	- Installation	• Reserved for future use	- tbd					
RI PS	- Pressure sensors	• Approx. cable length						_____ [m]
		• Type of screen	- Copper braid ?, Steel braid ?, Steel conduit ?, none ?					Cu brd ☐ Fe brd ☐ Fe cond ☐ None ☐
		• Screen NOT connected at sensor end ?						Yes ☐ No ☐
		• Screen connected to mounting plate of electrical enclosure ?	- Large area contact, no pig tails					Yes ☐ No ☐
		• Are measured pressures stable ?	- Indicate range of variation within 30 s					Yes ☐ No ☐ LP _____ HP _____ [bar]
RI RC	- Refrigeration compressor	• Oil present ?						Yes ☐ No ☐
		• Basic data entered into PROBLEM REPORT ?						Yes ☐ No ☐

10.4 TROUBLE SHOOTING LIST

Presently being written. Please refer to KIMO if there is any requirement.

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 / *MotorMaster* with *FrigoSoft* refrigeration software allow many special solutions to be quickly implemented at a favorable 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 system, then please contact our KIMO Application Service for Refrigeration/AC.

12.2 Training

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

12.3 Maintenance

MotorMaster Frequency 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 *MotorMaster* Frequency 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 *MotorMaster* Frequency Inverter must not be repaired by the user.

If repair is necessary return the unit to your supplier.

⚠️ **WARNINGS!**

Before disconnecting the *MotorMaster* Frequency Inverter, ensure isolation to the voltage supply. 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* Frequency Inverter retains parameter settings during power down, it is recommended that the Programming Pad is also used to record the valid settings and is not returned with the inverter. 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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