KIMO
Refrigeration HVAC

FrigoPack® cools and saves energy

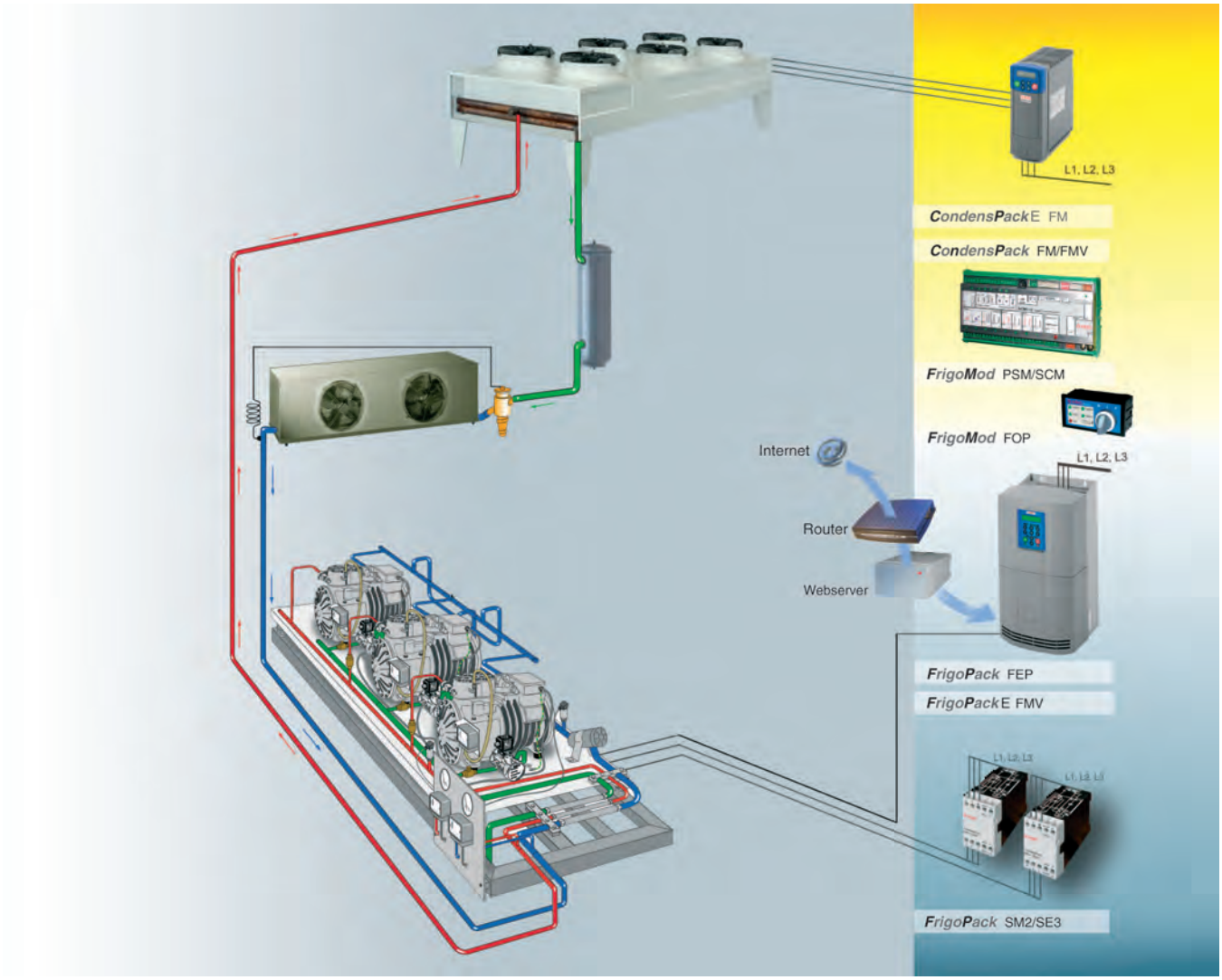
Intelligent Refrigeration Inverters for
Compressors and Condenser Fan Groups

FrigoPack®

Applications

- Commercial Refrigeration
- Industrial Refrigeration
- Supermarkets
- Heat Pumps
- Chillers
- Condensers
- Dry Coolers
- Heat Transfer Medium

Refrigeration Cycle



Features

- Suction-pressure control based on the variable-speed operation of a master compressor
  - Optimum operation of the compressors without unnecessary starting
  - Continuous stepless adjustment to match required refrigeration capacity
  - Increase of compressor capacity by operating up to 65 Hz (or more for special applications e.g. 75 Hz, 80 Hz etc.)
- Suitable Compressor Types:
  - Semi-Hermetic Reciprocating Compressors
  - Screw Compressors
  - Fully Hermetic Reciprocating Compressors of some manufacturers
  - Scroll Compressors of some manufacturers
  - Open- type compressors

FrigoPack® Equipment kits for Refrigeration Compressors

- Operation with multi-stage compressor racks:
  - Control of additional fixed-speed compressors
    FP FEP range:
    Up to 3 Fixed-speed compressors - 7 with special option;
    FPE FMV range:
    One Fixed-speed compressor;
  - Can be used with compressors with cylinder off-loading (capacity control)
- Universal setpoint of suction pressure:
  - Two adjustable setpoints
  - External setpoint (Analog, field bus system etc.)
- Special functions with the speed-controlled compressor:
  - Skip frequencies to prevent mechanical resonances
  - Adjustable minimum and maximum speed of the speed-controlled Compressor (depending on make and type of Compressor)
  - Control of Oil Pressure Switch or Crankcase Heater, Unloaded Start or Condenser Fans
- LOCAL MODE for system test or system refrigerant charging
- Settings
  - Pre-adjusted for medium temperature with R404A - Ready to go
  - No setting up of complicated parameters
  - The setpoints for suction pressure are the only settings required
- Additional Control Features:
  - “Icing protection of Evaporator” for air-conditioning and heat pump applications
  - Various functional variants while maintaining all ***FrigoSoft*** advantages (ref. to page 7)
  - Operation with an external control system (especially for supermarkets)
  - Glycol coolers; Chillers; Air coolers
  - Heat pumps
  - High pressure limiting by reducing the speed of the variable-speed Master Compressor (very important to maintain maximum availability with a condensor fan failure)
- Condenser control:
  - Integrated control of the condensing pressure (corresponds to condensing temperature)
  - Adaptation of condensing temperature in accordance with ambient temperature and compressor rack capacity

FrigoSoft® Refrigeration Software

- Fast and simple commissioning without prior knowledge of Frequency Inverter Technology
- Plain-Language Display on programming pad (***FP*** FEP: Standard; ***FP***E FMV: Option):
  - Suction and High Pressure (option)
  - ***FP*** FEP: Evaporating and Condensing Temperatures (depend on refrigerant)
  - Suction Pressure setpoint
  - Motor operating data (current, frequency etc.)
  - Various diagnostics
- Control of the multi-stage Compressor Racks:
  - Adjustable timers to prevent Compressors from switching on and off too frequently (e.g.when operating with a Low Refrigeration Capacity)
  - Variable compressor priority to equalize life time and to achieve good oil distribution.
- Fault processing:
  - Processing of thermistor winding protection
  - Detection of wire break to pressure sensor
  - Internal monitoring of electrical faults such as supply undervoltage, Phase failure, overload
  - Processing of safety trip circuit (HP/LP pressure cut-out switches, etc.)
  - Automatic delayed autostart following a supply or installation fault, 10 start attempts
- Closed-loop control:
  - P and I action of suction pressure controller adjustable (possibility of installation “fine tuning”)
  - High pressure limiting action on connection of a high pressure sensor
- ***FP*** FEP: Refrigeration software for various standard applications can be selected
  - Refrigeration (simple and standard)
  - Chillers / Glycol coolers
  - Heat pumps
  - Condenser fan control, Dry coolers

FrigoPack® Refrigeration Inverters

- Latest-Generation Frequency Inverters 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 (ref. to page 6)
- High current reserves (up to 180 % short duration)
- Versions suitable for use with 230 V, 460 V or 500 V 3Ph supply voltages are available on request
- Motor protection thermistors can be directly processed (external protection relay not required)

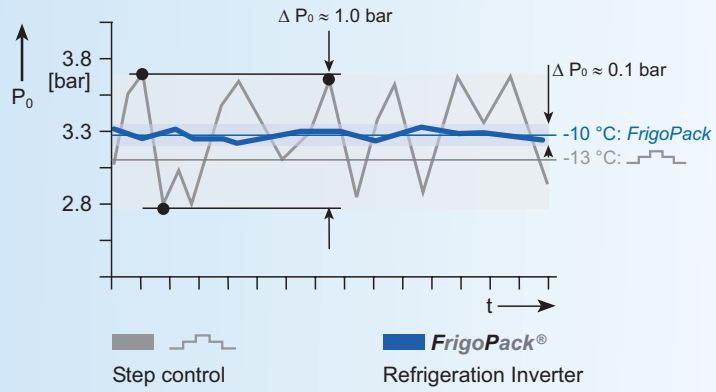
FrigoPack Soft Starters

- Electronic soft starters for the smooth starting of the fixed-speed Compressors
- Prevention of current and pressure surges on starting
- Fulfills the requirements of electrical supply companies

FrigoPack Remote control and diagnosis

- RS 485 with Modbus RTU
- Connection to Webserver for recording and fault history storage (e.g. DIXELL XWEB 500)

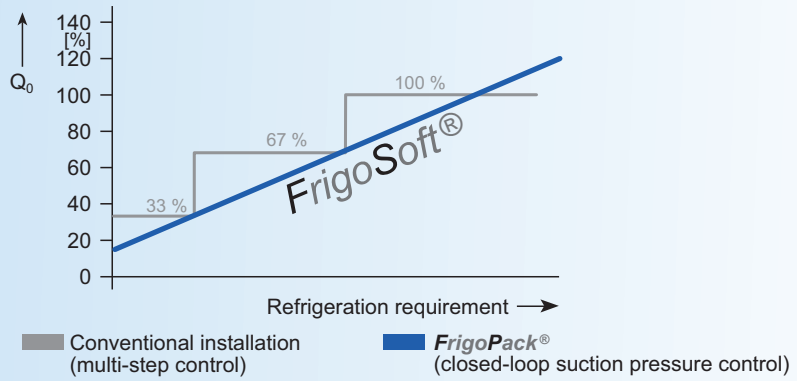
User Benefits



Improved cooling quality

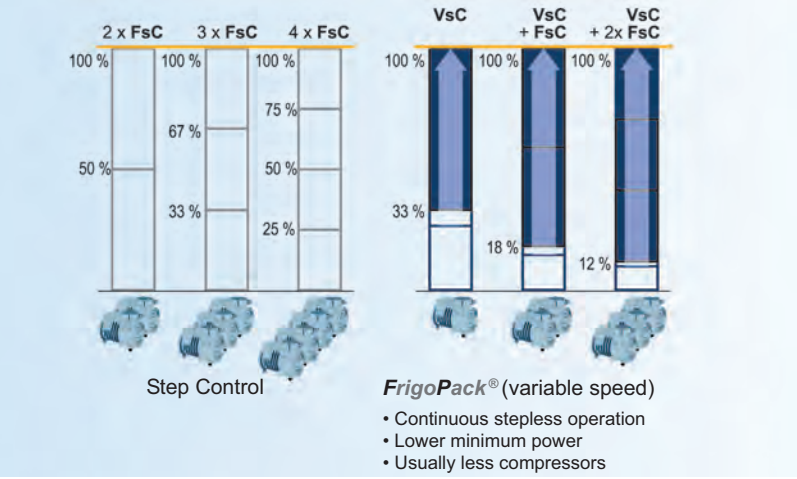
- Almost ideal constant-pressure characteristic in the suction line
- Reduced temperature deviation at the refrigeration points
- Lower dehumidification of stored goods
- Less icing of the evaporator
- Longer permissible times between defrosting

Note:
Rapid pressure changes cause instability with the Expansion Valves on the evaporators. This results in poor control performance with none ideal superheat.



Wide range of operation

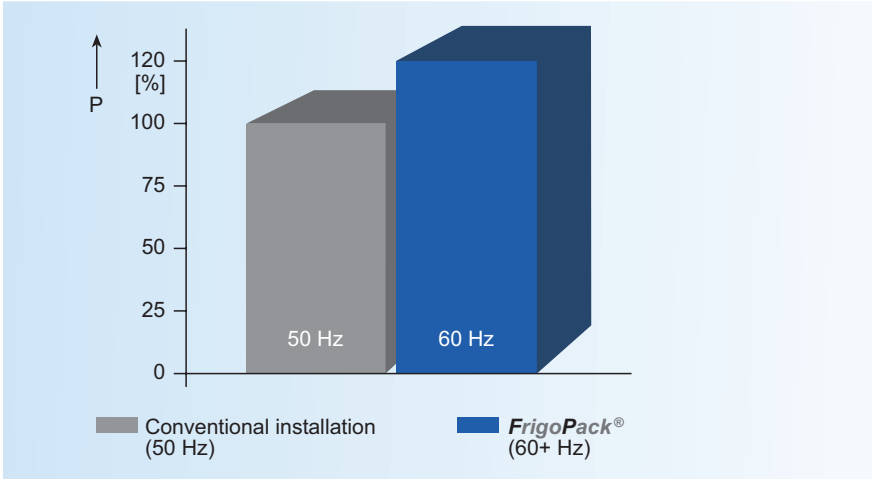
- Operation at required capacity without frequent on/off Compressor switching
- Similar control performance with fewer Compressors



Comparison based on an 3 Compressor Multi-stage Rack with 50 kW total refrigeration capacity

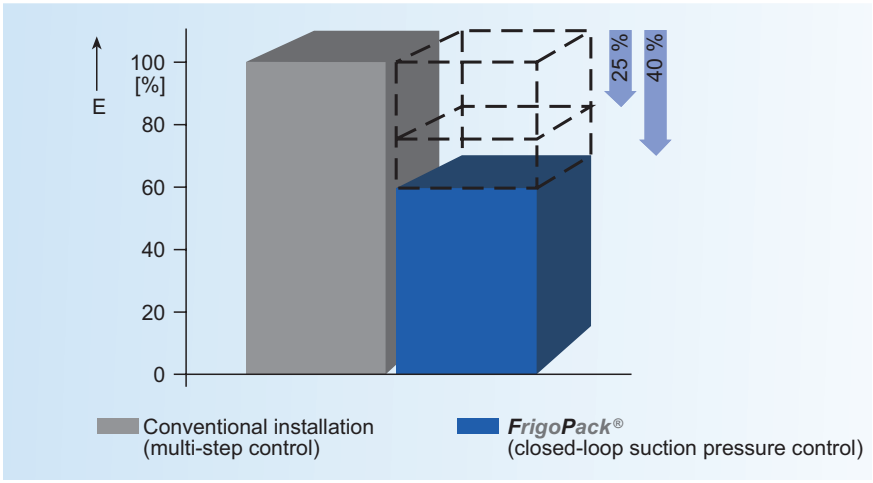
Frequenzy-Inverter	Without	With
Q_{min}	17 kW	6 ... 8* kW
Q_{max}	50 kW	53 ... 55* kW

* depending on Compressor



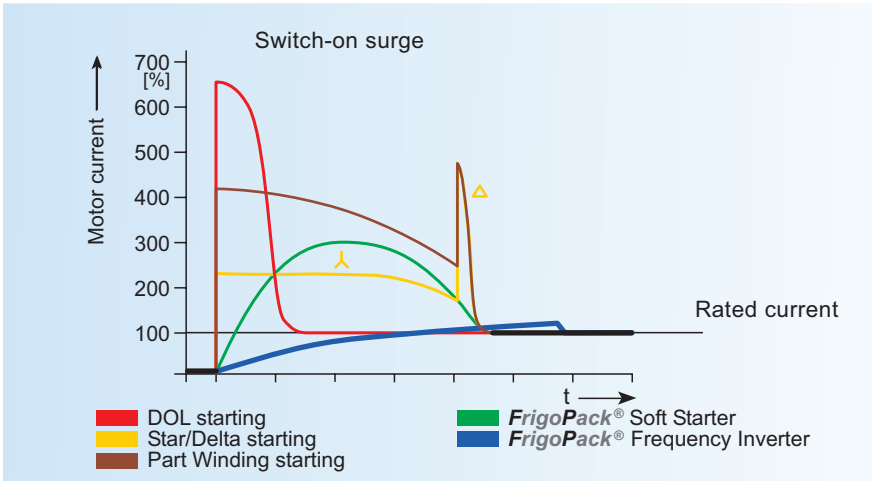
Increased power

- A Compressor when operated at 60 Hz rotates at approx. 1750 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 Variable-speed Compressors are operated used at frequencies up to 75 Hz



Energy saving

- Energy saving by stepless control of Refrigeration Capacity
  - up to 35 % with single Variable-speed Compressors
  - up to 20 % with multi-stage Compressor Racks
- Operation at a higher Evaporation and a lower Condensing Temperatures results in further significant energy savings
- Higher COP factor under normal and part-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 (a requirement of many electricity supply companies)
- Elimination of breakages to pipes and fittings due to smooth start

Extended lifetime

- Increased lifetime of the Compressor (due to reduced number of starts)
- Elimination of pressure surges in Refrigeration System due to continuous control
- Reduction of current surges in the electrical supply system by using ***FrigoPack*** Electronic Soft Starters

Development and experience

- ***FrigoSoft*** and ***FrigoPack*** were developed in close cooperation with Refrigeration Experts and manufacturers of Refrigeration Compressors
- The first installations were installed in 1995. We now have experience of very many installations within a power range of 1.0 ... 200 kW (electrical power)
- Trials at the TÜV Test Laboratories have confirmed that operation at 60 Hz has no negative effect on the lifetime of the Compressor. Operation at even higher speeds is possible with most semihermetic reciprocating compressors
- Experience over many years has shown that the operating life of a speed-controlled Compressor is usually substantially longer.

Selection assistance

- Compressor cross-reference lists for all common Compressors
- KIMO maintains a close contact with all the leading Compressor Manufacturers
- An Experienced Applications team is pleased to supply technical support and provide solutions for special applications

Pressure and Temperature

- The measured suction and condensing pressures are displayed in bar on the ***FrigoPack*** Refrigeration Inverter
- ***FP*** FEP: The saturated evaporating and condensing temperatures calculated to the ASHRAE formula are also indicated.

Product Conformity

EMC DIRECTIVE	LOW-VOLTAGE-DIRECTIVE	MACHINERY-DIRECTIVE
• EC Declaration of Conformity with CE marking based on: – RF interference EN 50081-1/-2 – Immunity EN 50082-1/-2 • Class B interference limit - suitable for unrestricted operation on public electricity supplies	• EC Declaration of Conformity with CE marking • Standards used: – EN 50178	• Manufacturer's Declaration available • Installation to EN 60204-1
UL, c-UL	• Standards used: – UL508C – UL840	

Equipment supplied

- ***MotorMaster*** Frequency Inverter including:
  – EMC filter to class B (integrated in inverter with ***FP*** 4.0FECP-EMC)
  – Programming pad
  – EMC optimised cable gland for screened motor cable
  – ***FP*** FEP: 5 output relays; ***FP***E FEP/FMV: 3 output relays
- ***FrigoSoft*** Refrigeration and Airconditioning software in 10 languages

FrigoSoft *Refrigeration Software*

- ***FrigoPack*** **FEP**

  FS 1.6: Basic refrigeration with up to 2 compressors

  FS 2.6: Standard refrigeration or aircon with up to 4 compressors
  Floating control of Condensing Temperature
  Also suitable for air cooling

  FS 3.6: Chiller or glycol coolers for single and multiple circuits
  Floating control of Condensing Temperature
  Also suitable for cooling and dehumidifiation in ducted air applications

  FS 4.6: For use with external controllers with a 0 ... +10 V output

  FS 5.6: For use with external controllers with a 0 ... +10 V output; Emergency cooling for cascaded CO2 systems (e.g.. R744+R134a)

  FS 6.6: Reverse cycle aircon / heat pump applications
  Control of the 4-way valve

  FS 7.6: Chiller / heat pump with Heat transfer Medium
  Control of expansion valve
  Control of the 4-way valve

  FS 8.6: Reverse cycle aircon / heat pump applications for high-speed scroll compressors
  Control of the 4-way valve

  FS 9.6: Heat pump with integrated defrosting control
  Control of the expansion valve
  Control of the 4-way valve

  FS A.6: Condensor control with the speed control of up to 6 fan groups

  FS B.6: Dry coolers with integrated pump control

- ***FrigoPack***E **FEP**

  FS 1.6: Basic refrigeration with up to 2 compressors

  FS 4.6: For use with external controllers with a 0 ... +10 V output

  FS A.6: Condensor control with the speed control of up to 3 fan groups

- ***FrigoPack***E **FMV**

  FS E1: Basic refrigeration with up to 2 compressors

- ***FrigoPack***EC **FMV**

  FS E4: For use with external controllers with a 0 ... +10 V output

- ***CondensPack*** **FMV** / ***CondensPack***E **FMV**

  FS EA: Speed control of refrigeration condensor fans

- ***FrigoPack*** **SM2** / ***FrigoPack*** **SE3**

  Soft-start kits for refrigeration compressors

Accessories

- Parts for installation:
  – Robust pressure sensors (suction and high pressure)
  – Temperature sensor for chiller or glycol cooler operation (PT1000)
  – IP40 top cover (required for wall-mounting without an electrical enclosure)
  – Terminal box for EMC filter (required for wall mounting without an electrical enclosure)

- Electrical components:
  – Supply chokes (recommended for unreliable electrical supplies) and motor chokes
  – Motor filter (sine-wave filter) for fan motors
  – Transformer 200/230/400 V 3Ph for operation of 400 V frequency inverters on 200/208/230 V 3Ph supplies
  – Fieldbus interfaces: RS485 Modbus RTU

FrigoPack FEP
Plus Line
Kits of parts

Product range	*Supply voltage*	*Output current*	*Product Code*	*Dimensions [mm] Width*	*Height*	*Depth*	*Weight [kg]*
Based on Frequency Inverters with internal EMC filter to class B protection							
FrigoPack FEP	3AC 400 V	9.5 A	FP 4.0FEP-EMC/1X	177	233	181	4.4
Based on Frequency Inverters with separate EMC filter to class B protection (can be used as "foot-print" or "book-style" filter)							
FrigoPack FEP	3AC 400 V	14 A	FP 6.0FEP-EMC/1X	177	233	181	5.1
FrigoPack FEP	3AC 400 V	14 A	FP 6.0FEP-emc*/1X	177	233	181	4.5
FrigoPack FEP	3AC 400 V	9.5 A	FP 4.0FEP-EMC/1X	177	233	181	4.4
FrigoPack FEP	3AC 400 V	23 A	FP 7.5FEP-EMC/1X	201	348	208	12.1
FrigoPack FEP	3AC 400 V	30 A	FP 11FEP-EMC/1X	201	348	208	12.3
FrigoPack FEP	3AC 400 V	37 A	FP 15FEP-EMC/1X	201	348	208	12.5
FrigoPack FEP	3AC 400 V	59 A	FP 22FEP-EMC/1X	252	453	245	22.0
FrigoPack FEP	3AC 400 V	73 A	FP 30FEP-EMC/1X	252	453	245	23.0
FrigoPack FEP	3AC 400 V	87 A	FP 37FEP-EMC/1X	257	669	312	39.0
FrigoPack FEP	3AC 400 V	105 A	FP 45FEP-EMC/1X	257	669	312	40.0
FrigoPack FEP	3AC 400 V	145 A	FP 55FEP-EMC/1X	257	720	355	56.0
FrigoPack FEP	3AC 400 V	165 A	FP 75FEP-EMC/X	257	720	355	58.0
FrigoPack FEP	3AC 400 V	205 A	FP 90FEP-EMC/1X	257	720	355	60.0
Based on Frequency Inverters with separate EMC filter to class A protection							
FrigoPack FEP	3AC 400 V	260 A	FP 110FEP-emc*/1X	569	1384	465	158.0
FrigoPack FEP	3AC 400 V	302 A	FP 132FEP-emc*/1X	569	1384	465	162.0
FrigoPack FEP	3AC 400 V	420 A	FP 180FEP-emc*/1X	569	1384	465	170.0
FrigoPack FEP	3AC 400 V	480 A	FP 200FEP-emc*/1X	684	1517	465	235.0
FrigoPack FEP	3AC 400 V	590 A	FP 280FEP-emc*/1X	684	1517	465	235.0
FrigoPack FEP	3AC 400 V	650 A	FP 315FEP-emc*/1X	789	1629	465	289.0

Specification for 3AC 230V on request

*emc = Class A protection
EMC = Class B protection

*FrigoPack*E FEP
Economy Line
Kits

Product range	*Supply voltage*	*Output current*	*Product Code*	*Dimensions [mm] Width*	*Height*	*Depth*	*Weight [kg]*
Based on Frequency Inverters with internal EMC filter to class B protection							
FrigoPackE FEP	3AC 400 V	10 A	FPE 4.0FEP-EMC/1X	177	233	181	5.1
FrigoPackE FEP	3AC 400 V	14 A	FPE 6.0FEP-EMC/1X	177	233	181	5.1
FrigoPackE FEP	3AC 400 V	14 A	FPE 6.0FEP-emc*/1X	177	233	181	5.1
Based on Frequency Inverters with separate EMC filter to class B protection (can be used as "foot-print" or "book-style" filter)							
FrigoPackE FEP	3AC 400 V	23 A	FPE 7.5FEP-EMC/1X	201	348	208	12.1
FrigoPackE FEP	3AC 400 V	30 A	FPE 11FEP-EMC/1X	201	348	208	12.3
FrigoPackE FEP	3AC 400 V	37 A	FPE 15FEP-EMC/1X	201	348	208	12.5
FrigoPackE FEP	3AC 400 V	59 A	FPE 22FEP-EMC/1X	252	453	245	22.0
FrigoPackE FEP	3AC 400 V	73 A	FPE 30FEP-EMC/1X	252	453	245	23.0

*FrigoPack*E FMV
Economy Line
Kits

Product range	*Supply voltage*	*Output current*	*Product Code*	*Dimensions [mm] Width*	*Height*	*Depth*	*Weight [kg]*
Based on Frequency Inverters with internal EMC filter to class B protection – "book-style"							
FrigoPackE FMV	3AC 400 V	5.5 A	FPE 2.2FMV-EMC/1X	73	205	172	2.0
FrigoPackE FMV	3AC 400 V	6.8 A	FPE 3.0FMV-EMC/1X	96	262	202	3.3
FrigoPackE FMV	3AC 400 V	9.0 A	FPE 4.0FMV-EMC/1X	96	262	202	3.3
FrigoPackE FMV	3AC 400 V	12.0 A	FPE 5.5FMV-EMC/1X	96	262	202	3.3
FrigoPackE FMV	3AC 400 V	16.0 A	FPE 7.5FMV-EMC/1X	96	262	202	3.3
Based on Frequency Inverters with internal EMC filter to class A protection – "book-style"							
FrigoPackE FMV	3AC 400 V	5.5 A	FPE 2.2FMV-emc/1X	73	205	172	1.5
FrigoPackE FMV	3AC 400 V	6.8 A	FPE 3.0FMV-emc/1X	96	262	202	2.8
FrigoPackE FMV	3AC 400 V	9.0 A	FPE 4.0FMV-emc/1X	96	262	202	2.8
FrigoPackE FMV	3AC 400 V	12.0 A	FPE 5.5FMV-emc/1X	96	262	202	2.8
FrigoPackE FMV	3AC 400 V	16.0 A	FPE 7.5FMV-emc/1X	96	262	202	2.8
Based on Frequency Inverters with separate EMC filter to class B protection – for operation with an external controller							
FrigoPackEC FMV	3AC 400 V	5.5 A	FPEC 2.2FMV-EMC/1X	73	205	172	3.3
FrigoPackEC FMV	3AC 400 V	6.8 A	FPEC 3.0FMV-EMC/1X	96	262	202	3.3
FrigoPackEC FMV	3AC 400 V	9.0 A	FPEC 4.0FMV-EMC/1X	96	262	202	3.3
FrigoPackEC FMV	3AC 400 V	12.0 A	FPEC 5.5FMV-EMC/1X	96	262	202	3.3
FrigoPackEC FMV	3AC 400 V	16.0 A	FPEC 7.5FMV-EMC/1X	96	262	202	3.3

FrigoPack SM2 / SE3
Soft Starter
Kits

Product range	*Supply voltage*	*Output current*	*Product Code*	*Dimensions [mm] Width*	*Height*	*Depth*	*Weight [kg]*
Soft-start modules for compressors with a three-phase electrical supply							
FrigoPack SM2	3AC 400 V	6 A	FP 2.2SM2/T400/1X	45	75	120	0.42
FrigoPack SM2	3AC 400 V	12 A	FP 5.5SM2/T400/1X	45	75	120	0.43
FrigoPack SM2	3AC 400 V	6 A	FP 7.5SM2/T400/1X	45	75	120	0.48
FrigoPack SE3	3AC 230 ... 500 V	18 A	FP 4.0SE3-2X	168	220	110	2.2
FrigoPack SE3	3AC 230 ... 500 V	40 A	FP 11SE3-2X	168	220	145	3.5
FrigoPack SE3	3AC 230 ... 500 V	65 A	FP 22SE3-2X	168	320	145	3.9
FrigoPack SE3	3AC 230 ... 500 V	95 A	FP 37SE3-2X	168	220	170	4.2
FrigoPack SE3	3AC 230 ... 500 V	180 A	FP 75SE3-2X	260	415	250	15.7
FrigoPack SE3	3AC 230 ... 500 V	350 A	FP 160SE3-2X	350	450	365	43
FrigoPack SE3	3AC 230 ... 500 V	750 A	FP 400SE3-2X	540	738	400	71

KIMO Refrigeration HVAC

KIMO Refrigeration HVAC Ltd
D-90768 Fürth Hüttendorfer Weg 60
Tel: +49 911-8018778 Fax: +49 911-9976118
E-Mail: info@frigokimo.com http://www.frigokimo.com