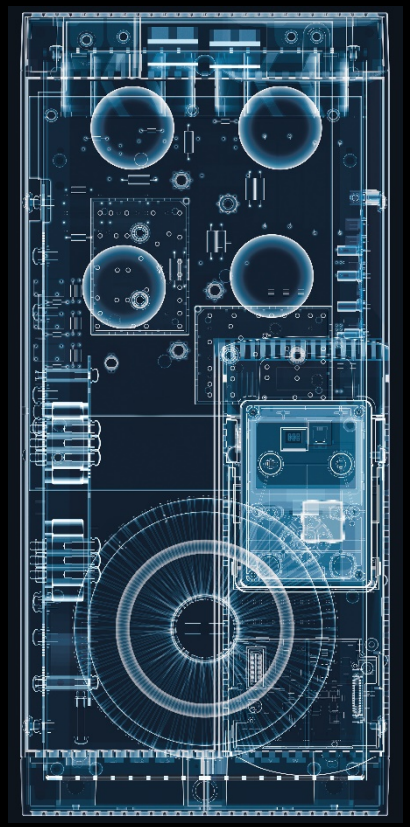
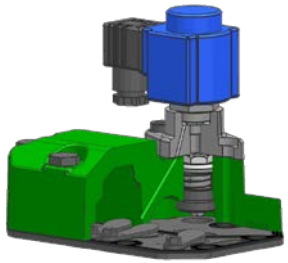


VARIPACK

Capacity regulation methods for BITZER reciprocating compressors

Sophisticated BITZER Solutions

CRII - System

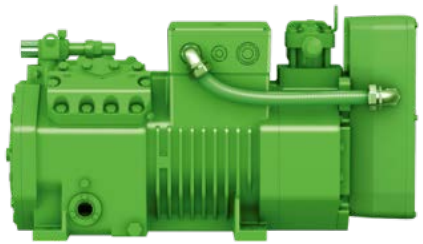


“The cheap way of enhanced capacity regulation”

VARIPACK NEW!

“The flexible solution. The easiest to use external frequency inverter”

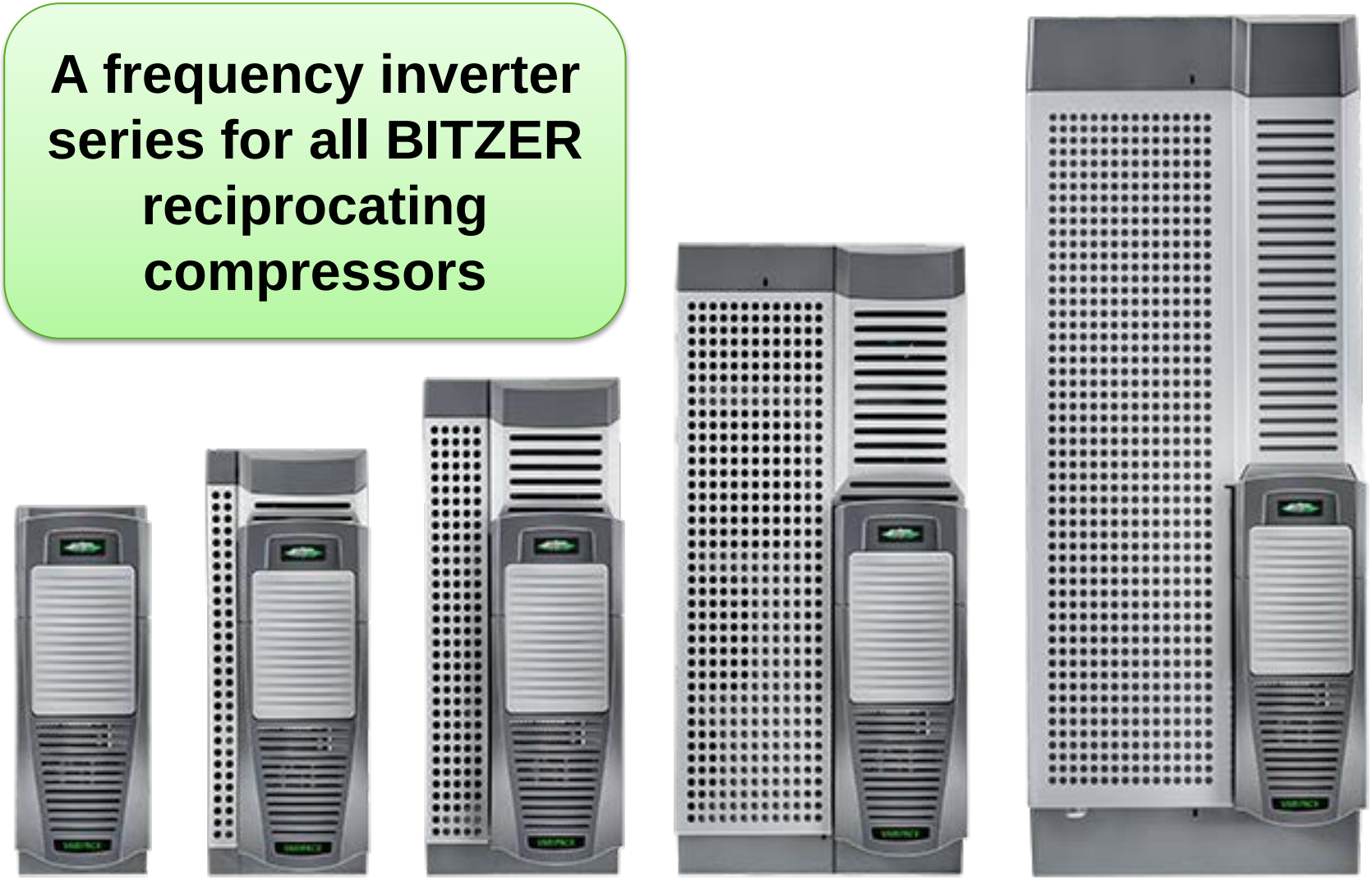
VARISPEED



“The easiest to use and most compact frequency inverter solution”

External BITZER frequency inverters (380 – 480 V)

A frequency inverter series for all BITZER reciprocating compressors



Technical details

General technical data

/ 380 – 480 V ± 10 %

/ IP20 → For switchboard mounting

/ Communication ports

- RS485: Modbus RTU
- Ethernet: Modbus TCP/IP, Webserver
- 2 x RS232 (for future extension cards)

/ Safe torque off (STO) → No mains/safety contactor required

/ Real time clock

/ EMC category C2 acc. EN61800-3 / corresponding to EN61000-6-4

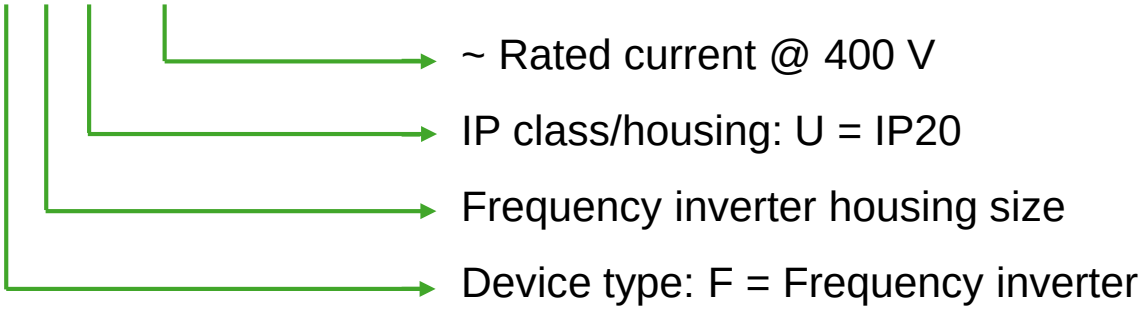
/ Approvals:

Brand name and nomenclature

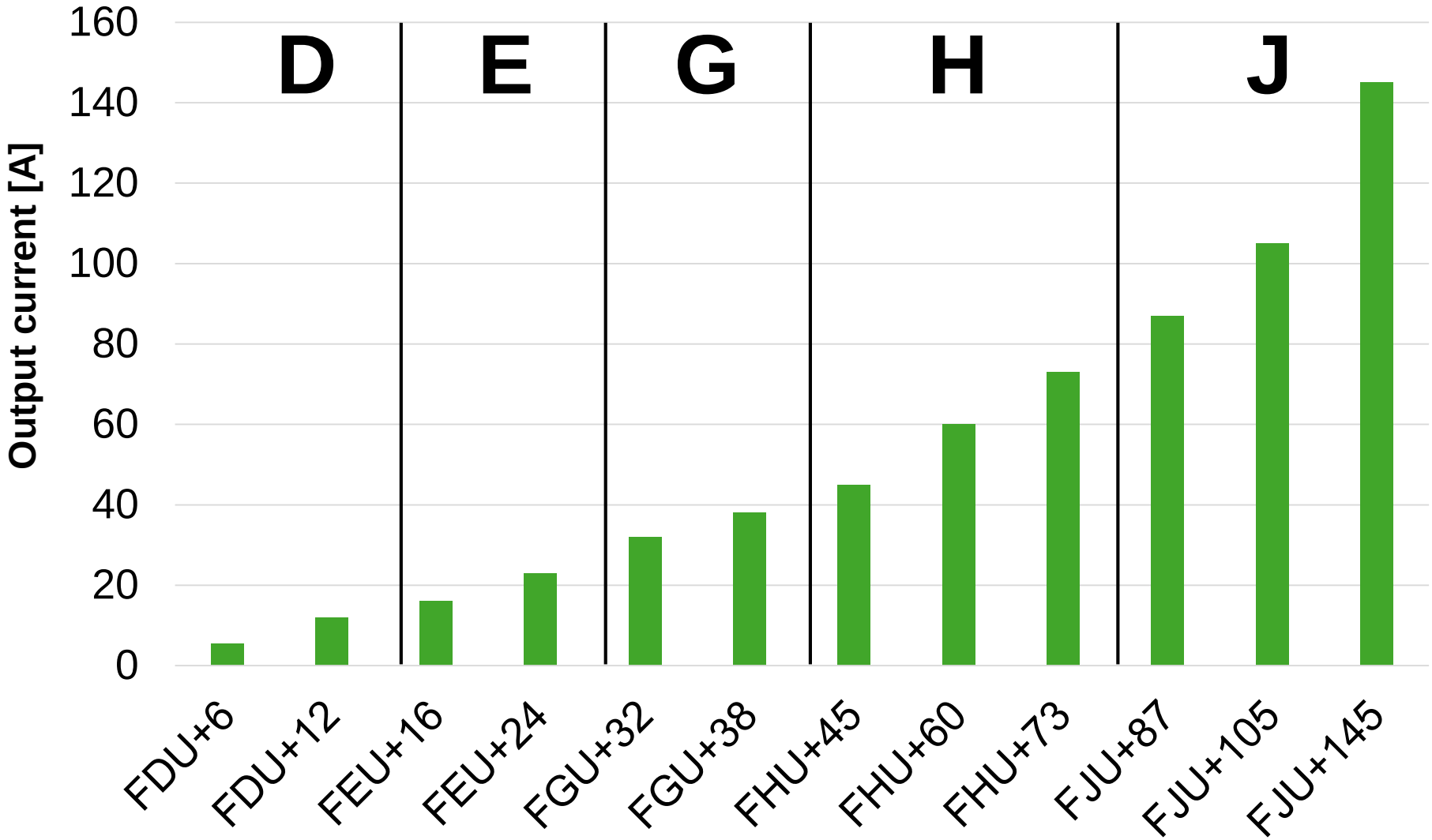
/ Brand name: **VARIPACK**

/ Nomenclature

- **FGU+38**



Power range (rated current vs. housing)



Available options

Frequency inverter	FDU+6	FDU+12	FEU+16	FEU+24	FGU+32	FGU+38	FHU+45	FHU+60	FHU+73	FJU+87	FJU+105	FJU+145
EMC filter for category C2 (according EN61800-3)	S	S	S	S	S							
Through-switch cabinet mounting kit	●	●	●	●	●							
BEST converter	●											
Removable display with key pad	●											
Display remote mounting kit (3 m)	●											
Extension kit for pressure regulation (12,5/33 bar(a))	●											

Legend:

/ S = Standard

/ ● = Available option

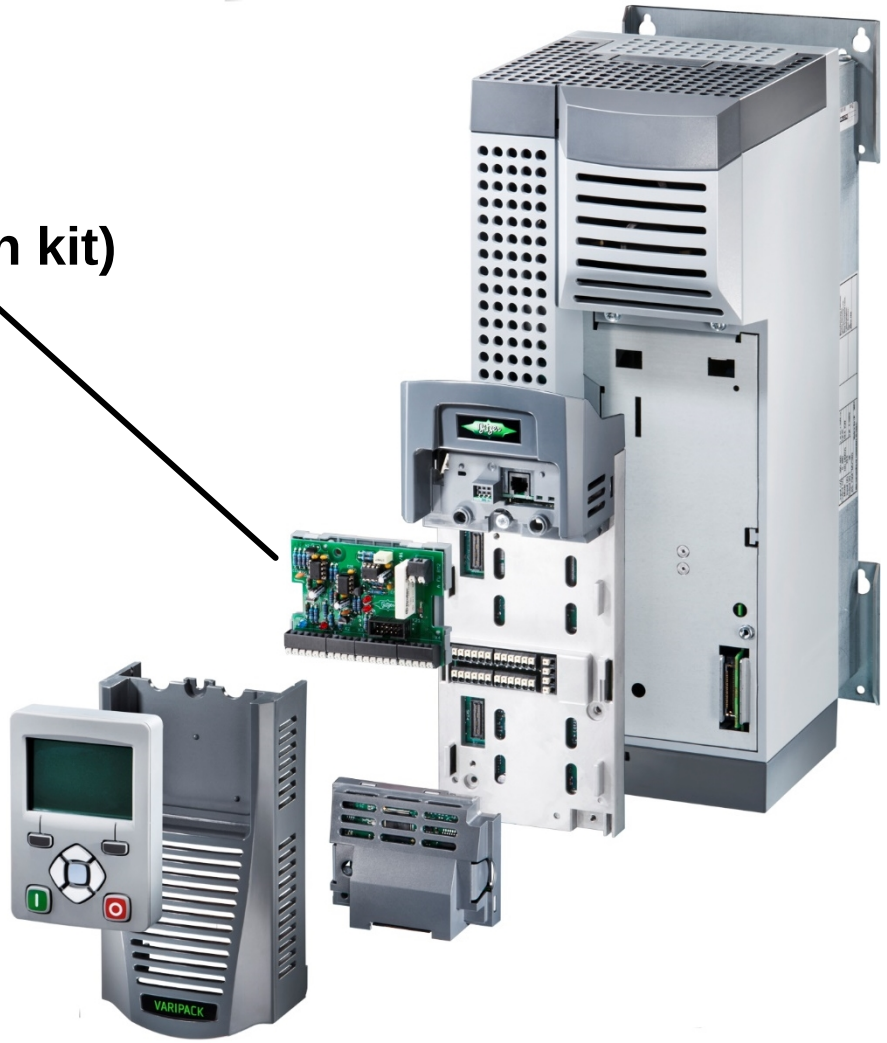
Operating modes

Operating modes

1. **External control**
2. **Evaporating and condensing pressure regulation (with option kit)**

/ General

- FI detects if an option card is mounted (and which one it is)
- Based on that, the FI changes automatically the control mode and visible parameters

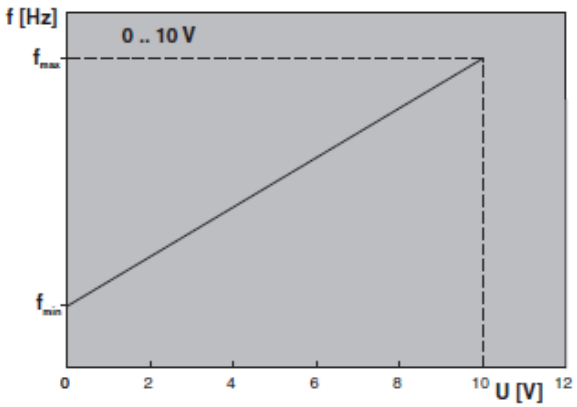


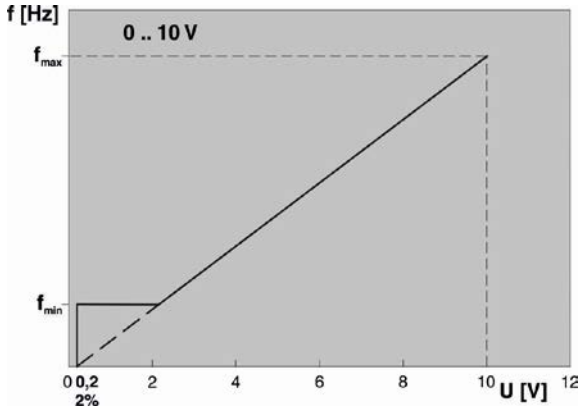
Operating modes: External control

/ **0 .. 10 V** or **4 .. 20 mA** signal can be used without parameter change

/ 2 control characteristics available

- “Min .. Max” (Standard)
  - Compressor starts when start signal is applied
  - External control signal corresponds to min. and max. frequency
- “0 .. Max”
  - Compressor starts when start signal + setpoint > 2 % are applied
  - External control signal corresponds to 0 Hz – max. frequency





Operating modes: Pressure regulation (1/2)

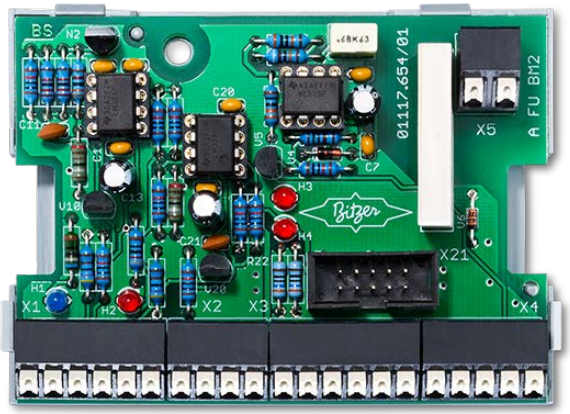
/ External controller not required anymore

/ **Features**

- **Direct evaporating pressure regulation**
- **Condenser fan regulation by 0 – 10 V output signal**
- **Control of another fixed speed compressor (FsCs)**

/ Pressure regulation kit includes

- Extension module for pressure regulation
- Low and High pressure transmitter (12,5 / 33 bar)
- Connection cables with 6 m in IP67



Operating modes: Pressure regulation (2/2)

/ Data for more than 35 refrigerants are integrated in the FIs

Refrigerant data integrated in the Frequency inverters							
R14	R22	R23	R134a	R152a	R170	R227ea	R236fa
R245fa	R290	R404A	R407A	R407C	R407F	R417A	R417B
R422A	R422D	R427A	R434A	R437A	R438A	R442A	R448A
R449A	R450A	R507A	R508A	R508B	R513A	R600	R600a
R1150	R1234yf	R1234ze	R1270				

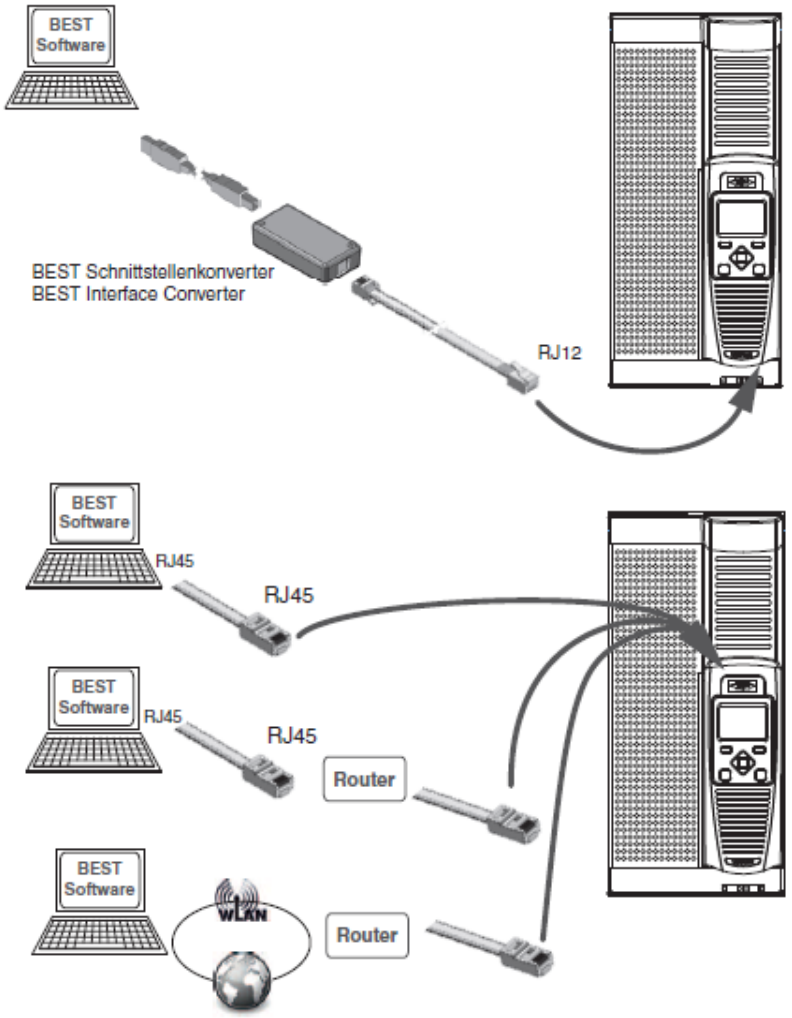
- Common safety measurements must be considered by flammable refrigerants
- R32, R410A, R717, R723 and R744 also implemented, but actually no pressure transducers available for these refrigerants

Communication with the VARIPACK

Communication with the VARIPACK (1/3)

/ **BEST**
(BITZER Electronics Service Tool)

- Recommended user interfaces
  - Most user-friendly one
  - Most powerful one
- Connection possibilities
  - Via BEST converter
  - Per Ethernet direct connection (crossed or not crossed cable)
  - Via the network (router with or without DHCP)



Communication with the VARIPACK (2/3)

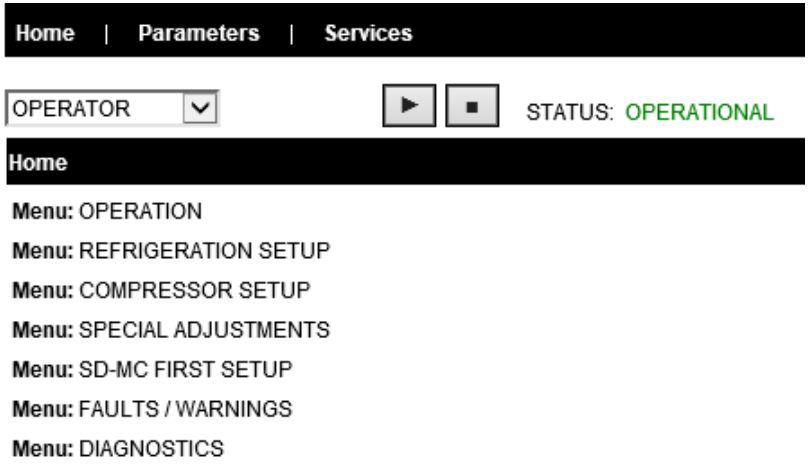
/ Removable Display with key pad (+ SD card)

- Multi-language
- SI and IP units selectable
- 2 modes for customers
  - ⇨ Standard
  - ⇨ Refrigeration technician (password protected)
- SD card includes the Compressor and Refrigerant databases

Communication with the VARIPACK (3/3)

/ Integrated Webserver

- Menu structure identical to the display
- For use with Smartphones and Apple PCs, for Windows devices the BEST Software is the preferred interface



/ For communication with superior controllers or building management systems

- Modbus RTU
- Modbus TCP/IP

Selection

Selection of the frequency inverters

/ The VARIPACK FIs will be fully implemented in the BITZER Software

/ They can be found under the button „**Accessories**“

/ The BITZER Software allows to select for each individual application, the optimum combination of compressor, frequency inverter and motor

/ Thanks to the visualisation of the application envelope, related to the actual selection, **it allows to design the most cost effective but still reliable solution without the need of having a lot of expertise** and doing several calculation steps.

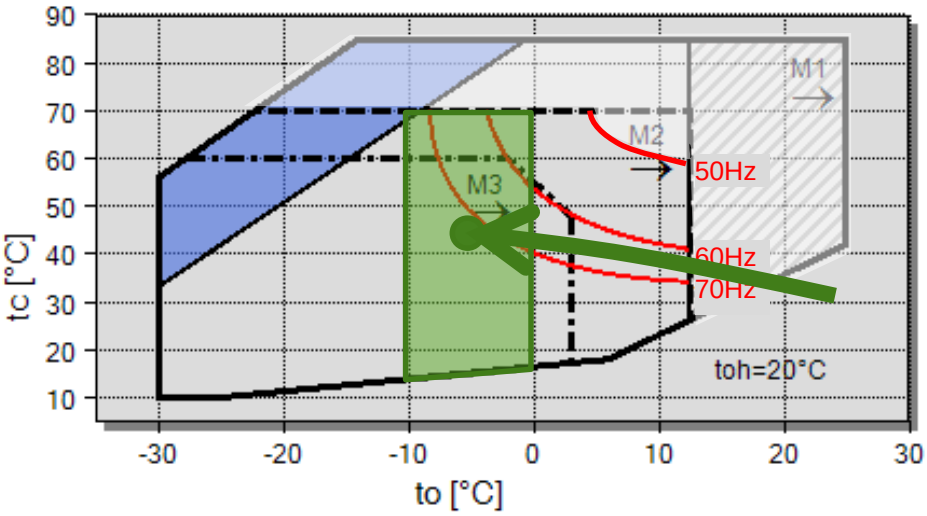
Selection example 1

/ **4CES-6Y; R134a; MT application**

- (-5 °C / 45 °C) ⇨ Q_0 = 17 kW @ 70 Hz
- I_{max} = 17,7 A ⇨ $I_{Starting}$ = 17,7 A * 1,6 = 28,3 A
  - ⇨ Standard selection: FEU+24

/ Looking into the BITZER Software

- ⇨ FDU+12 usually sufficient
- ⇨ 33 % cost savings
- ⇨ Or FEU+16 with reduced max. frequency limitation



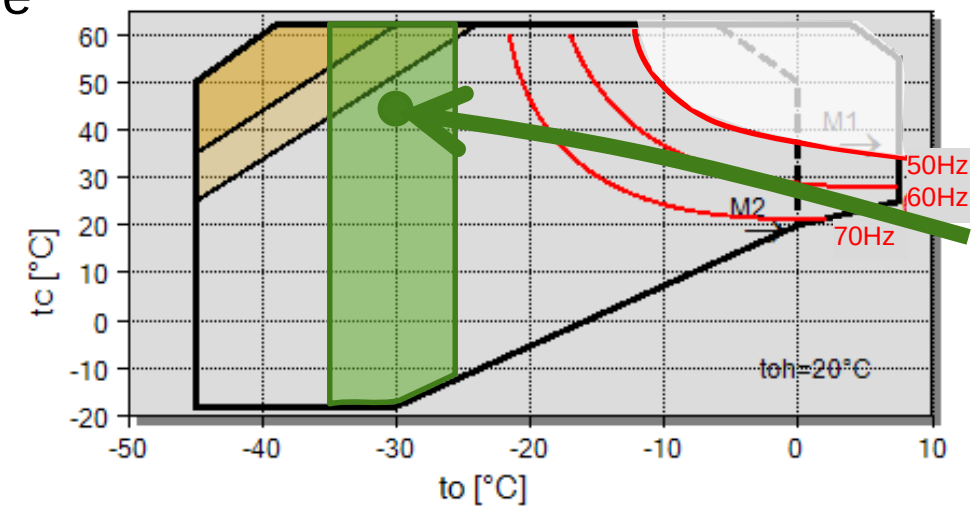
Selection example 2

/ **4NES-14Y; R404A; LT application**

- (-30 °C / 45 °C) ⇨ Q_0 = 5,5 kW @ 70 Hz
- I_{max} = 26,6 A ⇨ $I_{Starting}$ = 26,6 A * 1,6 = 42,6 A
  - ⇨ Standard selection: FGU+32

/ Looking into the BITZER Software

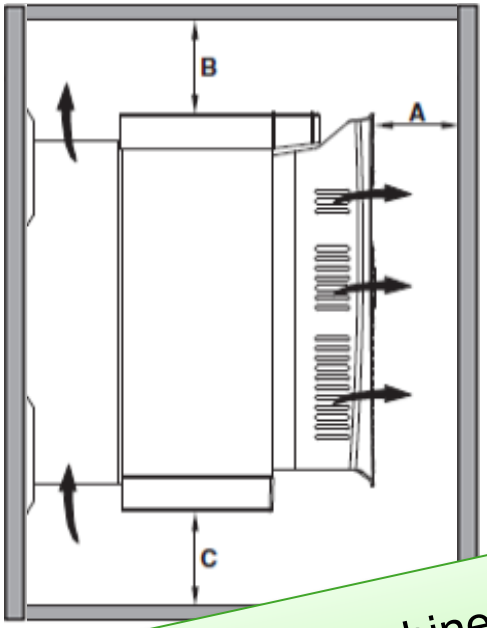
- ⇨ FEU+24 usually sufficient
- ⇨ 20 % cost savings



Installation

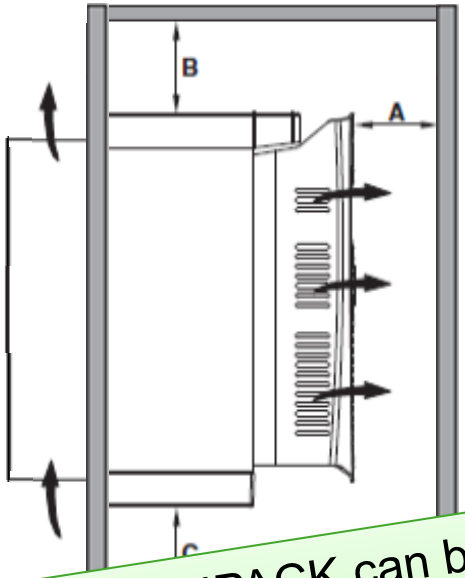
Mounting possibilities

/ Switch cabinet mounting



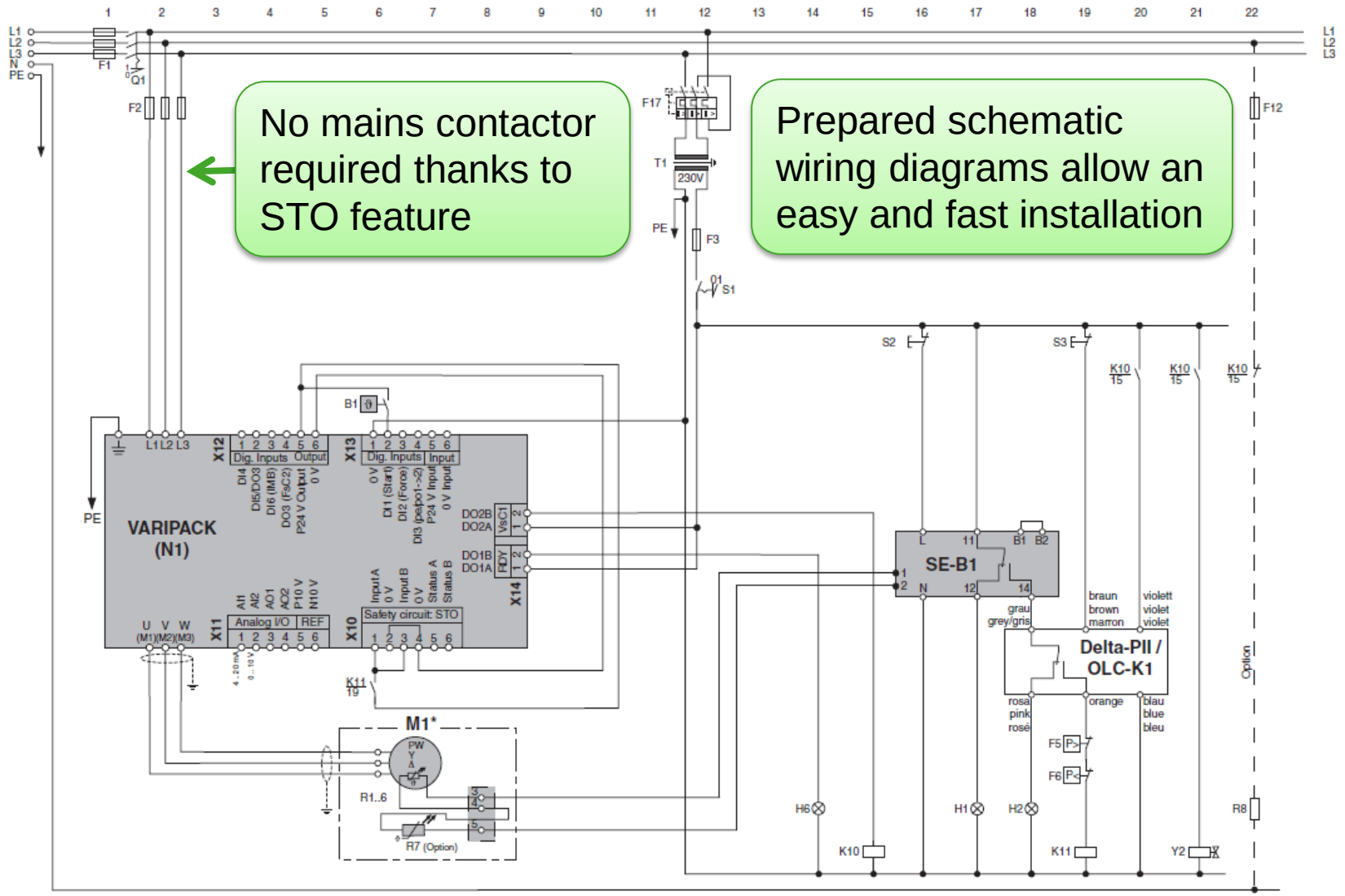
- “Trough-switch cabinet mounting kit” not required
- Faster installation

/ Through-switch cabinet mounting

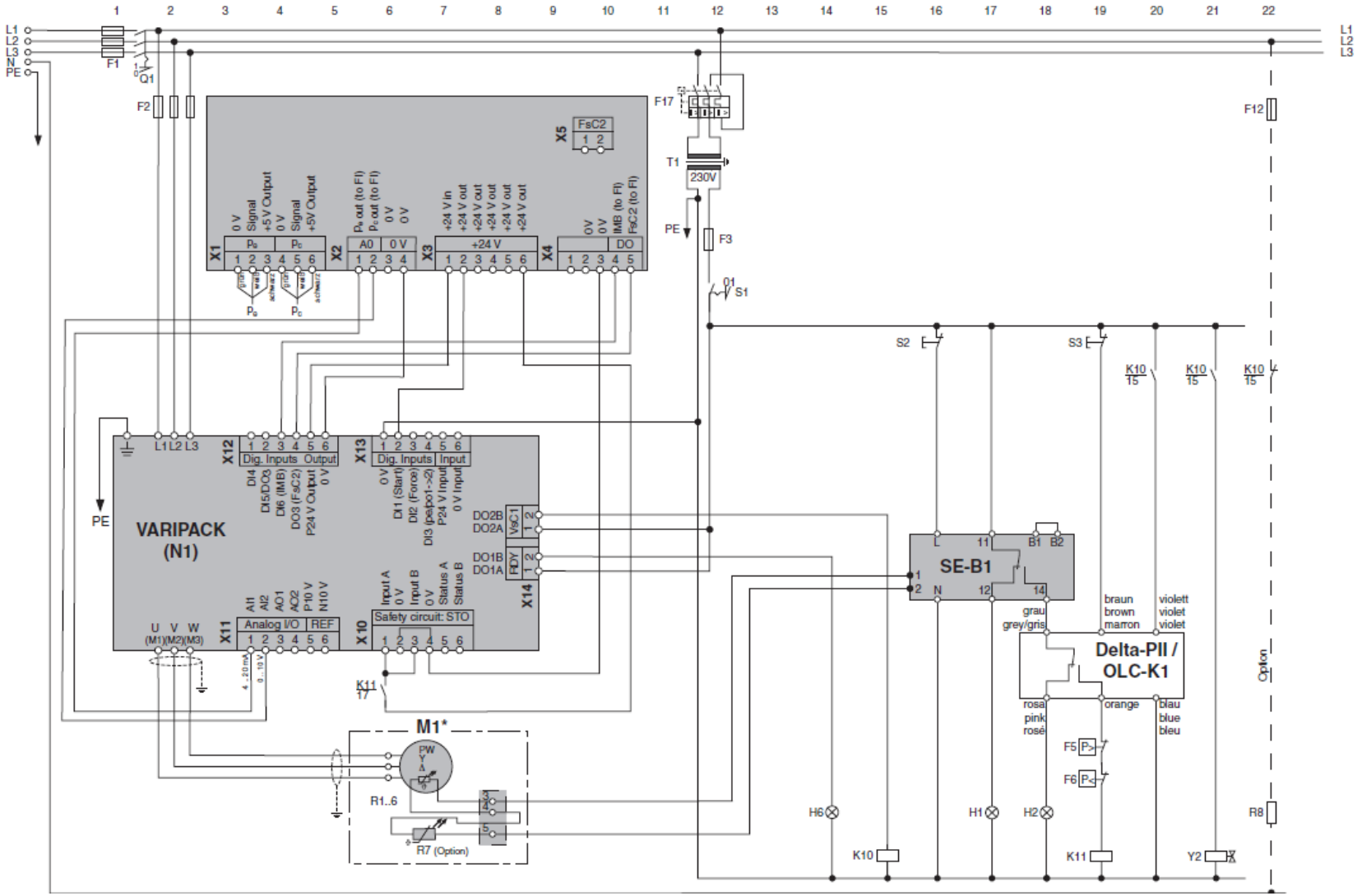


- The VARIPACK can be kept clean and dry more easily
- The ventilation of the switch cabinet can be reduced to a minimum

Schematic wiring diagram: External control

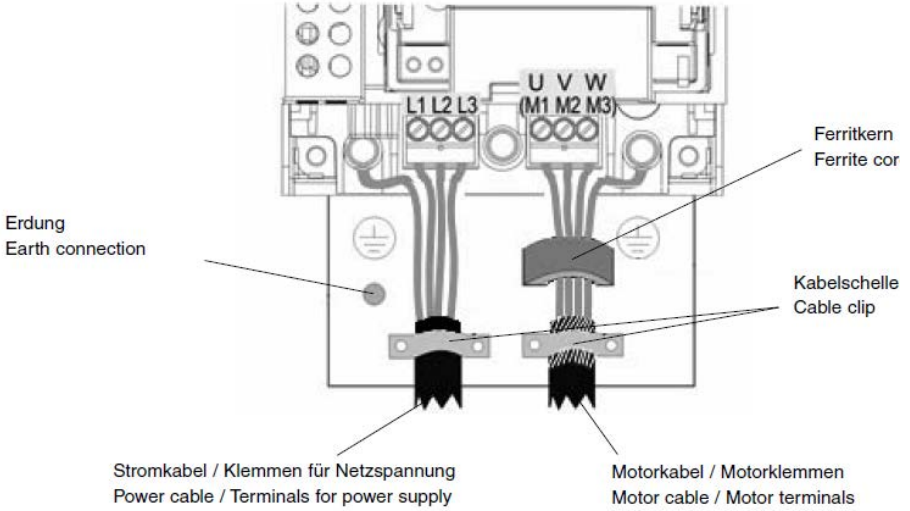


Schematic wiring diagram: Pressure control



Some words about EMC

- In general, EMC is a quite manifold and complex topic
- Our approach to reduce the risk of EMC issues
  - EMC C2 filters as standard up to FJU+145
  - Providing practical and clear hints and recommendations



	FI	FDU	FEU	FGU	FHU	FJU	FKU
Conducted emissions	EN 61800-3						
	Category C1	Specific filter in preparation	Specific filter in preparation	Specific filter in preparation	Unsuitable	Unsuitable	Unsuitable
	Category C2	Motor cable ≤ 10 m	Motor cable ≤ 10 m	Motor cable ≤ 10 m	Motor cable ≤ 10 m	Motor cable ≤ 10 m	Specific filter (upon request)
	Category C3	Motor cable ≤ 50 m	Motor cable ≤ 50 m	Motor cable ≤ 50 m	Motor cable ≤ 50 m	Motor cable ≤ 50 m	To be defined

Commissioning

Today‘s situation

No.	Overview User Setting
1	Language Selection
2	Access Level Selection
3	Control Method Selection
4	Initialize Parameters
5	Password
6	Password Setting
7	Application Preset
8	User Parameters 1 to 32
9	User Parameter Automatic Selection
10	Frequency Reference Selection 1
11	Run Command Selection 1
12	Stopping Method Selection
13	Reverse Operation Selection
14	Action Selection below Minimum Outp
15	Digital Input Reading
16	LOCAL/REMOTE Run Selection
17	Run Command Selection while in Pro
18	Phase Order Selection
19	Frequency Reference Selection 2
20	Run Command Selection 2
21	Run Command at Power Up
22	Start Condition Selection at Closed Lo
23	DC Injection Braking Start Frequency
24	DC Injection Braking Current
25	DC Injection Braking Time at Start
26	DC Injection Braking Time at Stop
27	Magnetic Flux Compensation Value
28	Short Circuit Brake Time at Start
29	Short Circuit Brake Time at Stop
30	Short Circuit Braking Current
31	Speed Search Selection at Start
32	Speed Search Deactivation Current
33	Speed Search Deceleration Time
34	V/f Gain during Speed Search
35	Speed Search Delay Time
36	Output Current 1 during Speed Searc
37	Output Current 2 during Speed Searc
38	Current Control Gain during Speed Se
39	Estimation Type)
40	Speed Search Detection Compensati
41	Minimum Current Detection Level dur
42	Bi-Directional Speed Search Selectio
43	Speed Search Restart Current Level
44	Speed Search Restart Detection Time
45	Number of Speed Search Restarts
46	Speed Search Method Selection
47	Speed Search Wait Time
48	Direction Determining Level
49	Start Speed Search Select
50	Speed Search Induced Voltage Level
51	Speed Search Selection whe
52	Timer Function On-Delay Tir
53	Timer Function Off-Delay Tir
54	H2-01 ON Delay Time
55	No. Name User
56	Setting
57	H2-01 OFF Delay Time
58	H2-02 ON Delay Time
59	H2-02 OFF Delay Time
60	H2-03 ON Delay Time
61	H2-03 OFF Delay Time
62	PID Function Setting
63	Proportional Gain Setting (P
64	Integral Time Setting (I)
65	Integral Limit Setting
66	Derivative Time (D)
67	PID Output Limit
79	PID Setpoint Selection
80	<2> PID Setpoint Value
81	PID Setpoint Scaling
82	PID Output Lower Limit
83	PID Input Limit
84	PID Feedback High Detectio
85	PID Feedback High Detectio
86	PID Setpoint User Display
87	PID Setpoint Display Digits
88	Frequency Reference Monit
89	PID Output Reverse Selectio
90	Dwell Reference at Start
91	Dwell Time at Start
92	Dwell Reference at Stop
93	Dwell Time at Stop
94	Droop Control Gain
95	Droop Control Delay Time
96	Droop Control Limit Selectio
97	Energy Saving Control Selec
98	Energy Saving Gain
99	Energy Saving Control Filter
100	Energy Saving Coefficient V
101	Power Detection Filte
102	Search Operation Vo
103	Energy Saving Paran
104	Energy Saving Paran
105	Zero Servo Gain
106	Zero Servo Completic
107	Acceleration Time 1
108	Deceleration Time 1
109	Acceleration Time 2
110	Deceleration Time 2
111	Acceleration Time 3 (
112	Deceleration Time 3 (
113	Acceleration Time 4 (I
114	Deceleration Time 4 (
115	<2> Fast-Stop Time
116	Accel/Decel Time Set
117	Accel/Decel Time Sw
128	Modulation)
129	Maximum Output Vol
130	Modulation)
131	Output Voltage Limit
132	Motor 2 Slip Compen
133	Motor 2 Slip Compen
134	Motor 2 Slip Compen
135	Motor 2 Slip Compen
136	Torque Compensatio
137	Torque Compensatio
138	Torque Compensatio
139	Torque Compensatio
140	Torque Compensatio
141	Torque Compensatio
142	Motor 2 Torque Comp
143	ASR Proportional Ga
144	ASR Integral Time 1
145	ASR Proportional Ga
146	ASR Integral Time 2
147	ASR Limit
148	ASR Primary Delay T
149	ASR Gain Switching
150	ASR Integral Limit
151	Integral Operation during
152	Motor Inertia
153	Load Inertia Ratio
154	Motor 2 ASR Proportiona
155	Motor 2 ASR Integral Tim
156	Motor 2 ASR Proportiona
157	Motor 2 ASR Integral Tim
158	Motor 2 ASR Limit
159	Motor 2 ASR Primary De
160	Motor 2 ASR Gain Switch
161	Motor 2 ASR Integral Lim
162	Integral Operation during
163	Motor 2 Inertia
164	Motor 2 Load Inertia Rati
165	<1> ASR Primary Delay
166	Drive Duty Selection
167	Carrier Frequency Select
169	Carrier Frequency Lower
172	Frequency Reference 1
173	Frequency Reference 2
174	Frequency Reference 3
179	No. Name User
180	Setting
181	Frequency Reference 8
182	Frequency Reference 9
183	Frequency Reference 10
184	Frequency Reference 11
185	Frequency Reference 12
186	Frequency Reference 13
187	Frequency Reference 14
188	Frequency Reference 15
189	Frequency Reference 16
190	Jog Frequency Referenc
191	Frequency Reference Up
192	Frequency Reference Lo
193	Master Speed Reference
194	Jump Frequency 1
195	Jump Frequency 2
196	Jump Frequency 3
197	Jump Frequency Width
198	Frequency Reference Ho
199	Frequency Reference Bia
200	Frequency Reference Bia
201	Frequency Reference Bias (Up
202	Analog Frequency Reference F (Up/Down 2)
203	Frequency Reference Bias Upp (Up/Down 2)
204	Frequency Reference Bias Low (Up/Down 2)
205	Up/Down Frequency Referenc
206	Bi-directional Output Selection
207	Stop Position Gain
208	Torque Control Selection
209	Torque Reference Delay Time
210	Speed Limit Selection
211	Speed Limit
212	Speed Limit Bias
213	Speed/Torque Control Switcho
214	Unidirectional Speed Limit Bias
215	Field Weakening Level
217	Field Forcing Selection
220	Offset Frequency 2
221	Offset Frequency 3
222	Input Voltage Setting
223	V/f Pattern Selection
226	Base Frequency
227	Middle Output Frequency
228	Middle Output Frequency Volta
229	Minimum Output Frequency
230	Minimum Output Frequency Vo
231	Middle Output Frequency 2
232	Middle Output Frequency Volta
233	Base Voltage
234	Motor Rated Current
235	Motor Rated Slip
236	Motor No-Load Current
237	Number of Motor Poles
238	Motor Line-to-Line Resistance
239	Motor Leakage Inductance
240	Motor Iron-Core Saturation Coe
241	Motor Iron-Core Saturation Coe
242	Motor Mechanical Loss
243	Motor Iron Loss for Torque Cor
244	Motor Rated Power
245	Motor 2 Control Mode Sele
246	Motor 2 Maximum Output
247	Motor 2 Maximum
248	Motor
251	Motor 2 Minimum Output Frequency
252	Motor 2 Minimum Output Frequency Voltage
253	Motor 2 Mid Output Frequency 2
254	Motor 2 Mid Output Frequency Voltage 2
255	Motor 2 Base Voltage
256	Motor 2 Rated Current
257	Motor 2 Rated Slip
258	Motor 2 Rated No-Load Current
259	Motor 2 Motor Poles
260	Motor 2 Line-to-Line Resistance
261	Motor 2 Leakage Inductance
262	Motor 2 Motor Iron-Core Saturation Coefficient 1
263	Motor 2 Motor Iron-Core Saturation Coefficient 2
264	Motor 2 Mechanical Loss
265	Motor 2 Iron Loss
266	Motor 2 Rated Power
267	Motor Code Selection (for PM Motors)
268	Motor Rated Power (for PM Motors)
269	Motor Rated Current (for PM Motors)
270	Number of Motor Poles (for PM Motors)
271	Motor Stator Resistance (for PM Motors)
272	Motor d-Axis Inductance (for PM Motors)
273	Motor q-Axis Inductance (for PM Motors)
274	Motor Induction Voltage Constant 1 (for PM Motors)
275	Encoder Z-pulse Offset (for PM Motors)
276	Motor Induction Voltage Constant 2 (for PM Motors)
277	Polarity Switch for Initial Polarity Estimation (for PM Motors)
278	PG 1 Pulses Per Revolution
279	Operation Selection at PG Open Circuit (PGo)
280	Operation Selection at Overspeed (oS)
281	Operation Selection at Deviation
282	PG 1 Rotation Selection
283	PG 1 Division Rate for PG Pulse Monitor
284	Overspeed Detection Level
285	Overspeed Detection Delay Time
286	Excessive Speed Deviation Detection Level
287	Excessive Speed Deviation Detection Delay Time
288	PG 1 Gear Teeth 1
289	PG 1 Gear Teeth 2
290	PG Open-Circuit Detection Time
291	dv3 Detectio
292	dv4

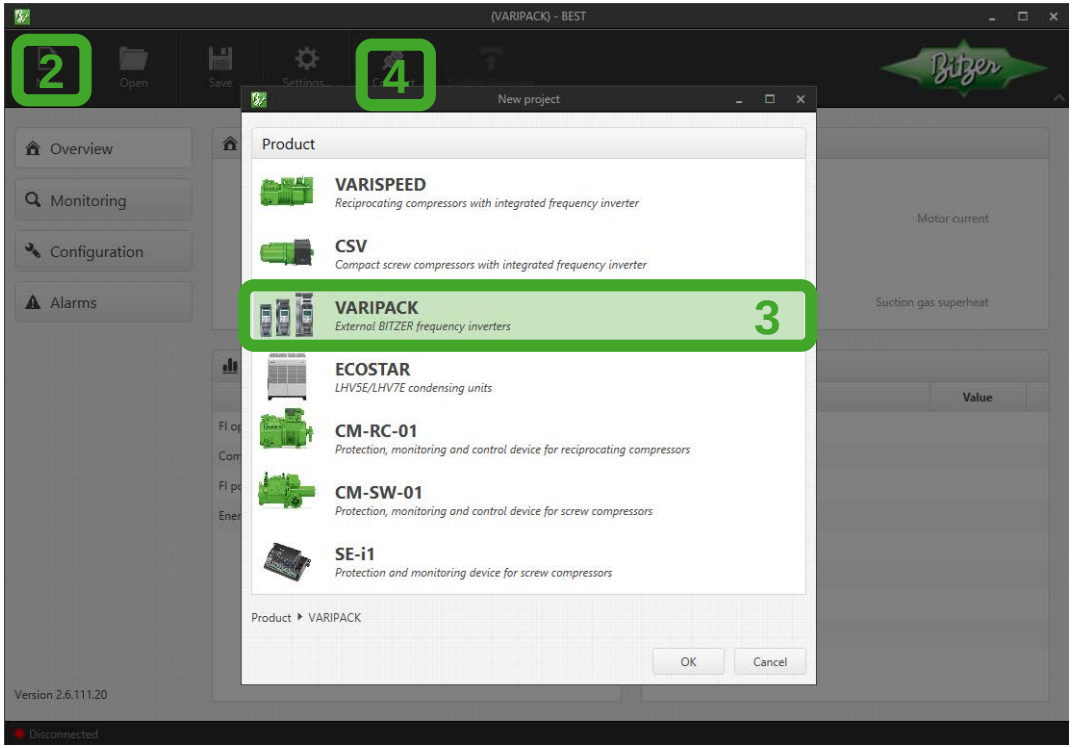
1. Up to 500 inverter settings

2. Inverter expert often required

	PG 2 Rotation Sele
298	PG 2 Gear Teeth 1
299	PG 2 Gear Teeth 2
300	**+ ~200 further parameters**

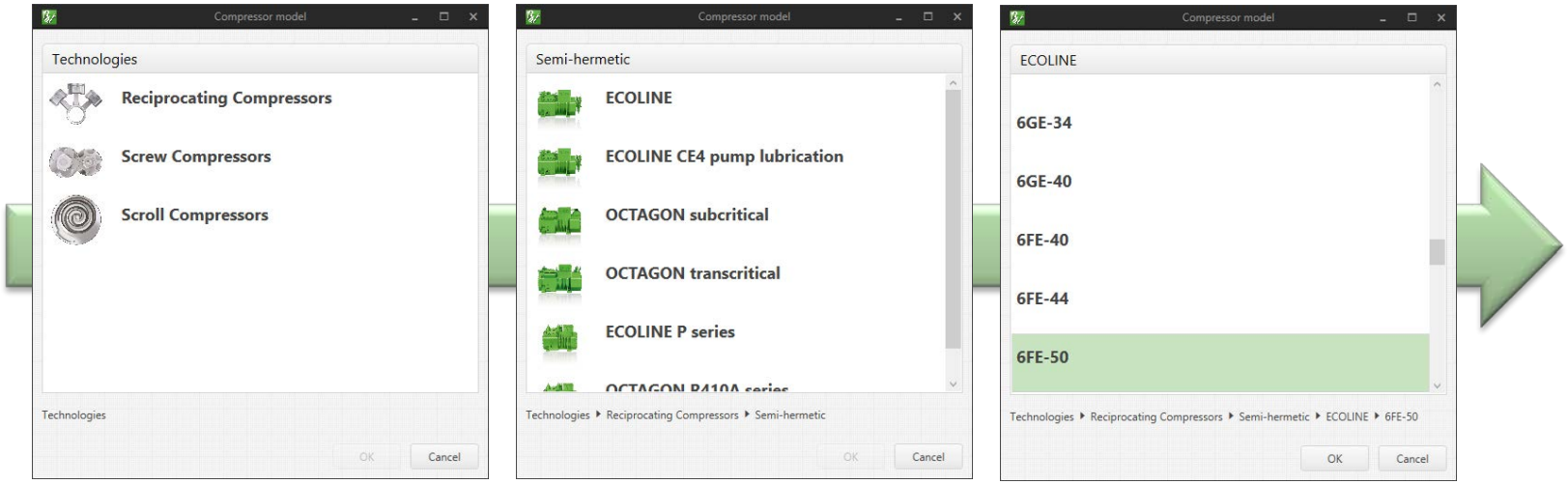
Connect to a VARIPACK

1. Start BEST
2. Click “New”
3. Select “VARIPACK”
4. Click “Connect”
5. Select “BEST converter” or “Ethernet”
6. Done



Configuring a VARIPACK for external control

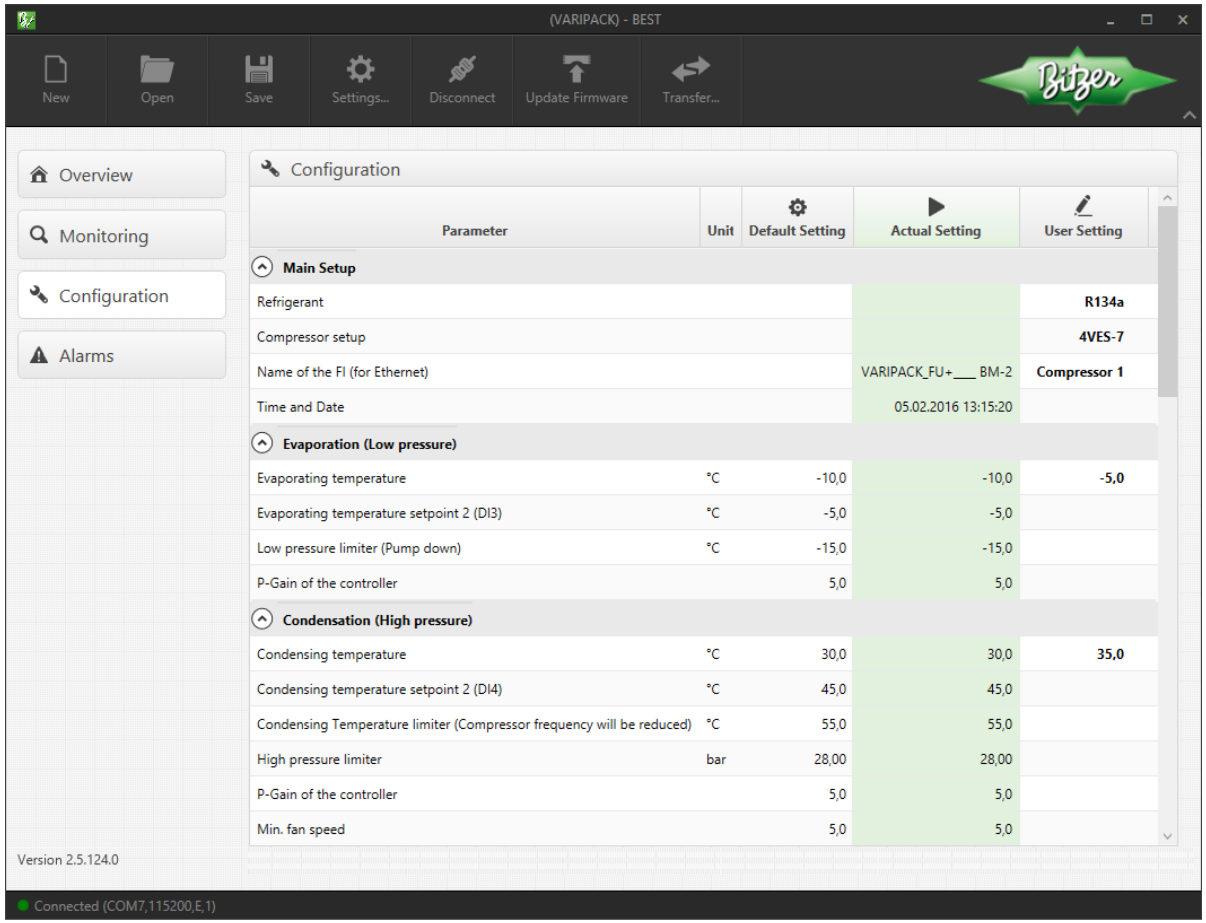
1. Go to the tab “Configuration”
2. Click on the parameter “Compressor” and select the compressor



3. Click on “Transfer…”, select “Transfer user values to device”
4. Main Configuration is done

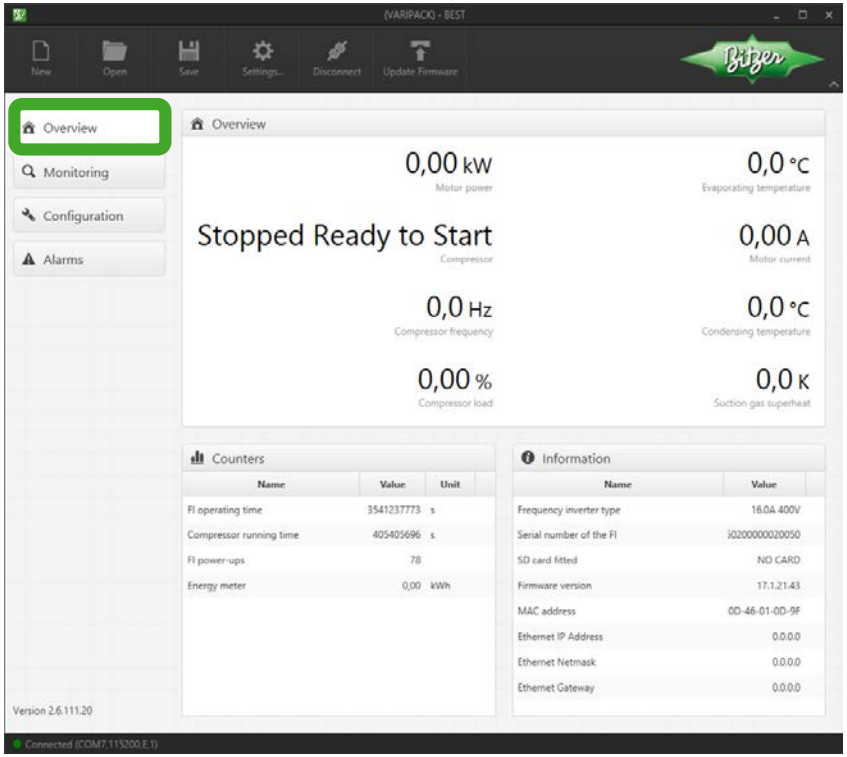
Configuring a VARIPACK for pressure control

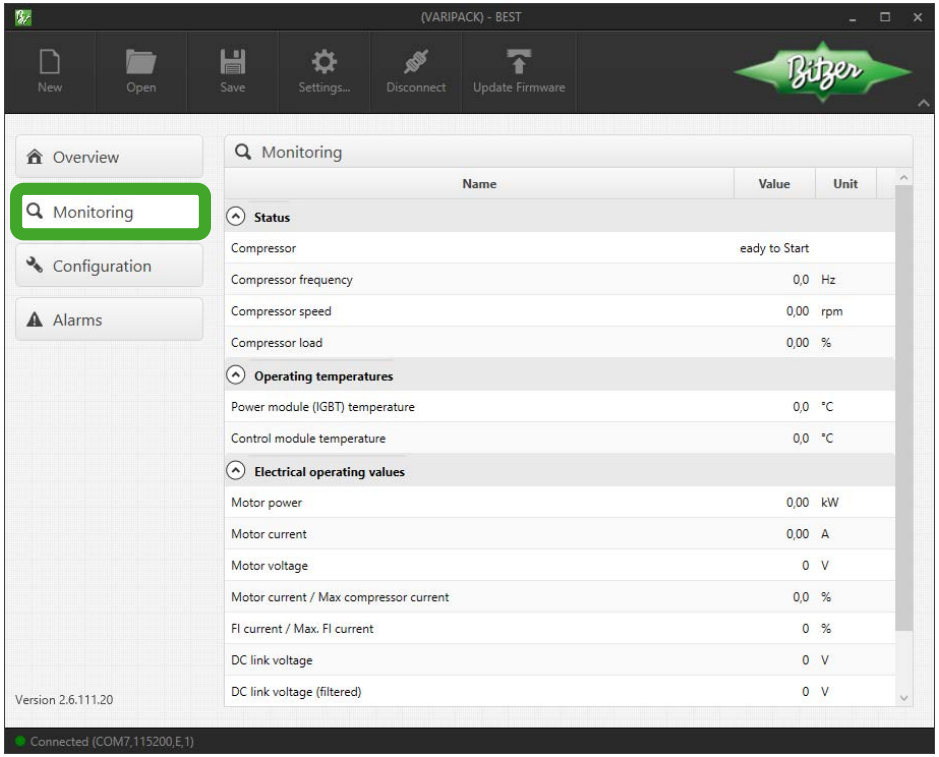
1. Select the “Compressor” as just described
2. Select the “Refrigerant”
3. Adapt the temperature and pressure settings if necessary
4. Transfer the changes
5. Done



Monitoring the operation

- The most important parameters are visible on the „Overview“ tab
- All monitoring parameters are shown on the „Monitoring“ tab
- Graphical visualisation will follow





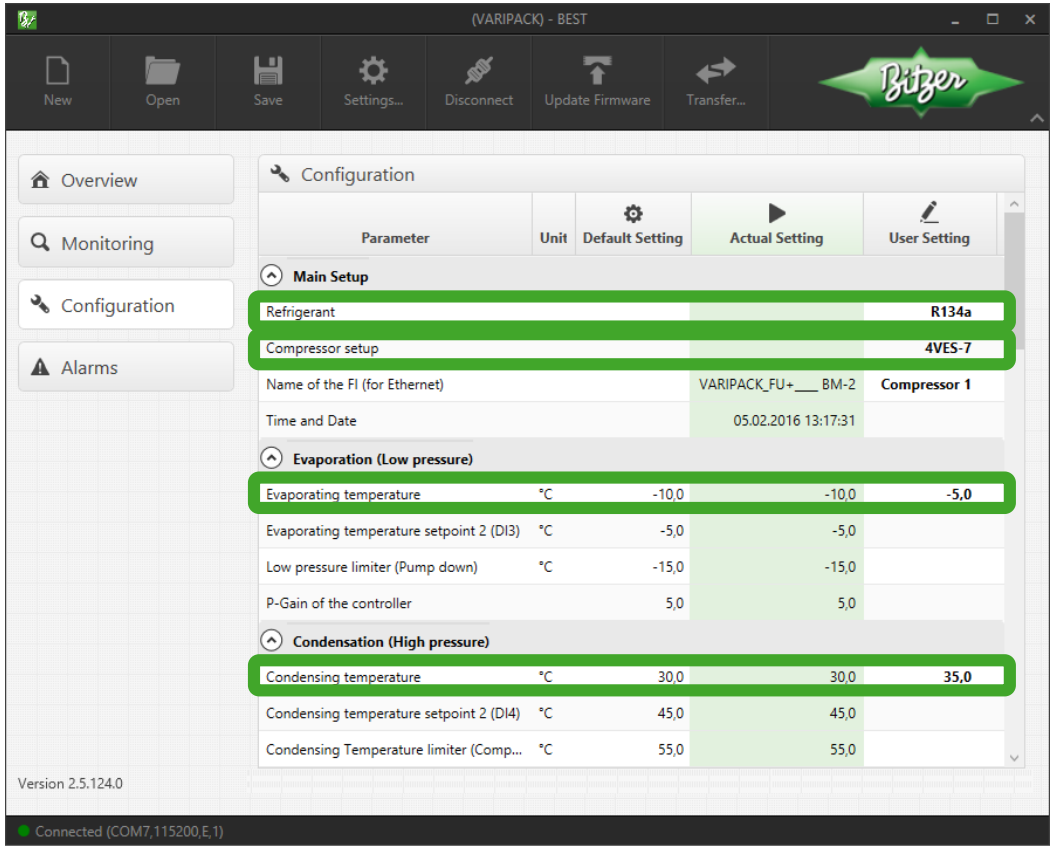
Summary: Frequency inverter configuration

/ External control

- 1 Parameter required to get the compressor up and running

/ Pressure control

- 4 Parameters required to get a system up and running



Miscellaneous and Summary

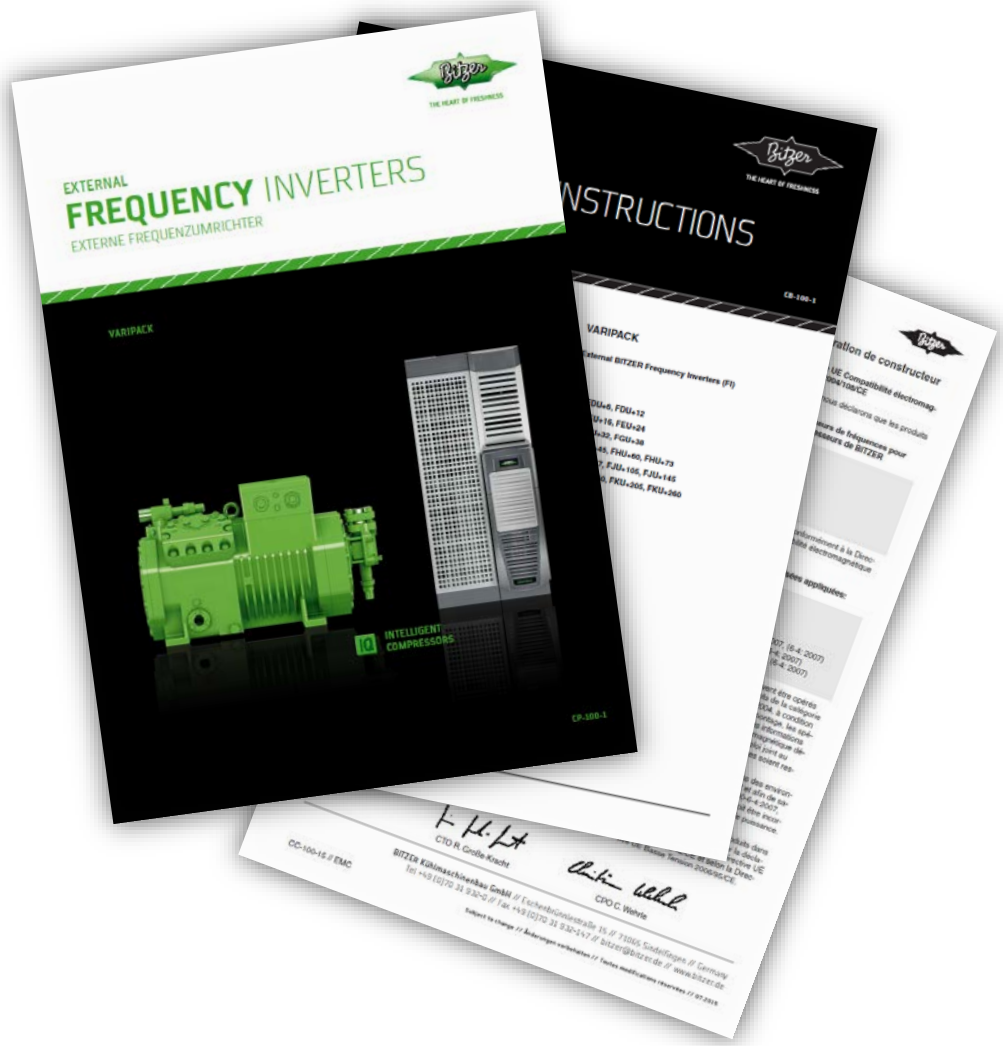
Documentation

/ Leaflet
- CP-100-1

/ Operating instructions
- CB-100-1

/ Declaration of conformity
- CC-100-15 + CC-101-15

/ Reference guide (Modbus Programming)
- CG-100-1
- In preparation



Extract of the product highlights

/ **Easy**

- Automatic and optimum selection by the BITZER Software
- Easy commissioning by the BEST Software

/ **Safe**

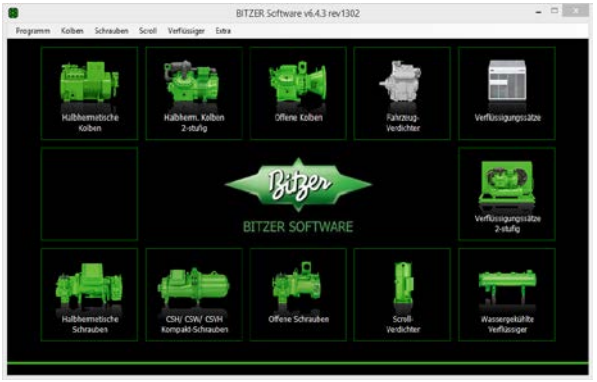
- VARIPACK + BITZER compressors are adapted to each other, tested and optimised

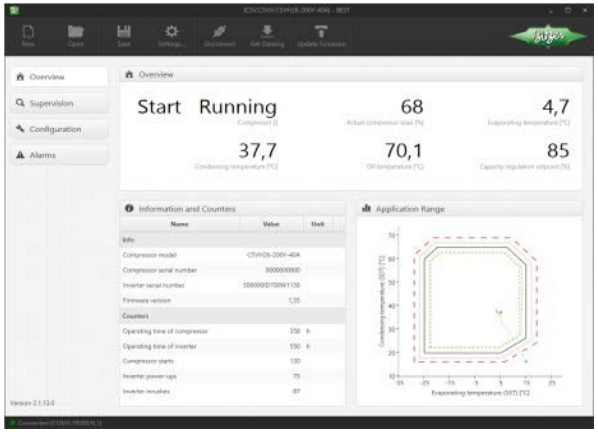
/ **Intelligent**

- During trans-synchronous operation, the maximum frequency is automatically limited according the load

/ **With surplus values**

- System control is possible via extension module





BENEFIT – BITZER **VARIPACK**

Easy to **select**

Easy to **install**

Easy to **support**

SOPHISTICATED SIMPLICITY

results in

SAFETY & RELIABILITY

… and not in time consuming phone calls from frustrated installers lost in configuration menus.

THE HEART OF FRESHNESS