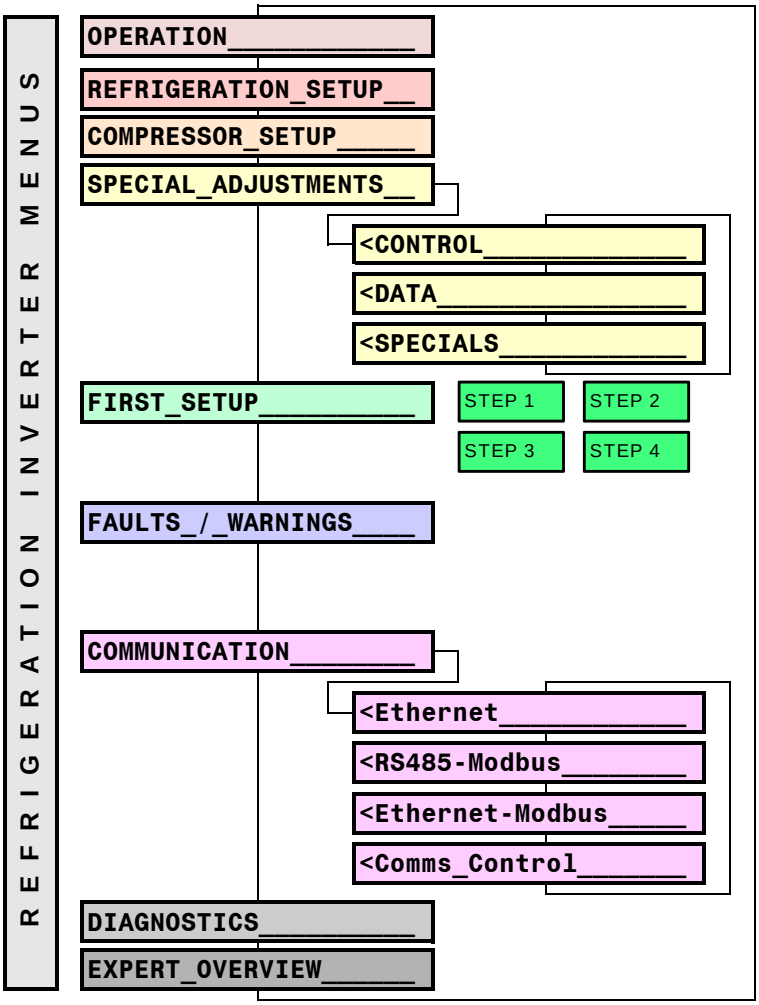
PLANNING GUIDE: *FrigoPack*®E FU+

KIMO RHVAC Controls

FrigoSoft 1.7 activated: Basic Pressure Control

FrigoPack® FU+
A New Generation

Intelligent Refrigeration Control Systems for Compressors, Condensers, HVAC & Pumps



Manufacturer	Agent / Partner	Customer	Installation	Name, Date
KIMO RHVAC Controls Ltd German Branch Hüttendorfer Weg 60 D-90768 Fürth, Germany www.frigokimo.com				

FrigoSoft 1.7 activated: Basic Pressure Control

OPERATION

Top Menu

Automatic (10 min)

				Password
View Level	OPERATOR	Operator, End Customer	Monitoring operation	None
	TECHNICIAN	Refrigeration technician	Refrigeration Contractor, Installer	Yes
	ENGINEER	KIMO RHVAC Controls	Special optimization, hotline support	Superuser
Language	ENGLISCH	English, French, German, Spanish, Italian, Dutch, Turkish, L7, L8, L9,		None
0	See Page 10: NO/YES	Resetting to factory settings, loading firmware and application		Yes

First 16 characters configurable (see p. 6)

FrigoPack_FU+_/11 BM-1
23 A 400 V
1.9.1
123.456.789.012

Alternatives depending on Option Modules fitted:

EXTN	BM-1	EM-1	EM-2	EM-6	EM-7	EM-8	...	...	Operating
Rating of Power Module									
Firmware									
IP address									

DIAGNOSTICS
OPERATION
REFRIGERATION SETUP

Menu OPERATION of operating observation parameters: Users

Measured Values

			Type / Value	Explanation	Further inform.
Compressor rack:	1	02:ted__RACK_tcd_____ Y.Y °C YY.Y °C	Calculated values ___._ °C ___._ °C	Saturated gas temperatures (dew): Evaporating and Condensing	3.1
	2	03:pe___RACK_pc_____ Y.Y bar YY.Y bar	Measured values ___._ bar ___._ bar	Gas pressures: Suction and Discharge gas	
Variable-speed Compressor (VsC):		04:ted__RACK_tcm_Diff Y.Y K Y.Y K	Deviations ___._ K ___._ K	Temp. Deviations from setpoints: Evaporating and Condensing	
		06:Spd__VsC__Power___ YYYY/min YYY kW	Internal value ____/min __.__ kW	Motor: Speed, Electrical power	1.1
Internal status:	3	08:Start_____Sl-Lm-Cp YYYY YYYY YYYY	Status values ____ ____ ____	Right: Seq.-Lmts-CpctyCntrl-Compr Left: ARS--AttmptsLeft-Time to start	2.1
			XXXX XXXX XXX1	VFsC1 V(F)sC2 FsC3 FsC4 FsC5... (Compressors running)	(Gray-Code: 0..F)
			XXXX XXXX XXX2		
			XXXX XXXX XXX4		
			XXXX XXXX XXX8		
			XXXX XXXX XX1X		
			XXXX XXXX XCXX	Capacity Control (CC):	Active
			XXXX XXXX X1XX / XDXX	tcd limit	tcd limit / +CC (Active limits)
			XXXX XXXX X2XX / XEXX	I limit	I limit / +CC
			XXXX XXXX X3XX / XFXX	tcd + I limits	tcd + I limits / +CC
			XXXX XXXX YXXX	0 1 2 3 4 5 6 7 8 9 A B C D	Sequencing State
			XXXX XYYY XXXX	Time to next possible start in s	
			XXXX YXXX XXXX	Auto Restart: Remaining Attempts	
			XXXX XFFF FXXX	Fault (Trip)	
			XXXX XEEE EXXX	Fault, No auto restarts left	
			YYYY XXXX XXXX	Rotation: Remaining time (automatic extending)	
				Key '1' pressed while running: *- Constant: Time to one FsC stage more* *- Flashing: Time to one FsC stage less*	
Frequency Inverter:		09:VsC_ELECTRICAL___ Y.Y Hz Y.Y A	Measured values ___._ Hz ___._ A	Variable-speed Compressor, Motor Frequency and Current	1.2
Condenser:		10:tc-bub_CND_tc-dew_ YY.Y °C YY.Y °C	Calculated values ___._ °C ___._ °C	Condenser: Condensing Temperatures, bubble	3.6
		11:delta_COND_setpnt_ YY.Y K YY.Y °C	Measured values ___._ K ___._ °C	Floating control with ambient temp.: Setpoints: (tc - tamb) (tcb + tcd)/2	
		12:VfG___COND_tamb___ YYY % YY.Y °C	Measured value ____ % ___._ °C	Air-cooled Condenser: Variab.-speed fan Group Ambient	
Performance:		16:Power_RACK_Energy_ YY.Y kW YY.Y kWh	Calculated values ___._ kW ___._ kWh	Compressor Rack: Electrical power and energy	1.3
Control Inputs:	4	20:OUTPUTS_INPUTS___ _YYYY_YYYY_YYYY_YYYY_	Status values ____ ____ ____ ____	Digital outputs and inputs: Bitstrings grouped in nibbles	2.4
				Rd-S-DO5-AO2_DO4...DO1_STO...DI5_DI4...DI1	
Refrigerant:	5	25:REFRIGERANT_____ R134a	Selected value _____	Refrigerant (SD-MC card) Selection in: FIRST_SETUP_____,P. 6	0.1
Variable-speed Compressor (VsC):	6	60:COMPRESSOR_____ No_Compressor_Selectd	Selected value _____	Compressor (SD-MC card) Selection in: FIRST_SETUP_____,P. 6	0.2
Assistance:		M:MODE_____ OPERATION-Automatic	Internal value _____	Information on Operating condition	4.1
Language:		Language ENGLISCH	Setting _____	Language Setting	9.1

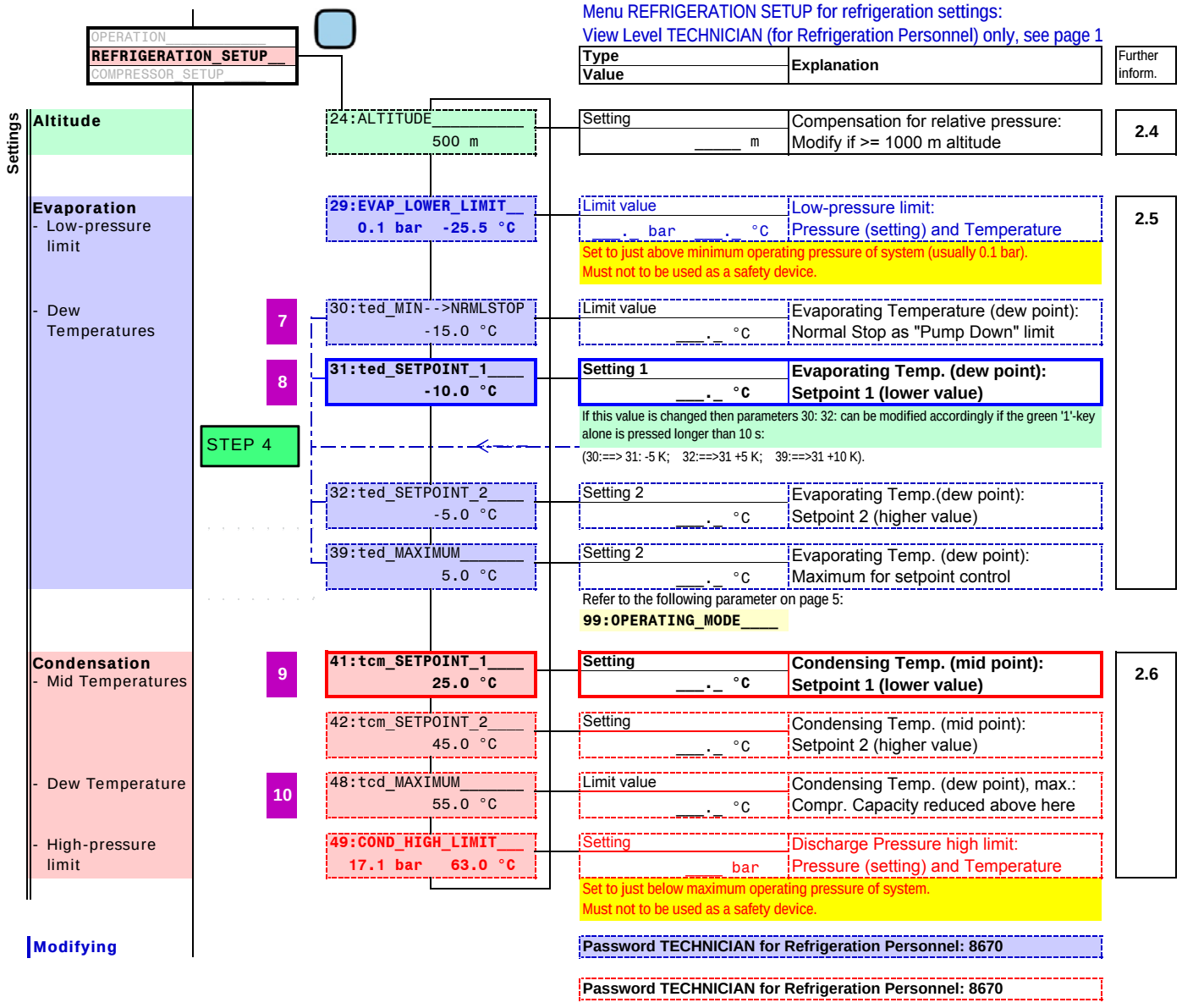
Settings: See page 6-7:

Abbreviations:	
VsC:	Variable-speed Compressor
FsC:	Fixed-speed Compressors
VFsC:	Variable- / Fixed-speed Compressor
VfG:	Variable-speed fan group (Condenser / Dry cooler)

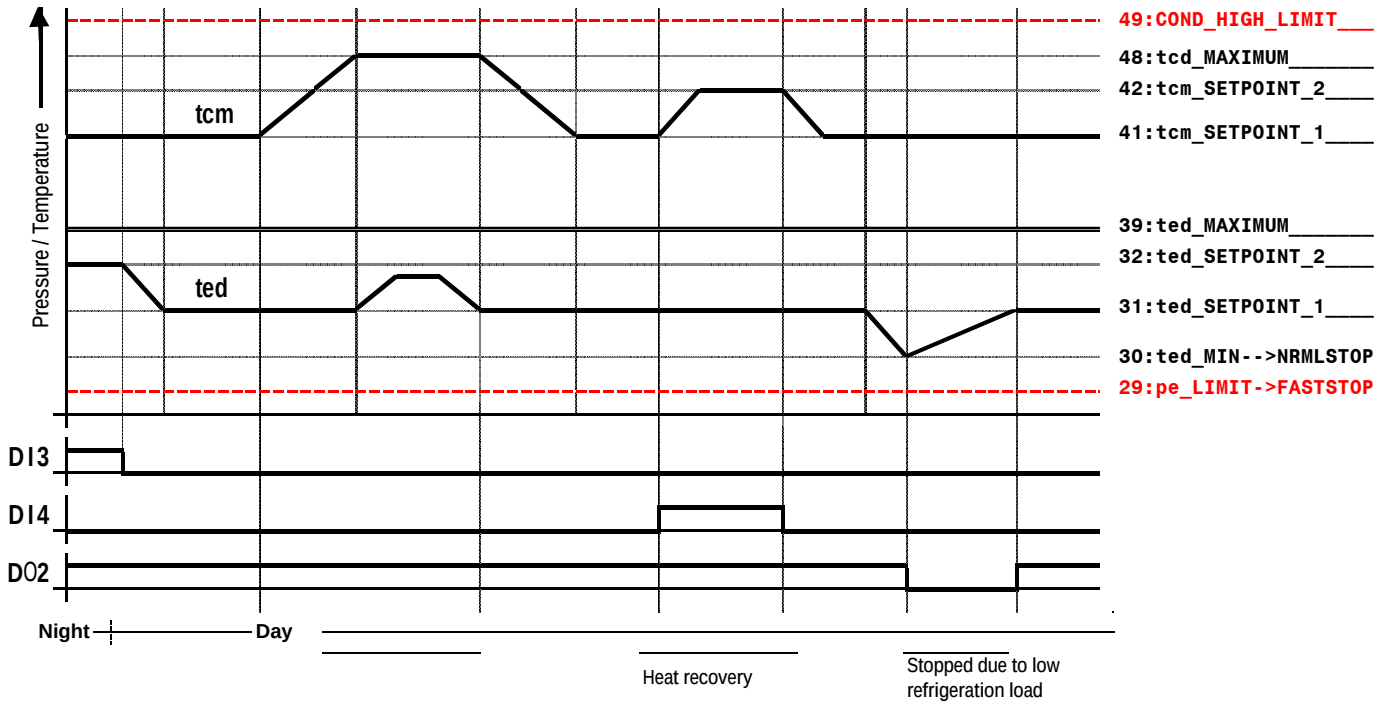
Password TECHNICIAN for Refrigeration Personnel: 8670

1 … 10 **Please report these values if there are any problems**

=	YY.Y %	: Measured value depending on operating point
→	FFF	: Factory default value depending on frame size and rated power



Explanation of adjustable operating temperatures:



REFRIGERATION_SETUP
COMPRESSOR_SETUP
SPECIAL_ADJUSTMENTS

Menu COMPRESSOR SETUP for setting compressor operation:
View Level TECHNICIAN (for Refrigeration Personnel) only, see page 1

	Type / Value	Explanation	Further inform.
Settings: Variable-speed Compressor (VsC):	61:VsC_CURRENT____MAX 0.0 A	Configuration Setting ___._ A	VsC Motor current max	5.1
	CAN ONLY BE CHANGED IF FRIGOPACK FU+ STOPPED FIRST Preset to 1000 A until a compressor is selected, see page 7		
- Limits:	62:VsC_FREQUENCY__MAX 65.0 Hz	Setting ___._ Hz	VsC Motor frequency max.: Max. settable value: Dt0, page 5	
	64:VsC_FREQUENCY__MIN 25.0 Hz	Setting ___._ Hz	VsC Motor frequency min.: Min. settable value: Dt1, page 5	
	65:VsC_MOTOR_NO_POLES 4	Setting ___	VsC Motor: No. of poles: 2, 4, 6, 8	
- Resonance avoidance:	66:VsC_SKIP_FREQ1_MIN 0.0 Hz	Setting ___._ Hz	VsC Resonance Avoid., Skip freq 1 min: 10.0..65.0 Hz *	5.2
	67:VsC_SKIP_FREQ1_MAX 0.0 Hz	Setting ___._ Hz	VsC Resonance Avoid., Skip freq 1 max: 10.0..65.0 Hz *	
	68:VsC_SKIP_FREQ2_MIN 0.0 Hz	Setting ___._ Hz	VsC Resonance Avoid., Skip freq 2 min: 10.0..65.0 Hz *	
	69:VsC_SKIP_FREQ2_MAX 0.0 Hz	Setting ___._ Hz	VsC Resonance Avoid., Skip freq 2 max: 10.0..65.0 Hz *	
	* Limited to fmin..fmax and range of next band. Set to 0.0 Hz when not in use.		
- Time settings:	70:VsC_tinhibit__TIME 300 s	Setting ___ s	VsC Inhibit Time after VsC start: 20..1200 s	6.1
	71:VsC_tlubrctn__TIME 4 s	Setting ___ s	VsC Oil Lubrication Pulse time: 0..100 s	
	72:VsC_thld_fmin_TIME 10 s	Setting ___ s	VsC Start Hold Time (at fmin): 0..120 s	
	74:VsC_tmon_fmin_TIME 300 s	Setting ___ s	VsC Monitoring time at fmin: 0..1800 s	
- Lubrication:				
Fixed-speed Compressors: Fixed-speed Compressor	STEP 4 ←3			
	80:FsC_PRIORITY_CNTRL 00000001	Setting _____	FsC9,8,7,6,5,4,3,2: Priority: 0: not available … 7: Maximum	5.4
	CAN ONLY BE CHANGED IF FRIGOPACK FU+ STOPPED FIRST:		
- Time settings:	Compressors with identical priorities >= 1 will be automatically swopped after the time set by parameter Dt7 (page 4):		
	000000DD: Special TCC Twin Compressor Control 000000EE: Rotation VFsC1 and VFsC2, Availabilities: Extension Module 000000FF: Rotation VFsC1 and VFsC2, Availabilities: DI3 / DI4 9XXXXXXX: Activate VFsC1 in bypass if there is a fault AXXXXXXX: Enable multiplex operation of FsC4 at DO1 BXXXXXXX: Enable multiplex operation of FsC4 + Activate VFsC1 in bypass		
	81:FsC_ton_____DELAY 120 s	Setting ___ s	FsC, Switch-on delay +: 1 … 1000 s	6.2
	82:FsC_toff____DELAY 10 s	Setting ___ s	FsC, Switch-off delay -: 1 … 100 s	
- Factors:	83:VsC/FsC_____RATIO 100%	Setting ___ s	VsC / FsC relative capacity in %: 100 %	
	84:VsC/FsC_CC__RATIO 50%	Setting ___ s	VsC/FsC, CC relative capacity activated in %: 4-pol: 50%;6-pol: 67%; 8-pol: 75%	
Commissioning aid:	86:_MANUAL_FsC__STATE Y YYYY	Commissioning _ ____	Manual ON/OFF activation: Left: Force input; Right: Status	5.5

Modifying

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COMPRESSOR_SETUP
SPECIAL_ADJUSTMENTS
FIRST_SETUP

Menu SPECIAL ADJUSTMENTS of special parameters:
View Level TECHNICIAN (for Refrigeration Personnel) only, see page 1

Type / Value	Explanation	Further inform.

<CONTROL

Sub-Menu <CONTROL of Optimizing Parameters

Settings

Controllers:

	Type / Value	Explanation
90:VsC_Voltage/Freq 8.00 V/Hz	Configuration Setting __	Ratio of Voltage / Frequency, usually: 8.00: 400 V/50 Hz // 4.62: 400 V/87 Hz
91:ted_CONTROLLR_P-GN 5.0	Setting __	ted Controller, Proportional gain: 1.0 … 25.0
92:tcm_CONTROLLR_P-GN 20	Setting __	tcm Controller, Proportional gain: 1.0 … 25.0
93:CND_VfG_SPEED__MIN 20 %	Setting ___ %	Condenser, Var.-speed fan Group, min. speed: 0.0 … 100.0 %
94:CND_VfG_SPEED__MAX 100 %	Setting ___ %	Condenser, Var.-speed fan Group, max. speed: 50.0 … 150.0 %
95:tcd_LIMITER___P-GN 25	Setting __	pc Limiter, Proportional gain: 10 … 250
97:START_BULGE_____ 2.0%	Setting _._ %	Optimization of starting torque: 0.0 … 5.0 %

Only change after reference to our Applications Department

Units:

98:UNITS_____ bar, °C	Setting _____	Selectable units: bar, °C, K; psi, °F, °R; bar, °F, °R

Operating Mode:

99:OPERATING_MODE____ D100	Setting ____	Defines Operating Mode: Input as hexadecimal

Setpoints ted1 / ted2 (DI3: Term. X13.4)	XXX**0**	Setpoints ted1 / ted2(DI3: Term. X13.4)
	XXX1	Setpoint tedmax..ted1/ted2 (EM-1..3 connected)
	XXX2	Setpoint ted1..ted2 (EM1..3 connected)
	XXX3	Test Setpoint ted = -100 °C
	XXX4	Cascade: Fast to 31:ted_SETPOINT_1
Setpoints tcm1 / tcm2 (DI4: Term. X12.1)	XX**0**X	Setpoints tcm1 / tcm2(DI4: Term. X12.1)
	XX1X	Setpoint 0 °C..tcm1/tcm2 (EM-1..3 connected)
	XX2X	Setpoint tcm1..tcm2 (EM1..3 connected)
	XX3X	Test Setpoint tcm = +100 °C
	XX4X	Cascade fast operation (relay at AO1)
Special funtionality	X**1**XX	Activate Capacity Controller
	X2XX	Activate GRAY Code
	X4XX	Stop at fmin after 74:VsC_tmon_fmin_TI
	X8XX	Activate delayed Oil Injection
	1XXX	Trip reset: DI1 (0->1) / 0XXX->1XXX
	2XXX	Allow slow stop ramp
	0XXX	Relay Ready DO1: No Fault
	4XXX	No Fault & Enabled & DI1 (Control Switch)
	8XXX	& DI1 (Control Switch) Delay OFF (15 min)
	CXXX	

<DATA

Sub-Menu <DATA of Special Parameters

Only change after reference to our Applications Department

Controllers:

Refer to 62: & 64: on page 4

	Type / Value	Explanation
Dt0 70.0 Hz	Configuration Setting __	VsC: Motor Frequency max. settable 15.0 … 120.0 Hz
Dt1 25.0 Hz	Configuration Setting __	VsC: Motor Frequency min. settable 15.0 … 120.0 Hz

Dt0 and Dt1 can only be changed with the inverter stopped.
Reset for operation by pressing the red 'O' key.

Dt7 1200 s	Setting ____	Compressor swop after this time: 0 s: none; 60 s … 65535 s swop

Control Mode:

Dt8 DCBA 8008	Configuration Setting FFFFFFFF … 00000000	Activations: Functional and Outputs:

Use special external relays

XXXX XXX0	Normal
XXXX XXX1	Activate Capacity Controller
XXXX XXX2	Activate extended current limit
XXXX XXX4	Activate pc transmitter monitoring
XXXX XXX**8**	**Activate envelope frequency-range limiting**
XXXX XX**0**X	Normal
XXXX XX1X	Activate inverter motor heating
XXXX XX2X	**Activate Autotune if there is a failed star**
XXXX XX4X	View Level OPERATOR: Extend menus
XXXX XX8X	Activate Serial Communication

Selectable outputs: (DO5) (DO4) DO3 DO2 AO2 AO1

Logic outputs with AO1, AO2

XXXX **0**0XX	A0: 0..+10 V Variable-speed fan Group
XXXX 11XX	A1: 0..+10 V Frequency (10 V = fmax)
XXXX 22XX	A2: 0..+10 V Hot-Gas Bypass control
0000 XXXX	D0: Activate Enclosure Fan
1111 XXXX	D1: Reserve
2222 XXXX	D2: Reserve
3333 33XX	D3: Monitor fmin (see 74:VsC tmon fmin TIME)
4444 44XX	D4: Inhibit Sump Heater
5555 55XX	D5: More Condens. capacity required (cascade)
6666 66XX	D6: Maintenance recommended
7777 77XX	D7: Connect supply filter trap
8888 **8**8XX	D8: Activate Capacity Control (CC)
9999 99XX	D9: Compressor turning / Start lubrication
AAA**A** AAXX	DA: Activate Compressor VFsC1
BB**B**B BBXX	DB: Activate Compressor VFsC2 / FsC2
C**C**CC CCXX	DC: Activate Compressor FsC3
DDDD DDXX	DD: Activate Compressor FsC4 (AO2)
E--- ----	DE: Activate Compressor FsC5 (MUX of DO1)
FFFF FFXX	DF: Activate Expansion Valve TEV

SD Card:

Dt9 _16c	Setting ____	SD Card (Secure Data Memory Card): Revision Designation

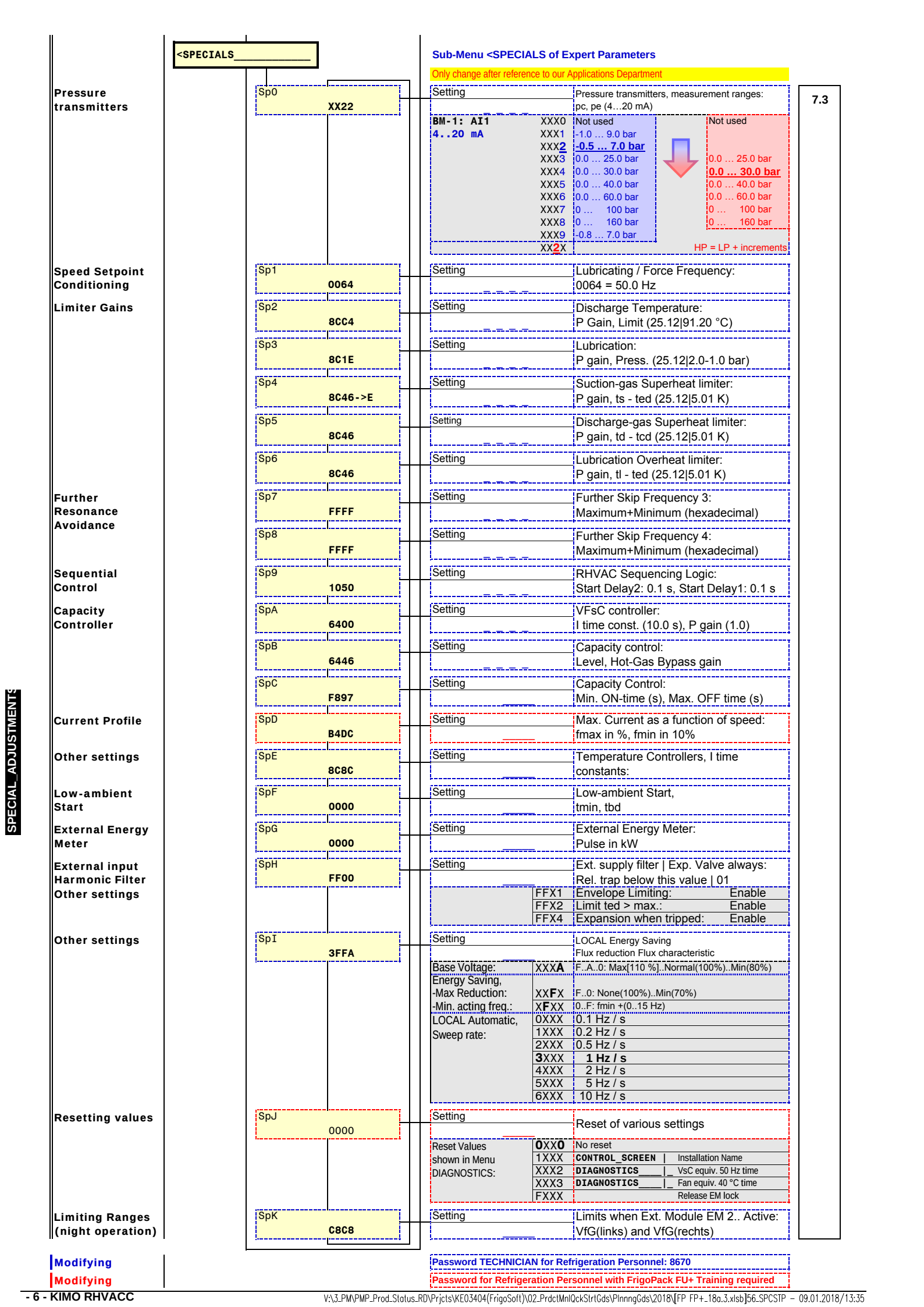
Password TECHNICIAN for Refrigeration Personnel: 8670

Modifying

7.1

7.2

SPECIAL_ADJUSTMENTS


<SPECIALS_____
Sub-Menu <SPECIALS of Expert Parameters
Only change after reference to our Applications Department
7.3
Pressure transmitters
Sp0 XX22
Setting
Pressure transmitters, measurement ranges: pc, pe (4…20 mA)
BM-1: AI1 4..20 mA
XXX0 Not used
XXX1 -1.0 … 9.0 bar
XXX2 -0.5 … 7.0 bar
XXX3 0.0 … 25.0 bar
XXX4 0.0 … 30.0 bar
XXX5 0.0 … 40.0 bar
XXX6 0.0 … 60.0 bar
XXX7 0 … 100 bar
XXX8 0 … 160 bar
XXX9 -0.8 … 7.0 bar
Not used
0.0 … 25.0 bar
0.0 … 30.0 bar
0.0 … 40.0 bar
0.0 … 60.0 bar
0 … 100 bar
0 … 160 bar
XX2X
HP = LP + increments
Speed Setpoint Conditioning
Sp1 0064
Setting
Lubricating / Force Frequency: 0064 = 50.0 Hz
Limiter Gains
Sp2 8CC4
Setting
Discharge Temperature: P Gain, Limit (25.12|91.20 °C)
Sp3 8C1E
Setting
Lubrication: P gain, Press. (25.12|2.0-1.0 bar)
Sp4 8C46->E
Setting
Suction-gas Superheat limiter: P gain, ts - ted (25.12|5.01 K)
Sp5 8C46
Setting
Discharge-gas Superheat limiter: P gain, td - tcd (25.12|5.01 K)
Sp6 8C46
Setting
Lubrication Overheat limiter: P gain, tl - ted (25.12|5.01 K)
Further Resonance Avoidance
Sp7 FFFF
Setting
Further Skip Frequency 3: Maximum+Minimum (hexadecimal)
Sp8 FFFF
Setting
Further Skip Frequency 4: Maximum+Minimum (hexadecimal)
Sequential Control
Sp9 1050
Setting
RHVAC Sequencing Logic: Start Delay2: 0.1 s, Start Delay1: 0.1 s
Capacity Controller
SpA 6400
Setting
VFsC controller: I time const. (10.0 s), P gain (1.0)
SpB 6446
Setting
Capacity control: Level, Hot-Gas Bypass gain
SpC F897
Setting
Capacity Control: Min. ON-time (s), Max. OFF time (s)
Current Profile
SpD B4DC
Setting
Max. Current as a function of speed: fmax in %, fmin in 10%
Other settings
SpE 8C8C
Setting
Temperature Controllers, I time constants:
Low-ambient Start
SpF 0000
Setting
Low-ambient Start, tmin, tbd
External Energy Meter
SpG 0000
Setting
External Energy Meter: Pulse in kW
External input Harmonic Filter
SpH FF00
Setting
Ext. supply filter | Exp. Valve always: Rel. trap below this value | 01
Other settings
FFX1 Envelope Limiting: Enable
FFX2 Limit ted > max.: Enable
FFX4 Expansion when tripped: Enable
Other settings
SpI 3FFA
Setting
LOCAL Energy Saving
Flux reduction Flux characteristic
Base Voltage: XXXA F..A..0: Max[110 %]..Normal(100%)..Min(80%)
Energy Saving, -Max Reduction: XXFX F..0: None(100%)..Min(70%)
-Min. acting freq.: XFXX 0..F: fmin +(0..15 Hz)
LOCAL Automatic, Sweep rate:
0XXX 0.1 Hz / s
1XXX 0.2 Hz / s
2XXX 0.5 Hz / s
3XXX 1 Hz / s
4XXX 2 Hz / s
5XXX 5 Hz / s
6XXX 10 Hz / s
Resetting values
SpJ 0000
Setting
Reset of various settings
Reset Values shown in Menu DIAGNOSTICS:
0XX0 No reset
1XXX CONTROL_SCREEN | Installation Name
XXX2 DIAGNOSTICS____|_ VsC equiv. 50 Hz time
XXX3 DIAGNOSTICS____|_ Fan equiv. 40 °C time
FXXX Release EM lock
Limiting Ranges (night operation)
SpK C8C8
Setting
Limits when Ext. Module EM 2.. Active: VfG(links) and VfG(rechts)
Modifying
Modifying
Password TECHNICIAN for Refrigeration Personnel: 8670
Password for Refrigeration Personnel with FrigoPack FU+ Training required

FrigoSoft 1.7 activated: Basic Pressure Control

Menu FIRST SET-UP for settings with a SD card with valid data:
View Level TECHNICIAN (for Refrigeration Personnel) only, see page 1

SPECIAL_ADJUSTMENTS__
FIRST_SETUP_____
FAULTS_/_WARNINGS___

Selections

		Type / Value	Explanation	Further inform.
Select data from the SD card	**SD-Card:Data_Select__ <0:Selection_disabld**	Settings:	One of the following must be activated	0.1, 0.2
		<0:Selection_disabld	Selection not activated (normal)	
		<1:Refrigerant_____	Refrigerant	
		<2:VFsC_Manufacturer	Compressor: Manufacturer	
		<3:VFsC_Type_____	Compressor: Type	
		<4:VFsC_Cylinders__	Compressor: Number of cylinders	
		<5:Supply_Voltage__	Electrical Supply Voltage	
		<6:VFsC_Compressor_	Compressor selection	
Read data from the SD card	**SD-Card:Data_Read___ __<14:R134aHFC <Long_Selectn_List**	Measured value	Read selected data from SD-MC card	

KEYS FOR SELECTION:
I – Next data set (short tip >= 0.5 s)
O – Previous data set (short tip >= 0.5 s)

IMPORTANT:
Requirement for Selection:
- SD memory card with valid authorized data plugged into SD slot of the FU+ Refrigeration
- The selection parameter SD Data_Selection must be set to:

<0:Selection_disabld to return to normal operation

REFER TO BACK PAGE FOR DETAILS

Selectable data from the SD card — *SD-MC: Secure Digital - Memory Card*

***FrigoSoft* 1.7: Standard**

REFRIGERANT selection: STEP 1 → 2

R134a, R14, R22, R23, R32, R134a, R152a, R170, R227ea,			**R600, R600a**
R236fa, R245fa, R290			**R717, R723,**
R404A, R407A, R407C, R407F, R410A, R417A, R417B, R422A,			**R744 sbcrt/trcrt**
R422D, R427A, R434A, R437A, R438A, R442A, R448A, R449A,			**R1150, R1234yf,**
R450A, R452B, R454B, R507A, R508A, R508B, R513A,			**R1234ze, R1270**

Compressor pre-selectio

_<20:no_name_____	**_<24:DORIN_____**	**_<28:GEA-Bock____**	**_<2C:LGE_____**
_<21:BITZER_____	**_<25:EMERSON____**	**_<29:HANBELL____**	**_<2D:SANYO_____**
_<22:CARLYLE____	**_<26:FRASCOLD___**	**_<2A:HITACHI____**	**_<2E:TECUMSEH___**
<23:DANFOSS	**<27:FRIGOPOL**	**<2B:J&EHALL**	<2F:other

_<30:no_type_____	**_<34:Recip_open___**	**_<38:Screw_Open___**	
_<31:Recip_Hermetic_	**_<35:Screw_Hermetic_**	**_<39:Scroll_____**	
_<32:Recip_Semihermt	**_<36:Screw_semihermt**	_<3A:Reserve_____	
_<33:Recip_2-stage_	**<37:Screw_Compact**		

_<40:No_cylinders___	**_<44:4_cylinders___**	**_<48:8_cylinders___**	_<4C:12_cylinders_
_<41:1_cylinder____	-	-	-
_<42:2_cylinders___	**_<46:6_cylinders___**	_<4A:10_cylinders__	-
_<43:3_cylinders___	-	-	_<4F:(15+_cylinders

Supply Voltage at 50/60 Hz:

_<50:notdefined_____	_<54:50_Hz_420_V____	_<58:60_Hz_200_V____	**_<5C:60_Hz_460_V__**
<51:50 Hz 200 V	<55:50 Hz 500 V	<59:60 Hz 208 V	<5D:60 Hz 575 V
_<52:50_Hz_230_V___	<56:50_Hz_690_V____	_<5A:60_Hz_230_V____	_<5E:60_Hz_660_V__
<53:50 Hz 400 V	<57:50 Hz tbd V	<5B:60 Hz 380 V	<5F:other

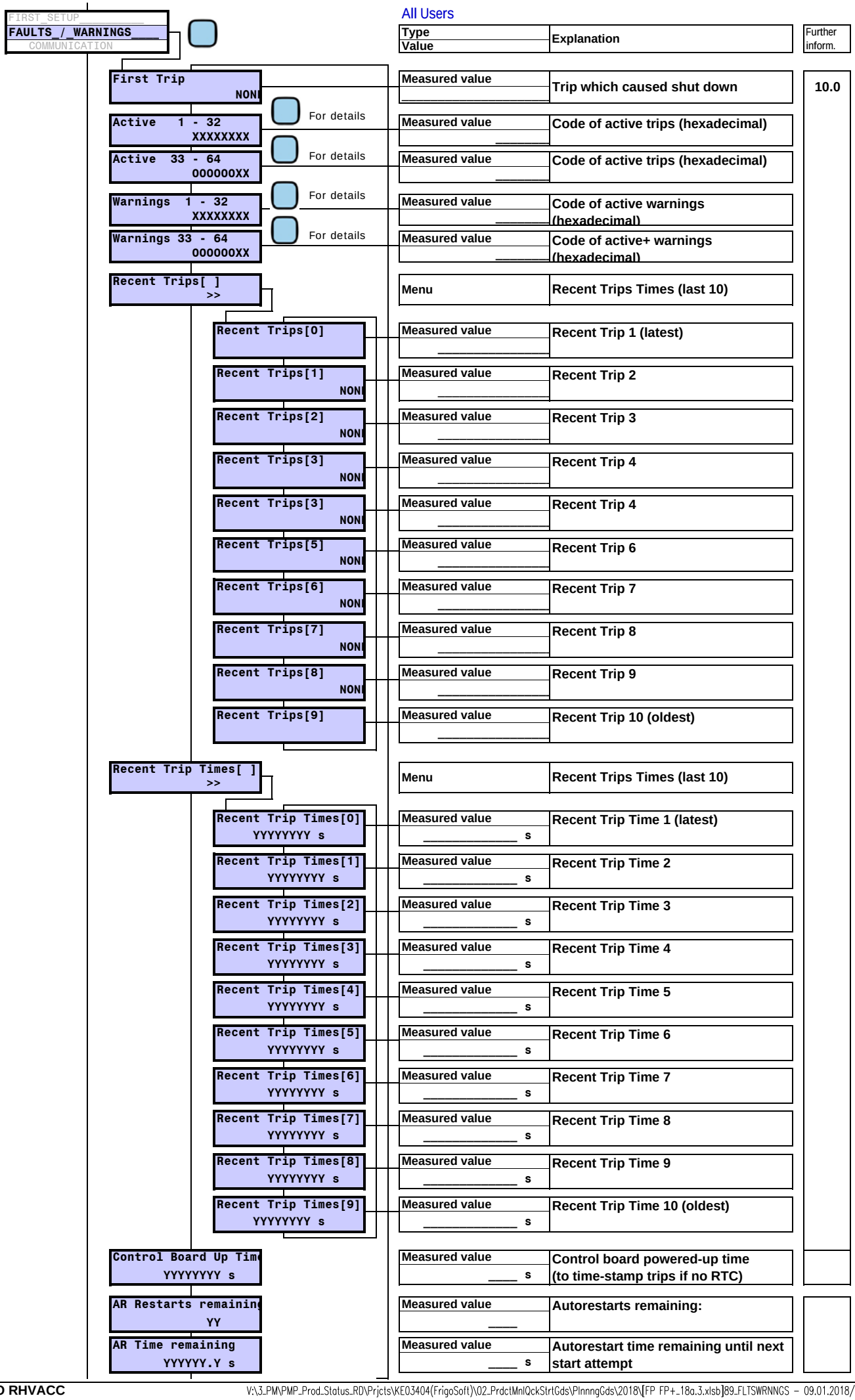
VsC COMPRESSOR selection: STUFE 2 → 4 _<No_Data_selected___

FIRST_SETUP

Selections

Real Time Clock:	**Time and Date 2015/07/04 16:08:51**	Setting	**Time and Date of RTC (if module A FU+ CM-1 fittted)**	0.3
Language:	**Language ENGLISCH**	Setting	**Set Language**	0.4
Units:	**98:UNITS_____ bar, °C**	Setting	Selectable units: bar, °C, K; psi, °F, °R; bar, °F, °R	7.5
Installation ID:	**Installation_Name_____ FrigoPack_FU+___**	Setting	**Welcome text in Control Menu: 16 settable characters:**	0.5

FrigoSoft 1.7 activated: Basic Pressure Control



Trips, Diagnosis, Fault Finding

Trip Message	Possible Cause	Hints for Fault Finding	Remedies
01 OVER VOLTAGE	• Voltage of supply too high	- Measure and document three input voltages	- Rectify cause of any high voltage
	• Compressor motor defect	- Test Compressor motor. Disconnect cables from the Refrigeration Inverter. Connect direct to the input supply through a suitable motor circuit breaker. Monitor if compressor runs normally by verifying current taken agrees with compressor manufacturer's data.	- Replace compressor motor
		- Measure resistance of motor winding and compare with manufacturer's data	
		- Disconnect Refrigeration Inverter and check winding insulation between phases and to earth	
	• Isolating contactor not controlled correctly	- Check wiring of control circuit and compare function with recommendations	- Modify wiring
02 UNDER VOLTAGE	• Voltage of supply too low	- Measure and document three input voltages	- Rectify cause of any low voltage
	• Phase of supply voltage missing		
03 OVER CURRENT	• Isolating contactor not controlled correctly	- Check wiring of control circuit and compare function with recommendations	- Modify wiring
04 STACK FAULT 05 STACK OVER CRRNT 21 PHASE FAIL 22 VDC RIPPLE	• Compressor motor defect	- Test Compressor motor. Disconnect cables from the Refrigeration Inverter. Connect direct to the input supply through a suitable motor circuit breaker. Monitor if compressor runs normally by verifying current taken agrees with compressor software data.	- Replace compressor motor
		- Measure resistance of motor winding and compare with manufacturer's data	
		- Disconnect Refrigeration Inverter and check winding insulation between phases and to earth	
	• Refrigeration Inverter faulty	- Remove motor cable connections to Refrigeration Inverter	- Replace Refrigeration Inverter
		- Check if operation of Refrigeration Inverter without a motor connected is possible	
		- Test operation with a small test motor	
	• Incorrect motor connection	- Check wiring to motor terminals (choice of star/delta, part winding etc.)	- Modify wiring
08 INVERSE TIME 09 MOTOR I2T 14 START FAILED	• Compressor start aborted	- Liquid refrigerant in compressor?	- Contact Supplier for advice
		- Defect compressor	
		- Incorrect size of Refrigeration Inverter or motor connected in delta instead of star	
27 STO ACTIVE	• Safety device in safety circuit tripped	- Check safety circuits. Possibly missing supply voltage at a monitoring device.	- Reset if necessary
	• Safety relay or contactor not controlled correctly	- Check wiring of control circuit and compare function with recommendations	- Verify wiring
	• Wiring fault in safety circuit		- Modify wiring
	• DC 24 V control voltage missing	- Check DC 24 V control voltage at Refrigeration Inverter	- Verify wiring
		- Short circuit with DC 24 V control voltage ?	
33 PRESSURE TRANSMITT	• Suction-pressure transmitter not connected or connections swapped	- Check if blue LED at the input of the Basic Module lights	- Verify correct connection of suction pressure transmitter. Exchange leads if necessary
	• Transmitter for suction pressure faulty	- Check if blue LED at the input of the Basic Module lights	- Replace faulty pressure transmitter
		- Ratiometric Types: Check connections	
34 PRESS RANGE EXCEED	• Pressure outside range or unsuitable pressure transmitter fitted	- Verify Pressure Transmitter	- Exchange Pressure Transmitter or correct wiring
35 DISCH TEMP TOO HGH	• Discharge-gas temperature too high	- Suction-gas superheat too high	- Investigate refrigeration components
		- Damaged compressor valves or leaking gasket	
		- Unsuitable refrigerant	
36 SUPERHEATS TOO LOW	• Suction and Discharge-Gas superheats too low	- Problem with an expansion valve	- Investigate refrigeration components
		- Liquid in suction line	
37 LUBRC TEMP TOO LOW	• Lubricant Overtemperature too low	- Suction-gas superheat too low	- Investigate refrigeration components
		- Liquid in suction line	
		Sump heater not used, not connected correctly or faulty	
		-	
38 LUBRC PRES TOO LOW	• Low lubricant pressure	- Lubricant migration	- Investigate refrigeration circuit
		- Problem with refrigeration piping	
39 EXT MODULE FAULT	• External Module or cable fault	- Verify wiring	- Correct wiring
40 MAINTENANCE NECESS	• Proactive Maintenance due	- Investigate Maintenance parameters in the menu DIAGNOSTICS	- Organize parts required and plan maintenance
?? OTHER TRIP	• Other	-	- Contact supplier for advice

COMMUNICATION

FAULTS_/_WARNINGS
COMMUNICATION
DIAGNOSTICS

Menu COMMUNICATION for setting up Communications:
View Level TECHNICIAN (for Refrigeration Personnel) only, see page 1

Type / Value	Explanation	Further inform.

Ethernet local area network

Settings — Ethernet:

<Ethernet

	Setting	Explanation	
DHCP: FALSE	_____	Ethernet local area network	12.1
Auto_IP: FALSE	_____	Automatic IP generation	
User_IP_Address: FFF.FFF.FFF.FFF	___.___.___.___	User set IP address	
User_Subnet_Mask: FFF.FFF.FFF.FFF	___.___.___.___	User set Subnet Mask	
User_Gateway_Address: FFF.FFF.FFF.FFF	___.___.___.___	User set Gateway Address	

RS485 Modbus RTU with Option Module A FU+ CM-1

RS485 Modbus RTU:

<RS485-Modbus

	Setting	Explanation	
Modbus_Device_Address: 1	___	Address 1..247	12.2
Modbus_RTU_Baud_Rate: 9600 BPS	_____ BPS	Baud Rate 1200..115200 BPS	
Parity_And_Stop_Bits: EVEN, 1 STOP	_____	Parity and Stop Bits	
High_Word_First_RTU: FALSE	_____	High-word first for 32-Bit interrogations	
Modbus_RTU_Timeout: 3.0 s	__._ s	No activity Timeout (Watchdog) 0.0 .. 65.0 s	

Modbus over ETHERNET

Ethernet Modbus:

<Ethernet-Modbus

	Setting	Explanation	
Maximum_Connections: 2	_	Maximum number of connections	12.3
High_Word_First: FALSE	_____	High-word first for 32-Bit interrogations	
Modbus_Timeout: 3.0 s	__._ s	No Modbus RTU activity Timeout 0.0 .. 65.0 s	
Modbus_Conn_Timeout: 66 s	_____ s	No Ethernet Fieldbus activity 0 .. 100000 s	

Comms remote control

Ethernet Modbus:

<Comms_Control

	Setting	Explanation	
Refrig_Control_Word: 0000	____	Refrigeration Comms Control Word	12.4
LODAM_Control_Word: 0000	____	LODAM Comms Control Word	
Refrig_Status_Word: YYYY	____	Refrigeration Status Word	
Comms_Reference: 0.00 %	____	Refrigeration Status Word	

Top Menu — Run Wizard?

Menu 'Run Wizard?' to reset to factory defaults:
View Level TECHNICIAN (for Refrigeration Personnel) only, see page 1

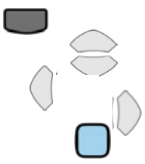
Reset to factory settings:

	Setting	Explanation	
Reset to defaults: FALSE	_____	Reset to factory defaults	13.1
	Set to TRUE followed by pressing the central blue key 4 times		

CAUTION: Reset ALL settings to factory defaults:
USE WITH CARE
Reset FrigoPack FU+ (removing, waiting and reapplying power)

Modifying — Password TECHNICIAN for Refrigeration Personnel: 8670

Keypad FU+ PROG:
Keys:



Key	Navigation Mode	Edit Mode
Softkey 1	Previous level menu	Edit Mode
UP	Moves up list of parameters	Increments displayed parameter
DOWN	Moves down list of parameters	Increments displayed parameter
LEFT	Previous level menu or parameter	Selects the digit to be changed
RIGHT	Next level menu or parameter	Selects the digit to be changed
OK	Next level menu or parameter	Edit mode when a parameter is selected
'1' 'O'	Refer to pages 7, 19	Refer to pages 7, 19

FrigoSoft 1.7 activated: Basic Pressure Control

Menu, Diagnostics:
Diagnostics and other Monitoring Data

COMMUNICATION
DIAGNOSTICS
EXPERT OVERVIEW

Diagnostics

		Type / Value	Explanation	Further inform.
Sequencing and Limits:	**SEQUENCR_Refr_____VSD** YY Y	Internal value __ __	**Modbus over ETHERNET**	11.1

Left:	Right:
0:Stppd_Rdy_to_Start_	0:NOT_READY_TO_SWTCH_ON
1:Start_Delay_____	1:SWITCH_ON_DISABLED___
2:Autotuning_____	2:READY_TO_SWITCH_ON___
3:Aligning_____	3:SWITCHED_ON_____
4:Prefluxing_____	4:OPERATION_ENABLED____
5:Starting_____	5:QUICKSTOP_ACTIVE_____
6:Lubricating_____	6:FAULT_REACTION_ACTIVE
7:Hold_at_fmin_____	7:FAULTED_____
8:Normal_operation___	
9:Stopping_____	
10:Stopped,_Inhibited	
11:Compressor_Heating	
12:Local_operation___	
13:Serial_communictns	
15:Fault_not_cleared_	

	_STARTS---_ENABLES--_ **_YYYY_YYYY_YYYY_YYYY_**	Internal value _...._...._...._....	**Logical conditions: Starting, Limiting**		
		_XXXX_XXXX_XXXX_XXX**1**_	Safety Circuit (STO)	Not active (OK)	
		_XXXX_XXXX_XXXX_XX**1**X_	Refrigeration Inverter	Enabled (fault free)	
		_XXXX_XXXX_XXXX_X**1**XX_	External Module EM1..3	Enable or not present	
		_XXXX_XXXX_XXXX_**1**XXX	ISESCO	Enable or not present	
		_XXXX_XXXX_XXX**1**_XXXX_	pe >> pe min limit	Suction pressure	
		_XXXX_XXXX_XX**1**X_XXXX_	ted > ted min	Evaporating temperature	
		_XXXX_XXXX_**1**XXX_XXXX_	pc << pc max limit	Exhaust gas pressure	
		_XXXX_XXX**1**_XXXX_XXXX_	DI1	Start input	
		_XXXX_XX**1**X_XXXX_XXXX_	ted > ted setpoint/ Force	Controller start / DI2	
		_XXXX_X**1**XX_XXXX_XXXX_	External Module EM1..3	Module start	
		XXXX**1**XXX_XXXX_XXXX_	Isesco	Isesco start	
		_XXX**1**_XXXX_XXXX_XXXX_	External Start Signal	AI1 or AI2 > 0.0 V	
		_XX**1**X_XXXX_XXXX_XXXX_	Compr. Swop active	Swop time >= 0 s	

	_LIMITING_CONDITIONS_ **_YYYY_YYYY_YYYY_YYYY_**	Internal value ____ ____	**Logical conditions: Limiting conditions**		
		_XXXX_XXXX_XXXX_XXX**1**_	tcd >= tcd max	Condensing Temperature	
		_XXXX_XXXX_XXXX_XX**1**X_	Icmp >= Icmp max	Current	
		_XXXX_XXXX_XXXX_X**1**XX_	LAS, RAS	Low Ambient Start	
		_XXXX_XXXX_XXXX_**1**XXX	Reserve	Reserve	
		_XXXX_XXXX_XXX**1**_XXXX_	td Discharge gas	Temperature limiting	
		_XXXX_XXXX_XX**1**X_XXXX_	pl Lubrication	Differential pressure	
		_XXXX_XXXX_X**1**XX_XXXX_	ts Suction Gas	Superheat	
		_XXXX_XXXX_**1**XXX_XXXX_	td Discharge gas	Superheat	

Relative Rack Capacity (volume flow):	Avrg_Rack-POWER_Actl_ YYY.Y % Y.YYY %	Measured value ___.__ % ___.__ %	Compressor Rack, Relative Capacity: 30(long) / 7 day(short) average and Actual	11.2
Electrical Values:	DC-LINK_____MOTOR____ YYY V YYVY V	Calculated values ____ V ____ V	DC Link and motor voltages	
	BASE-FRQ____POWER____ YY.Y Hz YYY.Y kW	Calculated value ___.__ kW	Actual Base Frequency Motor power	
Temperatures:	Cntrl_Modl__Heat_Sink YY.Y °C YY.Y °C	Measured value ___.__ °C ___.__ °C	Heatsink and Control Module Temperatures	11.3
Power Module:	Power Stack Fitted YYYYYYYYYYYYYYY	Measured value _____	Power Size Code	11.4
	Stack Serial No YYYYYYYYYYYYYYY	Measured value _____	Stack Serial Number	
	HV SMPS Up Time YYYYYYYYYY s	Measured value _____ s	Switched-Mode Power Supply ON time	
	HV Power On Count YYYYYYYYYYYYYYY	Measured values _____	Number of times the supply has been connected	
Control Module:	**Control Module Serial** **YYYYYYYYYYYYYYY**	**Measured values** _____	**Control Board Serial Number**	11.7
	Control Board Up Time **YYYYYYYYYY s**	Measured value ___.__ %	**Control board powered-up time in s**	
Compressor:	VsC_Serial_Number____ YYYYYYYYYYYYYYY	Measured values _____	VsC Compressor Serial Number	11.5
	Motor Run Time YYYYYYYYYY s	Measured values _____ s	Compressor ON time	
	Motor start count YYYYYYYYYY	Measured values _____	Number of motor starts	
Maintenance :	VsC_equiv_50_Hz_time_ YYYYYYYYYY s	Measured values _____ s	VsC Compr. Equiv. 50 Hz remaining operation	11.6
	Fan_equiv_40_°C_time_ YYYYYYYYYY s	Measured values _____ s	Fan equivalent 40 °C remaining operation	

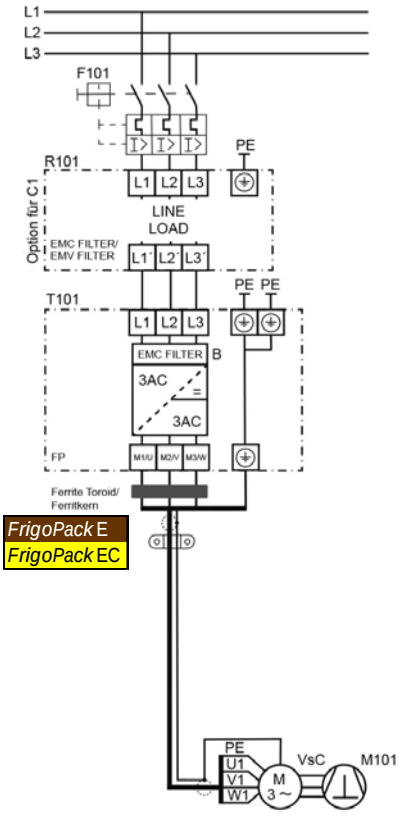
Password TECHNICIAN for Refrigeration Personnel with training require

Keypad FU+ PROG:
Diagnosis:

I	O	Explanation
OFF	Flashing	**Stopping**
OFF	ON	**Stopped**
ON	OFF	**Running**
Flashing	OFF	**Auto Start**
Flashing	Flashing	**Not Operational**
Green then Red Flashing		**Tripped / Fault**

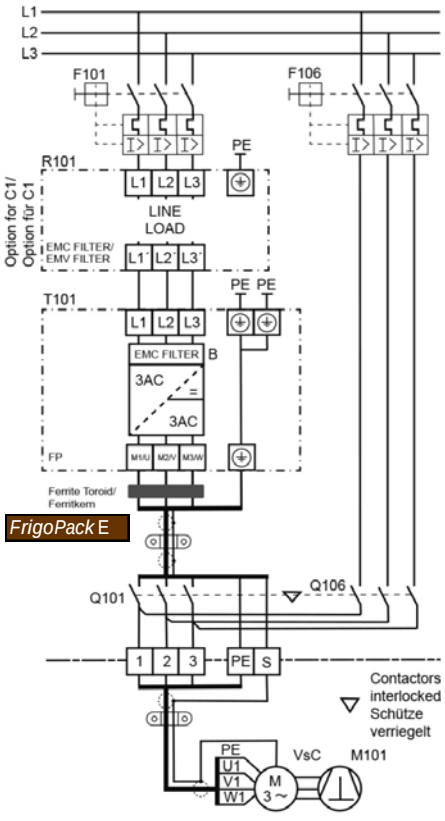
DIAGNOSTICS

Power connections



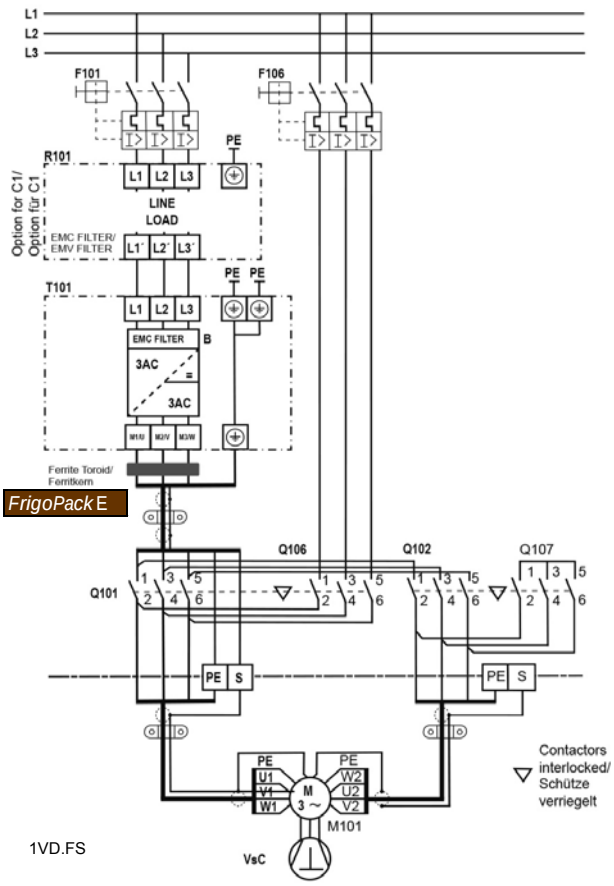
1V

Single compressor



1VB

Single compressor with bypass (for emergency operation)



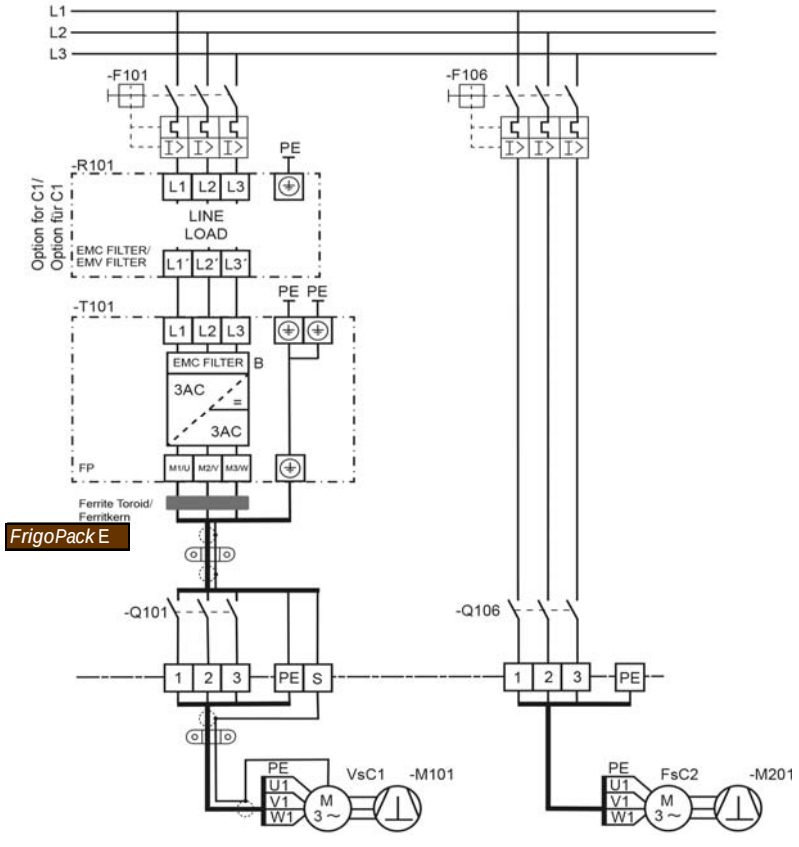
1VD.FS

Single compressor in DELTA with bypass in STAR (for emergency operation)

Settings:

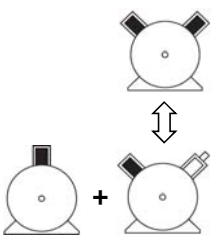
80:FsC_PRIORITY_CNTRL	0000000**0**	(See page 4)
Dt8:	DC**F**A8008	(See page 5)

Digital Control Outputs			Place/Part	
Relay DO1	Ready:	*FrigoPack*	*FrigoPack*	
Relay DO2	Operation:	VsC	*FrigoPack*	A
Relay DO3	Expansion (recommended)		*FrigoPack*	F



1V-2FC

Digital Control Outputs			Place/Part	
Relay DO1	Ready:	*FrigoPack*	*FrigoPack*	
Relay DO2	Operation:	VsC1	*FrigoPack*	A
Relay DO3	Operation:	FsC2	*FrigoPack*	B
Relay DO4	Capacity Control		Extern.P24 V	8
Relay AO2	Expansion (recommended)		Ext. P12 V *	F

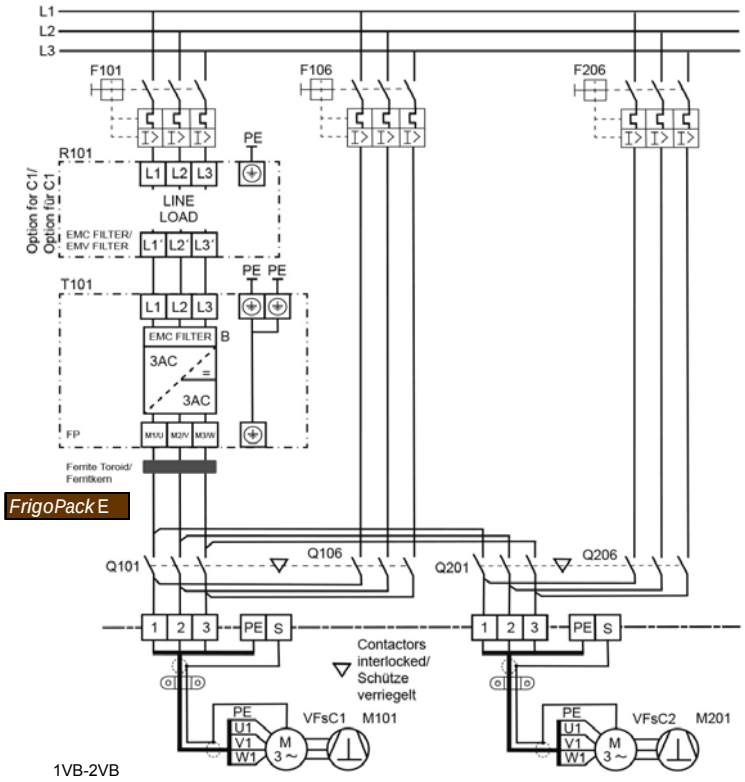


Variable-speed compressor + second larger compressor with Capacity Control

Settings:

80:FsC_PRIORITY_CNTRL	00000001	(See page 4)
Dt8:	D**8**BA**F**008	(See page 5)

*** Accessory required:** **A FU+ DC12V RL/11** (Special low coil-current relay module)



1VB-2VB

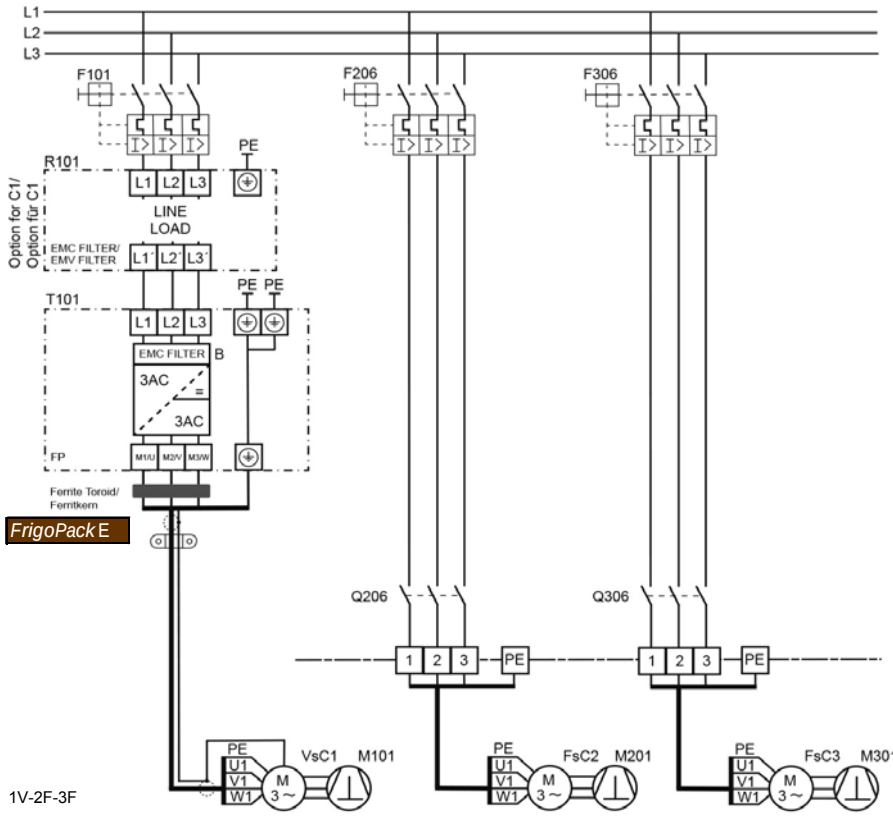
Two compressors, each with bypass and rotation

Digital Control Outputs			Place/Part	
Relay DO1	Ready:	*FrigoPack*	FrigoPack	
Relay DO2	Operation:	VFsC1	FrigoPack	A
Relay DO3	Operation:	VFsC2	FrigoPack	B
Relay AO2	Expansion (recommended)		Extern.P24 V	F

Note:
This connection requires a special arrangement of auxiliary contacts on the contactors.
Alternatively a special control module from KIMO RHVAC Controls may be used.

Settings:

8O:FsC_PRIORITY_CNTRL	000000**EE** / 000000**FF**	(See page 4)
Dt8:	D**FCB**8008	(See page 5)



1V-2F-3F

Three compressors, two Fixed-speed Compressors with rotation

Settings:

8O:FsC_PRIORITY_CNTRL	000000**11**	(See page 4)
Dt8:	DCBA**F**008	(See page 5)

Digital Control Outputs			Place/Part	
Relay DO1	Ready:	*FrigoPack*	FrigoPack	
Relay DO2	Operation:	VsC1	FrigoPack	A
Relay DO3	Operation:	FsC2	FrigoPack	B
Relay DO4	Operation:	FsC3	Ext. P24 V	C
Relay AO2	Expansion (recommended)		Ext. P12 V *	F

*** Accessory required:** **A FU+ DC12V RL/11** (Special low coil-current relay module)

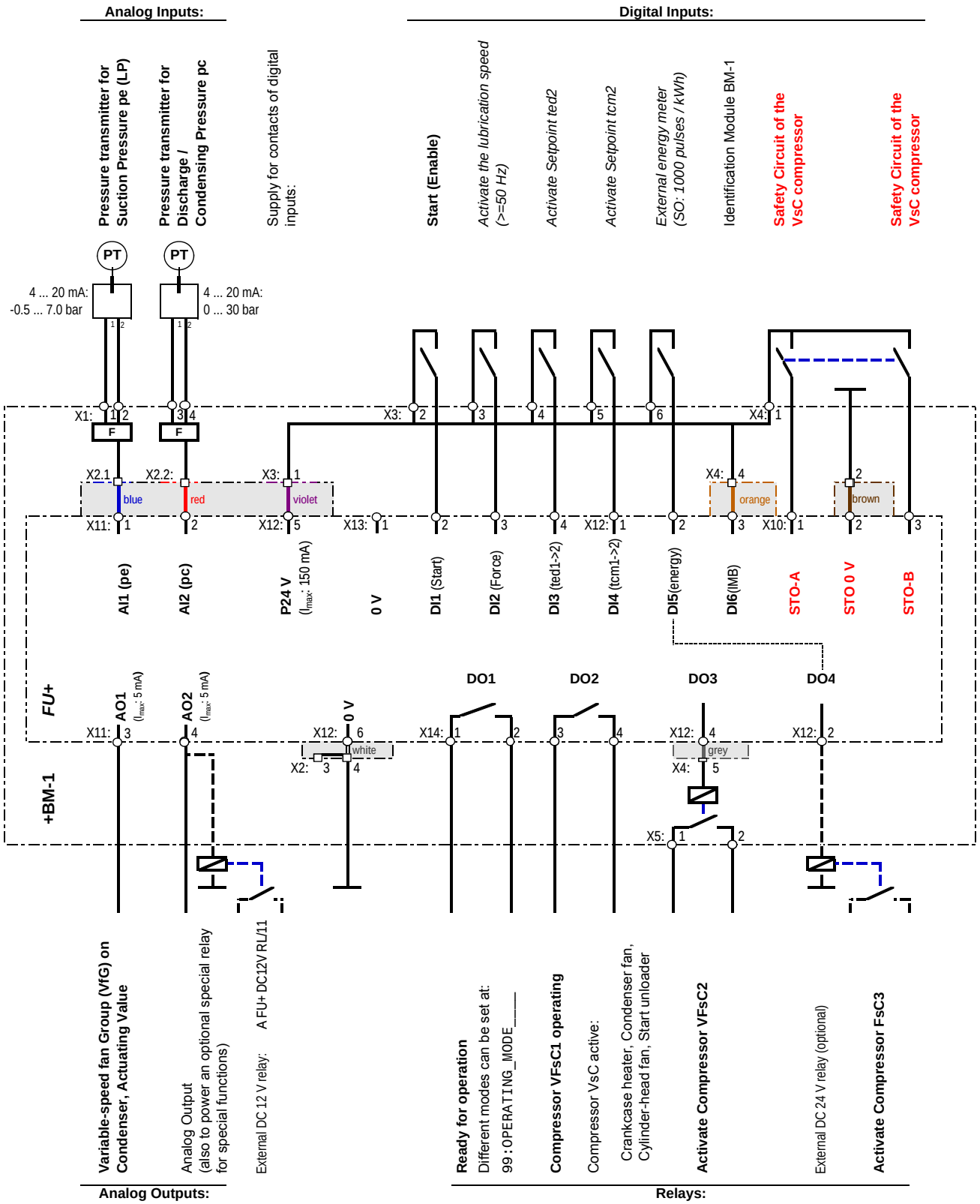
Various other configurations are possible (e.g. up to 8 compressors), please enquire.

POWER SECTION

Power terminals

Terminal / Designation	Signal / Function	Explanation	Further information
PE	**Protective Earth connection 1 to supply**	- Observe all safety and EMC requirements	**7.7.1**
L1	**Three phases of voltage supply**	- Ensure that supply voltage agrees with data on name plate	**7.7.1**
L2			
L3			
PE	**Protective Earth connection 2 to supply**	- Observe all safety and EMC requirements	**6.7**
M1/U	**Motor of Variable-speed Compressor**	- Through interlocked isolating contactor if required	**7.7.1/ 7.7.2**
M2/V			
M3/W			
PE	**Protective earth connection to compressor motor**		**7.7.2**

FrigoSoft 1.7 activated: Basic Pressure Control

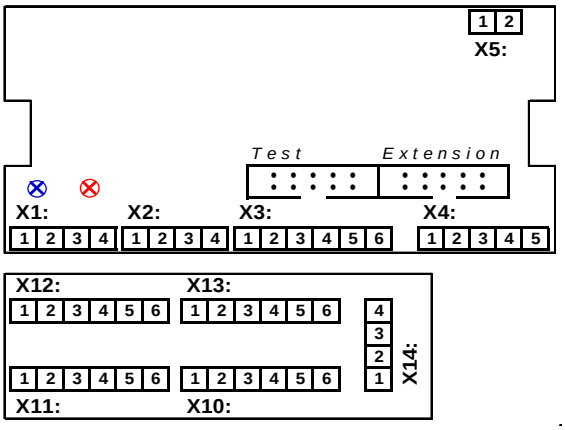


VfG: **Variable-speed fan group (Condenser / Dry cooler)**

VFsC1: **Variable-speed Compressor 1**
(also used as a Fixed-speed Compressor in some connections)

VFsC2: **Fixed-speed Compressors 2**
(also used as a Variable-speed Compressor in some connections)

Terminal position:



Terminal List for control functions

FrigoSoft 1.7 activated: Basic Pressure Control:

Terminal / Designation		Signal / Function	Explanation	Further information
BM-1: X1.1 / 2	**AI1**	**Analog Input:** **Pressure transmitter for Suction Pressure pe (LP)** 4...20 mA: -0.5 ... 7.0 bar 0 mA: Fault	- Must be used - Suitable pressure transducer: - A REFR-P-TRANSD-LP7+PL - Connections: 1-->X1.1, 2-->X1.2	
BM-1: X1.3 / 4	**AI2**	**Analog Input:** **Pressure transmitter for Discharge / Condensing** 20 mA: 0 ... 30 bar 0 mA: Fault	- Optional use - Suitable pressure transducer: - A REF-P-TRANSD-HP30+PL Connections: 1-->X1.3, 2-->X1.4	
X11.5	P10 V	Universal Analog Output (5 mA max. load)	- Do not use	
X11.6	N10 V	Universal Analog Output (5 mA max. load)	- Do not use	
X12.5	+24 V	Supply for contacts of digital inputs	- Not available	
BM-1: X3.1 / X13.2	**DI1**	**Digital Input:** **Start (Enable)** +24 V: Start 0 V: Controlled stop	- **Must be used:** - Load: 3.3 kΩ, 7.3 mA	
BM-1: X3.2/ X13.3	*DI2*	*Digital Input:* *Activate Lubrication Speed (50 Hz)* *+24 V: Lubrication speed* *0 V: Normal operation*	- *Optional use* - Load: 3.3 kΩ, 7.3 mA	
BM-1: X3.3/ X13.4	*DI3*	*Digital Input:* *Activate Setpoint pe2* *+24 V: Setpoint pe2* *0 V: No action*	- *Optional use* - Load: 3.3 kΩ, 7.3 mA	
BM-1: X3.4/ X12.1	*DI4*	*Digital Input:* *Activate Setpoint pc2* *+24 V: Setpoint pc2* *0 V: No action*	- *Optional use* - Load: 3.3 kΩ, 7.3 mA	
BM-1: X3.5/ X12.2	*DI5*	*Digital Input:* *Pulses from Energy Meter* *+24 V: Pulse* *0 V: Not activated*	- *Optional use* - Load: 3.3 kΩ, 7.3 mA	
X12.3	**DI6**	**Digital Input:** **Identification Module BM-1 (>=50 Hz)** +24 V: IMB Coding (mark) 0 V: IMB Coding (space)	- **Must be used:** - *Connect to Module BM-1, terminal tbd* - Load: 3.3 kΩ, 7.3 mA	
X10.1	**STO-A**	**Digital Input STO (Safe Torque Off), Channel A** +24 V: Operation Enable 0 V: Safe Stop	- **Must be used:** - Enable from contact pair of safety relay - Active if Channel B simultaneously activated - Load: 3.3 kΩ, 7.3 mA	
X10.2	**0 V**	**Ground for Safe Torque Off**	- **Must be used**	
X10.3	**STO-B**	**Digital Input STO (Safe Torque Off), Channel B** +24 V: Operation Enable 0 V: Safe Stop	- **Must be used:** - Enable from contact pair of safety relay - Active if Channel A simultaneously activated - Load: 3.3 kΩ, 7.3 mA	
X14.1 / X14.2	**DO1**	**Relay Output:** **"Ready" (without fault)** Closed: Ready (no fault) Open: No supply, fault or alarm	- Ready (no fault): - Function depends on the following setting: SPECIAL_ADJUSTMENTS__ | DATA | Dt1 - Max load: AC 230 V / 250 VA	
X14.3 X14.4	**DO2**	**Relay Output with alternative functionality:** **- Single compressor:** **- VsC1 Operating /** **- 1, 3 or more compressors without rotation:** **- VsC1 Operating** Closed: Operation / Activate Open: Stop, Deactivated	- To control auxiliaries such as: Crankcase heater, Condenser fan, Start unloader / - Activate VFsC1 - Max load: AC 230 V / 250 VA	
BM-1: X5:1 / X5:2	**DO3**	**Relay Output with alternative functionality:** **- 1, 3 or more compressors:** **- Activate Compressor FsC2** **- 2 compressors with rotation:** **- VFsC2 Operating** Closed: Operation / Activate Open: Stop, Deactivated	- Activate FsC2 - Activate VFsC2 - Max load: AC 230 V / 250 VA	
X13:2	**DO4**	**Relay Output with alternative functionality:** **- 1, 3 or more compressors:** **- Activate Compressor FsC3** Closed: Operation / Activate Open: Stop, Deactivated	- Activate FsC3 - External relay DC 24 V required - Max load: AC 230 V / 250 VA	
X11.3	**AO1**	**Analog Output with alternative functionality:** **VfG Condenser fan, actuating value** 0...+10 V: 0.0 ... 100.00 %	Function depends on the following setting: **SPECIAL_ADJUSTMENTS__||Dt8** - Max load: 5 mA	
X11.4	**AO2**	**Analog Output with alternative functionality:** **P10 V** 0...+10 V: 0.0 ... 100.00 %	Function depends on the following setting: **SPECIAL_ADJUSTMENTS__||Dt8** - Max load: 5 mA	

VsC: **Variable-speed Compressor**
FsC: **Fixed-speed Compressors**
VFsC: **Variable- / Fixed-speed Compressor**

VfG: **Variable-speed fan group (Condenser / Dry cooler)**

CONTROL SECTION

FrigoSoft 1.7 activated: Basic Pressure Control:

The regulations for refrigeration equipment reference the safety standard EN 60204-1
(Safety of machinery - Electrical equipment of machines - Part 1 General requirements).

It is established and proven practice that safety circuits (including pressure-limiting devices) are processed by electromechanical devices such as relays or contactors.

It is not permissible to use standard software-based automation controls (such as PLCs) as these are not functionally fail-safe or a software error can result in dangerous operating conditions.

In an emergency (such as a pressure-limit reached) the Stop Category 0 (immediate removal of power) is appropriate.

Contactor interruption in the energy supply to the compressor is a proven circuit technique for the immediate and safe stopping of compressor motors in an emergency condition.

The integrated Safe Torque-Off (STO) function of this Refrigeration Inverter may be used as an alternative method provided that a bypass contactor is not used. With correct installation a Safety Integrity Level of SIL3 can be achieved.

A typical safety circuit would normally consist of the following:
- Essential safety-relevant devices such as approved over-pressure switches
- Optional devices such as low-pressure switches, oil pressure or level monitoring controls

The safety circuit should terminate at a safety relay with two normally-open contacts wired as follows:
- Two individual or a single common connection from P24 V from the Refrigeration Inverter to the supply side of these two contacts.
- Two independent normally-open contacts dedicated to the Safe-Torque Off function of the refrigeration inverter wired to inputs STO-A and STO-B

The previously described standards and recommendations are general guidelines for the safety-relevant design of the installation.

However it is the installer or contractor's responsibility to assess the risk of each installation and to ensure that all safety measures are appropriate and functional.

Functional recommendations

A control switch should be provided with the following functionality:

- Middle position:	**OFF**	Controlled STOP of the compressor or compressor rack
- Right position:	**AUTO**	AUTOMATIC controlled operation
- Left position:	**MAN**	MANUAL test or emergency operation without activation of the Refrigeration Inverter

The normal automatic stopping and starting of the compressor should only be by using the AUTOMATIC (start) command at Digital Input DI1 of the Refrigeration Inverter.

Opening contactors in the input or output of the Refrigeration Inverter during operation must not be used for normal starting or stopping of the compressor as this will stress the Refrigeration Inverter and reduce the working life.

To ensure correct monitoring and fault logging the operating commands should be separate from the safety circuit.

The MANUAL mode of operation should preferably make use of a pump-down pressure switch to enable controlled operation.

It is recommended that control circuit automatically reverts to MANUAL operation if the FrigoPack Refrigeration Inverter is not available. This condition should be signalled to a supervising or warning system.

If in a fault condition no compressor is available, then a means of stopping the evaporation is recommended to minimize the risk of liquid in the suction line should be provided.

Example of suitable safety and control circuits

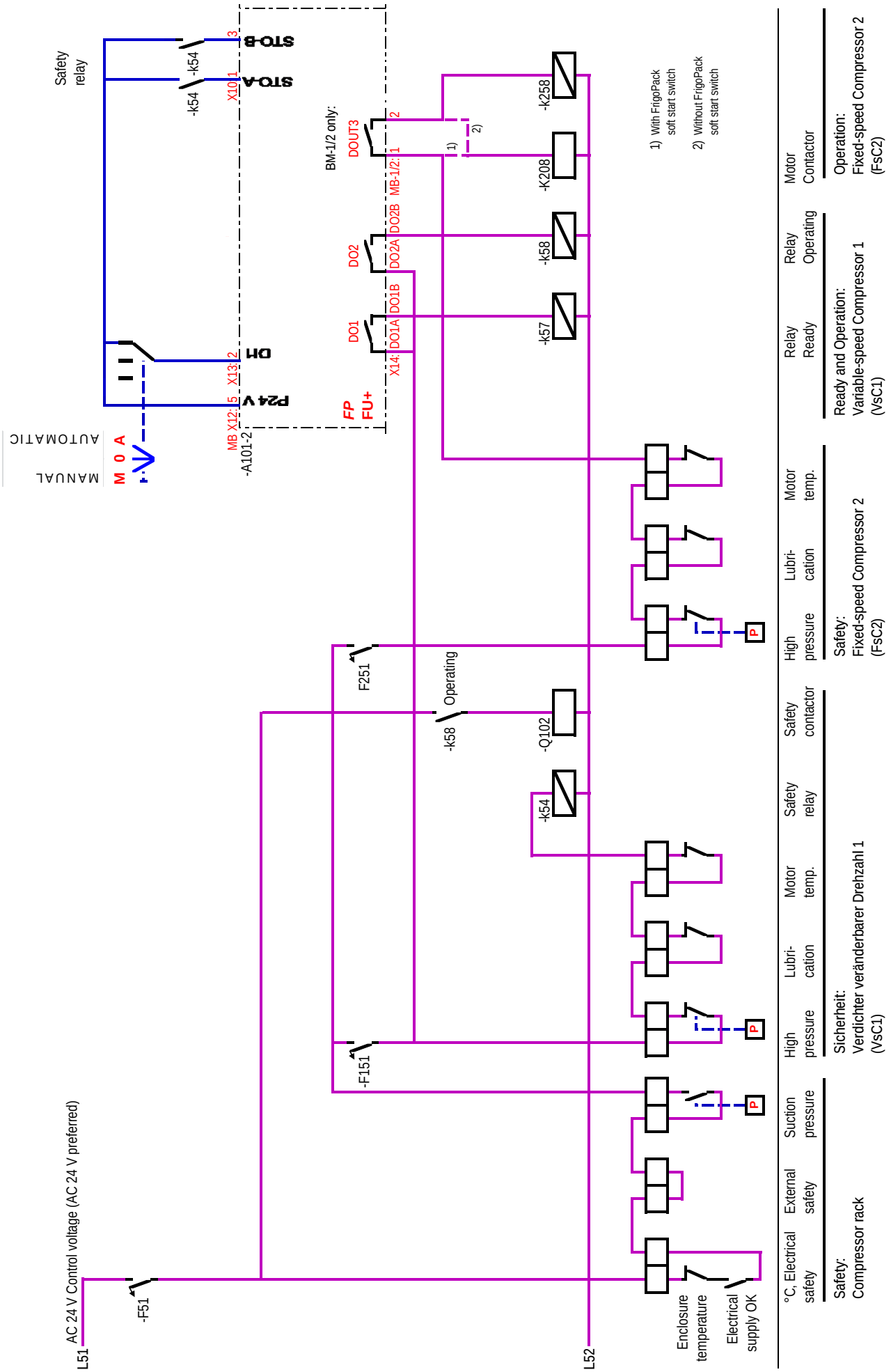
The following simplified overview of the safety and control wiring of a typical system only includes the wiring for AUTOMATIC operation.

Standard suggestions for the safety and control wiring with these features are available on request.

Please enquire at your supplier for assistance with the planning of complex systems or systems with special requirements.

SAFETY CIRCUIT

FrigoSoft 1.7 activated: Basic Pressure Control:



FIRST-TIME POWER UP

Mounting and electrical safety:

Ensure that all recommendations in the Product Manual have been adhered to.

UL compliance where appropriate:

Ensure that all recommendations in the Product Manual for UL compliance have been adhered to.

EMC compliance:

Ensure that all recommendations in the Product Manual for EMC compliance have been adhered to.

View Level:

There are three basic view levels selectable in the Wizard (see page 2):

OPERATOR:
Available without restriction as it is not possible to change any settings at this level.

TECHNICIAN:
For refrigeration-trained and authorized personnel (Password 8670). This level is sufficient for normal commissioning.

ENGINEER:
Special applications and usage (special Super-User password).

Language:

The language selection is only relevant when the 4-line Graphic Key Pad is fitted to the inverter
The following languages can be selected (see page 2):
English, German
(French, Spanish and Italian in preparation)

Refrigeration application:

The following refrigeration applications are automatically selected by fitting the correct Basic Module (auto-detection):

***FrigoSoft*® 1.7:** **Upper module for pressure transmitters: BM-1 (4 … 20 mA).**

Optional External Modules:
CM-1, EM-6/7.

Pressure transmitters:

This refrigeration application is preset for use with the following pressure transducers:
Industry-Standard 4 … 20 mA relative (gauge) pressure transmitters:

- pe: -0.5 ... 7.0 bar *(-7.25…101.53 psig)*	**- pc: 0...30 bar** *(0.0…101.5 psig)*
A REFR-P-SENSOR-LP7	A REFR-P-SENSOR-HP30

For alternative other preset pressure ranges refer to page 6.

WARNING: Only use approved pressure transmitters

Recommended basic commissioning steps:

- Verify that the power circuit corresponds to the suggestions on the previous pages 12/13

- In particular ensure that an interlocked safety contactor is fitted between the Refrigeration Inverter and the compressor if a parallel bypass connection is used.

- Verify that the control circuit corresponds to the suggestions on the previous pages 14…16.

- In particular ensure that two isolated contacts of the safety relay are connected to the Safe Torque Off inputs of FrigoPack: STO-A (Terminal X10.1) / STOP-B (Terminal X10.3) X10:1&3

- Remove Start Command: DIN1: X13:2.

- Connect main power supply.

- Verify that the blue LED for Suction Pressure near terminals BM-1: 1 & 2 lights. If not, then check that the wiring to the pressure transmitter is correct

- If a discharge-pressure transmitter is used, then verify that the red LED near terminals BM-1: 3 & 4 for the discharge pressure lights. If not, then check that the wiring

- Measure the pressures with a refrigeration pressure gauge. Verify that the pressure indicated at parameters 03:pe____VsC_pc_PRESS agree with these external measurements.

Recommended basic commissioning steps (cont.):

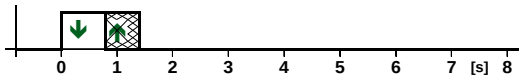
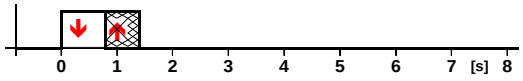
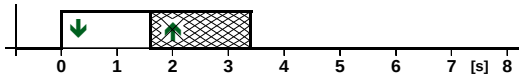
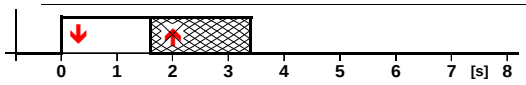
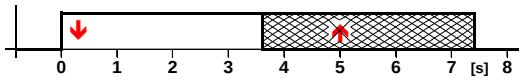
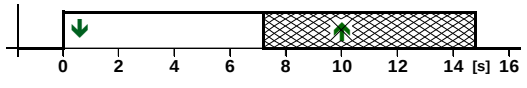
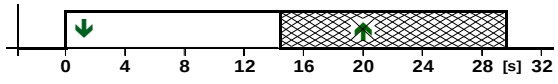
- Set the Refrigerant at the following parameter:
  `FIRST_SETUP_____ | SD-Card:Data_Select__ |`
  `<1:Refrigerant_____`
  as described in detail on pages 6,7

- Set the Compressor at the following parameter:
  `FIRST_SETUP_____ | SD-Card:Data_Select__ |`
  `<2:VFsC_Manufacturer`
  `<3:VFsC_Type_____`
  `<4:VFsC_Cylinders___`
  `<5:Supply_Voltage___`
  `<6:VFsC_Compressor__`
  as described in detail on pages 6,7

- Reset to the following starting position (VERY IMPORTANT) :
  `FIRST_SETUP_____ | SD-Card:Data_Select__ |`
  `<0:Selection_disabld`

MULTI-FUNCTIONAL SPECIAL KEYS "1"&"0"

Further inform. tbd

Timed Operation:	Key:	Action:	Amount:
 *Press Green Key 1 s*	I	Increase speed in LOCAL: Reset Inhibit Timer: SD FIRST-TIME SETUP setup mode (page 6,7): Next set of data.	+1 Hz
 *Press Red Key 1 s*	O	Reduce speed in LOCAL: Reset trip: SD FIRST-TIME SETUP setup mode (page 6,7): Previous set of data.	-1 Hz
 *Press Green Key 2 s*	I	Increase speed in LOCAL:	+5 Hz
 *Press Red Key 2 s*	O	Reduce speed in LOCAL: Stop and LOCAL reset on reaching fmin Restart will occur automatically when the inhibit time is expired Retains floc 60 s after switching to AUTOMATIC, otherwise revert to floc = fmin	-5 Hz
Press Green and Red Keys together 2 s and release	I + O	Interrogate Application Software version: Project: +5 s Version: +5 s	
 *Press Red Key 5 s*	O	Stop and LOCAL reset:	0 Hz
Press Green and Red Keys together 5 s and release	O + I	Start LOCAL operation: With Digital Input DI2 activated: Set LOCAL frequency as described above: :	fmin 50 Hz fmin..fmax
Repeat two key activation:		Set LOCAL test ramping (continuous up and down):	1 Hz ↑↓ / 2 s
 *Press Green Key 10 s*	I	Modify evaporating temperature setpoints to correspond to: `31:ted_SETPOINT_1____`	(see page 2).
 *Press Green Key 10 s*	I	Reset diagnostic values:	Refer to SPECIALS | SpJ on page 6:

Setting-up step by step

Starting condition:

```
SD-Card:Data_Select__
 <O:Selection_disabld
SD-Card:Data_Read____
```

1: REFRIGERANT:

STEP 1 ↓

Set Refrigerant selection mode:

```
SD-Card:Data_Select__
 <1:Refrigerant_____
```

Select Refrigerant:

```
SD-Card:Data_Read____
__<14:R134aHFC
```

Modify as follows if necessary:

I - After 1 s on release: +1 Refrigerant

O - After 1 s on release: -1 Refrigerant

2a..d: Compressor pre-selections:

2a.

Set Manufacturer selection mode:

```
SD-Card:Data_Select__
 <2:VFsC_Manufacturer
```

Select manufacturer:

```
SD-Card:Data_Read____
_<21:BITZER_________
```

Modify if necessary:

I - After 1 s on release: +1 Manufacturer

O - After 1 s on release: -1 Manufacturer

2b.

Set Type selection mode:

```
SD-Card:Data_Select__
 <3:VFsC_Type_______
```

Select Type:

```
SD-Card:Data_Read____
_<32:Recip_Semihermtc
```

Modify if necessary:

I - After 1 s on release: +1 Type

O - After 1 s on release: -1 Type

2c.

Set no of cylinders (0 for screw or scroll):

```
SD-Card:Data_Select__
 <4:VFsC_Cylinders___
```

Select no.:

```
SD-Card:Data_Read____
_<44:4_cylinders_____
```

Modify if necessary:

I - After 1 s on release: +1 Cylinder

O - After 1 s on release: -1 Cylinder

2d.

Set Supply voltage:

```
SD-Card:Data_Select__
 <5:Supply_Voltage__
```

Select supply voltage:

```
SD-Card:Data_Read____
_<53:50_Hz_400_V____
```

Modify if necessary:

I - After 1 s on release: +1 Voltage

O - After 1 s on release: -1 Voltage

2: COMPRESSOR:

STEP 2 ➔4

Set Compressor selection mode:

```
SD-Card:Data_Select__
 <6:VFsC_Compressor__
```

Select compressor:

```
SD-Card:Data_Read____
_<Long_Selectn_List__
```

Select compressor:

I - After 1 s on release: +1 Compressor

O - After 1 s on release: -1 Compressor

VERY IMPORTANT:
Deactivate after completion of steps 1 and 2a...2d:

Alternative: Wait 60 s, then automatic deactivation:

Reset to starting position: 5x

```
SD-Card:Data_Select__
 <O:Selection_disabld
```

Indication:

```
SD-Card:Data_Read____
```

VERIFICATION OF SETTINGS:

Select menu:

```
OPERATION___________
```

Verify settings:

```
25:REFRIGERANT______
  <14:R134a      HFC
60:COMPRESSOR______
 <6          2CES-4Y
```

Example compressor

Expert Overview

```
DIAGNOSTICS
EXPERT_OVERVIEW_____
OPERATION
```

Compakt overview for experts

Type / Value	Explanation	Further inform.
04:ted__RACK_tcm_Diff Y.Y K Y.Y K	Deviations ___._ K ___._ K	Temp. Deviations from setpoints: Evaporating and Condensing	3.1
02:ted__RACK_tcd_____ Y.Y °C YY.Y °C	Calculated values ___._ °C ___._ °C	Saturated gas temperatures (dew): Evaporating and Condensing	
03:pe___RACK_pc______ Y.Y bar YY.Y bar	Measured values ___._ bar ___._ bar	Gas pressures: Suction and Discharge gas	
0A:VsC_compressr_RACK Y.Y Hz XXXX	Deviations ___._ K ___._ K	Motor Frequency Rack Status	

FIRST_SETUP

EXPERT_OVERVIEW