

Application guidelines

# Optyma™ Plus INVERTER

Stepless capacity modulation from 30 to 100 rps in a simple plug and play package





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**1.1 Symbols are shown left of the text**

There are 3 symbols, used for different degrees of danger:



Warning! Risk of serious injury or death to person!



Caution! Danger which can lead to serious damages!



Notice! Risk of damage to equipment!

This guideline is intended to enable users to ensure the safe installation, starting, operation and maintenance of Optyma™ Plus INVERTER condensing units. This guideline is not intended to replace the system expertise available from system manufacturers.

In addition to this instruction application instructions of compressor drive, controller and other internal components must be taken into consideration as well.

**2.1 Optyma™ Plus INVERTER condensing unit**

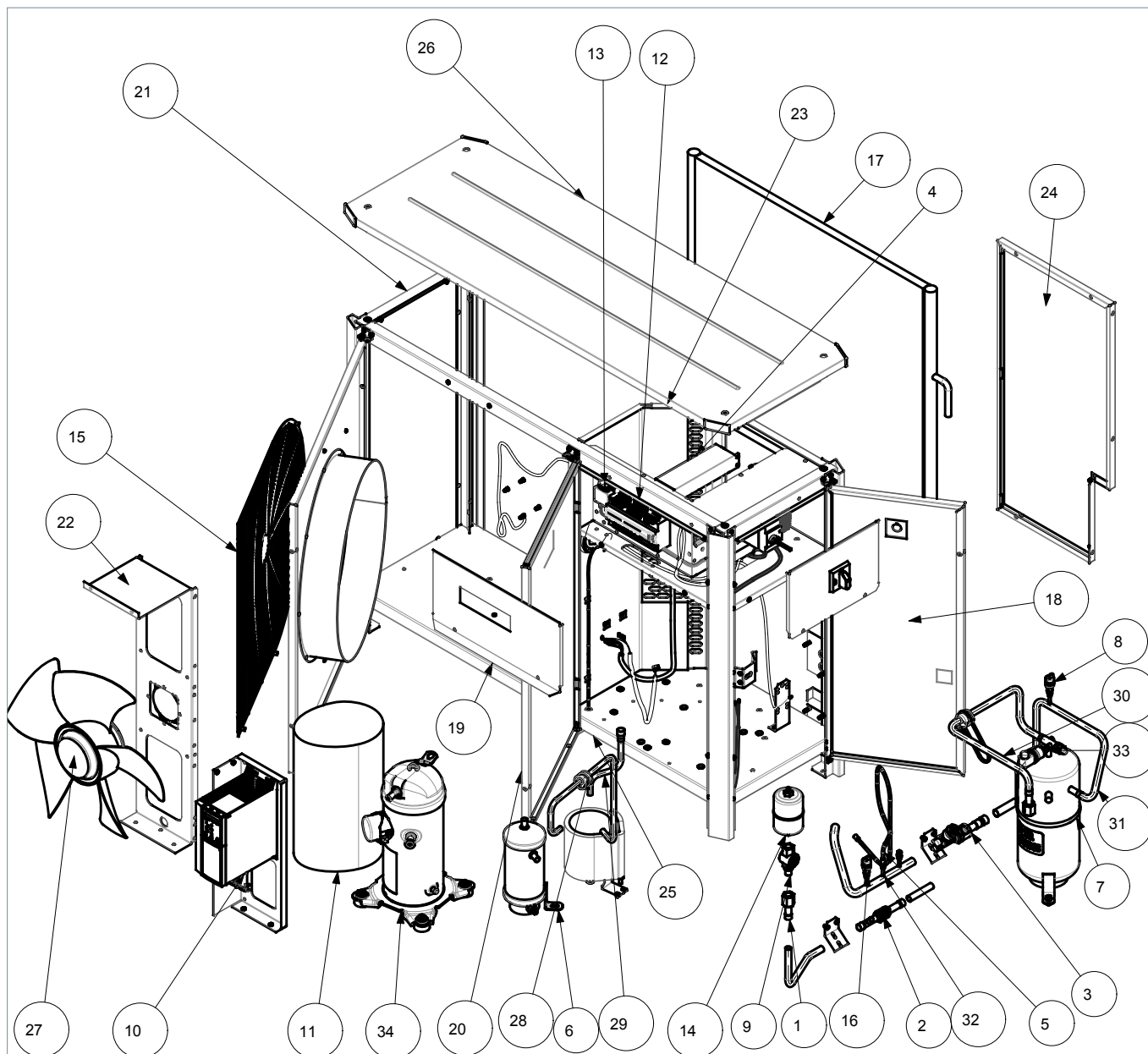
Optyma™ Plus INVERTER combines our market leading expertise in condensing unit design with the unique benefits of stepless inverter scroll technology. The result is 20-30% higher energy efficiency in a flexible plug-and-play package, for medium and high temperature refrigeration applications in the range of 2kW to 9kW.

**Standard equipment features:**

- Variable speed compressor (scroll) with acoustic housing and crankcase heater
- Compressor drive (with EMI filter)
- MCHX condenser
- Condenser fan motor
- Oil separator with oil heater
- Receiver with stop valve
- Ball valves
- Sight glass
- HP and LP switches
- Filter drier
- Optyma™ Plus controller
- Circuit Breaker MCB, compressor contactor with overload relay
- Robust weather proof housing



2.2 Exploded view  
Optyma™ Plus INVERTER



Legend:

- |  |                                 |                               |
|--|---------------------------------|-------------------------------|
| 1: FSA Adaptor                                   | 12: Optyma™ Plus controller     | 24: Back panel                |
| 2: Liquid line valve (with schrader)             | 13: EMI filter (controller)     | 25: Base plate                |
| 3: Suction line valve + Extra service connection | 14: Refrigerant filter          | 26: Top panel                 |
| 4: EMI filter (drive)                            | 15: Fan guard                   | 27: Fan assembly              |
| 5: Oil return pipe                               | 16: Low pressure switch         | 28: Discharge pipe            |
| 6: Oil separator                                 | 17: Microchannel heat exchanger | 29: Condenser outlet pipe     |
| 7: Receiver                                      | 18: Right side door             | 30: Receiver outlet pipe      |
| 8: High pressure switch                          | 19: E-box cover                 | 31: Oil separator outlet pipe |
| 9: Sight glass                                   | 20: Front door, right side      | 32: Suction line              |
| 10: Compressor drive                             | 21: Unit frame                  | 33: Rotalock valve            |
| 11: Acoustic hood                                | 22: Fan bracket                 | 34: Compressor                |
|  | 23: Separation panel            |                               |

2.3 Condensing unit nomenclature system

# OP - M P L M 028 VVL P01 E

1      2 3 4 5      6      7      8 9

1.	Product family	Optyma™
2.	Application	M = MBP
3.	Design	P = Packaged units
4.	Refrigerant	L = R404A, R407A, R407F
5.	Condenser type	M = Standard with micro channel heat exchanger
6.	Displacement	028 = 28 cm <sup>3</sup> /rev
7.	Compressor platform	VVL = variable speed scroll VLZ compressor
8.	Version	P01
9.	Electrical code	E = Compressor 400 V/3 phase/50 Hz, fan 230 V/1 phase/ 50 Hz

2.4 Label

MADE IN INDIA

**A** → **OP-MPLM044VVLP01E**

**B** → **Code Number.:** 114X4333

**C** → **Application** MBP

**D** → **Refrigerant** (1) R407F/R407A/R404A (2)

**E** → **M.W.P**    HP    (1) 28 bar    (2)

LP    (1) 7 bar    (2)

**F** → **Voltage**    380V-400V~3N~50Hz

**LRA**    Inverter Driven    **MCC**    12.1 A

**G** → **Serial No.**    123456CG1015

**H** ← IP 54

**CE EAC**

- A:** Model
- B:** Code number
- C:** Application
- D:** Refrigerant
- E:** Housing Service Pressure
- F:** Supply voltage, Maximum Current Consumption
- G:** Serial Number and bar code
- H:** Protection

## Application Guidelines      Product description

### 2.5 Approvals and certificates

	All models OP-MPLM
	All models OP-MPLM
	Contact Danfoss

### 2.6 Technical specifications

Unit	Condenser coil			Condenser fan	Receiver	Dimensions					Weight [kg]	
	Type	Air flow [m <sup>3</sup> /h]	Internal volume [dm <sup>3</sup> ]	Fan blade Ø [mm]	volume [L] (without valve)	Depth D [mm]	Width W [mm]	Height H [mm]	Suction line	Liquid line	Gross	Net
OP-MPLM028	G7	5200	1.8	1x500	6.2	481	1406	965	3/4"	5/8"	150	124
OP-MPLM035	G7	5200	1.8	1x500	6.2	481	1406	965	3/4"	5/8"	151	125
OP-MPLM044	G7	5200	1.8	1x500	6.2	481	1406	965	3/4"	5/8"	151	125

Unit	MCC compressor [A] 400V/3phase	Max cont. power consumption [kW]	MCC Fan [A] 230V/1 phase	Fan power output [W]	Fan power consumption [W]
OP-MPLM028	8.1	3.98	0.96	1x130	1x220
OP-MPLM035	9.8	4.94	0.96	1x130	1x220
OP-MPLM044	12.0	6.33	0.96	1x130	1x220

### 2.7 Spare part codes

Unit	Compressor	Condenser	Fan assembly	Receiver	Filter	Sight glass	Liquid line valve	Suction line valve	High pressure transmitter	Low pressure transmitter	Suction and ambient temperature	Discharge temperature sensor	Fan grill
OP-MPLM028	120G0069	118U3494	118U3829	118U3476	023Z5045	014F0174	009G7053	009G7054	118U3722	118U3721	084N0003	084N2007	118U3485
OP-MPLM035	120G0070	118U3494	118U3829	118U3476	023Z5045	014F0174	009G7053	009G7054	118U3722	118U3721	084N0003	084N2007	118U3485
OP-MPLM044	120G0071	118U3494	118U3829	118U3476	023Z5045	014F0174	009G7053	009G7054	118U3722	118U3721	084N0003	084N2007	118U3485

Unit	Controller*	Main switch	Compressor contact	Door handle	Crankcase heater	High pressure switch	Low pressure switch	Acoustic hood	Compressor drive CDS803	EMI filter (Drive)	EMI filter (Controller)	Compressor oil	Oil separator
OP-MPLM028	118U3465	118U3852	118U3847	118U3858	120Z5040	118U3718	118U3720	120Z5043	118U3973	118U3972	118U3974	120Z5034	118U3981
OP-MPLM035	118U3465	118U3852	118U3847	118U3858	120Z5040	118U3718	118U3720	120Z5043	118U3973	118U3972	118U3974	120Z5034	118U3981
OP-MPLM044	118U3465	118U3852	118U3847	118U3858	120Z5040	118U3718	118U3720	120Z5043	118U3973	118U3972	118U3974	120Z5034	118U3982

\* For service replacement of controller in Optyma™ Plus INVERTER only new version of controller can be used: code number on the controller is 084B8080.

**NOTICE** For service purpose original components (spare parts) recommended by Danfoss should be used.



**2.8 Cooling capacities, sound data, power consumption**
**Optyma™ Plus INVERTER, R407A**

Unit	Code no	Compressor	Compressor speed, rps	Amb. temp. °C	Capacity range in (W) at evaporating temperature [°C]					Sound power level dB(A)	Sound pressure level full speed @10m dB(A)	Power consumption EN13215, SH10K, Amb. temp. 32°C	
					-15 °C	-10 °C	-5 °C	0 °C	5 °C			-10 °C	0 °C
OP-MPLM028	114X4300	VLZ028	30	27	1440	1810	2240	2750	3340	72.8	41.8	894	897
				32	1350	1690	2100	2590	3150				
				38	-	1570	1940	2400	2920				
				43	-	-	-	-	-				
			50	27	2400	3020	3740	4580	5560	73.4	42.4	1321	1417
				32	2260	2850	3540	4350	5280				
				38	-	2640	3300	4060	4940				
				43	-	2470	3080	3800	4630				
			75	27	3530	4460	5530	6780	8200	74.0	43.0	1978	2176
				32	3340	4220	5250	6430	7790				
				38	-	3930	4890	6000	7270				
				43	-	3670	4570	5620	6810				
			100	27	4600	5820	7220	8830	10650	75.3	44.3	2781	3069
				32	4360	5520	6840	8360	10080				
				38	-	5150	6380	7790	9390				
				43	-	4830	5980	7300	8810				
OP-MPLM035	114X4315	VLZ035	30	27	1810	2270	2820	3450	4200	71.7	40.7	1049	1059
				32	1700	2130	2640	3250	3950				
				38	-	1970	2440	3010	3670				
				43	-	-	-	-	-				
			50	27	3010	3790	4690	5740	6940	72.3	41.3	1580	1711
				32	2840	3580	4440	5440	6600				
				38	-	3320	4130	5070	6160				
				43	-	3090	3850	4740	5770				
			75	27	4420	5580	6910	8440	10180	72.9	41.9	2404	2671
				32	4180	5280	6540	8000	9650				
				38	-	4900	6090	7450	8990				
				43	-	4570	5680	6960	8420				
			100	27	5750	7250	8960	10920	13120	74.6	43.6	3414	3811
				32	5450	6870	8480	10330	12400				
				38	-	6400	7900	9600	11530				
				43	-	5990	7400	8990	10800				
OP-MPLM044	114X4333	VLZ044	30	27	2320	2900	3590	4390	5330	72.6	41.6	1265	1286
				32	2170	2720	3370	4130	5020				
				38	-	2510	3110	3830	4660				
				43	-	-	-	-	-				
			50	27	3830	4810	5950	7270	8780	73.1	43.1	1944	2127
				32	3610	4540	5630	6890	8330				
				38	-	4210	5230	6410	7760				
				43	-	3910	4870	5980	7260				
			75	27	5610	7050	8710	10600	12740	73.7	43.7	3006	3379
				32	5290	6670	8240	10030	12060				
				38	-	6180	7650	9320	11210				
				43	-	5750	7120	8690	10460				
			100	27	7260	9120	11220	13590	16240	74.4	43.4	4317	4883
				32	6870	8630	10610	12840	15330				
				38	-	8020	9850	11920	14230				
				43	-	7500	9210	11130	13290				

Electrical code E: Compressor 400V/3/50 Hz, fan 230V/1/50 Hz

**Optyma™ Plus INVERTER, R407F**

Unit	Code no	Compressor	Compressor speed, rps	Amb. temp. °C	Capacity range in (W) at evaporating temperature [°C]					Sound power level dB(A)	Sound pressure level full speed @10m dB(A)	Power consumption EN13215, SH10K, Amb. temp. 32 °C	
					-15 °C	-10 °C	-5 °C	0 °C	5 °C			-10 °C	0 °C
OP-MPLM028	114X4300	VLZ028	30	27	1540	1920	2380	2910	3520	71.7	40.7	939	943
				32	1450	1820	2250	2750	3340				
				38	-	1690	2090	2560	3120				
				43	-	-	-	-	-				
			50	27	2620	3280	4060	4950	5970	72.3	41.3	1395	1475
				32	2470	3110	3850	4700	5680				
				38	-	2890	3590	4400	5320				
				43	-	2700	3360	4130	5010				
			75	27	3860	4850	5970	7270	8730	72.9	41.9	2090	2277
				32	3650	4590	5670	6910	8310				
				38	-	4280	5300	6470	7790				
				43	-	4000	4970	6080	7340				
			100	27	5010	6260	7700	9330	11180	74.2	43.2	2923	3226
				32	4750	5950	7320	8880	10640				
				38	-	5560	6850	8320	9980				
				43	-	5230	6450	7840	9420				
OP-MPLM035	114X4315	VLZ035	30	27	1940	2420	2990	3650	4420	71.2	40.2	1106	1117
				32	1830	2290	2820	3460	4190				
				38	-	2120	2630	3220	3910				
				43	-	-	-	-	-				
			50	27	3280	4120	5080	6190	7450	71.9	40.9	1675	1788
				32	3100	3900	4820	5880	7090				
				38	-	3620	4490	5490	6630				
				43	-	3370	4200	5160	6240				
			75	27	4830	6060	7450	9040	10830	72.5	41.5	2546	2805
				32	4560	5730	7070	8590	10300				
				38	-	5330	6590	8030	9640				
				43	-	4980	6180	7540	9070				
			100	27	6250	7800	9550	11550	13780	73.55	42.5	3595	4014
				32	5920	7400	9070	10970	13100				
				38	-	6910	8480	10270	12270				
				43	-	6490	7980	9670	11560				
OP-MPLM044	114X4333	VLZ044	30	27	2480	3090	3810	4650	5620	72	41	1338	1362
				32	2340	2920	3600	4400	5320				
				38	-	2710	3350	4100	4960				
				43	-	-	-	-	-				
			50	27	4180	5230	6450	7830	9410	72.6	41.6	2069	2235
				32	3940	4950	6110	7430	8940				
				38	-	4590	5680	6930	8350				
				43	-	4270	5310	6500	7850				
			75	27	6120	7650	9380	11350	13560	73.2	42.2	3194	3566
				32	5770	7230	8890	10770	12870				
				38	-	6710	8280	10040	12020				
				43	-	6260	7740	9420	11290				
			100	27	7880	9790	11960	14390	17090	74	43	4558	5156
				32	7460	9280	11340	13650	16220				
				38	-	8650	10580	12750	15160				
				43	-	8110	9940	11980	14260				

Electrical code E: Compressor 400V/3/50 Hz, fan 230V/1/50 Hz

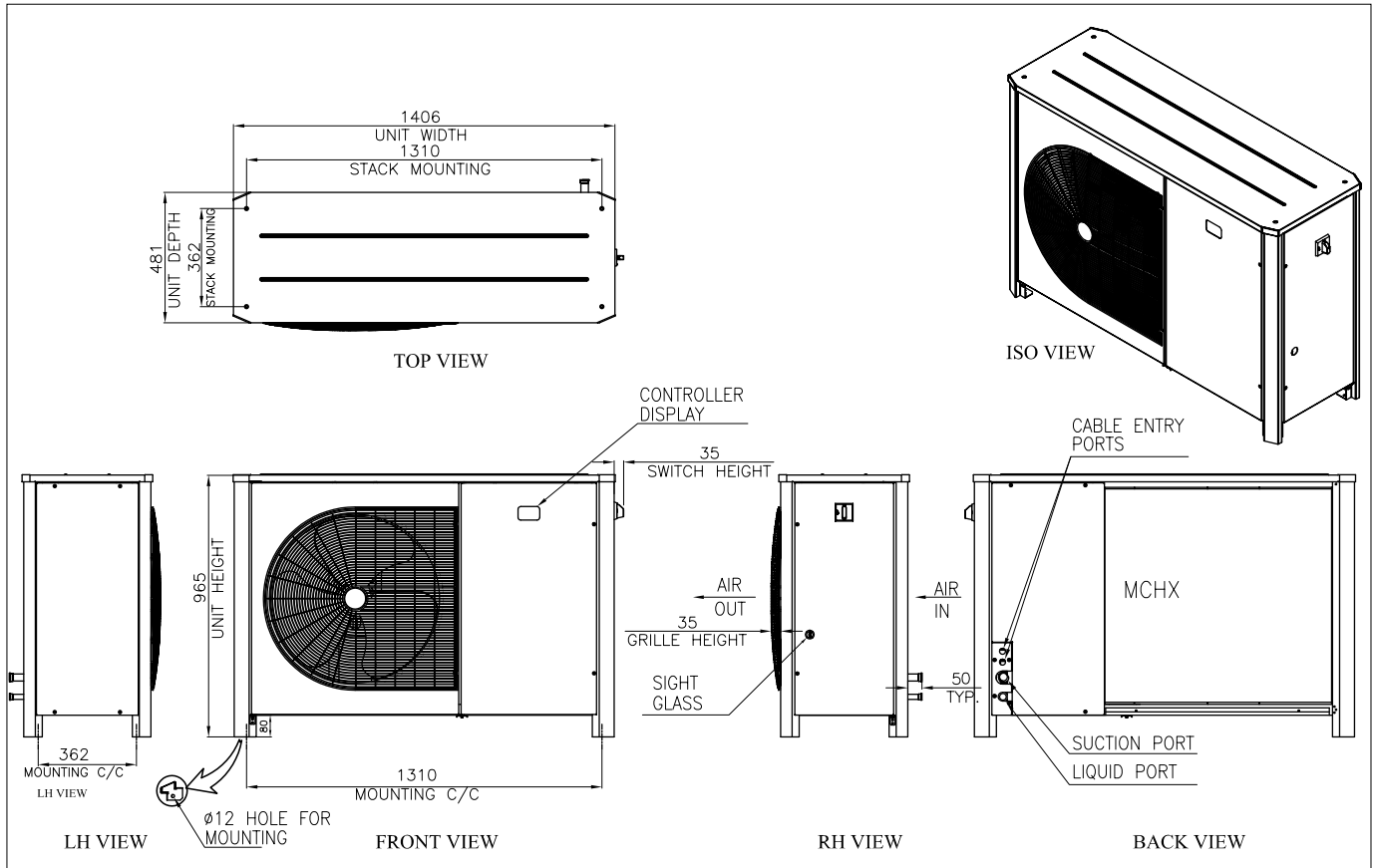
**Application Guidelines      Product description**
**Optyma™ Plus INVERTER, R404A**

Unit	Code no	Compressor	Compressor speed, rps	Amb. temp. °C	Capacity range in (W) at evaporating temperature [°C]					Sound power level dB(A)	Sound pressure level full speed @10m dB(A)	Power consumption EN13215, SH10K, Amb. temp. 32 °C	
					-15 °C	-10 °C	-5 °C	0 °C	5 °C			-10 °C	0 °C
OP-MPLM028	114X4300	VLZ028	30	27	1540	1920	2380	2910	3530	71.2	40.2	971	962
				32	1450	1800	2210	2700	3280				
				38	-	-	-	-	-				
				43	-	-	-	-	-				
			50	27	2680	3340	4100	4970	5950	71.9	40.9	1462	1492
				32	2510	3130	3850	4660	5580				
				38	2300	2880	3540	4290	5140				
				43	2110	2650	3270	3970	4770				
			75	27	4000	4980	6080	7320	8710	72.5	41.5	2197	2328
				32	3730	4660	5700	6870	8180				
				38	3380	4250	5220	6310	7530				
				43	3070	3890	4810	5830	6960				
			100	27	5200	6440	7840	9400	11140	73.7	42.7	3064	3348
				32	4840	6020	7340	8810	10440				
				38	4390	5480	6710	8060	9570				
				43	4000	5020	6160	7420	8830				
OP-MPLM035	114X4315	VLZ035	30	27	1940	2420	2980	3650	4410	73.1	42.1	1147	1143
				32	1830	2260	2780	3390	4100				
				38	-	-	-	-	-				
				43	-	-	-	-	-				
			50	27	3360	4190	5130	6200	7400	73.8	42.8	1760	1811
				32	3140	3920	4810	5820	6950				
				38	2870	3600	4420	5350	6390				
				43	2640	3310	4080	4950	5920				
			75	27	4990	6190	7550	9070	10750	74.4	43.4	2679	2865
				32	4640	5790	7070	8500	10080				
				38	4200	5270	6470	7790	9260				
				43	3810	4820	5940	7180	8550				
			100	27	6450	7970	9670	11550	13630	75.4	44.4	3767	4148
				32	6000	7430	9030	10800	12750				
				38	5420	6760	8230	9860	11660				
				43	4920	6170	7540	9050	10720				
OP-MPLM044	114X4333	VLZ044	30	27	2480	3080	3790	4630	5590	73.1	42.1	1393	1400
				32	2340	2880	3530	4300	5190				
				38	-	-	-	-	-				
				43	-	-	-	-	-				
			50	27	4270	5310	6490	7820	9310	73.9	42.9	2178	2267
				32	3990	4970	6070	7320	8720				
				38	3640	4550	5570	6720	8010				
				43	3340	4180	5140	6210	7410				
			75	27	6290	7790	9460	11320	13360	74.5	43.5	3363	3635
				32	5840	7260	8840	10590	12510				
				38	5270	6590	8060	9680	11450				
				43	4750	6000	7380	8880	10540				
			100	27	8070	9940	11990	14260	16720	75.5	44.5	4771	5297
				32	7480	9240	11170	13290	15600				
				38	6740	8370	10150	12090	14210				
				43	6080	7600	9260	11060	13010				

Electrical code E: Compressor 400V/3/50 Hz, fan 230V/1/50 Hz

2.9 Layout

OP-MPLM028-035-044



**3.1 Main applications**

Optyma™ Plus INVERTER is a perfect cooling solution for typical MBP applications like food retail, petrol forecourt sites, cold rooms. All units are fully wired and factory tested. They have one cabinet sizes and are equipped with one fan.

Optyma™ Plus INVERTER outdoor condensing units are released for R407A/F and R404A.

**3.2 Condensing unit selection**

Inverter technology offers more flexibility in condensing unit selection than fixed-speed units. Selection of the right inverter condensing unit size can be made by next method:  
Select a condensing unit size which achieves the peak load system cooling capacity demand at its maximum speed.

Evaporator1= 1 kW  
Evaporator2= 2,1 kW  
Evaporator3= 2,5 kW  
Evaporator4=1,5 kW  
Total Q = 7,1 kW (maximum cooling capacity)  
Minimum cooling capacity = minimum evaporator capacity = Evaporator1 = 1 kW.

**NOTICE** It is compulsory to secure that condensing unit capacity at minimum speed (30 rps) will not be higher than necessary cooling capacity for the smallest evaporator!

According to the capacities at evaporating -10 °C, ambient 32 °C and refrigerant R404A condensing unit OP-MPLM035 (maximum capacity 7,2 kW) achieves the peak load system cooling capacity (7,1 kW) demand at its maximum speed but at the same time condensing unit capacity at minimum speed (minimum capacity 2 kW) is higher than necessary cooling capacity for the smallest evaporator (1 kW).

**In case minimum (at 30 rps) condensing unit capacity is higher than capacity of smallest evaporator it can cause work of condensing unit outside its application envelope and as consequence reduce lifetime.**

In this case it is recommended to connect few evaporators together (regulated by one thermostat) to achieve smallest required capacity higher than minimum capacity of condensing unit: by managing Evaporator1 and Evaporator4 via one thermostat minimum required capacity will be 2,1 kW (Evaporator2) which is higher than minimum capacity of condensing unit at low speed (2 kW).

Example1 (evaporating temperature -10 °C, ambient temperature 32 °C, R404A):  
Evaporator1= 3,5 kW  
Evaporator2= 2,8 kW  
Evaporator3= 3 kW  
Total Q = 9,3 kW (maximum cooling capacity)  
Minimum cooling capacity = minimum evaporator capacity = Evaporator2 = 2,8 kW  
According to the capacities at evaporating -10 °C, ambient 32 °C and refrigerant R404A condensing unit OP-MPLM044 (maximum capacity 9,3 kW) achieves the peak load system cooling capacity (9,3 kW) demand at its maximum speed and at the same time condensing unit capacity at minimum speed (minimum capacity 2,6 kW) is not higher than necessary cooling capacity for the smallest evaporator (2,8 kW).

**NOTICE** Compressor of Optyma™ Plus INVERTER is equipped with a four-pole BLAC (brushless AC) motor. The compressor cannot operate without frequency converter. It will be destroyed immediately if connected directly to public network. The applied frequency from the inverter will be 60 Hz for 30 rps (1800 rpm) up to 200 Hz for 100 rps (6000 rpm).

Example2 (evaporating temperature -10 °C, ambient temperature 32 °C, R404A):

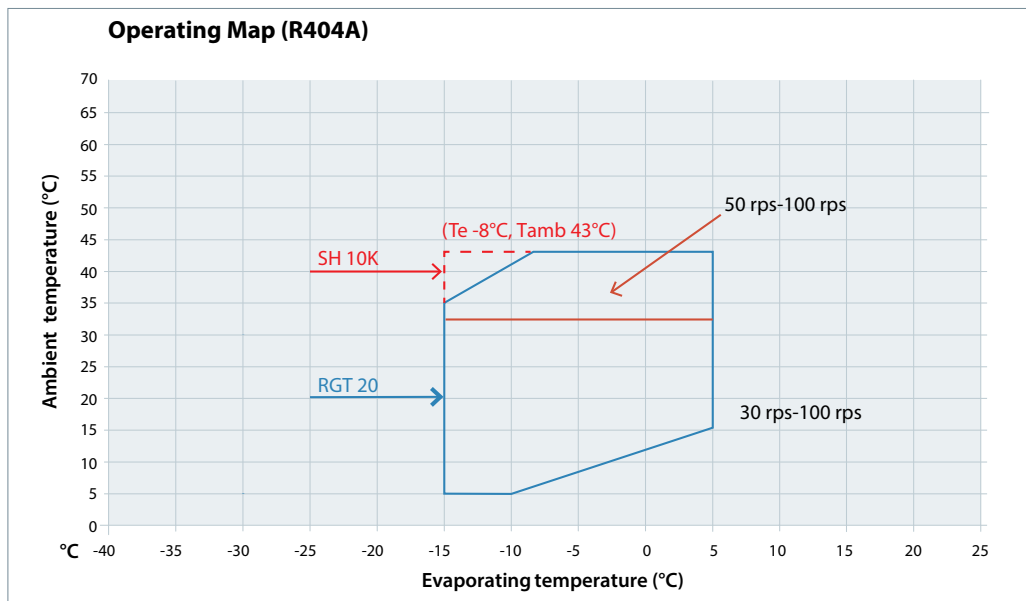
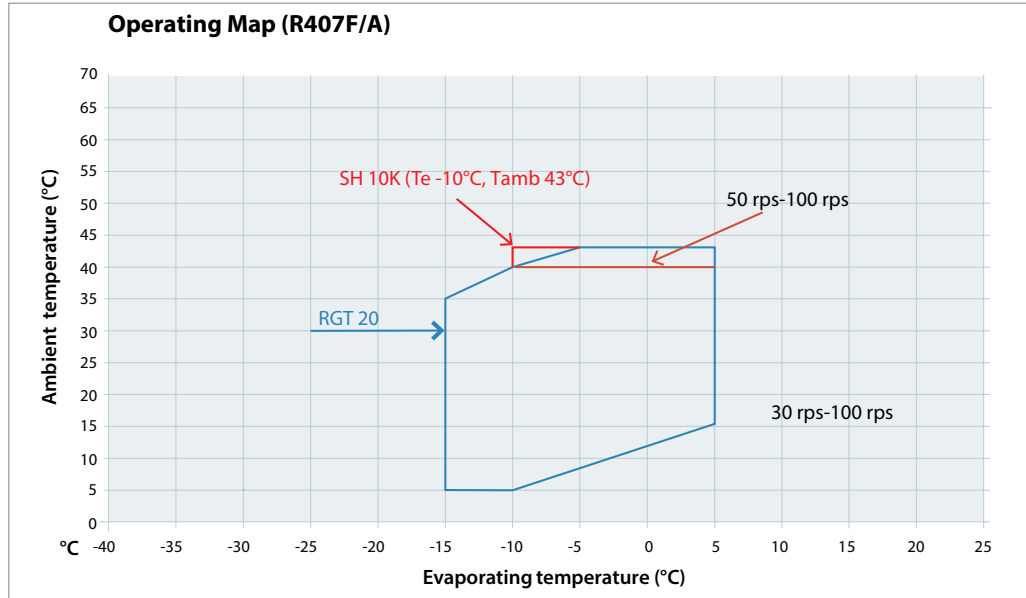
Please refer to the table below

Compressor speed	Min	Max
rps	30	100
rpm	1800	6000
Drive output frequency Hz	60	200

**3.3 Application envelopes**

The operating envelopes of Optyma™ Plus INVERTER are given in the figures below, where the ambient and evaporating temperatures represent the range for steady state operation. The figures below show the operating envelopes

for condensing units with refrigerants R407A/F and R404A. The operating limits serve to define the envelopes within which reliable operation of the condensing units are guaranteed.



Red line on the application envelope indicates maximum safe ambient temperature for low load (30-50 rps) and high ambient conditions (above 32 °C for R404A and above 40 °C for R407A/F).

In case low unit capacity required (30-50 rps) at high ambient temperatures controller will increase compressor speed up to minimum safe

speed at high temperature. This minimum safe speed at high temperature is factory preset to 50 rps (controller parameter c47: Start speed of the compressor). It is not recommended to decrease setting of parameter c47 below 50 rps as this can lead to work of compressor at low speed during high ambient conditions which can reduce lifetime of the unit.

Minimum and maximum evaporating and condensing temperatures as per the operating

envelopes – compressor should work inside application envelope.

Other operating limits:	Recommendation
Discharge gas temperature	125 °C maximum
Evaporator outlet superheat	above 6K (to avoid liquid flood back)
Suction gas superheat at compressor inlet	within the limits shown on the application envelope

Special attention to suction line insulation will have to be secured in order to:

- Avoid too high superheat during high ambient conditions that can create too high discharge gas temperature.

- Avoid too low superheat during low ambient conditions that can create condensation of refrigerant in suction line.

### 3.4 Ambient conditions

Optyma™ Plus INVERTER units can be used with ambient temperature from -25°C to 43°C. For altitudes above 2000 m, contact Danfoss. The other working conditions should be within the limits of application envelope.

To assure that the unit can start during cold conditions the parameter “c94 LpMinOnTime” can be used. If this parameter is set to a value that is higher than 0 and the ambient temperature (Tamb) is below 5°C, the internal transmitter “LP switch c75” and “pump down limit c33” will be overridden for the number of seconds defined in “c94 LpMinOnTime”. And the value for Min on time for the compressor will be set to the largest of the values of “c94 MinLpOnTime” and “c01 Min. on time”.

The CDS803 drive forces the compressor to 50rps (see Optyma Controller parameter c47) for 30s always at compressor start, to ensure proper oil return at low load and short runtimes. The start delay time can be modified via drive parameter 1-71, if a proper oil return is always ensured without or by modifying this start delay function.

In order to change 1-71, a separate LCP panel needs used to change the settings on the drive, the LCP panel has the ordering code 120Z0581.

When changing 1-71, a value not lower as 10 seconds should get applied.

### 3.5 Limits for voltage supply

Voltage limits: Min: 360 V Max 440 V  
 Phase asymmetry: ±3%  
 Frequency limits: 50Hz ±1%

**CAUTION** Optyma™ Plus INVERTER unit has to be installed by competent authorized

personnel and the installation shall comply to applicable local laws and rules.

**4.1 Location & fixings**

The unit is to be placed in such a way that it is not blocking or expose an obstacle for walking areas, doors, windows etc. The foundation where the unit is to be placed upon has to be strong enough to carry the entire weight, see unit data. Ensure adequate space around the unit for air circulation. Avoid installing the unit in locations which are exposed to direct sunshine daily for long periods. Unit has to be placed on a horizontal surface - less than 3° slope, which has to be strong and stable enough to eliminate vibrations and interference. It is recommended to install the unit on rubber grommets or vibration dampers (not part of the Danfoss supply). Installation of unit shall not be done in aggressive and dusty environments.

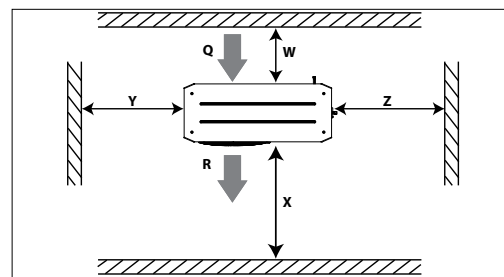
Furthermore the installation of the unit shall not be done in facilities containing flammable gasses or in installation containing flammable gasses.

**NOTICE** Special attention should be paid if unit needs to be installed close to the sea as this can reduce unit lifetime due to corrosion of metal parts.

Where multiple units are to be installed in the same location, please consider each individual case carefully. Air by-pass around each condenser and between the units should be avoided at all times.

Optyma™ Plus INVERTER condensing units can also be used for wall mounting on suitable brackets. Wall mounting brackets are not supplied by Danfoss.

Another factor to consider in finding a good installation site is the direction of the prevailing wind. For example if the air leaving the condenser faces the prevailing wind, the air flow through the condenser can be impeded, causing high condensing temperatures, improper functioning of the unit and ultimately resulting in reducing the life of the unit. A baffle is a remedy for this situation.



Picture 1: Minimum mounting distances

Unit	R: Air out			
	W [mm]	X [mm]	Y [mm]	Z [mm]
Housing 3	250	760	581	581



**4.2 Electrical connection**

**⚠️ WARNING** Ensure that power supply cannot be switched on during installation.

Below table lists recommended wiring sizes for the condensing unit power supply cables. These wiring sizes are valid for a cable length up to 30 m.

Model	Cable size, mm <sup>2</sup> (from network to unit main switch)
OP-MPLM028	4
OP-MPLM035	4
OP-MPLM044	4

Note: 1. The wire size here is the guideline. In each specific case required cable size should be specified by the installer depending on the system design, ambient temperature, the wire material, current, etc.

found in the wiring diagram. Wiring diagram can be found in front door of unit. Unit is equipped with high and low pressure switches, which directly cuts the power supply of the compressor contactor in case of activation.

In order to ensure a safe and problem free operation of the unit it is recommended to:

Unit is equipped with an electronic controller and compressor drive.

- Ensure that the power supply corresponds to the unit and that the power supply is stable (see nominal values on unit label and power supply limits in paragraph 3.5).

The controller and compressor drive are pre-programmed with parameters ready for use with the actual unit.

- Make the power supply according to present norm and legal requirements. Ensure that the unit is properly connected to ground.

As standard the parameters for operation with refrigerant R404A set. If another refrigerant is to be used refrigerant parameter (o30) needs to be changed (refer to description in Controller application manual). Parameters for high and low pressure cut outs are preset in the controller adapted to the compressor and refrigerant installed in the unit.

The unit is equipped with a main switch with overload protection. Overload protection is preset from factory. Value for overload protection can be

**4.2.1 Power supply protection**

You should use only original circuit breaker, min. short circuit breaking capacity needs to

be 100kA. Please refer to spare part section for selection of components for service replacement.

**4.2.2 Protection and features**

- Electronic thermal compressor protection against overload.

- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips, when the intermediate circuit voltage is too low or too high.

- Temperature monitoring of the heat sink ensures that the frequency converter trips in case of overtemperature.

- The frequency converter is protected against ground faults on compressor terminals U, V, W.

- The frequency converter is protected against short-circuits between compressor terminals U, V, W.

- Occurring alarms will be shown in the controller display and by the red LED in front of the frequency converter.

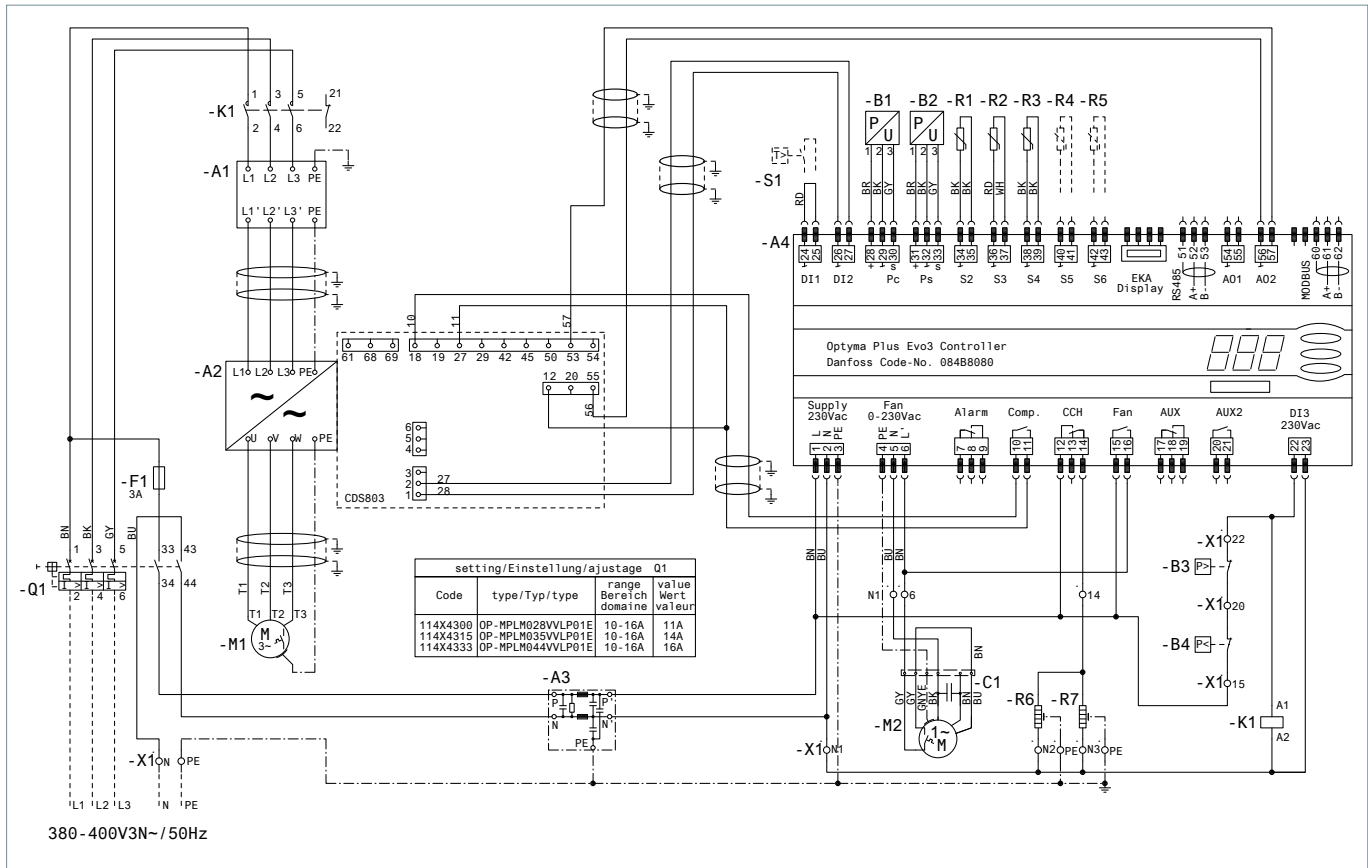
- When a compressor phase is missing, the frequency converter trips and issues an alarm.

- The root cause of an individual alarm can be shown with an optional LCP (local control panel, code 120Z0581) or the MCT10 setup software.

- When a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).

4.3 Wiring diagrams

OP-MPLM028-035-044



- A1** : EMC/RFI Filter (Compressor)
  - A2** : Frequency Converter
  - A3** : EMI Filter (Controls)
  - A4** : Optyma™ Plus Controller
  - B1** : Condensing Pressure Transducer
  - B2** : Suction Pressure Transducer
  - B3** : High Pressure Switch
  - B4** : Low Pressure Switch
  - C1** : Run Capacitor (Fan)
  - F1** : Fuse (Control Circuit)
  - K1** : Contactor
  - M1** : Compressor
  - M2** : Fan Motor
  - Q1** : Main Switch
  - R1** : Ambient Temp. Sensor
  - R2** : Discharge Temp. Sensor
  - R3** : Suction Temp. Sensor
  - R4,R5** : Auxiliary Temp. Sensor (optional)
  - R6** : Crankcase Heater
  - R7** : Oil Separator Heater
  - S1** : Room Thermostat (optional)
  - X1** : Terminal
- 
- Supply** : Supply
  - Fan** : Fan
  - Alarm** : Alarm
  - Comp.** : Compressor
  - CCH** : Crankcase Heater
  - Aux** : Auxiliary

**4.3.1 Emergency running without controller**

In case of controller failure, the condensing unit can still be operated when the controller standard wiring (WD1) is modified into a temporary wiring (WD2) as described below.

This modification may be done by authorized electricians only. Country legislations have to be followed.

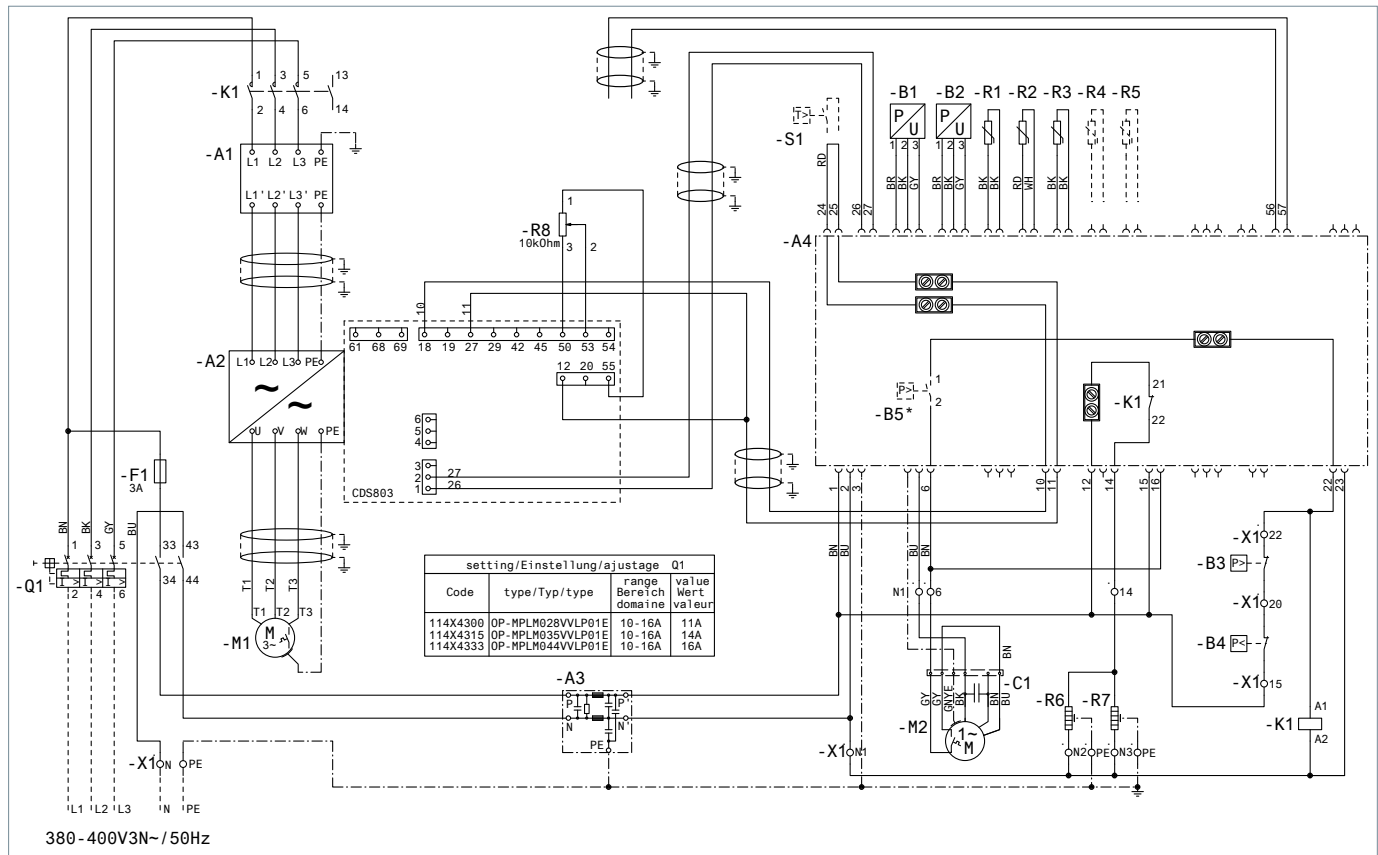
Disconnect the condensing unit from power supply (turn hardware main switch off).

- Contact of Room Thermostat must be possible to switch 250VAC.
- Remove wire 22 (safety input DI3) and wire 6 (fan supply) and put them together. A fan pressure switch (e.g. KP5) or a fan speed controller (e.g. XGE) can be connected in series to wire 6.
- Remove wire 10 (drive start) and wire 24 (room thermostat) and put them together.
- Remove wire 11 (drive start) and wire 25 (room thermostat) and put them together.
- Remove wire 53 and 55 from drive terminals and connect the attached 10kOhm potentiometer as below:

wire 1 to drive terminal 55  
 wire 2 to drive terminal 53  
 wire 3 to drive terminal 50

- Turn the knob of the potentiometer to middle position, which corresponds approximately compressor speed 50rps.
- Remove wire 14 (crankcase and oil separator heaters) and connect it to the compressor contactor terminal 22.
- Remove wire 12 (supply crankcase and oil separator heaters), extend this wire by using an 250 Vac 10mm<sup>2</sup> terminal bridge and 1,0mm<sup>2</sup> brown cable and connect it to compressor contactor terminal 21.
- Remove the large terminal block from the controller terminals 10 to 19.
- Connect the condensing unit to power supply (turn hardware main switch on).
- Adjust the potentiometer to get the desired speed.
- Replace the controller as soon as possible.

**OP-MPLM028-035-044 - Emergency Wiring**



- |   |  |  |                                     |
|---|--|--|-------------------------------------|
| <b>A1</b> : EMC/RFI Filter (Compressor)             | <b>A2</b> : Frequency Converter            | <b>A3</b> : EMI Filter (Controls)                | <b>A4</b> : Optyma™ Plus Controller |
| <b>B1</b> : Condensing Pressure Transducer          | <b>B2</b> : Suction Pressure Transducer    | <b>B3</b> : High Pressure Switch                 | <b>B4</b> : Low Pressure Switch     |
| <b>B5*</b> : Fan Speed Controller / Pressure Switch | <b>C1</b> : Run Capacitor (Fan)            | <b>F1</b> : Fuse (Control Circuit)               | <b>K1</b> : Contactor               |
| <b>M1</b> : Compressor                              | <b>M2</b> : Fan Motor                      | <b>Q1</b> : Main Switch                          | <b>R1</b> : Ambient Temp. Sensor    |
| <b>R2</b> : Discharge Temp. Sensor                  | <b>R3</b> : Suction Temp. Sensor           | <b>R4,R5</b> : Auxiliary Temp. Sensor (optional) | <b>R6</b> : Crankcase Heater        |
| <b>R7</b> : Oil Separator Heater                    | <b>R8</b> : Compressor Speed Potentiometer | <b>S1</b> : Room Thermostat (optional)           | <b>X1</b> : Terminal                |
| <b>Supply</b> : Supply                              | <b>Fan</b> : Fan                           | <b>Alarm</b> : Alarm                             | <b>Comp.</b> : Compressor           |
| <b>CCH</b> : Crankcase Heater                       | <b>Aux</b> : Auxiliary                     |  |                                     |

Picture1. Normal wiring



Picture2. Emergency wiring



**4.4 Electrical protection standard (protection class)**

- Scroll compressors: IP22
- Fan: IP54
- Controller: IP20
- Drive: IP20
- Complete unit IP54

**⚠️ WARNING** Power connections under voltage and can cause danger by electrical shock.

Opty™ Plus INVERTER units are fully wired and factory tested. Electrical connection compromises only power supply.

**4.5 EMC compliance**

All necessary actions are taken to secure EMC compliance of complete condensing unit!

**4.5.1 Warning when touching unit when OFF**

**⚠️ WARNING** Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect AC mains and wait 15 min for the capacitors to fully discharge before performing any service or repair work. Failure to wait the specified time after power has been removed before doing service or repair could result in death or serious injury.

The digital inputs are not a safety switch. They do not disconnect the frequency converter from the mains.

Do not remove mains connections, compressor connections or other power connections while the frequency converter is connected to power.

**⚠️ CAUTION** **Leakage Current**  
The ground leakage current from the frequency converter exceeds 3.5 mA. According to IEC 61800-5-1 a reinforced Protective Earth connection

must be ensured with a min. 10 mm<sup>2</sup> Cu or an additional PE wire – with the same cable cross-section as the mains wiring - must be terminated separately.

**Residual Current Device**

This product can cause a DC current in the protective conductor. Where a residual current device (RCD) is used for extra protection, only an RCD of Type B (time delayed) shall be used on the supply side of this product.

**Recommended Brand & Model Number :**

Make	RCCB Model Number
Doepke	DFS 4B SK, Type B
ABB	F 804 B, Type B
ABL	RA4403, Type B

Protective earthing of the frequency converter and the use of RCDs must always follow national and local regulations.

**4.6 Phase sequence**

Optyma™ Plus INVERTER units are equipped with variable speed scroll compressors for which proper phase sequence is compulsory in order to secure rotation in right direction and therefore compression.

The phase sequence has to be secured between the drive and compressor.  
(The phase sequence between network and unit drive is of no influence on the compressor rotation direction).

**4.7 Brazed connections**

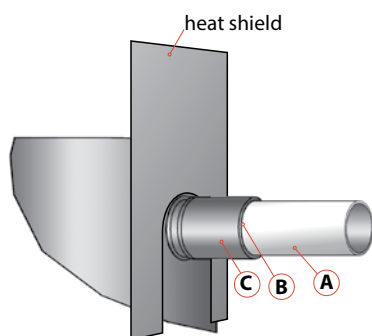
**NOTICE** Refrigerant connections, brazing and flange connections has to be done by a qualified installer according to EN378.

The unit is supplied with an positive protective pressure of Nitrogen (1 bar).  
The use of substances containing chlorine, mineral oil or other chemicals is not allowed.

Piping has to be designed to avoid vibrations, either through flexibility or piping brackets. Furthermore piping has to be done in such a way that oil return for the compressor is ensured and the risk of liquid slug over in compressor is eliminated.

Only use clean and dehydrated refrigeration grade copper tubing. Tube-cutting must be carried out so as not to deform the tubing roundness and to ensure that no foreign debris remains within the tubing. Only refrigerant grade fittings should be used and these must be of both a design and size to allow for a minimum pressure drop through the completed assembly. Follow the brazing instructions bellow. Never drill holes into parts of the pipe-work where filings and particles cannot be removed. Even during installation, if the system is left for any reasonable period of time (say 1 hour), pipes should be re-capped to prevent moisture and contaminant from entering the system.

Liquid/suction tubes are extended from the condensing unit housing, therefore we recommend to isolate the housing by using a heat shield and/or a heat-absorbent compound (e.g. wet cloth) on the copper tubing. Use a double-tipped torch.



- For brazing the suction and liquid line connections, the following procedure is advised:
- Make sure that no electrical wiring is connected to the compressor.
  - Use brazing material with a minimum of 5% silver content.
  - Fit the copper tube into the unit tube.
  - Apply heat evenly to area A until the brazing temperature is reached. Move the torch to area B and apply heat evenly until the brazing temperature has been reached there as well, and then begin adding the brazing material. Move the torch evenly around the joint, in applying only enough brazing material to flow the full circumference of the joint.
  - Move the torch to area C only long enough to draw the brazing material into the joint.
  - Remove all remaining flux “once the joint has been soldered” with a wire brush or a wet cloth.

Remaining flux would cause corrosion of the tubing. Ensure that no flux is allowed to enter into the tubing. Flux is acidic and can cause substantial damage to the internal parts of the system and compressor.

The polyolester oil used in VLZ compressors is highly hygroscopic and will rapidly absorb moisture from the air. Condensing unit must therefore not be left open to the atmosphere for a long period of time. Unit fitting plugs shall be removed just before brazing. Condensing unit should always be the last component brazed into the system.

Before eventual unbrazing of the compressor or any system component, the refrigerant charge must be removed from both the high- and low-pressure sides. Failure to do so may result in serious personal injury. Pressure gauges must be used to ensure all pressures are at atmospheric level.

For more detailed information on the appropriate materials required for brazing or soldering, please contact the product manufacturer or distributor. For specific applications not covered herein, please contact Danfoss for further information.

It is compulsory to braze with a protective atmosphere of nitrogen inside the piping. Nitrogen displaces the air and prevents the formation of copper oxides in the system.



(Copper oxide could block capillary tubes, thermal expansion valves and generate damage of compressor).

(Insulation should be at least 19 mm thick and is not a part of Danfoss supply). Use only dry pipes and components in order to avoid moisture in the system.

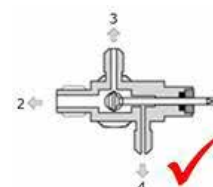
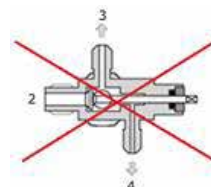
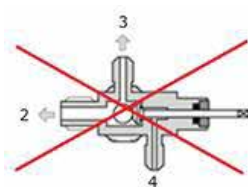
Furthermore it is recommended to insulate the suction pipe up to the compressor inlet.

**NOTICE** Maximum test pressure is 28 bar.

**4.8 High pressure transmitter connection**

**NOTICE** Do not open the receiver Rotalock valve entirely, it must be turned 1 round (360°) to the closed direction to provide system pressure to the transmitter!

1. Valve In (from receiver).
2. Valve Out (to evaporator).
3. Service port (for safety devices).
4. Service port (for transmitter or service only).



A) Valve fully closed (Valve spindle entirely turned clockwise).

- 1, 3 and 4 connected.
- 2 has no connection the other ports.

B) Valve opened some turns (Valve spindle somewhere between open and close).

- 1, 2, 3 and 4 connected.

C) Valve entirely opened (Valve spindle entirely turned counterclockwise).

- 1, 2 and 3.

• 4 has no connection the other ports.

Normal operation: Valve spindle shall not be entirely opened (1 turn back), so that pressure transmitter gets its pressure.

Transmitter failure: Valve shall be opened entirely to disconnect transmitter port from the others.



5.1 Piping design

**Connection sizes! Unsuitable refrigerant flow rate!**

**NOTICE** Do not assume that the liquid/suction connection sizes on the unit are in fact the correct sizes to run your interconnecting refrigeration pipes!

The pipes should be sized to ensure optimum performance and good oil return. The sizing must also take into account the full capacity range through which this particular unit will need to operate.

Pipe runs should be kept as short as possible, using the minimum number of directional changes. Use large radius bends and avoid trapping of oil and refrigerant. This is particularly important for the suction line.

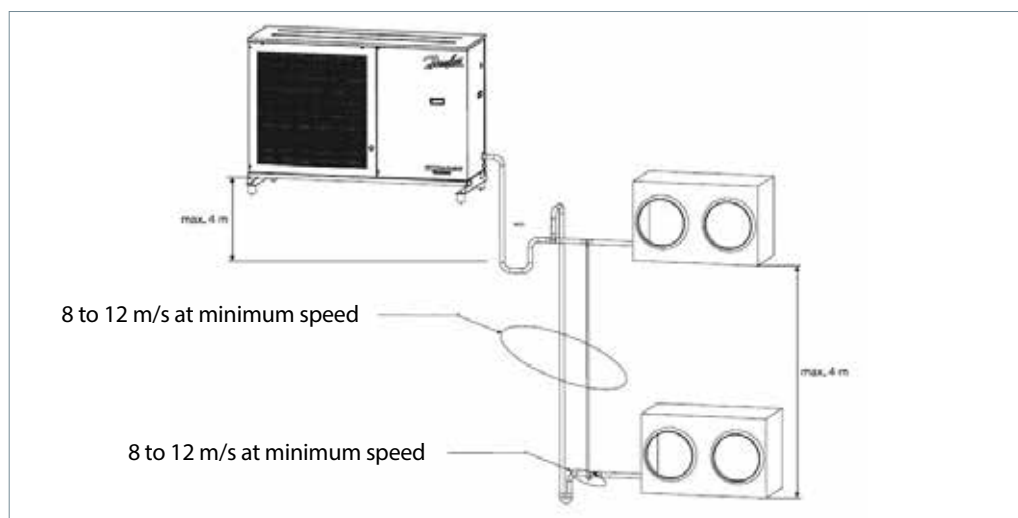
All pipes should be adequately supported to prevent sagging which can create oil traps. The recommended pipe clamp support distance is shown in Table below:

Tube size	Distance between 2 clamp supports
12 mm (1/2")	1 m
16 mm (5/8")	1,5 m
19 mm (3/4")	1,8 m
22 mm (7/8")	2 m

The suction line should:

- secure gentle slope towards the unit (recommended slope minimum 0,5/100).
- have P traps, double risers and reduced pipe diameters where long vertical risers cannot be avoided.

The suction gas velocity must be sufficient to ensure a good oil return, within 8 to 12 m/s in vertical risers. In horizontal pipes this velocity can decrease down to 4 m/s. The use of U-trap and double suction risers is often required. These suction risers must always be fitted with a U-trap at the bottom and a P-trap at the top and never be higher than 4 m unless a second U-trap system is fitted.



If the evaporator lies above the CU, a pump-down cycle is strongly recommended. If a pump-down cycle were to be omitted, the suction line must have a loop at the evaporator outlet to prevent refrigerant from draining into the compressor during off-cycles. If the evaporator are situated below the CU, the suction riser must be trapped so as to prevent liquid refrigerant from collecting at the outlet of the evaporator while the system is idle, which would mislead the expansion valve's sensor (thermal bulb) at start-up.

Maximum safety length of pipes between CU and last evaporator is 20 m.

If pipes length is more than 20 m special adjustment of complete system is needed (oil and refrigerant charge adjustments).

Diameter of separate suction lines from evaporators to condensing unit manifold should be with appropriate size according evaporator capacity (securing recommended speed for proper oil return). Common manifold tube should be as close as possible to condensing unit.

**NOTICE** The installer is responsible for the installation of the unit and complete refrigeration system design according particular conditions of each application as this is not scope of current Guideline.

## 5.2 Evacuation

Moisture obstructs the proper functioning of both the compressor and the refrigeration system. Air and moisture reduce service life and increase condensation pressure, which causes abnormally high discharge temperatures that are then capable of degrading the lubricating properties of the oil. The risk of acid formation is also increased by air and moisture, and this condition can also lead to copper plating. All these phenomena may cause both mechanical and electrical compressor failures. The typical method for avoiding such problems is a vacuum pump-down executed with a vacuum pump, thus creating a minimum vacuum of 500 microns (0.67 mbar).

**NOTICE** The evacuation procedure is based upon achieving an actual system Vacuum standard and is NOT TIME DEPENDENT!

Evacuate the installation down to 0,67 mbar to ensure quality vacuum.

It is recommended to evacuate on both high and low pressure side to achieve fast and uniform vacuum in the entire refrigeration system.

When the vacuum level has been reached, the system must be isolated from the pump. A vacuum of 0.67mbar has to be reached and maintained for 4 hours. This pressure is to be measured in the refrigeration system, and not at the vacuum pump gauge.

If pressure increases rapidly, the system is not airtight. Locate and repair leaks. Restart the vacuum procedure.

If pressure increases slowly, the system contains moisture inside. Break the vacuum with nitrogen gas and restart the vacuum process again.

**CAUTION** Do not use a megohmmeter nor apply power to the compressor while it is under vacuum as this may cause internal damage.

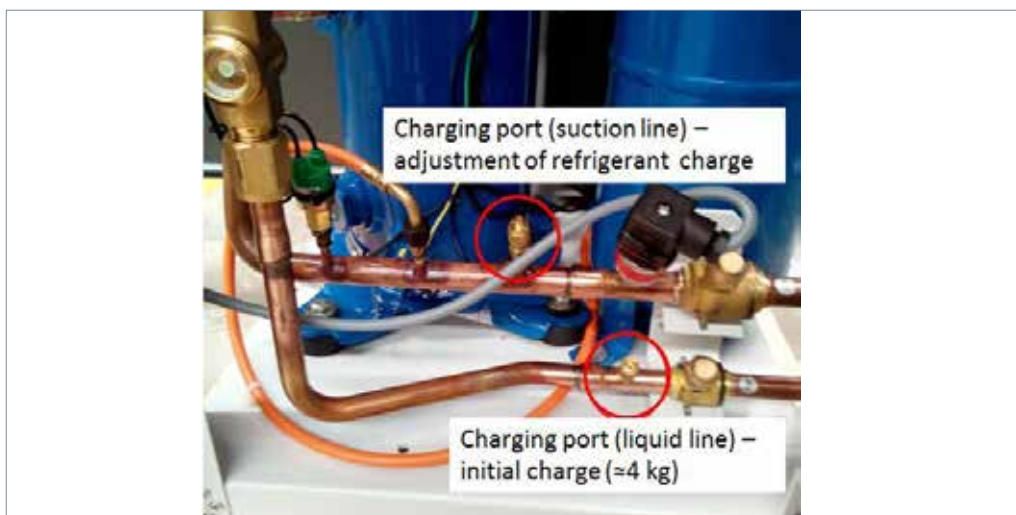
**CAUTION** Leak detection must be carried out using a mixture of nitrogen and refrigerant or nitrogen and helium. Never use other gasses such as oxygen, dry air or acetylene as these may form an inflammable mixture. Pressurize the system on HP side first then LP side.

### 5.3 Refrigerant charge

For the initial charge condensing must not run and eventual service valves must be closed. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. As maximum safe refrigerant charge for compressor is 3,6 kg initial charge can be considered close to 4 kg (will depend on tube sizes, lengths of each individual system). This initial

charging operation must be done in liquid phase as far away as possible from the compressor.

Never start the compressor under vacuum, ensure a progressive charge of the system to 4– 5 bar.



For the initial refrigerant charge service port on liquid line ball valve can be used. This port is equipped with Schrader valve.

For the adjustment of refrigerant charge port on the suction line can be used (located between oil return port and suction ball valve port). This port is also equipped with Schrader valve.

**Refrigerant charge should secure stable work at minimum and maximum heat load within the limits of condensing unit application envelope!**

The remaining charge is done until the installation has reached a level of stable nominal condition during operation.

Next steps can be followed for proper charging or the system:

- keep system working under the max load conditions (all evaporators working, maximum air/liquid flow via evaporator(s)).
- slowly throttling liquid in on the low pressure side as far away as possible from the compressor suction connection by default via the port on suction line as described before.
- keep under the control evaporating pressure, condensing pressure, suction superheat.

- charge system until reaching suction superheat 6-12 K at desired evaporating temperature.

Suction superheat as well as suction, condensing pressures (temperatures) can be read from controller display.

To avoid system overcharging (which can cause higher energy consumption, high pressure alarms) maximum refrigerant charge can be calculated as follows:

$$M_{max} = (V_{rec} + V_{liqL}) * 0.9,$$

Where

$M_{max}$  = approximate maximum refrigerant charge, kg

$V_{rec}$  = receiver volume, L, for Optyma™ Plus INVERTER 6,2 L

$V_{liqL}$  = internal volume of liquid line, L (specific for each system)

0.9 – correlation coefficient due to refrigerant density.

Liquid line – Dimension			Liquid line - Volume	
OD [inch]	OD [mm]	ID [mm]	VliqL [L/1m]	VliqL [L/10m]
3/8	9.5	7.9	0.05	0.5
1/2	12.7	11.1	0.10	1.0
5/8	15.9	14.1	0.16	1.6
3/4	19.1	17.3	0.23	2.3
7/8	22.2	19.9	0.31	3.1

During all of the charge procedure keep the oil heaters ON and keep an eye on the oil sight glass, so that it doesn't change color, density or appearance and it doesn't start foaming. Refrigerant charge quantity must be suitable for maximum load conditions as well as for minimum load conditions for both summer and winter operations.

It means that refrigerant charge should be enough to feed all evaporators during the peak load conditions and condenser should not be flooded by liquid refrigerant during minimum load conditions.

Receiver and liquid lines should be able to contain remaining refrigerant during low load conditions.

Only refrigerant for which the unit is designed for has to be charged, see unit data.

In case of refrigerant blend charging has to be done in liquid form in order to avoid chemical changes of the refrigerant.

**NOTICE** Don't judge the refrigerant charge by the liquid sight glass as 100% correct way. It may mislead you!

**CAUTION** When Optyma™ Plus INVERTER unit has to be scrapped, refrigerant has to be disposed for destruction. Local laws and rules have to be followed for disposal of refrigerant.

#### 5.4 Oil level

Optyma™ Plus INVERTER condensing units are supplied with PVE oil, the oil separator is pre-charged with 0,3l oil. In case of adding oils always use original Danfoss PVE oil from new cans.

After commissioning, the oil level should be checked and topped up if necessary.

When the compressor is running under stabilized conditions, the oil level must be visible in the sight glass. The presence of foam filling in the sight glass indicates large concentration of refrigerant in the oil and / or presence of liquid returning to the compressor. The oil level can also be checked a few minutes after the compressor stops, the level must be between ¼ and ¾ of sight glass. When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

In installations with good oil return and line runs up to 20 m, no additional oil is required. If installation lines exceed 20 m, additional oil may be needed. Oil charge has to be adjusted based on the oil level in the compressor sight glass.

Top-up the oil while the compressor is idle. Use the schrader connector or any other accessible connector on the compressor suction line and a suitable pump.

The oil fills connection and gauge port is a 1/4" male flare connector incorporating a Schrader valve.

Oil changing is not normally necessary for package units.

#### 5.5 Check before start

1. Compliance between unit and power supply.
  2. Check that valves are opened.
- Remark: Do not open receiver valve entirely to get correct pressure to the discharge pressure transmitter. Turn valve spindle one round (360°) in close direction.

3. Check that crankcase and oil separator heaters are working.
4. Check that fan can rotate freely.
5. Check for possible faults in the installation.
6. Check main switch overload protection setting.

**5.6 Startup of the unit**

After below steps are completed:

- 1) System is completely installed.
- 2) All electrical connections are done.
- 3) System is charged.

Next steps are needed to start the unit:

The controller of the condensing unit is set for R404A. If this factory setting of refrigerant as well as other factory settings of parameters fits for the requirement of your application, no controller parameter must be changed.

- For a refrigerant change go into the parameter menu (press upper button 5 seconds).
- Select parameter "r12" (software main switch) with a short press on lower button.
- Activate parameter "r12" with middle button and change the value to 0 (zero).
- Confirm the value with a short press on the middle button (the 3 LED's start flashing).
- Go to the parameter "o30" (Refrigerant).
- Change the value of parameter "o30" to 21 if R407A, 37 if R407F will be used.
- Confirm the value with a short press on the middle button.

Press short the upper (or lower) button to go to the next Parameter of the Parameter menu, e.g. Parameter r23 for suction pressure setpoint or r82

for Min Condensing Pressure. Scroll fast through the Parameters with a long press on these buttons.

- Press short the middle button to show the value of the selected Parameter.
- Press afterwards the upper (or lower) button to change the value of the selected parameter. A long press on these buttons will change the value fast
- Select parameter "r12" again.
- Change the value to 1 (one).
- Confirm the value with a short press on the middle button (the 3 LED-signs stop flashing and the condensing unit will start if required).
- After 20 seconds the display returns to the evaporation temperature in °C, the new refrigerant and all relevant parameters are changed.

It is compulsory to energize crankcase and oil separator heaters at least 1 hour before initial start-up and start-up after prolonged shutdown to remove refrigerant in liquid phase from the compressor.

Condensing unit is factory preset for quick installation and start up. Compressor drive is fully managed by condensing unit controller and therefore all parameters settings should be done only via condensing unit controller.

**5.7 Check after start**

After a couple of hours of stable operation following has to be checked via service parameters U :

1. Unit current consumption.
2. Rotation of fan (suction through condenser).
3. Check for leakages in refrigerant system.

4. Check superheat.
5. Check oil level.
6. Check for abnormal noises.
7. Check for abnormal vibrations.
8. Suction and discharge pressures.

In order to provide the highest level of compressor protection, energy efficiency and adaptation to variable conditions condensing unit is equipped with specific controller.

**6.1 Advantages**

- Condensing pressure control in relation to outside temperature.
- Fan speed regulation.
- On/off and variable speed regulation of the compressor.
- Crankcase heating element control.
- Day/night controller operation.
- Built-in clock function with power reserve .
- Built-in Modbus data communication.
- Monitoring discharge temperature td.
- Oil return management control at variable speed operation.

**6.2 Controller's regulation logic**

The controller receives a signal for demanded cooling, and it then starts the compressor. If compressor is controlled by variable speed, the suction pressure (converted to temperature) will be controlled according to the set evaporating temperature.

sensor and the set reference corresponding to difference between condensing and ambient temperatures. The controller will then control the fan, which allows the condensing temperature to be maintained at the desired value. The controller can also control the heating element in the crankcase so that oil is kept separate from the refrigerant.

Condenser pressure regulation is performed following a signal from the ambient temperature

**6.3 Functions**

- Control of condensing temperature.
- Control of fan speed.
- On/off control or speed regulation of the compressor.
- Control of heating element in crankcase.
- Liquid injection into economizer port.
- Raising the condenser pressure regulation reference during night operation.
- Both internal and external start/stop cooling.
- Safety cut-out activated via signal from automatic safety control.

**6.4 Regulation reference for condensing temperature**

The controller controls the condensing temperature in relation to the ambient temperature. This difference is preset in the

controller. It can also, via another parameter, get increased at night.

**6.5 Fan operation**

The controller will control the fan so that the condensing temperature is maintained at the desired value above the ambient temperature.

**6.6 Compressor control**

The compressor is controlled by a signal at the DI1 input. The compressor will start once the input is connected. Three restrictions have been implemented to avoid frequent start/stops:

- minimum ON time.
- minimum OFF time.
- time elapsed between two starts.

These three restrictions have the highest priority during regulation, and the other functions will wait until they are complete before regulation can continue. When the compressor is 'locked'

by a restriction, this can be seen in a status notification. DI3 input is used as a safety stop for the compressor, an insufficient input signal will immediately stop the compressor. The compressor is speed-controlled with a voltage signal at the AO2 output. If the compressor has been running for a long period at low speed, the speed is increased for a short moment for the purpose of oil return.

**6.7 Maximum discharge gas temperature**

The temperature is recorded by sensor Td. If variable speed control is chosen for the compressor, this control will initially reduce the compressor capacity if the Td temperature approaches the set maximum value. If higher temperature is detected than the set max. temperature, the fan's speed will be set to 100%. If this does not cause the temperature to drop, and if the temperature remains high after the

set delay time, the compressor will be stopped. The compressor will only be re-started once the temperature is 10 K lower than the set value. The above mentioned re-start restrictions must also be complete before the compressor can start once again. If the delay time is set to '0', the function will not stop the compressor. The Td sensor can be deactivated (o63).

**6.8 High pressure monitoring**

During regulation, the internal high pressure monitoring function is able to detect an over the limit condensing pressure so that the regulation can continue. However, if the C73 setting is exceeded, the compressor will be stopped.

If, on the other hand, the signal comes from the interrupted safety circuit connected to DI3, the compressor will immediately be stopped and the fan will be set to 100%. When the signal is once again 'OK' at the DI3 input, the regulation will resume.

**6.9 Low pressure monitoring**

During regulation, the internal low pressure monitoring function will cut out the compressor upon detecting a suction pressure that falls below the lower limit, but only once the minimum ON

time is exceeded. An alarm will be issued. This function will be time delayed, if the compressor starts at low ambient temperature.

**6.10 Pump down limit**

The compressor will be stopped if a suction pressure that falls below the set value is registered, but only once the minimum ON time is exceeded.

**6.11 Data communication**

The controller is delivered with built-in MODBUS data communication and can be connected to an ADAP KOOL® network. If a different form of data communication is requested, a LON RS-485 module can be inserted in the controller. The connection will then be made on terminal RS 485.

Important:  
All connections to the data communication must comply with the requirements for data communication cables.

All condensing units are delivered with controllers which are factory pre-set. See below table with factory setting of controllers integrated into condensing units and controllers supplied separately for service replacement (when controller is supplied as spare part for service replacement its factory settings are slightly different and should be adjusted according to controller unit specific settings in paragraph 6.12 and application specific requirements).

**6.12 Controller settings**

NOTE! In case of controller replacement beware that unit controller settings are different from default controller factory settings!

Function	Code	Min.value	Max.value	Default controller settings	Unit controller settings
<b>Normal operation</b>					
Set point Tc (regulation reference follows the number of degrees above the outside temperature Tamb)	---	2.0 K	20.0 K	8.0 K	
<b>Regulation</b>					
Select SI or US display. 0=SI (bar and °C). 1=US (Psig and °F)	r05	0/ °C	1/F	0/ °C	
Internal Main Switch. Manual and service = - 1, Stop regulation = 0, Start regulation =1	r12	-1	1	0	1
Offset during night operation. During night operation the reference is raised by this value	r13	0 K	10 K	2 K	
Set point for suction pressure Ts	r23	-25 °C	10°C	-7°C	
Readout of reference for Tc	r29	-	-	-	
Min. condensing temperature (lowest permitted Tc reference)	r82	0°C	40°C	10°C	
Max. condensing temperature (highest permitted Tc reference)	r83	0°C	50°C	40°C	
Max. discharge gas temperature Td	r84	50°C	160°C	135°C	125°C
<b>Alarms</b>					
Alarm time delay on signal on the DI2 input	A28	0 min.	240 min.	30 min.	
Alarm for insufficient cooling in condenser. Set temperature difference.	A70	3.0 K	20.0 K	10.0 K	
Delay time for A70 alarm	A71	5 min.	240 min.	30 min.	
<b>Compressor</b>					
Min. ON-time	c01	5 s	240 s	5 s	
Min. OFF-time	c02	3 s	240 s	30 s	
Min. time between compressor starts	c07	0 min.	30 min.	5 min.	
Pump down limit at which the compressor is stopped (setting 0.0 = function dis-activated)	C33	0.0 bar	15.0 bar	0.0 bar	2.3
Min. compressor speed	c46	30 rps	70 rps	30 rps	
Start speed for compressor and min. speed for high condensing temperatures	c47	30 rps	70 rps	50 rps	
Max. compressor speed	c48	50 rps	100 rps	100 rps	
Max. compressor speed during night operation (% value of c48)	c69	50%	100%	70%	
Definition of compressor control: 0=no external start/stop; 1=switch on DI1 must start/stop; 2=inverter compressor speed control	c71	0	2	1	2
Time delay for high Td. The compressor will stop when time expires	c72	0 min.	20 min.	3 min.	
Max. pressure. Compressor stops if a higher pressure is recorded	c73	7.0 bar	50.0 bar	23.0 bar	25.8
Difference for max. pressure (c73)	c74	1.0 bar	10.0 bar	3.0 bar	
Min. suction pressure Ps. Compressor stops if a lower pressure is recorded	c75	-0.3 bar	10.0 bar	3.0 bar	2
Difference for min. suction pressure and pump down	c76	0.1 bar	5.0 bar	0.7 bar	
Amplification factor Kp for compressors PI regulation	c82	3.0	30.0	20.0	
Integration time Tn for compressors PI regulation	c83	30 s	360 s	60 s	
Liquid Injection Offset	c88	0.1 K	20.0 K	5.0 K	
Liquid Injection hysteresis	c89	10.0 K	30.0 K	15.0 K	
Compressor stop delay after Liquid injection	c90	0 s	10 s	3 s	
Desired compressor speed if the signal from the pressure transmitter Ps fails	c93	30 rps	70 rps	60 rps	
Min On time during Low Ambient LP	c94	0	0	120	
Measured Tc for which the Comp min speed is raised to StartSpeed	c95	40.0	10.0	70.0	
<b>Control parameters</b>					
Amplification factor Kp for PI regulation	n04	1.0	20.0	7.0	
Integration time Tn for PI regulation	n05	20	120	40	
Kp max for PI regulation when the measurement is far from reference	n95	5.0	50.0	20.0	



## Application Guidelines      Condensing unit controller

Function	Code	Min.value	Max.value	Default controller settings	Unit controller settings
<b>Fan</b>					
Readout of fan speed in %	F07	-	-	-	
Permitted change in fan speed (to a lower value) % per second	F14	1,0%	5,0%	1,0%	
Jog speed (speed as a % when the fan is started)	F15	10%	100%	40%	
Jog speed at low temperature	F16	0%	40%	10%	
Definition of fan control: 0=Off; 1=Internal control. 2=External speed control	F17	0	2	1	
Minimum fan speed. Decreased need will stop the fan	F18	0%	40%	10%	
Maximum fan speed	F19	40%	100%	100%	
Manual control of the fan's speed. (Only when r12 is set to -1)	F20	0%	100%	0%	
<b>Real time clock</b>					
Time at which they switch to day operation	t17	0 hrs	23 hrs	0	
Time at which they switch to night operation	t18	0 hrs	23 hrs	0	
Clock - Setting of hours	t07	0 hrs	23 hrs	0	
Clock - Setting of minute	t08	0 min.	59 min.	0	
Clock - Setting of date	t45	1 day	31 day	1	
Clock - Setting of month	t46	1 mon.	12 mon.	1	
Clock - Setting of year	t47	0 year	99 year	0	
<b>Miscellaneous</b>					
Network address	o03	0	240	0	
On/Off switch (Service Pin message) IMPORTANT! o61 must be set prior to o04 (used at LON 485 only)	o04	0/Off	1/On	0/Off	
Access code (access to all settings)	o05	0	100	0	
Readout of controllers software version	o08				
Select signal for display view. 1=Suction pressure in degrees, Ts 2=Condensing pressure in degrees, Ts	o17	1	2	1	
Pressure transmitter working range Ps - min. value	o20	-1 bar	5 bar	-1	
Pressure transmitter working range Ps- max. value	o21	6 bar	200 bar	12	
Refrigerant setting: 2=R22. 3=R134a. 13=User defined. 19=R404A. 20=R407C 21=R407A. 37=R407F	* o30	0	37	0	19
Input signal on DI2. Function: 0=not used, 1=External safety function. Regulate when closed, 2=external main switch, 3=Night operation when closed, 4=alarm function when closed, 5=alarm function when open, 6=on/off Status for monitoring 7=drive alarm	o37	0	7	0	
Pressure transmitter working range Pc- min. value	o47	-1 bar	5 bar	0 bar	
Pressure transmitter working range Pc - max. value	o48	6 bar	200 bar	32 bar	
Setting of condensing unit type (is factory set when the controller is mounted and cannot be subsequently changed)	* o61	0	57	0	55 or 56 or 57*
The sensor input S3 is to be used to measure the discharge gas temperature (1=yes)	o63	0	1	1	
Replace the controllers factory settings with the present settings	o67	off	On	Off	
Defines the use of the Taux sensor: 0=not used; 1=measuring of oil temperature; 2=other optional use	o69	0	2	0	
Period time for heating element in crankcase (ON + OFF period)	P45	30 s	255 s	240 s	
Difference for heating elements 100% ON point	P46	-20 K	-5 K	-10 K	
Difference for heating elements 100% OFF point	P47	5 K	20 K	10 K	
Read-out of operating time for condenser unit. (Value must be multiplied by 1,000). The value can be adjusted	P48	-	-	0 h	
Read-out of compressor operating time. (Value must be multiplied by 1,000). The value can be adjusted	P49	-	-	0 h	

## Application Guidelines      Condensing unit controller

Function	Code	Min.value	Max.value	Default controller settings	Unit controller settings
Read-out of operating time of heating element in crankcase. (Value must be multiplied by 1,000). The value can be adjusted	P50	-	-	0 h	
Read-out of number of HP alarms. The value can be adjusted	P51	-	-	0	
Read-out of number of LP alarms. The value can be adjusted	P52	-	-	0	
Read-out of number of Td alarms. The value can be adjusted	P53	-	-	0	
Oil return management. Compressor speed for the counter starting point	P77	30 rps	70 rps	40 rps	
Oil return management. Limit value for counter	P78	5 min.	720 min.	20 min.	
Oil return management. Boost-speed	P79	40 rps	100 rps	50 rps	
Oil return management. Boost-time	P80	10 s	600 s	60 s	
<b>Service</b>					
Readout pressure on Pc	u01	bar			
Readout temperature Taux	u03	°C			
Status on DI1 input. 1=on=closed	u10				
Status on night operation (on or off) 1=on=night operation	u13				
Readout superheat	u21	K			
Readout temperature at S6 sensor	u36	°C			
Status on DI2 input. 1=on=closed	u37				
Readout the compressor capacity in %	u52	%			
Status on relay to compressor. 1=on=closed	** u58				
Status on relay to fan. 1=on=closed	** u59				
Status on relay to alarm. 1=on=closed	** u62				
Status on relay "Aux". 1=on=closed	** u63				
Status on relay to heating element in crank case. 1=on=closed	** u71				
Status on high voltage input DI3. 1=on=230 V	u87				
Readout condensing pressure in temperature	U22	°C			
Readout pressure Ps	U23	bar			
Readout suction pressure in temperature	U24	°C			
Readout ambient temperature Tamb	U25	°C			
Readout discharge temperature Td	U26	°C			
Readout suction gas temperature Ts	U27	°C			
Readout the voltage on the output AO1	U44	V			
Readout the voltage on the output AO2	U56	V			

**NOTICE** Following controller parameters are modified from factory setting by condensing unit production.

- r12: 1 (main switch = ON).
- c71: 2 (compressor type = variable speed compressor).
- c73: 25.8 (max. condensing pressure = 25.8bar(g)).
- c75: 2.0 (min. suction pressure = 2.0 bar(g)).
- o30: 19 (refrigerant: 19=R404A, 21=R407A, 37=R407F).
- o61: 55, 56 or 57 (compressor size: 55=VLZ028, 56=VLZ035, 57=VLZ044).

Following parameter should be modified by installer if controller is used as pump down device.

- c33: 2.3 (pump down limit, should be min. 0.3bar higher than c75 to avoid unwanted alarms).

Modification of controller parameters shall be done by qualified persons only.

In case of any problems with controller it is possible to connect unit bypassing it: see details in chapter 4.3.1 of this guideline.

**7.1 General recommendations**

**⚠️WARNING** Even if main switch of condensing unit is in position OFF power still available at income terminals of main switch.

In case of any service related to electrical components inside condensing unit it is recommended to disconnect condensing unit from the power by switch located before condensing unit.

It is recommend to check the unit for leakages minimum once a year and in accordance with national requirements.

Furthermore following should be checked:

1. Electrical and refrigerant connections for damages, corrosion etc.
2. The mounting devices (bolts, nuts, etc) of the unit.
3. Vibrations: if it is on the same level as after installation or any signs of abnormal vibration.
4. Operation conditions.
5. Airflow across the condenser.
6. Oil level.
7. Tightness of electrical connections.
8. Operation of the crankcase and oil separator heaters.

Compressor must always be warmer than any other component in the circuit, even if the circuit is switched off for seasonal stop.

**7.2 Condenser**

Condenser should at least once a year be checked for clogging and be cleaned if deemed necessary. Access to internal side of condenser takes place through fan door. Remember to switch off the unit at main switch before opening the fan door.

In comparison to fin and tube heat exchangers, microchannel coils tend to accumulate more of the dirt on the surface and of the less dirt inside which can make them easier to clean.

Step 1: Remove surface debris  
Remove surface dirt, leaves, fibres, etc. with a vacuum cleaner (preferably with a brush or other soft attachment rather than a metal tube), compressed air blown from the inside out, and/or a soft bristle (not wire!) brush. Do not impact or scrape the coil with the vacuum tube, air nozzle, etc.

Step 2: Rinse

Do not use any chemicals (including those advertised as coil cleaners) to wash microchannel heat exchangers. They can cause corrosion. Rinse only with water.

Hose the MCHE off gently, preferably from the inside out and top to bottom, running the water through every fin passage until it comes out clean. Microchannels fins are stronger than traditional tube & fin coil fins but still need to be handled with care. Do not bang the hose into the coil.

Step 3: Optional blow dry

Microchannel heat exchangers, because of their fin geometry, tend to retain water more than traditional fin & tube coils. It may be beneficial to blow or vacuum out the rinse water from your unit to speed drying and prevent pooling.

**7.3 Service and safety advice**

If the refrigerant system has been opened the system has to be flushed with dry air or nitrogen to remove moisture and a new filter dryer has to be installed. If evacuation of refrigerant has to be done, it shall be done in such a way that no refrigerant can escape to the environment. Beware of hot and cold components in the refrigeration system. The components in the refrigeration system are pressurized; as a consequence special attention has to be paid during operation on these components.

**⚠️CAUTION** Do not operate condensing unit without refrigerant charge or without being connected to the system.

Safety goggles, gloves, protective clothing, safety boots, hard hats or another safety equipment should be worn when necessary.

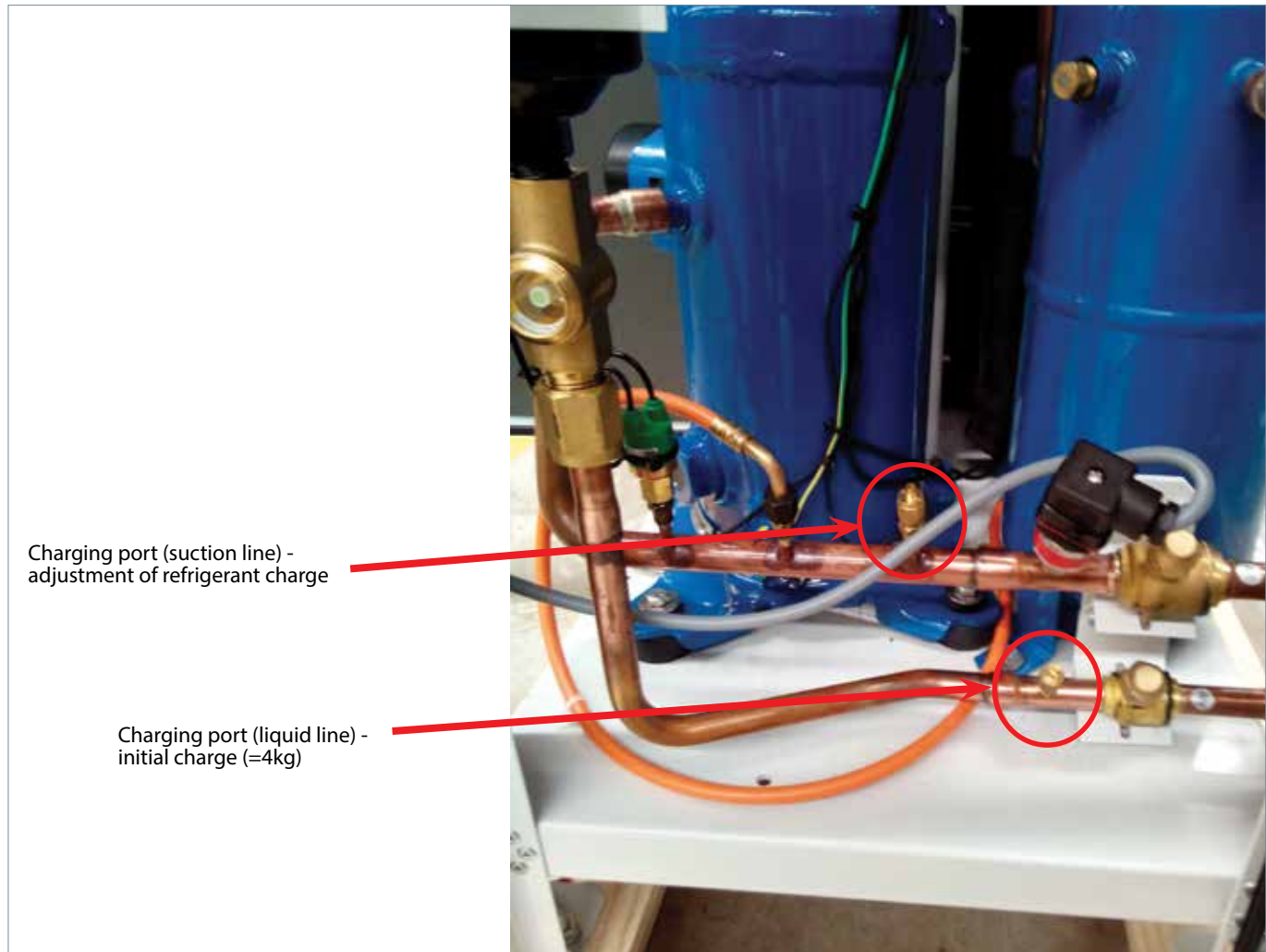
Never install a system in the field and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.

Do not touch the compressor until it has cooled down. Ensure that other materials in the area of the compressor do not get in touch with it.

**⚠️WARNING** Before Starting Repair Work

- Disconnect from mains
- Wait as stated before for discharge of the DC-link.
- Remove compressor cable.»

7.4 Access ports



**8.1 Unpacking**

When unit reaches your warehouse, inspect the packing for any visible damage and make sure it is in good condition. In the event you detect any damage, please contact your forwarder

immediately: send a registered letter to the shipping company claiming the suffered damage, a copy of which should be sent responsible contact in Danfoss.

**8.2 Transportation and handling**

Move the condensing unit only with appropriate mechanical or handling equipment according to weight. It is recommended not to open the packaging before the unit is at the final place for installation. Handle the unit with care. The packaging allows for the use of a forklift or pallet

jack. Use appropriate and safe lifting equipment. Store and transport the unit in an upright position. Store the unit between -35°C and 50°C. Don't expose the packaging to rain or corrosive atmosphere. After unpacking, check that the unit is complete and undamaged.

**8.3 Disposal Instruction**

Equipment containing electrical components must not be disposed of together with domestic waste. It must be separately collected with electrical and

electronic waste according to local and currently valid legislation.

**9.1 Warranty conditions**

Always transmit the model number and serial number with any claim filed regarding this product. The product warranty may be void in following cases:

- Absence of nameplate.
- External modifications, in particular drilling, welding, broken feet and shock marks.
- Compressor opened or returned unsealed.
- Rust, water or leak detection dye inside the compressor.
- Use of a refrigerant or lubricant not approved by Danfoss.
- Any deviation from recommended instructions pertaining to installation, application or maintenance.

- Use in mobile applications.
- Use in explosive atmospheric environment.
- No model number or serial number transmitted with the warranty claim.

**NOTICE** Charging of refrigerant or oil not specified by Danfoss as suitable for the unit will lead to annulment of warranty from Danfoss A/S side (if the refrigerant or oil are not approved in writing by Danfoss). Annulment of warranty from Danfoss side will also take place if the unit is altered without written approval from Danfoss.

Warranty is governed by the Danfoss general terms of warranty.

**9.2 Unauthorized changes**

Warranty can also be rejected in case of unauthorized modifications of the condensing unit:

- Modification of electrical box.
- Modification of internal piping system of the condensing unit.

- Direct changes of drive parameter setting (all parameter changes should be limited to controller setting changes. No changes allowed on the drive itself).
- Replacement of drive, compressor, fan or other components on the condensing unit by similar components which are not Danfoss original components or approved by Danfoss.

## Application Guidelines      Data collected during start up

<b>Identification</b>				
Country				
Installation reference (shop name)				
City of installation				
Installer Company				
Unit Code/Type				
Serial N° of unit				
Installation Date				
Commission Date				
<b>Installation</b>				
Refrigerant				
Number of evaporators connected to the variable speed condensing unit				
Expected maximum Ambient temperature °C				
Expected minimum Ambient temperature °C				
<b>Evaporators</b>				
Evaporator N°		1	2	3
Type of application (cold room, cabinet, process cooling, etc.)				
Distance to the unit [m]				
Vertical position of the unit (+ if above or - if below)				
Evaporator Cooling capacity [kW]				
Evaporating pressure [bar] / temperature [°C]				
Superheat at evaporator outlet [K]				
Type of expansion valve used : Thermostatic (TEV) - electronic (EEX)				
<b>Compressor</b>				
Suction gas temperature [°C] or pressure [bar] at compressor inlet				
Frequency observed at stabilised condition				
Oil level in oilsightglass after start-up (1/4 - 1/2 - 3/4)				
Oil topup [L]				
Refrigerant charge [kg]				
<b>Electrics &amp; controls</b>				
Has the installation a stable power supply				
Voltage (between L1/L2/L3)		U1:	U2:	U3:
What's the type of grid (IT, TT, TN)				
If system-manager used (AK-SM, AK-SC....), type				

Kind request to provide after start-up completed copy of this page to your wholesaler of purchase, as part of warranty modalities.







# Danfoss Commercial Compressors

is a worldwide manufacturer of compressors and condensing units for refrigeration and HVAC applications. With a wide range of high quality and innovative products we help your company to find the best possible energy efficient solution that respects the environment and reduces total life cycle costs.

We have 40 years of experience within the development of hermetic compressors which has brought us amongst the global leaders in our business, and positioned us as distinct variable speed technology specialists. Today we operate from engineering and manufacturing facilities spanning across three continents.



Danfoss Scrolls



Danfoss Inverter Scrolls



Danfoss Turbocor Compressors



Danfoss Light Commercial Refrigeration Compressors



Danfoss Maneurop Reciprocating Compressors



Danfoss Optyma Condensing Units

Our products can be found in a variety of applications such as rooftops, chillers, residential air conditioners, heatpumps, coldrooms, supermarkets, milk tank cooling and industrial cooling processes.

<http://cc.danfoss.com>

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