MAKING MODERN LIVING POSSIBLE

VTZ Compressor Drive™

R404A - R507A - R407C

REFRIGERATION &
AIR CONDITIONING DIVISION

SELECTION &
APPLICATION GUIDELINES

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CONTENTS

Speed control

The introduction of speed control for refrigeration compressors is one of the major developments towards the optimization of refrigeration systems for the years to come. The capability of controlling speed is leading to a new approach in the design of refrigeration systems based on average load. For periods of high cooling demand, the compressor speed can be increased which results in a higher refrigerant flow and thus higher cooling capacity. For periods of lower cooling demand, compressor speed can be decreased resulting in a lower cooling capacity.

Advantages of speed control

Smaller compressors can be selected than normally required with fixed speed compressors.

Energy savings are realized because the compressor speed is adapted to the actual cooling demand. The compressor power input is directly related to its speed. Further improvements can be achieved by adjusting the speed of other motors (fans, pumps, ...) to the actual needs.

Reduction of inrush current at start-up. The starting current is reduced to a value close to the nominal current.

Cooling process optimization. By continuously adapting the compressor speed to the actual needs, a more precise cooling process control is achieved.

Increased reliability. The number of on / off cycles is drastically decreased resulting in a reduction of mechanical and electrical stresses and wear, consequently improving the overall system reliability.

Reduced sound nuisance. At night, when cooling demand is usually low, the compressor speed can be decreased, contributing to lower system operating sound levels.

Danfoss VTZ compressors with CD frequency converters

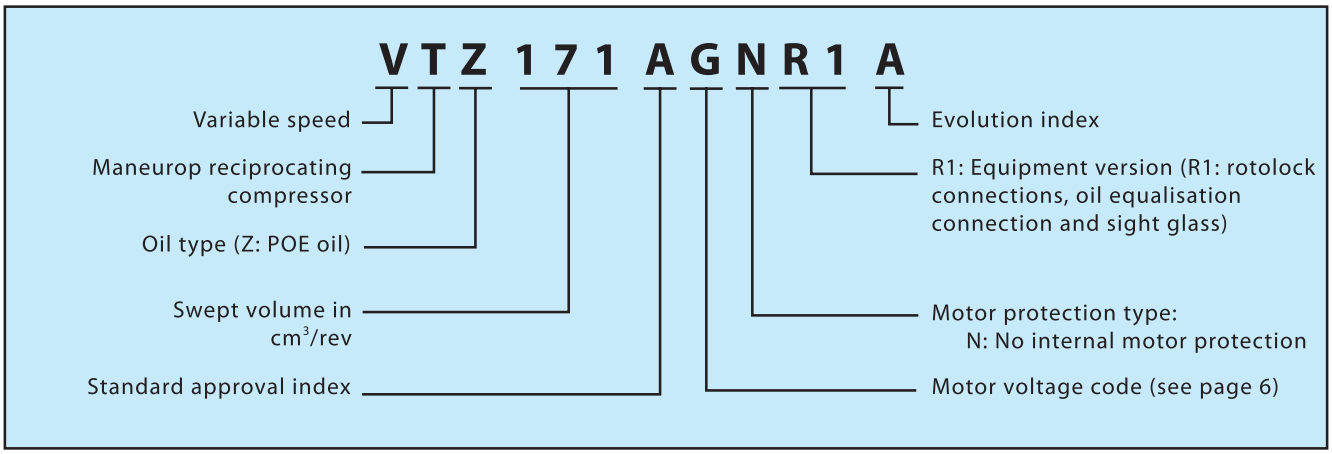
Selecting the right frequency converter for a variable speed refrigeration compressor can be very complex. Several parameters and characteristics have to be taken into account such as voltage, current, torque, heat generation, ramp-up, IP-rate, EMC and RFI.

For that reason, Danfoss has created pre-defined sets of VTZ compressors with dedicated CD302 frequency converters. All above mentioned parameters have been taken into account during the design and test phase already. This is your guarantee that the compressor and frequency converter are fully compatible.

Of course these packs also simplify your selection considerably. And during commissioning the pre-programmed factory settings of the CD302 will save you valuable time.

NOMENCLATURE AND SPECIFICATIONS

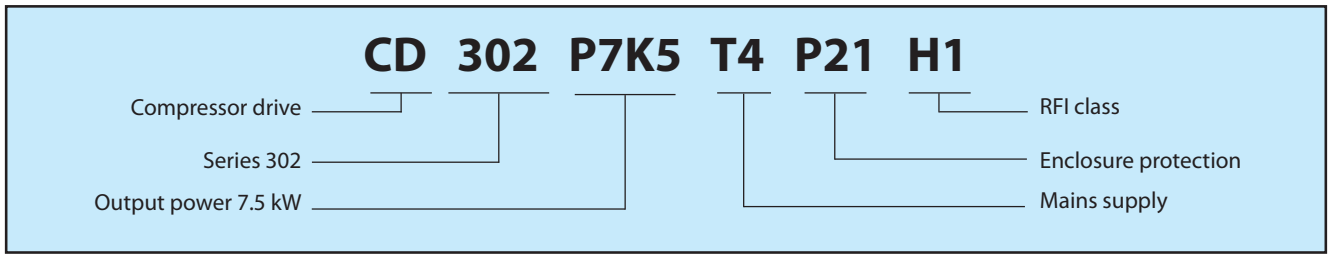
Compressor nomenclature



Compressor specifications

Compressor model	Swept volume (cm^3/rev)	Displacement			Cyl. nbr	Oil charge (dm^3)	Net Weight (kg)
		Min speed (m^3/h)	50 Hz (m^3/h)	Max speed (m^3/h)			
VTZ038	38.12	4.57	6.63	12.12	1	0.95	21
VTZ054	53.86	6.46	9.37	17.13	1	0.95	24
VTZ086	85.64	8.74	14.90	27.23	2	1.80	35
VTZ121	120.94	12.34	21.04	36.28	2	1.80	40
VTZ171	171.26	17.47	29.80	54.46	4	3.90	60
VTZ215	215.44	21.97	37.49	68.51	4	3.90	64
VTZ242	241.87	24.67	42.09	72.56	4	3.90	67

Frequency converter nomenclature



Frequency converter general specifications

Mains supply voltage	200 - 240 V +/-10% (3-phase)
	380 - 480 V +/-10% (3-phase)
	525 - 600 V +/-10% (3-phase)
Supply frequency	50 / 60 Hz
Output voltage	0 - 100 % of supply voltage
Inputs	6 digital (0 - 24 V), 2 analogue (-10 / +10 V or 0 / 4 V -20 mA, scalable)
Programmable outputs	2 digital (0- 24 V), 1 analogue, 2 relay
Protection functions	Over-current protection, over-modulation handling, low / high current handling
Smart Logic Control functions	Pump-down function, Anti short-cycle function, Oil return management

COMPRESSOR AND FREQUENCY CONVERTER SELECTION

Compressor size

Variable speed technology offers more flexibility in compressor selection than fixed speed compressors. Selection of the right variable speed compressor size can be done by different methods:

1. Maximum cooling capacity: Select a compressor size which achieves the peak load system cooling capacity demand at its maximum speed.

2. Nominal cooling capacity: Select a compressor size which achieves the nominal system cooling capacity at a rotational speed of 3600 – 4500 rpm (60-75 Hz).

3. Best Seasonal Efficiency Ratio: Select a compressor size which achieves the minimum system cooling demand at its minimum speed. Ensure that the compressor is able to cover the peak load system cooling capacity. This selection makes the compressor to run for a maximum of time at part load where the system efficiency is highest.

Simplified compressor performance tables can be found from page 12 onwards. For more complete performance data, please refer to the data sheets or the Danfoss Foresee calculation tool.

Voltage

Because VTZ compressors are powered by a frequency converter, the mains frequency, 50 or 60 Hz, is no longer an issue. Only the mains voltage is to be taken into account. With 3 motor voltage codes, the most common mains voltages and frequencies are covered. Never connect the VTZ compressor directly to the mains power supply.

Voltage code	Mains voltage range of drive
J	200-240 V / 3 ph / 50 Hz & 200-240 V / 3 ph / 60 Hz
G	380-480 V / 3 ph / 50 Hz & 380 - 480 V / 3 ph / 60 Hz
H	525-600 V / 3 ph / 50 Hz & 525-600 V / 3 ph / 60 Hz

Frequency converter variants

When the refrigerant, the compressor size and mains voltage have been defined with above selection criteria, the code number tables at page 7 & 8 give the appropriate frequency converter size and up to 8 corresponding code numbers for packs of compressor + frequency converter. The individual code numbers identify different frequency converter variants:

1. IP class (CD302 drives are available in IP20 / IP21 and IP55)

2. RFI class (Radio Frequency Interference)

3. Local Control Panel (LCP) provided or not

Packs versus separate components

The tables on pages 7 & 8 give code numbers for a pack of a VTZ compressor with a CD302 frequency converter. Such pack consists of one box of indicated dimensions with compressor and frequency converter packed together. It is possible to order only the VTZ compressor or only the CD302 frequency converter for special applications or replacement. Refer to page 9 for code numbers of separate components.

COMPRESSOR AND FREQUENCY CONVERTER SELECTION

R404A - R507A - R407C

	Compressor	Frequency converter		Code number for pack of VTZ + CD302				Packaging dimensions				Availability*
		Model & power	IP class	RFI class H1		RFI class H2		Height (mm)	Width (mm)	Depth (mm)	Weight (kg)	
				with LCP	no LCP	with LCP	no LCP					
200-240 Volt	VTZ038-J	CD-302 3k7 (3.7 kW)	IP20	121F0015	121F0251	121F0252	121F0253	504	800	600	37	1
			IP55									
	VTZ054-J	CD-302 5K5 (5.5 kW)	IP21	121F0016	121F0266	121F0267	121F0268	588	1150	800	67	1
			IP55	121F0269	121F0270	121F0271	121F0272	588	1150	800	67	
	VTZ086-J	CD-302 7K5 (7.5 kW)	IP21	121F0017	121F0281	121F0282	121F0283	588	1150	800	80	1
			IP55	121F0284	121F0285	121F0286	121F0287	588	1150	800	80	
	VTZ121-J	CD-302 11K (11.0 kW)	IP21	121F0018	121F0296	121F0297	121F0298	588	1150	800	87	1
			IP55	121F0299	121F0300	121F0301	121F0302	588	1150	800	87	
380-480 Volt	VTZ038-G	CD-302 4K0 (4.0 kW)	IP20	121F0001	121F0042	121F0043	121F0044	504	800	600	35	1
			IP55	121F0023	121F0045	121F0046	121F0047	504	800	600	45	
	VTZ054-G	CD-302 5K5 (5.5 kW)	IP20	121F0002	121F0056	121F0057	121F0058	504	800	600	40	1
			IP55	121F0024	121F0059	121F0060	121F0061	504	800	600	48	
	VTZ086-G	CD-302 7K5 (7.5 kW)	IP20	121F0003	121F0070	121F0071	121F0072	583	800	600	51	1
			IP55	121F0025	121F0073	121F0074	121F0075	583	800	600	59	
	VTZ121-G	CD-302 11K (11.0 kW)	IP21	121F0004	121F0090	121F0091	121F0092	588	1150	800	79	1
			IP55	121F0026	121F0093	121F0094	121F0095	588	1150	800	79	
	VTZ171-G	CD-302 15K (15.0 kW)	IP21	121F0005	121F0104	121F0105	121F0106	688	1150	800	100	1
			IP55	121F0027	121F0107	121F0108	121F0109	688	1150	800	100	
	VTZ215-G	CD-302 18K (18.5 kW)	IP21	121F0006	121F0118	121F0119	121F0120	688	1150	800	108	1
			IP55	121F0028	121F0121	121F0122	121F0123	688	1150	800	108	
	VTZ242-G	CD-302 22K (22.0 kW)	IP21	121F0007	121F0132	121F0133	121F0134	688	1150	800	111	1
			IP55	121F0029	121F0135	121F0136	121F0137	688	1150	800	111	
525-600 Volt	VTZ038-H	CD-302 4K0 (4.0 kW)	IP20	121F0008	121F0146	121F0147	121F0148	504	800	600	35	2
			IP55	121F0149	121F0150	121F0151	121F0152	504	800	600	45	
	VTZ054-H	CD-302 5K5 (5.5 kW)	IP20	121F0009	121F0161	121F0162	121F0163	504	800	600	40	2
			IP55	121F0164	121F0165	121F0166	121F0167	504	800	600	48	
	VTZ086-H	CD-302 7K5 (7.5 kW)	IP20	121F0010	121F0176	121F0177	121F0178	583	800	600	51	2
			IP55	121F0179	121F0180	121F0181	121F0182	583	800	600	59	
	VTZ121-H	CD-302 11K 11.0 kW)	IP21	121F0011	121F0191	121F0192	121F0193	588	1150	800	79	2
			IP55	121F0194	121F0195	121F0196	121F0197	588	1150	800	79	
	VTZ171-H	CD-302 15K (15.0 kW)	IP21	121F0012	121F0206	121F0207	121F0208	688	1150	800	100	2
			IP55	121F0209	121F0210	121F0211	121F0212	688	1150	800	100	
	VTZ215-H	CD-302 18K (18.5 kW)	IP21	121F0013	121F0221	121F0222	121F0223	688	1150	800	108	2
			IP55	121F0224	121F0225	121F0226	121F0227	688	1150	800	108	
	VTZ242-H	CD-302 22K (22.0 kW)	IP21	121F0014	121F0236	121F0237	121F0238	688	1150	800	111	2
			IP55	121F0239	121F0240	121F0241	121F0242	688	1150	800	111	

RFI: Radio Frequency Interface (= Electromagnetic Interference)
LCP: Local Control Panal
* Availability:
1. Immediate
2. Januray 2007

COMPRESSOR AND FREQUENCY CONVERTER SELECTION

R134a

Compressor		Frequency converter		Code number for pack of VTZ + CD302				Packaging dimensions				Availability*
		Model & power	IP class	RFI class H1		RFI class H2		Height (mm)	Width (mm)	Depth (mm)	Weight (kg)	
				with LCP	no LCP	with LCP	no LCP					
200-240 Volt	VTZ038-J	CD-302 3k7 (3.7 kW)	IP20	121F0015	121F0251	121F0252	121F0253	504	800	600	37	2
			IP55									
	VTZ054-J	CD-302 3k7 (3.7 kW)	IP20	121F0016	121F0266	121F0267	121F0268	588	1150	800	67	2
			IP55									
	VTZ086-J	CD-302 5K5 (5.5 kW)	IP21	121F0273	121F0274	121F0275	121F0276	588	1150	800	80	2
			IP55	121F0277	121F0278	121F0279	121F0280	588	1150	800	80	
	VTZ121-J	CD-302 7K5 (7.5 kW)	IP21	121F0288	121F0289	121F0290	121F0291	588	1150	800	87	2
			IP55	121F0292	121F0293	121F0294	121F0295	588	1150	800	87	
380-480 Volt	VTZ038-G	CD-302 4K (4.0 kW)	IP20	121F0034	121F0035	121F0036	121F0037	504	800	600	35	1
			IP55	121F0038	121F0039	121F0040	121F0041	504	800	600	45	
	VTZ054-G	CD-302 5K5 (5.5 kW)	IP20	121F0002	121F0056	121F0057	121F0058	504	800	600	40	1
			IP55	121F0024	121F0059	121F0060	121F0061	504	800	600	48	
	VTZ086-G	CD-302 5K5 (5.5 kW)	IP20	121F0062	121F0063	121F0064	121F0065	583	800	600	59	1
			IP55	121F0066	121F0067	121F0068	121F0069	583	800	600	59	
	VTZ121-G	CD-302 11K (11.0 kW)	IP21	121F0004	121F0090	121F0091	121F0092	588	1150	800	79	1
			IP55	121F0026	121F0093	121F0094	121F0095	588	1150	800	79	
	VTZ171-G	CD-302 11K (11.0 kW)	IP21	121F0096	121F0097	121F0098	121F0099	688	1150	800	100	1
			IP55	121F0100	121F0101	121F0102	121F0103	688	1150	800	100	
	VTZ215-G	CD-302 15K (15.0 kW)	IP21	121F0110	121F0111	121F0112	121F0113	688	1150	800	104	1
			IP55	121F0114	121F0115	121F0116	121F0117	688	1150	800	104	
	VTZ242-G	CD-302 15K (15.0 kW)	IP21	121F0124	121F0125	121F0126	121F0127	688	1150	800	111	1
			IP55	121F0128	121F0129	121F0130	121F0131	688	1150	800	111	
525-600 Volt	VTZ038-H	CD-302 4K0 (4.0 kW)	IP20	121F0138	121F0139	121F0140	121F0141	504	800	600	35	2
			IP55	121F0142	121F0143	121F0144	121F0145	504	800	600	45	
	VTZ054-H	CD-302 4K0 (4.0 kW)	IP20	121F0153	121F0154	121F0155	121F0156	504	800	600	35	2
			IP55	121F0157	121F0158	121F0159	121F0160	504	800	600	48	
	VTZ086-H	CD-302 5K5 (5.5 kW)	IP20	121F0168	121F0169	121F0170	121F0171	583	800	600	59	2
			IP55	121F0172	121F0173	121F0174	121F0175	583	800	600	59	
	VTZ121-H	CD-302 7K5 (7.5 kW)	IP20	121F0183	121F0184	121F0185	121F0186	583	800	600	72	2
			IP55	121F0187	121F0188	121F0189	121F0190	583	800	600	72	
	VTZ171-H	CD-302 11K (11.0 kW)	IP21	121F0198	121F0199	121F0200	121F0201	688	1150	800	100	2
			IP55	121F0202	121F0203	121F0204	121F0205	688	1150	800	100	
	VTZ215-H	CD-302 15K (15.0 kW)	IP21	121F0213	121F0214	121F0215	121F0216	688	1150	800	104	2
			IP55	121F0217	121F0218	121F0219	121F0220	688	1150	800	104	
	VTZ242-H	CD-302 18K (18.5 kW)	IP21	121F0228	121F0229	121F0230	121F0231	688	1150	800	111	2
			IP55	121F0232	121F0233	121F0234	121F0235	688	1150	800	111	

RFI: Radio Frequency Interface (= Electromagnetic Interference)
LCP: Local Control Panal
* Availability:

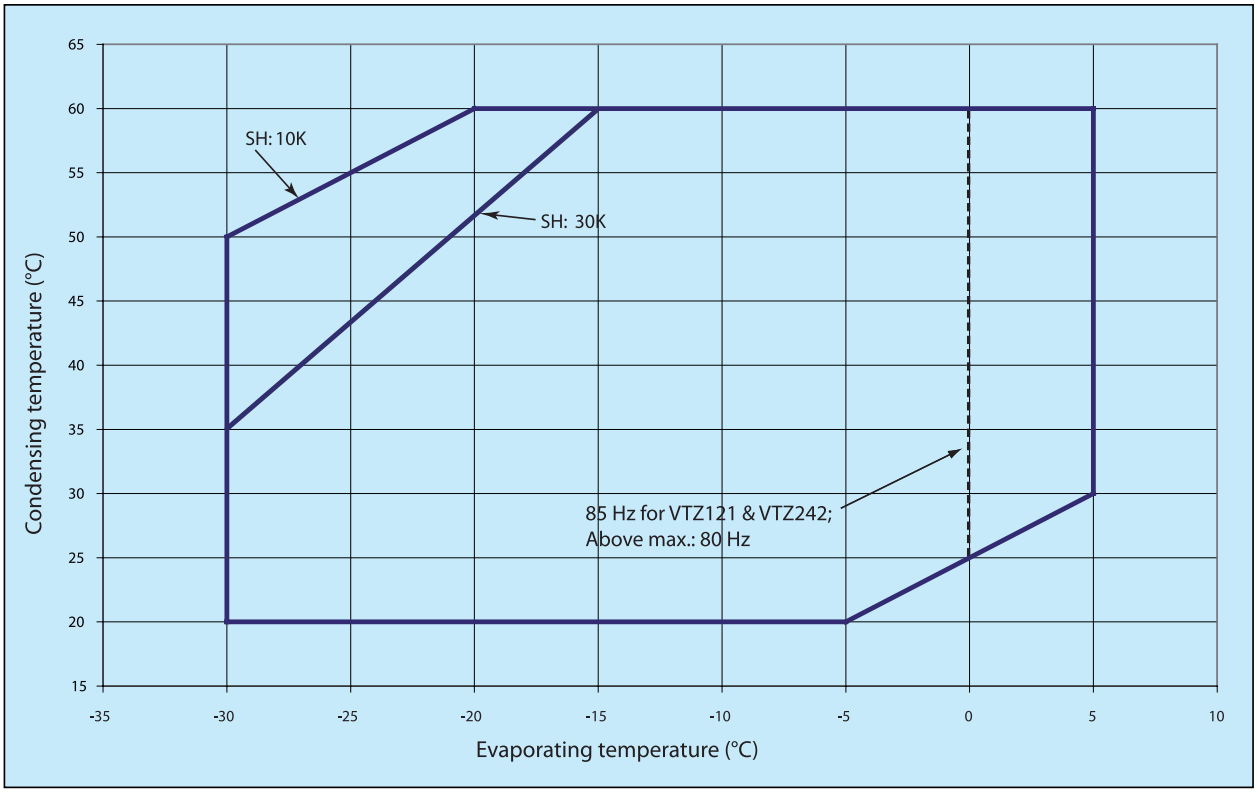
1. Immediate
2. January 2007

COMPRESSOR AND FREQUENCY CONVERTER SELECTION

Mains voltage	Compressor	Code numbers for compressors
200-240 Volt 3-phase 50 & 60 Hz	VTZ038-J	120B0029
	VTZ054-J	120B0030
	VTZ086-J	120B0031
	VTZ121-J	120B0032
380-480 Volt 3-phase 50 & 60 Hz	VTZ038-G	120B0001
	VTZ054-G	120B0002
	VTZ086-G	120B0003
	VTZ121-G	120B0004
	VTZ171-G	120B0005
	VTZ215-G	120B0006
	VTZ242-G	120B0007
525-600 Volt 3-phase 50 & 60 Hz	VTZ038-H	120B0015
	VTZ054-H	120B0016
	VTZ086-H	120B0017
	VTZ121-H	120B0018
	VTZ171-H	120B0019
	VTZ215-H	120B0020
	VTZ242-H	120B0021

Main voltage	Frequency converter		Code number for frequency converter			
	Model & power	IP class	RFI class H1		RFI class H2	
			with LCP	no LCP	with LCP	no LCP
200-240 Volt	CD302 3K7 (3.7 kW)	IP20	131B5347	131B5348	131B5349	131B5350
		IP55				
	CD302 5K5 (5.5 kW)	IP21	131B5351	131B5352	131B5355	131B5356
		IP55	131B5353	131B5354	131B5357	131B5358
	CD302 7K5 (7.5 kW)	IP21	131B5009	131B5359	131B5010	131B5360
		IP55	131B5361	131B5362	131B5363	131B5364
	CD302 11K (11.0 kW)	IP21	131B5365	131B5366	131B5367	131B5368
		IP55	131B5369	131B5370	131B5371	131B5372
380-480 Volt	CD302 3K0 (3.0 kW)	IP20				
		IP55				
	CD302 4K0 (4.0 kW)	IP20	131B3543	131B3544	131B3545	131B3546
		IP55	131B3547	131B3548	131B3550	131B3549
	CD302 5K5 (5.5 kW)	IP20	131B3552	131B3553	131B3554	131B3555
		IP55	131B3556	131B3557	131B3558	131B3559
	CD302 7K5 (7.5 kW)	IP20	131B3560	131B3561	131B3562	131B3563
		IP55	131B3564	131B3565	131B3566	131B3567
	CD302 11K (11.0 kW)	IP21	131B3568	131B3569	131B3570	131B3571
		IP55	131B3572	131B3573	131B3574	131B3575
	CD302 15K (15.0 kW)	IP21	131B3576	131B3577	131B3578	131B3579
		IP55	131B3580	131B3581	131B3582	131B3583
	CD302 18K (18.5 kW)	IP21	131B3584	131B3585	131B3586	131B3587
		IP55	131B3588	131B3589	131B3590	131B3591
	CD302 22K (22.0 kW)	IP21	131B3592	131B3593	131B3594	131B3595
		IP55	131B3596	131B3597	131B3598	131B3599
525-600 Volt	CD302 4K0 (4.0 kW)	IP20	131B5381	131B5382	131B5383	131B5384
		IP55				
	CD302 5K5 (5.5 kW)	IP20	131B5385	131B5386	131B5387	131B5388
		IP55				
	CD302 7K5 (7.5 kW)	IP20	131B5389	131B5390	131B5391	131B5392
		IP55				
	CD302 11K (11.0 kW)	IP21				
		IP55				
	CD302 15K (15.0 kW)	IP21				
		IP55				
	CD302 18K (18.5 kW)	IP21				
		IP55				
	CD302 22K (22.0 kW)	IP21				
		IP55				

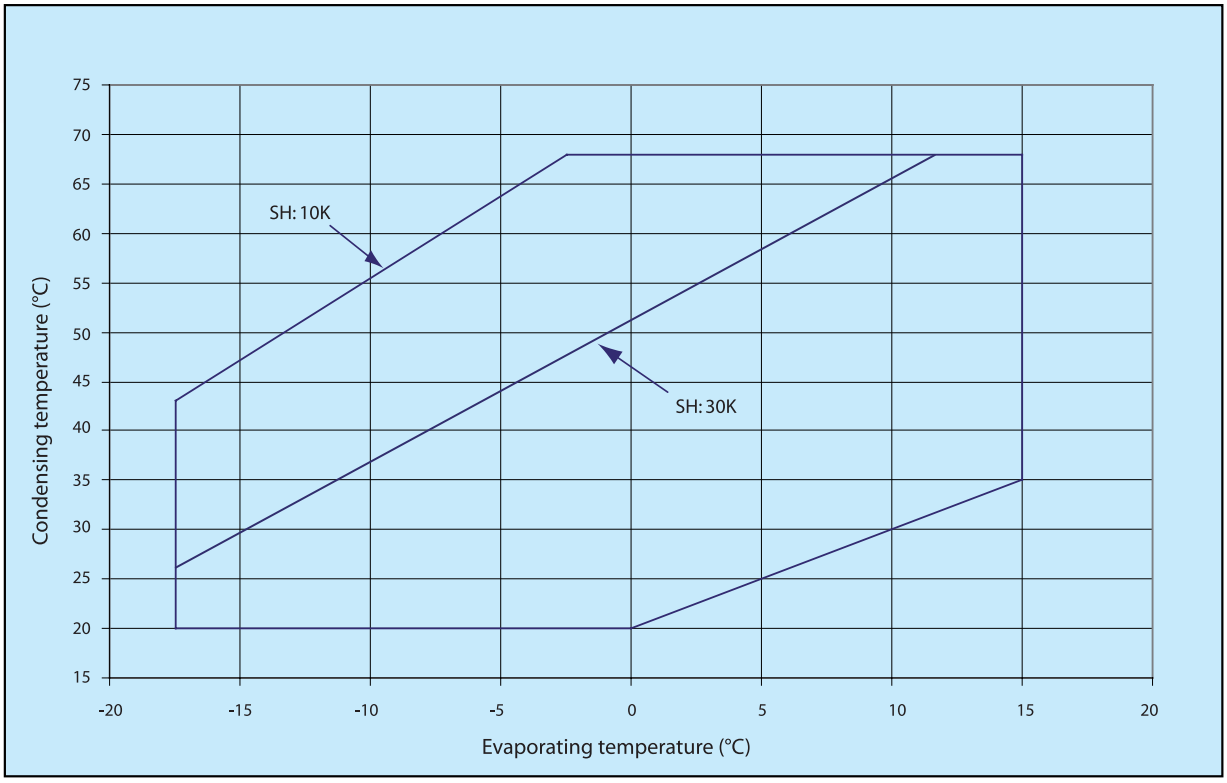
Operating envelope
R404A/R507A



Frequency range
R404A/R507A

		Frequency low limit	Frequency high limit
1 cylinder	VTZ038	35 Hz	90 Hz
	VTZ054	35 Hz	90 Hz
2 cylinders	VTZ086	30 Hz	90 Hz
	VTZ121	30 Hz	Tevap<0°C: 85 Hz Tevap>0°C: 80 Hz
4 cylinders	VTZ171	30 Hz	90 Hz
	VTZ215	30 Hz	90 Hz
	VTZ242	30 Hz	Tevap<0°C: 85 Hz Tevap>0°C: 80 Hz

Operating envelope
R407C



Frequency range
R407C

		Frequency low limit	Frequency high limit
1 cylinder	VTZ038	35 Hz	90 Hz
	VTZ054	35 Hz	90 Hz
2 cylinders	VTZ086	30 Hz	90 Hz
	VTZ121	30 Hz	85 Hz
4 cylinders	VTZ171	30 Hz	90 Hz
	VTZ215	30 Hz	90 Hz
	VTZ242	30 Hz	85 Hz

COMPRESSOR AND FREQUENCY CONVERTER SELECTION

Performance data

R404A

	To	-30		-25		-20		-15		-10		-5		0		5	
	Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VTZ038																	
Min rpm	20	1 090	0.61	1 430	0.67	1 850	0.71	2 350	0.74	2 950	0.76	3 650	0.77	-	-	-	-
	30	840	0.64	1 130	0.72	1 480	0.79	1 910	0.85	2 420	0.89	3 030	0.93	3 730	0.95	4 550	0.96
	40	610	0.64	850	0.75	1 140	0.85	1 500	0.94	1 920	1.02	2 430	1.09	3 030	1.14	3 730	1.18
	50	400	0.62	590	0.76	830	0.90	1 110	1.02	1 450	1.14	1 860	1.24	2 350	1.32	2 930	1.40
	60	-	-	-	-	530	0.92	750	1.08	1 010	1.23	1 320	1.37	1 700	1.50	2 160	1.61
3600 rpm	20	1 720	1.08	2 290	1.19	3 000	1.29	3 860	1.37	4 890	1.43	6 110	1.45	-	-	-	-
	30	1 380	1.10	1 920	1.26	2 570	1.40	3 360	1.52	4 290	1.62	5 400	1.69	6 690	1.74	8 190	1.75
	40	1 020	1.10	1 490	1.30	2 070	1.49	2 760	1.66	3 580	1.81	4 560	1.93	5 700	2.03	7 040	2.11
	50	640	1.04	1 040	1.29	1 520	1.52	2 100	1.75	2 800	1.95	3 630	2.14	4 610	2.30	5 760	2.44
	60	-	-	-	-	960	1.47	1 410	1.75	1 960	2.02	2 620	2.27	3 420	2.50	4 370	2.70
Max rpm	20	2 200	1.75	3 080	2.01	4 160	2.22	5 450	2.39	6 990	2.51	8 790	2.57	-	-	-	-
	30	1 680	1.74	2 480	2.08	3 460	2.38	4 640	2.64	6 030	2.86	7 650	3.03	9 550	3.15	11 730	3.22
	40	1 140	1.60	1 860	2.03	2 710	2.43	3 740	2.78	4 960	3.10	6 400	3.37	8 070	3.60	10 010	3.78
	50	630	1.34	1 230	1.85	1 940	2.34	2 800	2.79	3 830	3.21	5 050	3.58	6 480	3.92	8 150	4.20
	60	-	-	-	-	1 190	2.11	1 860	2.66	2 670	3.17	3 640	3.65	4 810	4.09	6 190	4.49
VTZ054																	
Min rpm	20	1 480	0.88	1 970	0.97	2 590	1.05	3 370	1.11	4 310	1.16	5 450	1.18	-	-	-	-
	30	1 180	0.94	1 600	1.05	2 120	1.16	2 770	1.26	3 570	1.34	4 540	1.40	5 700	1.45	7 060	1.48
	40	920	0.96	1 260	1.11	1 690	1.25	2 220	1.38	2 890	1.50	3 700	1.60	4 670	1.69	5 820	1.76
	50	680	0.96	950	1.14	1 290	1.32	1 710	1.49	2 240	1.64	2 890	1.79	3 680	1.92	4 640	2.03
	60	-	-	-	-	900	1.37	1 220	1.57	1 610	1.77	2 110	1.96	2 730	2.13	3 490	2.29
3600 rpm	20	2 520	1.58	3 300	1.75	4 270	1.91	5 450	2.05	6 870	2.16	8 550	2.26	-	-	-	-
	30	2 120	1.67	2 840	1.88	3 720	2.09	4 790	2.28	6 070	2.44	7 590	2.59	9 380	2.72	11 450	2.82
	40	1 660	1.69	2 300	1.96	3 070	2.22	4 010	2.46	5 130	2.69	6 460	2.90	8 030	3.09	9 870	3.25
	50	1 190	1.64	1 720	1.97	2 360	2.29	3 130	2.60	4 070	2.89	5 190	3.17	6 520	3.42	8 090	3.66
	60	-	-	-	-	1 590	2.29	2 180	2.66	2 910	3.03	3 790	3.37	4 870	3.71	6 150	4.02
Max rpm	20	3 740	2.45	4 870	2.76	6 250	3.06	7 910	3.34	9 880	3.61	12 210	3.84	-	-	-	-
	30	2 970	2.47	4 010	2.84	5 270	3.21	6 780	3.57	8 580	3.92	10 710	4.26	13 190	4.58	16 070	4.87
	40	2 170	2.43	3 090	2.84	4 190	3.28	5 520	3.72	7 110	4.15	9 000	4.59	11 210	5.02	13 800	5.43
	50	1 410	2.30	2 150	2.77	3 070	3.26	4 170	3.77	5 510	4.29	7 120	4.82	9 040	5.35	11 290	5.87
	60	-	-	-	-	1 950	3.15	2 800	3.73	3 850	4.32	5 150	4.94	6 720	5.56	8 600	6.19
VTZ086																	
Min rpm	20	1 840	1.18	2 580	1.31	3 520	1.42	4 660	1.49	6 030	1.54	7 650	1.56	-	-	-	-
	30	1 340	1.21	1 950	1.40	2 720	1.56	3 660	1.69	4 800	1.80	6 160	1.87	7 750	1.92	9 600	1.94
	40	930	1.16	1 420	1.42	2 040	1.66	2 800	1.85	3 720	2.02	4 830	2.16	6 140	2.27	7 670	2.35
	50	580	1.04	980	1.38	1 460	1.69	2 050	1.97	2 770	2.21	3 650	2.42	4 690	2.60	5 920	2.75
	60	-	-	-	-	950	1.67	1 390	2.03	1 930	2.36	2 580	2.65	3 380	2.91	4 330	3.14
3600 rpm	20	4 290	2.46	5 790	2.74	7 620	2.97	9 820	3.15	12 430	3.29	15 490	3.38	-	-	-	-
	30	3 260	2.53	4 590	2.91	6 200	3.25	8 140	3.54	10 440	3.78	13 140	3.96	16 290	4.10	19 910	4.18
	40	2 290	2.46	3 430	2.97	4 810	3.42	6 470	3.82	8 440	4.17	10 770	4.47	13 500	4.71	16 650	4.91
	50	1 400	2.24	2 340	2.87	3 460	3.45	4 820	3.98	6 450	4.46	8 390	4.88	10 680	5.25	13 360	5.56
	60	-	-	-	-	2 180	3.34	3 230	4.00	4 500	4.62	6 040	5.18	7 870	5.68	10 050	6.12
Max rpm	20	6 160	3.89	8 310	4.34	10 950	4.74	14 130	5.09	17 890	5.40	22 290	5.66	-	-	-	-
	30	4 960	4.00	6 910	4.59	9 290	5.13	12 130	5.61	15 490	6.05	19 410	6.44	23 940	6.78	29 120	7.07
	40	3 640	3.91	5 360	4.66	7 440	5.35	9 920	5.99	12 830	6.58	16 250	7.11	20 190	7.60	24 730	8.03
	50	2 260	3.59	3 720	4.51	5 470	5.38	7 540	6.19	9 980	6.94	12 850	7.64	16 190	8.28	20 040	8.87
	60	-	-	-	-	3 420	5.16	5 060	6.15	6 990	7.08	9 280	7.96	11 970	8.78	15 110	9.55
VTZ121																	
Min rpm	20	2 750	1.89	3 660	2.05	4 810	2.19	6 230	2.30	7 940	2.39	9 980	2.46	-	-	-	-
	30	2 280	2.03	3 110	2.25	4 130	2.43	5 390	2.60	6 900	2.74	8 710	2.85	10 840	2.95	13 320	3.02
	40	1 770	2.10	2 480	2.38	3 360	2.64	4 430	2.86	5 730	3.06	7 280	3.24	9 120	3.39	11 280	3.51
	50	1 230	2.08	1 810	2.44	2 520	2.77	3 390	3.07	4 450	3.35	5 730	3.59	7 250	3.81	9 060	4.01
	60	-	-	-	-	1 650	2.82	2 300	3.21	3 090	3.57	4 070	3.90	5 270	4.20	6 700	4.48
3600 rpm	20	5 530	3.69	7 470	4.09	9 890	4.47	12 850	4.84	16 410	5.21	20 620	5.56	-	-	-	-
	30	4 500	3.88	6 220	4.35	8 360	4.82	10 990	5.26	14 150	5.70	17 900	6.12	22 300	6.54	27 410	6.96
	40	3 530	3.99	4 980	4.56	6 800	5.11	9 040	5.64	11 760	6.17	15 020	6.68	18 860	7.18	23 360	7.68
	50	2 630	4.00	3 770	4.68	5 230	5.33	7 040	5.97	9 280	6.60	11 990	7.21	15 230	7.81	19 070	8.41
	60	-	-	-	-	3 660	5.48	5 010	6.24	6 710	6.99	8 840	7.72	11 440	8.43	14 570	9.14
Max rpm	20	8 060	5.47	10 760	6.11	14 150	6.73	18 330	7.32	23 400	7.85	29 440	8.31	-	-	-	-
	30	6 400	5.63	8 760	6.38	11 710	7.14	15 340	7.90	19 750	8.64	25 040	9.34	31 310	9.99	38 660	10.57
	40	4 870	5.67	6 870	6.50	9 350	7.38	12 420	8.29	16 170	9.20	20 690	10.10	26 100	10.99	32 470	11.84
	50	3 450	5.64	5 070	6.53	7 080	7.49	9 560	8.51	12 630	9.57	16 370	10.65	20 890	11.74	26 280	12.82
	60	-	-	-	-	4 860	7.52	6 750	8.62	9 120	9.79	12 070	11.02	15 690	12.29	20 070	13.58

COMPRESSOR AND FREQUENCY CONVERTER SELECTION

Performance data

R404A

	To	-30		-25		-20		-15		-10		-5		0		5	
	Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VTZ171																	
Min rpm	20	3 900	2.31	5 360	2.59	7 180	2.83	9 400	3.04	12 050	3.20	15 160	3.31	-	-	-	-
	30	2 920	2.32	4 150	2.65	5 680	2.96	7 550	3.24	9 790	3.47	12 450	3.67	15 540	3.82	19 120	3.91
	40	2 090	2.31	3 090	2.72	4 340	3.11	5 870	3.47	7 720	3.81	9 910	4.10	12 500	4.36	15 500	4.57
	50	1 380	2.23	2 170	2.74	3 140	3.23	4 340	3.70	5 790	4.14	7 540	4.56	9 620	4.94	12 070	5.28
	60	-	-	-	-	2 070	3.24	2 940	3.84	4 010	4.41	5 320	4.97	6 900	5.49	8 790	5.98
3600 rpm	20	7 670	4.52	10 390	5.12	13 830	5.66	18 060	6.16	23 160	6.61	29 220	7.03	-	-	-	-
	30	6 220	4.73	8 660	5.49	11 700	6.16	15 400	6.77	19 870	7.32	25 170	7.82	31 380	8.28	38 600	8.71
	40	4 700	4.78	6 840	5.74	9 450	6.61	12 620	7.39	16 430	8.08	20 960	8.71	26 280	9.28	32 490	9.80
	50	3 110	4.54	4 930	5.76	7 100	6.87	9 720	7.87	12 860	8.77	16 600	9.58	21 020	10.31	26 200	10.98
	60	-	-	-	-	4 660	6.81	6 710	8.08	9 160	9.24	12 090	10.29	15 590	11.24	19 740	12.10
Max rpm	20	11 310	7.31	15 890	8.35	21 460	9.26	28 030	10.05	35 630	10.73	44 290	11.32	-	-	-	-
	30	8 920	7.54	12 990	8.95	17 920	10.20	23 720	11.32	30 410	12.32	38 030	13.21	46 580	14.03	56 090	14.77
	40	6 400	7.24	9 960	9.03	14 240	10.66	19 260	12.14	25 040	13.50	31 610	14.73	38 980	15.87	47 190	16.93
	50	3 750	6.29	6 790	8.51	10 420	10.55	14 660	12.43	19 520	14.17	25 040	15.78	31 230	17.28	38 110	18.69
	60	-	-	-	-	6 470	9.78	9 910	12.09	13 850	14.25	18 310	16.27	23 310	18.16	28 870	19.95
VTZ215																	
Min rpm	20	4 790	3.00	6 690	3.31	9 050	3.58	11 940	3.79	15 400	3.95	19 490	4.04	-	-	-	-
	30	3 700	3.18	5 330	3.60	7 350	3.97	9 820	4.30	12 800	4.57	16 320	4.79	20 450	4.94	25 240	5.02
	40	2 690	3.24	4 070	3.78	5 760	4.28	7 820	4.74	10 310	5.15	13 270	5.51	16 750	5.80	20 820	6.03
	50	1 750	3.15	2 880	3.83	4 250	4.48	5 910	5.08	7 910	5.65	10 320	6.16	13 170	6.62	16 530	7.02
	60	-	-	-	-	2 800	4.52	4 060	5.30	5 600	6.03	7 450	6.72	9 670	7.36	12 330	7.95
3600 rpm	20	9 250	5.45	12 750	6.26	17 190	7.01	22 690	7.68	29 370	8.27	37 360	8.76	-	-	-	-
	30	7 600	5.86	10 700	6.85	14 570	7.79	19 340	8.68	25 130	9.49	32 060	10.23	40 260	10.86	49 840	11.38
	40	5 910	6.12	8 600	7.28	11 900	8.41	15 940	9.49	20 840	10.53	26 720	11.49	33 700	12.38	41 900	13.16
	50	4 130	6.24	6 420	7.55	9 160	8.85	12 470	10.13	16 470	11.37	21 290	12.56	27 050	13.68	33 880	14.72
	60	-	-	-	-	6 270	9.13	8 850	10.58	11 970	12.02	15 740	13.41	20 280	14.76	25 730	16.04
Max rpm	20	15 190	9.71	20 520	11.10	27 020	12.40	34 830	13.62	44 110	14.73	54 990	15.73	-	-	-	-
	30	12 240	9.94	17 180	11.64	23 160	13.30	30 300	14.90	38 760	16.44	48 670	17.91	60 180	19.30	73 430	20.59
	40	9 030	9.79	13 430	11.78	18 700	13.76	25 000	15.73	32 450	17.67	41 210	19.58	51 430	21.44	63 230	23.24
	50	5 820	9.21	9 480	11.45	13 880	13.73	19 140	16.03	25 420	18.35	32 860	20.66	41 600	22.97	51 780	25.26
	60	-	-	-	-	8 910	13.17	12 970	15.77	17 900	18.43	23 830	21.13	30 910	23.85	39 290	26.60
VTZ242																	
Min rpm	20	5 250	3.37	7 200	3.70	9 630	4.00	12 580	4.26	16 110	4.47	20 280	4.65	-	-	-	-
	30	4 150	3.46	5 860	3.87	7 970	4.25	10 540	4.60	13 610	4.90	17 250	5.17	21 500	5.38	26 410	5.54
	40	3 100	3.56	4 540	4.08	6 320	4.57	8 480	5.04	11 070	5.46	14 150	5.85	17 780	6.19	21 990	6.48
	50	2 100	3.55	3 270	4.21	4 690	4.85	6 420	5.46	8 510	6.04	11 020	6.58	14 000	7.09	17 500	7.54
	60	-	-	-	-	3 100	4.97	4 380	5.76	5 950	6.53	7 870	7.26	10 180	7.95	12 940	8.60
3600 rpm	20	10 980	6.66	14 990	7.50	20 020	8.29	26 200	9.00	33 630	9.61	42 440	10.09	-	-	-	-
	30	8 980	7.06	12 500	8.07	16 880	9.06	22 220	10.00	28 650	10.88	36 290	11.67	45 260	12.35	55 670	12.89
	40	7 020	7.35	10 040	8.50	13 750	9.67	18 250	10.82	23 680	11.95	30 140	13.02	37 770	14.01	46 670	14.90
	50	5 040	7.52	7 550	8.79	10 580	10.11	14 240	11.46	18 650	12.80	23 940	14.13	30 210	15.41	37 590	16.63
	60	-	-	-	-	7 330	10.40	10 140	11.91	13 530	13.45	17 620	15.01	22 540	16.56	28 390	18.08
Max rpm	20	14 950	9.71	20 550	11.09	27 650	12.42	36 470	13.62	47 190	14.64	60 020	15.42	-	-	-	-
	30	11 840	10.05	16 580	11.66	22 560	13.32	30 000	14.95	39 080	16.49	50 010	17.88	62 990	19.06	78 210	19.97
	40	9 100	10.23	13 060	11.98	18 020	13.87	24 160	15.83	31 690	17.79	40 800	19.70	51 700	21.50	64 590	23.12
	50	6 520	10.36	9 790	12.17	13 800	14.19	18 730	16.39	24 790	18.68	32 170	21.02	41 090	23.33	51 730	25.56
	60	-	-	-	-	9 700	14.41	13 510	16.74	18 180	19.27	23 920	21.93	30 930	24.67	39 410	27.42

To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W
Pe: Power input in kW

Superheat = 10 K
Subcooling = 0 K

Min rpm: Minimum rotation speed
3600 rpm: Rotation speed 3600 rpm
Max rpm: Maximum rotation speed

COMPRESSOR AND FREQUENCY CONVERTER SELECTION

Performance data

R407C

	To	-17.5		-15		-10		-5		0		5		10		15	
	Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VTZ038																	
Min rpm	20	1 780	0.66	2 030	0.68	2 610	0.71	3 310	0.72	4 140	0.72	-	-	-	-	-	-
	30	1 460	0.73	1 690	0.77	2 200	0.84	2 820	0.89	3 560	0.91	4 420	0.93	5 430	0.93	-	-
	40	1 150	0.76	1 340	0.82	1 790	0.93	2 330	1.01	2 980	1.08	3 730	1.13	4 620	1.17	5 640	1.20
	50	-	-	-	-	1 390	0.98	1 860	1.11	2 400	1.22	3 050	1.32	3 810	1.40	4 700	1.47
	60	-	-	-	-	-	-	1 390	1.18	1 840	1.34	2 390	1.48	3 030	1.61	3 780	1.73
3600 rpm	20	2 750	1.07	3 170	1.11	4 170	1.19	5 400	1.25	6 900	1.30	-	-	-	-	-	-
	30	2 330	1.17	2 700	1.24	3 580	1.35	4 650	1.45	5 960	1.53	7 530	1.59	9 390	1.63	-	-
	40	1 910	1.25	2 240	1.33	3 010	1.49	3 940	1.63	5 070	1.75	6 430	1.86	8 040	1.94	9 930	2.00
	50	-	-	-	-	2 440	1.60	3 250	1.79	4 220	1.96	5 370	2.11	6 740	2.25	8 370	2.36
	60	-	-	-	-	-	-	2 550	1.91	3 370	2.14	4 330	2.35	5 490	2.54	6 860	2.71
Max rpm	20	4 050	1.68	4 620	1.79	5 970	2.00	7 650	2.19	9 720	2.35	-	-	-	-	-	-
	30	3 440	1.82	3 970	1.96	5 200	2.22	6 720	2.47	8 580	2.70	10 850	2.90	13 580	3.08	-	-
	40	2 780	1.91	3 260	2.06	4 360	2.37	5 700	2.68	7 350	2.98	9 360	3.26	11 790	3.51	14 700	3.73
	50	-	-	-	-	3 480	2.49	4 650	2.85	6 070	3.21	7 810	3.55	9 930	3.88	12 480	4.18
	60	-	-	-	-	-	-	3 580	2.98	4 760	3.40	6 230	3.81	8 020	4.21	10 210	4.59
VTZ054																	
Min rpm	20	2 350	0.87	2 680	0.90	3 460	0.94	4 400	0.97	5 530	0.99	-	-	-	-	-	-
	30	1 980	0.99	2 280	1.03	2 970	1.11	3 820	1.17	4 840	1.21	6 040	1.24	7 460	1.26	-	-
	40	1 590	1.06	1 850	1.13	2 460	1.26	3 190	1.36	4 080	1.44	5 150	1.51	6 400	1.56	7 870	1.60
	50	-	-	-	-	1 930	1.37	2 550	1.53	3 300	1.67	4 210	1.78	5 300	1.88	6 580	1.96
	60	-	-	-	-	-	-	1 910	1.65	2 520	1.86	3 270	2.04	4 170	2.20	5 250	2.33
3600 rpm	20	4 080	1.59	4 690	1.66	6 120	1.79	7 840	1.90	9 900	1.99	-	-	-	-	-	-
	30	3 420	1.73	3 960	1.82	5 240	2.00	6 800	2.16	8 680	2.32	10 890	2.45	13 480	2.58	-	-
	40	2 810	1.85	3 270	1.96	4 370	2.19	5 740	2.41	7 400	2.62	9 380	2.83	11 720	3.02	14 440	3.20
	50	-	-	-	-	3 560	2.33	4 700	2.62	6 120	2.89	7 840	3.16	9 900	3.43	12 330	3.68
	60	-	-	-	-	-	-	3 740	2.76	4 880	3.10	6 320	3.45	8 070	3.79	10 170	4.13
Max rpm	20	5 770	2.54	6 620	2.70	8 650	3.01	11 180	3.28	14 300	3.51	-	-	-	-	-	-
	30	4 910	2.72	5 670	2.92	7 460	3.32	9 680	3.70	12 420	4.05	15 750	4.37	19 760	4.63	-	-
	40	4 080	2.81	4 740	3.05	6 290	3.53	8 220	4.01	10 590	4.48	13 490	4.93	17 000	5.33	21 180	5.69
	50	-	-	-	-	5 160	3.63	6 800	4.20	8 810	4.78	11 290	5.35	14 300	5.89	17 920	6.41
	60	-	-	-	-	-	-	5 410	4.26	7 080	4.93	9 140	5.62	11 670	6.29	14 740	6.96
VTZ086																	
Min rpm	20	3 140	1.10	3 680	1.14	4 970	1.19	6 550	1.22	8 450	1.24	-	-	-	-	-	-
	30	2 410	1.28	2 860	1.34	3 900	1.45	5 180	1.53	6 720	1.58	8 560	1.62	10 730	1.65	-	-
	40	1 800	1.36	2 180	1.47	3 050	1.66	4 100	1.81	5 350	1.93	6 850	2.02	8 610	2.09	10 670	2.14
	50	-	-	-	-	2 320	1.78	3 200	2.03	4 240	2.23	5 450	2.40	6 880	2.53	8 550	2.63
	60	-	-	-	-	-	-	2 390	2.13	3 270	2.45	4 280	2.71	5 440	2.93	6 790	3.12
3600 rpm	20	5 300	2.51	6 290	2.61	8 630	2.76	11 470	2.88	14 850	2.96	-	-	-	-	-	-
	30	4 570	2.72	5 470	2.86	7 560	3.10	10 070	3.28	13 040	3.42	16 520	3.53	20 550	3.62	-	-
	40	3 750	2.83	4 570	3.04	6 440	3.40	8 640	3.69	11 220	3.92	14 220	4.10	17 690	4.25	21 670	4.38
	50	-	-	-	-	5 220	3.61	7 140	4.04	9 350	4.40	11 900	4.69	14 830	4.94	18 190	5.16
	60	-	-	-	-	-	-	5 520	4.27	7 390	4.80	9 510	5.24	11 930	5.63	14 690	5.96
Max rpm	20	8 900	3.71	10 190	3.86	13 360	4.11	17 450	4.31	22 630	4.44	-	-	-	-	-	-
	30	7 760	4.13	8 850	4.33	11 490	4.69	14 870	5.02	19 150	5.30	24 510	5.52	31 120	5.65	-	-
	40	6 700	4.48	7 660	4.72	9 910	5.19	12 710	5.65	16 230	6.07	20 650	6.45	26 130	6.76	32 830	7.00
	50	-	-	-	-	8 430	5.62	10 790	6.19	13 690	6.75	17 300	7.28	21 790	7.77	27 320	8.21
	60	-	-	-	-	-	-	8 910	6.66	11 330	7.35	14 270	8.03	17 900	8.69	22 400	9.31
VTZ121																	
Min rpm	20	4 520	1.58	5 230	1.66	6 890	1.77	8 890	1.84	11 260	1.85	-	-	-	-	-	-
	30	3 740	1.80	4 370	1.91	5 840	2.10	7 600	2.25	9 710	2.35	12 180	2.40	15 060	2.39	-	-
	40	2 990	1.96	3 550	2.11	4 830	2.39	6 370	2.62	8 200	2.80	10 360	2.94	12 890	3.02	15 820	3.04
	50	-	-	-	-	3 870	2.63	5 180	2.94	6 750	3.21	8 610	3.43	10 780	3.60	13 320	3.71
	60	-	-	-	-	-	-	4 070	3.23	5 370	3.58	6 910	3.89	8 740	4.15	10 890	4.35
3600 rpm	20	9 710	3.77	11 090	3.93	14 290	4.27	18 160	4.60	22 770	4.92	-	-	-	-	-	-
	30	8 140	4.01	9 370	4.21	12 240	4.60	15 720	4.98	19 890	5.34	24 820	5.69	30 590	6.03	-	-
	40	6 670	4.27	7 750	4.52	10 270	5.01	13 350	5.47	17 060	5.93	21 470	6.36	26 670	6.77	32 730	7.16
	50	-	-	-	-	8 420	5.36	11 070	5.97	14 290	6.55	18 170	7.11	22 770	7.64	28 190	8.15
	60	-	-	-	-	-	-	8 900	6.33	11 620	7.09	14 940	7.82	18 940	8.51	23 680	9.18
Max rpm	20	13 480	5.40	15 370	5.71	19 760	6.33	25 030	6.98	31 290	7.64	-	-	-	-	-	-
	30	11 420	5.76	13 130	6.10	17 100	6.81	21 900	7.52	27 610	8.26	34 340	9.02	42 180	9.79	-	-
	40	9 440	6.08	10 940	6.48	14 430	7.28	18 690	8.09	23 800	8.92	29 860	9.77	36 960	10.64	45 210	11.52
	50	-	-	-	-	11 850	7.68	15 500	8.61	19 940	9.56	25 270	10.53	31 570	11.51	38 950	12.51
	60	-	-	-	-	-	-	12 430	9.03	16 140	10.13	20 670	11.23	26 120	12.35	32 570	13.49

COMPRESSOR AND FREQUENCY CONVERTER SELECTION

Performance data

R407C

	To	-17.5		-15		-10		-5		0		5		10		15	
	Tc	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe	Qo	Pe
VTZ171																	
Min rpm	20	5 980	2.20	6 880	2.27	9 030	2.38	11 660	2.45	14 850	2.47	-	-	-	-	-	-
	30	5 120	2.57	5 960	2.68	7 920	2.88	10 330	3.05	13 240	3.17	16 710	3.24	20 810	3.27	-	-
	40	4 150	2.83	4 890	3.00	6 630	3.31	8 760	3.59	11 350	3.84	14 460	4.03	18 140	4.19	22 460	4.28
	50	-	-	-	-	5 250	3.64	7 060	4.05	9 280	4.44	11 970	4.78	15 180	5.08	18 990	5.33
	60	-	-	-	-	-	-	5 310	4.38	7 120	4.93	9 340	5.44	12 040	5.92	15 290	6.34
3600 rpm	20	13 400	4.86	15 260	5.05	19 570	5.33	24 760	5.49	30 920	5.50	-	-	-	-	-	-
	30	11 210	5.37	12 930	5.67	16 910	6.18	21 710	6.59	27 450	6.88	34 220	7.02	42 140	7.00	-	-
	40	9 010	5.66	10 540	6.06	14 110	6.82	18 450	7.49	23 670	8.06	29 890	8.50	37 190	8.80	45 700	8.93
	50	-	-	-	-	11 300	7.25	15 090	8.19	19 720	9.04	25 290	9.80	31 900	10.42	39 670	10.91
	60	-	-	-	-	-	-	11 760	8.69	15 710	9.84	20 550	10.91	26 390	11.88	33 320	12.72
Max rpm	20	18 360	7.46	21 080	7.82	27 350	8.46	34 810	9.00	43 610	9.43	-	-	-	-	-	-
	30	15 930	8.27	18 540	8.77	24 510	9.71	31 580	10.55	39 880	11.31	49 560	11.97	60 730	12.54	-	-
	40	13 130	8.82	15 560	9.47	21 090	10.71	27 620	11.87	35 290	12.95	44 230	13.96	54 570	14.89	66 440	15.73
	50	-	-	-	-	17 260	11.40	23 120	12.88	30 010	14.31	38 080	15.66	47 450	16.95	58 250	18.18
	60	-	-	-	-	-	-	18 270	13.52	24 250	15.29	31 300	17.01	39 550	18.67	49 150	20.29
VTZ215																	
Min rpm	20	8 120	2.86	9 230	2.96	11 840	3.13	15 050	3.26	18 950	3.37	-	-	-	-	-	-
	30	7 050	3.33	8 080	3.48	10 490	3.75	13 430	3.98	16 980	4.16	21 240	4.31	26 290	4.42	-	-
	40	5 820	3.70	6 760	3.93	8 930	4.34	11 550	4.70	14 730	5.00	18 540	5.26	23 070	5.47	28 430	5.64
	50	-	-	-	-	7 240	4.82	9 510	5.35	12 270	5.82	15 590	6.22	19 570	6.58	24 300	6.88
	60	-	-	-	-	-	-	7 390	5.87	9 680	6.54	12 480	7.14	15 870	7.68	19 930	8.15
3600 rpm	20	18 340	6.40	20 730	6.67	26 240	7.17	32 810	7.63	40 570	8.03	-	-	-	-	-	-
	30	15 560	7.08	17 770	7.45	22 830	8.14	28 860	8.79	35 990	9.38	44 350	9.92	54 070	10.39	-	-
	40	12 770	7.55	14 760	8.04	19 310	8.97	24 750	9.85	31 200	10.68	38 800	11.45	47 660	12.16	57 920	12.81
	50	-	-	-	-	15 780	9.62	20 570	10.78	26 290	11.88	33 060	12.93	41 010	13.92	50 280	14.85
	60	-	-	-	-	-	-	16 390	11.54	21 320	12.96	27 220	14.33	34 210	15.64	42 420	16.89
Max rpm	20	24 800	10.30	28 360	10.93	36 500	12.14	46 160	13.25	57 500	14.22	-	-	-	-	-	-
	30	21 240	10.93	24 570	11.71	32 150	13.25	41 100	14.75	51 600	16.17	63 790	17.48	77 850	18.63	-	-
	40	17 530	11.38	20 580	12.27	27 520	14.11	35 690	15.96	45 260	17.81	56 390	19.60	69 250	21.30	84 000	22.87
	50	-	-	-	-	22 680	14.80	29 990	16.98	38 570	19.20	48 570	21.43	60 150	23.64	73 480	25.78
	60	-	-	-	-	-	-	24 100	17.85	31 600	20.42	40 380	23.06	50 610	25.73	62 450	28.40
VTZ242																	
Min rpm	20	8 590	3.14	10 010	3.26	13 380	3.44	17 490	3.57	22 450	3.63	-	-	-	-	-	-
	30	7 210	3.56	8 460	3.73	11 400	4.05	15 000	4.30	19 350	4.50	24 520	4.64	30 580	4.71	-	-
	40	5 950	3.89	7 030	4.14	9 570	4.59	12 670	5.00	16 420	5.35	20 900	5.65	26 180	5.89	32 360	6.06
	50	-	-	-	-	7 870	5.08	10 480	5.65	13 640	6.18	17 440	6.65	21 960	7.07	27 270	7.43
	60	-	-	-	-	-	-	8 430	6.25	11 020	6.97	14 150	7.64	17 900	8.26	22 360	8.82
3600 rpm	20	17 320	6.76	20 010	7.07	26 450	7.66	34 490	8.20	44 370	8.69	-	-	-	-	-	-
	30	15 210	7.55	17 570	7.95	23 130	8.72	29 980	9.45	38 340	10.14	48 450	10.77	60 520	11.35	-	-
	40	13 070	8.26	15 250	8.77	20 220	9.75	26 170	10.70	33 330	11.61	41 910	12.48	52 140	13.29	64 250	14.06
	50	-	-	-	-	17 150	10.69	22 500	11.89	28 740	13.06	36 090	14.18	44 780	15.27	55 030	16.31
	60	-	-	-	-	-	-	18 380	12.96	24 000	14.41	30 420	15.84	37 860	17.22	46 550	18.56
Max rpm	20	25 910	10.61	29 800	11.26	38 790	12.50	49 510	13.63	62 150	14.62	-	-	-	-	-	-
	30	22 110	11.23	25 670	12.03	33 820	13.59	43 490	15.09	54 870	16.48	68 110	17.75	83 420	18.86	-	-
	40	18 310	11.71	21 550	12.65	28 870	14.52	37 510	16.37	47 620	18.15	59 390	19.84	72 980	21.41	88 590	22.84
	50	-	-	-	-	23 900	15.24	31 510	17.41	40 370	19.57	50 660	21.67	62 570	23.70	76 270	25.61
	60	-	-	-	-	-	-	25 460	18.18	33 080	20.70	41 910	23.20	52 140	25.66	63 940	28.05

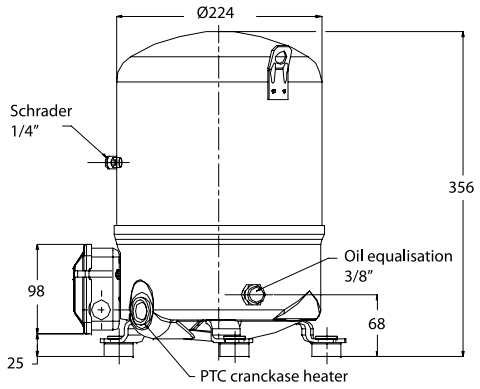
To: Evaporating temperature in °C
Tc: Condensing temperature in °C
Qo: Cooling capacity in W
Pe: Power input in kW

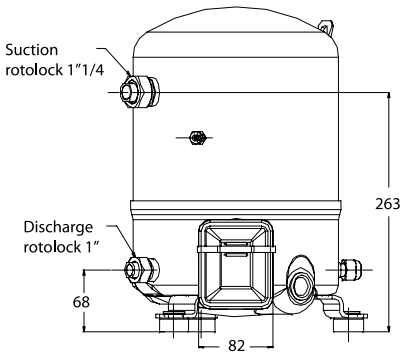
Superheat = 10 K
Subcooling = 0 K

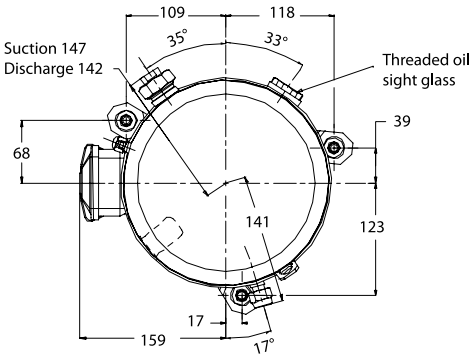
Min rpm: Minimum rotation speed
3600 rpm: Rotation speed 3600 rpm
Max rpm: Maximum rotation speed

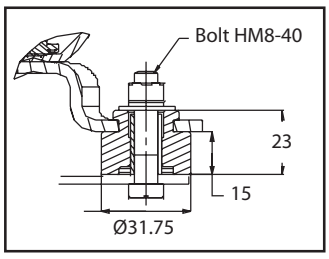
DIMENSIONS

1 cylinder compressors
VTZ038 / VTZ054





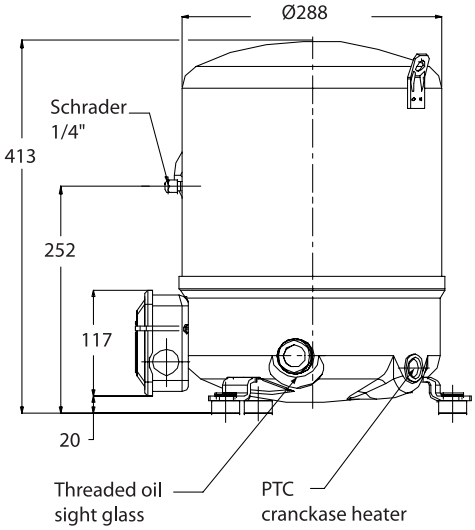


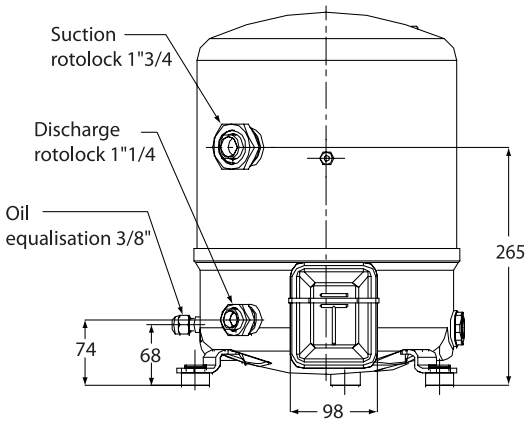


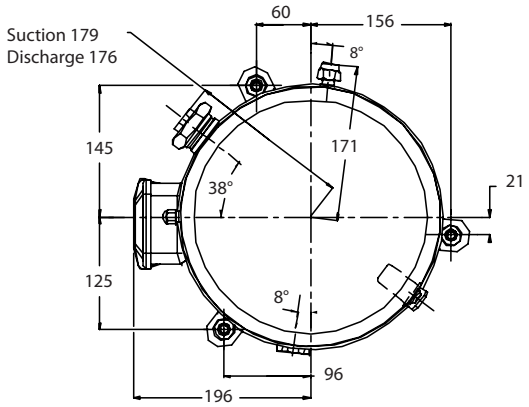
Silent block
Grommet compression not
included around 1 mm

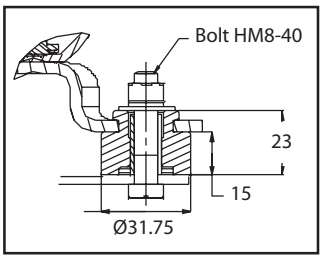
DIMENSIONS

2 cylinder compressors
VTZ086 / VTZ121





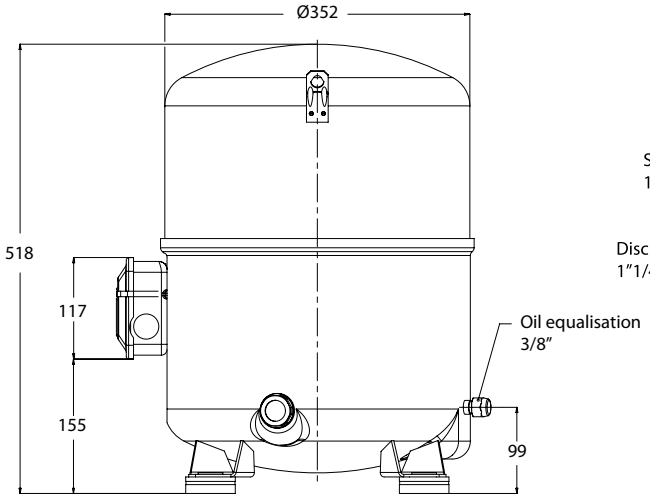


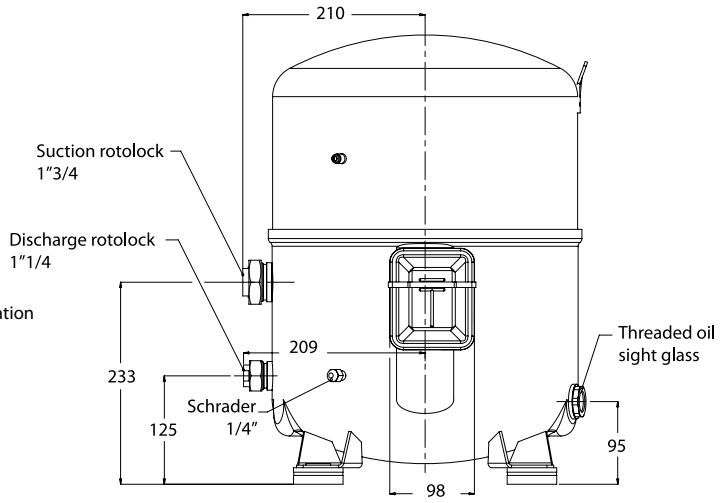


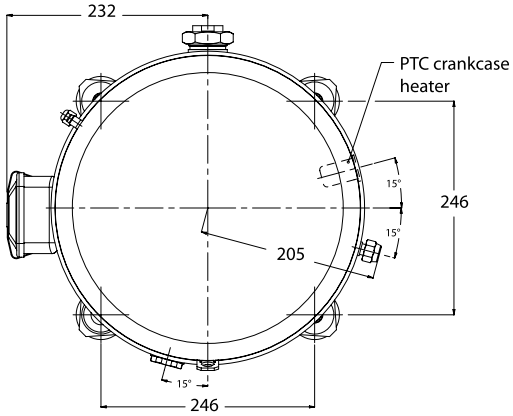
Silent block
Grommet compression not
included around 1 mm

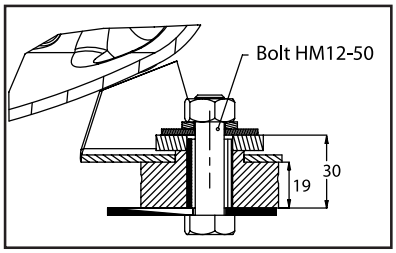
DIMENSIONS

4 cylinder compressors
VTZ171 / VTZ215 / VTZ242





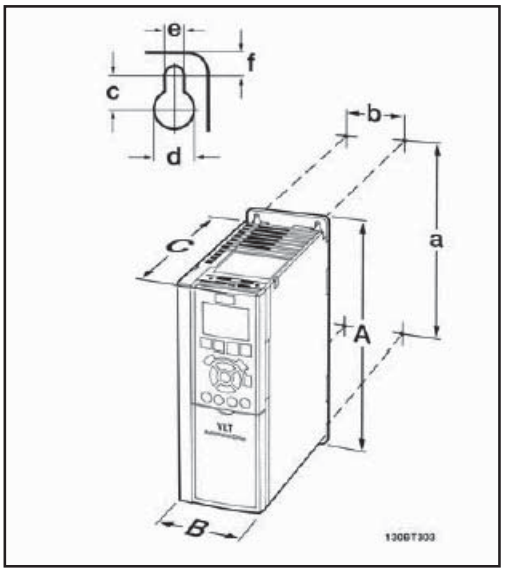




Silent block
Grommet compression not
included around 1 mm

DIMENSIONS

Frequency converters



		Frame size A2	Frame size A3	Frame size A5	Frame size B1	Frame size B2
		4.0 kW (380-480 V) 4 kW (525-600 V)	3.0 kW (200-240 V) 5.5 - 7.5 kW (380-480 V) 5.5 - 7.5 kW (525-600 V)	4.0 kW (200-240 V) 4.0 - 7.5 kW (380-480 V)	5.5 - 7.5 kW (200-240 V) 11-15 kW (380-480 V)	11kW (200-240 V) 18.5-22 kW (380-480 V)
		IP20	IP20	IP55	IP21 / IP55	IP21 / IP55
Height						
Height of backplate	A	268mm	268mm	420mm	480mm	650mm
Distance between mounting holes	a	257mm	257mm	402mm	454mm	624mm
Width						
Width of back plate	B	90mm	130mm	242mm	242mm	242mm
Distance between mounting holes	b	70mm	110mm	215mm	210mm	210mm
Depth						
Depth without option A/B	C	205mm	205mm	195mm	260mm	260mm
With option A/B	C	220mm	220mm	195mm	260mm	260mm
Screw holes						
	c	8.0mm	8.0mm	8.25mm	12mm	12mm
	d	ø11 mm	ø11 mm	ø12 mm	ø19 mm	ø19 mm
	e	ø5.5 mm	ø5.5 mm	ø6.5 mm	ø9 mm	ø9 mm
	f	9mm	9mm	9mm	9mm	9mm
Max weight		4.9 kg	6.6 kg	13.5 kg	23 kg	27 kg

This chapter summarizes the most essential points for VTZ and CD302 electrical installation. An exhaustive description can be found in literature 85.10.233 (instructions for installation).

VTZ Electrical specifications

	Compressor	RW (Ohm)	RT (Ohm)	RLA (A)	MMT (A)	LRA (A)
200-240 V	VTZ038-J	0.31	0.65	13.5	17	69
	VTZ054-J	0.215	0.44	20	25	93
	VTZ086-J	0.158	0.317	32.5	40.6	88
	VTZ121-J	0.095	0.156	50	64.4	160
380-480 Volt	VTZ038-G	1.684	3.37	7.35	9.2	30.5
	VTZ054-G	1.039	2.08	12	15	47
	VTZ086-G	0.685	1.37	16	20	74
	VTZ121-G	0.294	0.59	23.2	29	139
	VTZ171-G	0.337	0.67	30.5	38.1	130
	VTZ215-G	0.236	0.47	40.8	51	197
	VTZ242-G	0.186	0.37	42.5	53.1	218
525-600 Volt	VTZ038-H	3.162	6.32			24
	VTZ054-H	2.335	4.67			35
	VTZ086-H	0.806	1.61			79
	VTZ121-H	0.653	1.31			91
	VTZ171-H	0.623	1.25			102
	VTZ215-H	0.409	0.82			143
	VTZ242-H	0.362	0.72			165

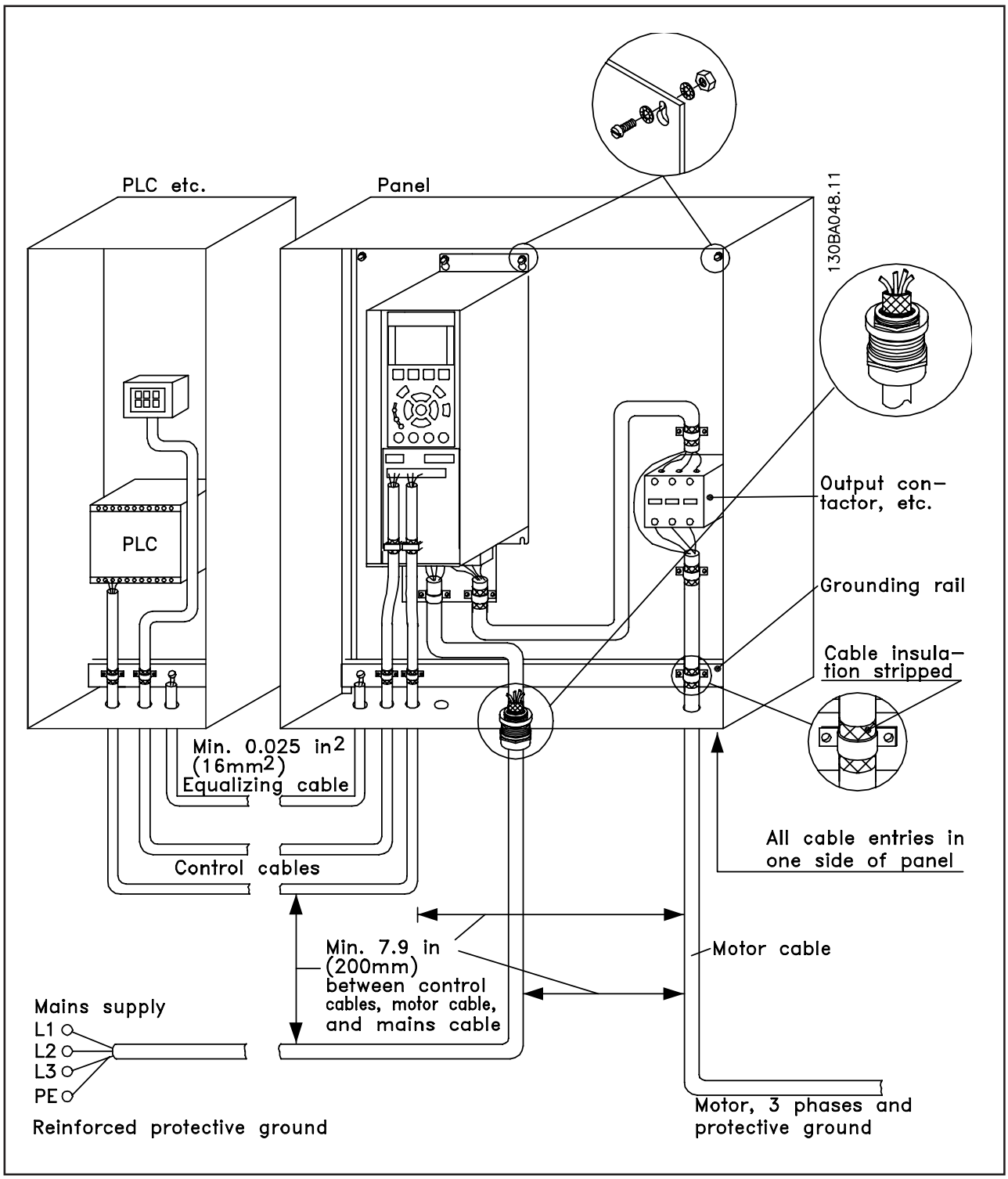
RW: Winding resistance per winding (in CD302 parameter list)
RT: Winding resistance as measured at motor terminals
RLA: Rated load current with R404A @ +5/+60°C
MMT: Maximum must trip current
LRA: Locked rotor current
Note that parameter 1-30 in the frequency converter settings reflects the winding resistance per winding. This is not the same value as measured at the motor terminals.

Wiring & EMC protection

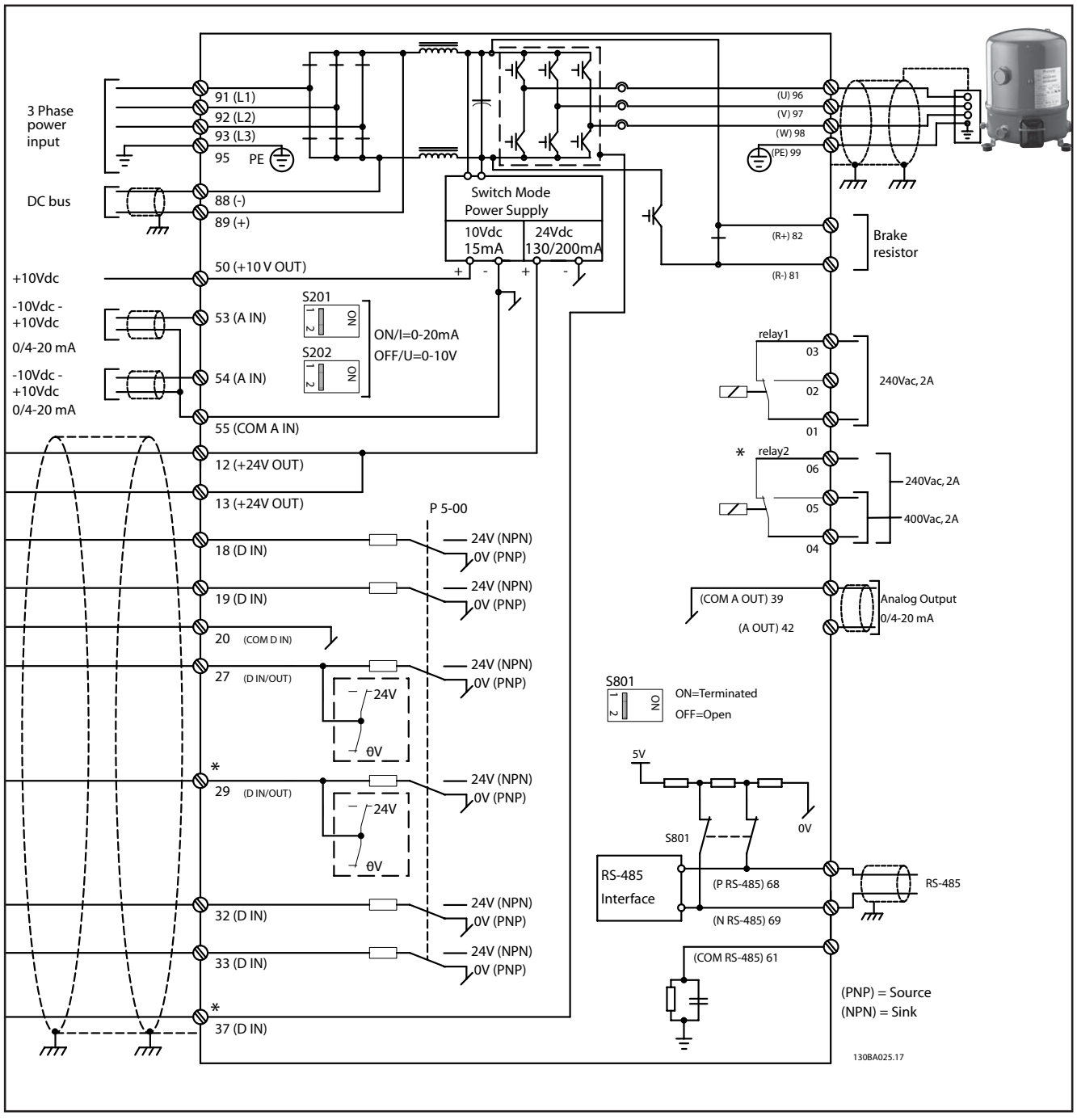
The motor compressor power supply (from the CD302 frequency converter to the VTZ compressor) must be done with a braided screened/armored cable. This cable needs to have its screen/armor conduit connected to earth on both ends. Avoid terminating this cable connection with twisting ends (pigtails) because that would result in an antenna phenomena and decreases the effectiveness of the cable.
Control cables to the CD302 frequency converter must use the same installation principles as the power supply cable.
The motor compressor cable must be installed in a conduit separate from the control and mains cables.
Physical installation of the frequency converter on the mounting plate must ensure good electrical contact between the mounting plate and the metal chassis of the converter. Use star-washers and galvanically conductive installation plates to secure good electrical connections. Refer to instructions 85.10.233 for tightening torques and screw sizes.
Below table lists recommended wiring sizes for the motor compressor power supply cables. These wiring sizes are valid for a cable length up to 20 m.

	Compressor	Recommended wiring size	
		mm^2	AWG
200-240 V	VTZ038-J	4	12
	VTZ054-J	4	12
	VTZ086-J	6	10
	VTZ121-J	10	8
380-480 Volt	VTZ038-G	2.5	14
	VTZ054-G	2.5	14
	VTZ086-G	4	12
	VTZ121-G	6	10
	VTZ171-G	10	8
	VTZ215-G	10	8
	VTZ242-G	10	8
525-600 Volt	VTZ038-H	1.5	16
	VTZ054-H	1.5	16
	VTZ086-H	2.5	14
	VTZ121-H	4	12
	VTZ171-H	6	10
	VTZ215-H	10	8
	VTZ242-H	10	8

Recommended wiring size



Wiring diagram



Fuses

The main power supply to the frequency converter must be done through a circuit breaker or a set of fuses, type gG. For motor code J (200-240 V) also gR type fuses may be applied.

Frequency converter		EN50178 compliant fuses		UL Compliant fuses						
				Bussmann			SIBA	Little fuse	Ferraz-Shawmut	
		Size	Type	Type RK1	Type J	Type T	Type RK1	Type RK1	Type CC	Type RK1
200-240 V	CD-302 3K7	32 A	gG / gR	KTN-R30	JKS-30	JJN-30	5012406-32	KLN-R30	ATM-R30	A2K-30R
	CD-302 5K5	tbd	gG / gR	KTN-R50	JKS-50	JJN-50	5012406-50	KLN-R50	ATM-R50	A2K-50R
	CD-302 7K5	tbd	gG / gR	KTN-R60	JKS-60	JJN-60	5012406-63	KLN-R60	ATM-R60	A2K-60R
	CD-302 11K	tbd	gG / gR	KTN-R80	JKS-80	JJN-80	5014006-80	KLN-R80		A2K-80R
380-480 Volt	CD-302 3K0	20 A	gG							
	CD-302 4K0	20 A	gG	KTS-R20	JKS-20	JJS-20	5017906-020	KLS-R20	ATM-R20	A6K-20R
	CD-302 5K5	32 A	gG	KTS-R30	JKS-30	JJS-30	5012406-32	KLS-R30	ATM-R30	A6K-30R
	CD-302 7K5	32 A	gG	KTS-R30	JKS-30	JJS-30	5012406-32	KLS-R30	ATM-R30	A6K-30R
	CD-302 11K	63 A	gG	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40		A6K-40R
	CD-302 15K	63 A	gG	KTS-R50	JKS-50	JJS-50	5014006-50	KLS-R50		A6K-50R
	CD-302 18K	63 A	gG	KTS-R60	JKS-60	JJS-60	5014006-63	KLS-R60		A6K-60R
	CD-302 22K	63 A	gG	KTS-R80	JKS-80	JJS-80	5014006-100	KLS-R80		A6K-80R
525-600 Volt	CD-302 4K	Not applicable (Must always be UL compliant)								
	CD-302 5K									
	CD-302 7K									
	CD-302 11K									
	CD-302 15K									
	CD-302 18K									
	CD-302 22K									

Piping design

Oil in a refrigeration circuit is required to lubricate moving parts in the compressor. During normal system operation small oil quantities will continuously leave the compressor, with the discharge gas. With good system piping design this oil will return to the compressor. As long as the amount of oil circulating through the system is small it will contribute to good system operation and improved heat transfer efficiency. However, too large amounts of oil in the system will have a negative effect on condenser and evaporator efficiency. If, in a poorly designed system, the amount of oil returning to the compressor is lower than the amount of oil leaving the compressor, the compressor will become starved of oil and the condenser, evaporator and/or refrigerant lines will become filled with oil. In such situations, additional oil charge will only correct the compressor oil level for a limited period of time and increase the amount of surplus oil in the rest of the system.

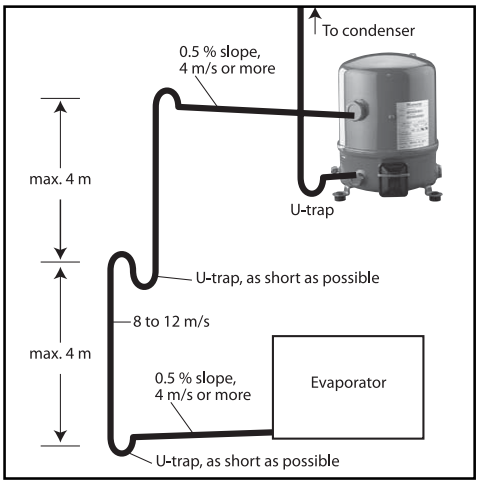
Only correct piping design and oil system management including oil separator, oil reservoir and oil level regulator can ensure a good oil balance in the system.

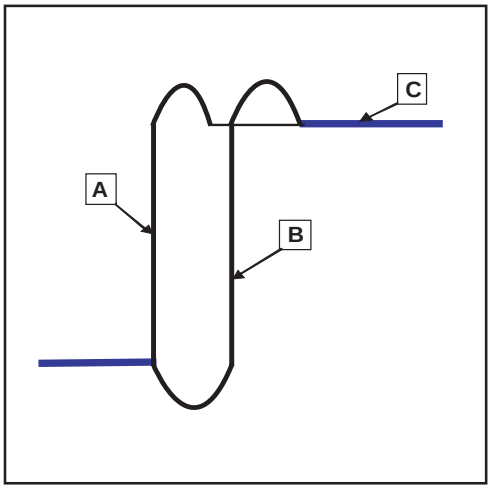
Suction lines

Horizontal suction line sections shall have a slope of 0.5% in the direction of refrigerant flow (5 mm per meter). The cross-section of horizontal suction lines shall be such that the resulting gas velocity is at least 4 m/s. In vertical risers, a gas velocity of 8 to 12 m/s is required to ensure proper oil turn. A U-trap is required at the foot of each vertical riser. If the riser is higher than 4 m, additional U-traps are needed for each additional 4 meters. The length of each U-trap must be as short as possible to avoid the accumulation of excessive quantities of oil (see figure below).

For compressors mounted in parallel, the common suction riser should be designed as a double riser. Also refer to the News bulletin "Mounting instructions for installation of Maneurop® compressors in parallel" and "Parallel application guidelines".

Gas velocities higher than 12 m/s will not contribute to significantly better oil return. However they will cause higher noise levels and result in higher suction line pressure drops which will have a negative effect on the system capacity.





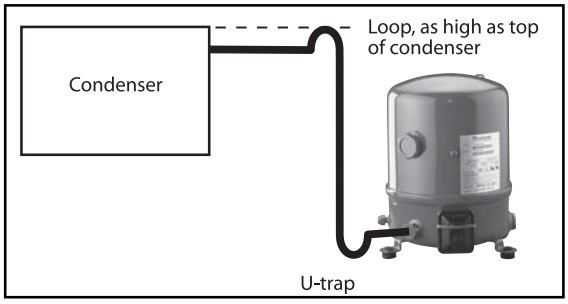
Suction pipe selection		VTZ038	VTZ054	VTZ086	VTZ121	VTZ171	VTZ215	VTZ242
VTZ R404A (-10/+45°C)	Mini riser (A)	1/2″	1/2″	5/8″	3/4″	7/8″	1″1/8	1″1/8
	Max riser (B)	5/8″	3/4″	7/8″	1″1/8	1″3/8	1″3/8	1″3/8
	Suct. header (C)	3/4″	7/8″	1″1/8	1″3/8	1″5/8	1″5/8	1″5/8

Note that the suction rotolock valves, which can be ordered from Danfoss as accessories, are designed for average pipe sizes, selected for systems running at nominal conditions. The pipe sizes selected for specific systems may differ from these recommended sizes.

It is recommended that the suction gas lines are insulated to limit superheat.

Discharge line

When the condenser is mounted above the compressor, a loop above the condenser and a U-trap close to the compressor are required to prevent liquid draining from the condenser into the discharge line during standstill.



Filter driers

For new installations with VTZ compressors Danfoss recommends using the Danfoss DML 100% molecular sieve, solid core filter drier. Molecular sieve filter driers wit loose beads from third party suppliers shall be avoided. For servicing of existing installations where acid formation is present the Danfoss DCL solid core filter driers containing activated alumina are recommended.

The drier is to be oversized rather than undersized. When selecting a drier, always take into account its capacity (water content capacity), the system refrigerating capacity and the system refrigerant charge.

High pressure

A high pressure safety switch is required to stop the compressor, should the discharge pressure exceed the values shown in the table below. The high pressure switch can be set to lower values depending on the application and ambient conditions. The HP switch must either be in a lockout circuit, or be a manual reset device to prevent compressor cycling around the high pressure limit. When a discharge valve is used, the HP switch must be connected to the service valve gauge port, which cannot be isolated.

Low pressure

A low pressure safety switch is recommended to avoid compressor operation at too lower suction pressures.

	R407C	R134a	R404A / R507A
Test pressure low side bar (g)	25	25	25
Working pressure range high side bar (g)	12.5 – 29.4	7.9 – 22.6	13.2 – 27.7
Working pressure range low side bar (g)	1.4 – 6.6	0.6 – 4.7	1.0 – 7.2

SYSTEM DESIGN RECOMMENDATIONS

Low ambient temperature operation

At low ambient temperatures, the condensing temperature and condensing pressure in air cooled condensers will decrease.
This low pressure may be insufficient to supply enough liquid refrigerant to the evaporator. As a result the evaporator temperature will strongly decrease with the risk of frosting. At compressor start-up, the compressor can pull a deep vacuum and it can be switched off by the low pressure protection. Depending on the low pressure switch setting and delay timer short cycling can occur. To avoid these problems, several solutions are possible, based on reducing condenser capacity:
- Indoor location of condensers
- Liquid flooding of condensers (note: this solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is required and special care should be taken when designing the discharge line.)
- Reduce air flow to condensers.

Other problems can also occur when the compressor is operating at low ambient temperature. During shut down periods, liquid refrigerant can migrate to a cold compressor.
For such conditions a belt-type crankcase heater is strongly recommended.
Note that with 100% suction gas cooled motors, Maneurop® compressors can be externally insulated.
Refer to section «Liquid refrigerant migration & charge limits» for more details.

Operating voltage and cycle rate

Operating voltage range

The operating voltage limits are directly managed by the CD302 frequency converter generating a constant U/f ratio equal to the one of the motor design and factory preset in the inverter.

Cycle rate limit

There may be no more than 12 starts per hour. A higher number reduces the service life of the motor-compressor unit. If necessary, use an anti-short-cycle timer in the control circuit.
A time-out of five minutes is recommended. The system must be designed in such a way to guarantee a minimum compressor running time in order to provide proper oil return and sufficient motor cooling after starting.
Note that the oil return rate varies as a function of the system design.
Note: when using "process loop" control with the frequency converter these control operations are factory preset in the CD302 on "Smart Logic Control" section.
Parameter 13.00 has to be set at ON then:
- Compressor Minimum On Time preset at 0 can be adjusted
- Delay between two starts is set at 5 minutes

A pump down function is preset:
Cut-out pressure 3 bar(g)
Cut-in pressure 1 bar(g)

Liquid refrigerant control and charge limits

Refrigeration compressors are basically designed as gas compressors. Depending on the compressor design and operating conditions, most compressors can also handle a limited amount of liquid refrigerant. Maneurop® VTZ compressors have a large internal volume and can therefore handle relatively large amounts of liquid refrigerant without major problems. However even when a compressor can handle liquid refrigerant this will not be favourable to its service life. Liquid refrigerant can dilute the oil, wash oil out of bearings and result in high oil carry over, resulting in loss of oil from the sump. Good system design can limit the amount of liquid refrigerant in the compressor, which will have a positive effect on the compressor service life.
Liquid refrigerant can enter a compressor in different ways, with different effects on the compressor.

Off-cycle migration

During system standstill and after pressure equalisation, refrigerant will condense in the coldest part of the system. The compressor can easily be the coldest spot, for example when it is placed outside in low ambient temperatures. After a while, the full system refrigerant charge can condense in the compressor crankcase. A large amount will dissolve in the compressor oil until the oil is completely saturated with refrigerant. If other system components are located at a higher level, this process can be even faster because gravity will assist the liquid refrigerant to flow back to the compressor. When the compressor is started, the pressure in the crankcase decreases rapidly.
At lower pressures the oil holds less refrigerant, and as a result part of the refrigerant will violently evaporate from the oil, causing the oil to foam.
This process is often called "boiling". The negative effects from migration on the compressor are:

- oil dilution by liquid refrigerant
- oil foam, transported by refrigerant gas and discharged into the system, causing loss of oil and in extreme situations risk for oil slugging
- in extreme situations with high system refrigerant charge, liquid slugging could occur (liquid entering the compressor cylinders)

Liquid floodback during operation

During normal and stable system operation, refrigerant will leave the evaporator in a superheated condition and enter the compressor as a superheated vapour.
Normal superheat values at compressor suction are 5 to 30 K. However the refrigerant leaving the evaporator can contain an amount of liquid refrigerant due to different reasons:

- wrong dimensioning, wrong setting or malfunction of expansion device
- evaporator fan failure or blocked air filters. In these situations, liquid refrigerant will continuously enter the compressor. The negative effects from continuous liquid floodback are:
- permanent oil dilution
- in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could occur.

Liquid floodback at change over cycles in reversible heat pumps

In heat pumps, change over from cooling to heating cycles, defrost and low load short cycles may lead to liquid refrigerant floodback or saturated refrigerant return conditions.
The negative effects are :

- oil dilution
- in extreme situations with high system refrigerant charge and large amounts of floodback, liquid slugging could appear.

Liquid floodback and zeotropic refrigerants

Liquid floodback in systems working with a zeotropic refrigerant such as R407C introduces additional negative effects. A part of the refrigerant leaves the evaporator in liquid phase and this liquid has a different composition than the vapour.
This new refrigerant composition may result in different compressor operating pressures and temperatures.

Crankcase heater

A crankcase heater protects against the off-cycle migration of refrigerant and proves effective if oil temperature is maintained 10 K above the saturated LP temperature of the refrigerant. Tests must thereby be conducted to ensure that the appropriate oil temperature is maintained under all ambient conditions. A PTC crankcase heater is recommended on all stand-alone compressors and split systems. PTC crankcase heaters are self-regulating.
Under extreme conditions such as very low ambient temperature a belt type crankcase heater could be used in addition to the PTC heater, although this

is not a preferred solution for 1 and 2 cylinder compressors. The belt crankcase heater must be positioned on the compressor shell as close as possible to the oil sump to ensure good heat transfer to the oil.
Belt crankcase heaters are not self-regulating. Control must be applied to energise the belt heater once the compressor has been stopped and then to de-energise it while the compressor is running. The belt heater must be energised 12 hours before restarting the compressor following an extended down period. If the crankcase heater is not able to maintain the oil temperature at 10 K above the saturated LP temperature of the refrigerant during off cycles or if repetitive floodback is present at the Liquid Line Solenoid Valve (LLSV), then pump-down cycle is required, eventually in conjunction with a suction accumulation

Liquid line solenoid valve & pump-down

In refrigeration applications, the Liquid Line Solenoid Valve (LLSV) is highly recommended. During the off-cycle, the LLSV isolates the liquid charge in the condenser side, thus preventing against refrigerant transfer or excessive migration of refrigerant into the compressor. Furthermore, when using a LLSV in conjunction with a pump-down cycle, the quantity of refrigerant in the low-pressure side of the system will be reduced..
A pump-down cycle design is required when evaporators are fitted with electric defrost heaters.

Suction accumulator

A suction accumulator offers considerable protection against refrigerant floodback at start-up, during operation or after the defrost operation. This device also helps to protect against off-cycle migration by means of providing additional internal free volume to the low pressure side of the system. The suction accumulator must be selected in accordance with the accumulator manufacturer recommendations. As a general rule, Danfoss recommends to size the accumulator for at least 50% of the total system charge. Tests however must be conducted to determine the optimal size.
A suction accumulator shall not be used in sytems with zeotropic refrigerant mixtures if the suction superheat cannot be safelymanaged.

Vibration

The mounting grommets delivered with the compressor should always be used. They reduce the vibration transmitted by the compressor mounting feet to the base frame.
The base on which the compressor is mounted should be sufficiently rigid and of adequate mass to ensure the full effectiveness of the mounting grommets.
The compressor should never be directly mounted to the base frame without the grommets, otherwise high vibration transmission would occur and the compressor service life reduced. Suction and discharge lines must have adequate flexibility in 3 planes. Eventually vibration absorbers may be required.
Care must be taken to avoid tubing having resonant frequencies close to those of the compressor frequency.
Vibration is also transmitted by the refrigerant gas. Maneurop®, compressors have built in mufflers to reduce this vibration.
To further reduce vibration an extra muffler can be installed.
Note: Maneurop® VTZ compressors have been designed and qualified for stationary equipment used in A/C and Refrigeration applications. Danfoss doesn't warrant these compressors for use in mobile applications, such as trucks, railways, subways, etc...

System cleanliness

System contamination is one of the main factors affecting equipment reliability and compressor service life.

Therefore it is important to ensure system cleanliness when manufacturing a refrigeration sytem. During the manufacturing process, system contamination can be caused by:

- Brazing and welding oxides
- Filings and particles from removing burrs from pipe-work
- Brazing flux
- Moisture and air.

Only use clean and dehydrated refrigeration grade copper tubes and silver alloy brazing material. Clean all parts before brazing and always purge nitrogen or CO_2 through the pipes during brazing to prevent oxidation. If flux is used, take every precaution to prevent leakage into the piping. Do not drill holes (e.g. for Schrader valves) in parts of the installation that are already completed, when filings and burrs can not be removed. Carefully follow the instructions below regarding brazing, mounting, leak detection, pressure test and moisture removal. All installation and service work shall only be done by qualified personnel respecting all procedures and using tools (charging systems, tubes, vacuum pump, etc.) dedicated for the refrigerant that will be used.

Compressor handling

Maneurop® VTZ compressors are provided with a lifting lug. This lug should always be used to lift the compressor. Once the compressor is installed, the compressor lifting lug should never be used to lift the complete installation.

Keep the compressor in an upright position during handling.

Compressor mounting

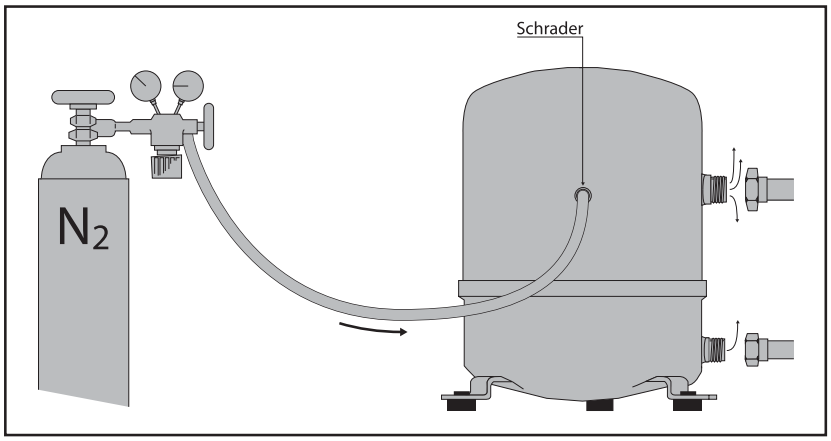
Mount the compressor on a horizontal plane with a maximum slope of 3 degrees. All compressors are supplied with three or four rubber mounting grommets, each complete with metal sleeves and nuts and bolts. Refer to the outline drawings.

These grommets largely attenuate the compressor vibration transmitted to the base frame. The compressor must always be mounted with these grommets. Refer to the table below for torque values.

Connection		Recommended torque (Nm)
Cable screw of T connector in electrical box	Screw 10/32 - UNF x 3	3
Rotolock valves and solder sleeves	1″	80
	1″1/4	90
	1″3/4	110
Mounting grommet	1 – 2 – 4 Cylinder	15
Oil sight glass	-	50
Oil equalisation connection	1 – 2 – 4 Cylinder	30

Compressor connection to system

New compressors have a protective nitrogen holding charge. The suction and discharge caps should only be removed just before connecting the compressor to the installation to avoid air and moisture entering the compressor.
Whenever possible the compressor must be the last component to be integrated in the system. It is advisable to braze the solder sleeves or service valves to the pipe work before the compressor is mounted. When all brazing is finished and when the total system is ready, the compressor caps can be removed and the compressor can be connected to the system with a minimum exposure to ambient air.



If this procedure is not possible, the sleeves or valves may be brazed to the pipes when mounted on the compressor.
In this situation nitrogen or CO_2 must be purged through the compressor via the Schrader valve to prevent air and moisture ingress. Purging must start when the caps are removed and preceded during the brazing process.
When rotolock valves are used on the compressor, they shall be closed immediately after mounting, thus keeping the compressor isolated from atmosphere or from a not yet dehydrated system.
Note : When the compressor is built into a "pack" or "rack" configuration which is not installed immediately on its final location, a vacuum pull-down and moisture removal must be performed to this pack (rack) as if it were a complete system (see below). The pack must be charged with nitrogen or CO_2 and open tubes must be blocked with caps or plugs.

System pressure test

It is recommended that an inert gas such as nitrogen be used for pressure testing. Dry air may also be used but care should be taken since it can form an inflammable mixture with the compressor oil. When performing a system pressure test, the maximum allowed pressure for the different components should not be exceeded.
For VTZ compressors the maximum test pressures are shown in the table below.

Maximum compressor test pressure, low side	25 bar(g)
Maximum compressor test pressure, high side	30 bar(g)

Leak detection

Whenever possible (if valves are present) the compressor must be kept isolated from the system. Perform a leak detection using the final refrigerant. Pressurise with nitrogen or another neutral gas and use a leak detector for the applied refrigerant. Any spectrometric detection system using helium can also be applied.
Eventual leaks shall be repaired respecting the instructions written above. It is not recommended to use other gasses such as oxygen, dry air or acetylene as these gasses can form an inflammable mixture. Never use CFC or HCFC refrigerants for leak detection of HFC systems.
Note 1: Leak detection with refrigerant may not be allowed in some countries. Check local regulations.
Note 2: Leak detecting additives shall not be used as they may affect the lubricant properties. Warranty may be voided if leak detecting additives have been used.

Vacuum pull-down moisture removal

Moisture obstructs the proper functioning of the compressor and the refrigeration system.

Air and moisture reduce service life and increase condensing pressure, and cause excessively high discharge temperatures, which can destroy the lubricating properties of the oil. Air and moisture also increase the risk of acid formation, giving rise to copper platting. All these phenomena can cause mechanical and electrical compressor failure.

To eliminate these factors, a vacuum pull-down according to the procedure below is recommended:

1. Whenever possible (if valves are present) the compressor must be kept isolated from the system.
2. After the leak detection, the system must be pulled-down under a vacuum of 500 microns (0.67 mbar). A two stage vacuum pump shall be used with a capacity appropriate to the system volume. It is recommended to use connection lines with a large diameter and to connect these to the service valves and not to the Schrader connection to avoid too high pressure losses.
3. When the vacuum level of 500 micron is reached, the system must be isolated from the vacuum pump. Wait 30 minutes during which the system pressure should not rise. When the pressure rapidly increases, the system is not leak tight. A new leak detection must be per-formed and the vacuum pull-down procedure should be restarted from step 1. When the pressure slowly increases, this indicates the presence of moisture. In this case step 2 and 3 should be repeated.
4. Connect the compressor to the system by opening the valves. Repeat step 2 and 3.
5. Break the vacuum with nitrogen or the .nal refrigerant.
6. Repeat step 2 and 3 on the total sys-tem. At commissioning, system moisture content may be up to 100 ppm. During operation the filter drier must reduce this to a level < 20 ppm.

Warning: do not use a megohmmeter or apply power to the compressor while it is under vacuum, as this may cause motor winding damage. Never run the compressor under vacuum as it may cause compressor motor burnout.

Start-up

Before initial start-up or after a prolonged shut down period, energise the crankcase heater (if fitted) 12 hours prior to start-up.

Refrigerant charging

Zeotropic and «near-azeotropic» refrigerant mixtures such as R407C and R404A must always be charged in the liquid phase. For the initial charge, the compressor must not run and service valves must be closed. Charge refrigerant as close as possible to the nominal system charge before starting the compressor. Then slowly add refrigerant in the liquid phase, on the low pressure side as far away as possible from the running compressor.

The refrigerant charge quantity must be suitable for both winter and summer operation. Refer also to section «Protection against flooded starts and liquid floodback» for information about refrigerant charge limits.

Warning : when a liquid line solenoid valve is used, the vacuum in the low pressure side must be broken before applying power to the system.

Oil charge and oil level

The oil charge must be checked before commissioning (1/4 to 3/4 of the oil sight glass). Check the oil level again after a minimum of 2 hours operation at nominal conditions. In most installations the initial compressor oil charge will be sufficient. In installations with line runs exceeding 20 m or with many oil traps or an oil separator, additional oil may be required. Normally the quantity of oil added should be no more than 2% of the total refrigerant charge (this percentage does not take into account oil contained in accessories such as oil separators or oil traps). If this amount has already been added and the oil level in the compressor keeps decreasing, the oil return in the installation is insufficient. Refer also to section "Piping design". In installations where slow oil return is likely such as in multiple evaporator or multiple condenser installations, an oil separator is recommended. An oil separator is always recommended in manifolded compressor systems. Refer to the oil table to select the correct oil.

Suction gas superheat

The optimum suction gas superheat is 8 K. A lower superheat value will contribute to better system performance (higher mass flow and more efficient use of evaporator surface). Low superheat values however increase the risk of unwanted liquid floodback to the compressor. For very low superheat values an electronically controlled expansion valve is recommended.

The maximum allowable superheat is about 30 K. Higher values can be accepted but in these cases, tests have to be performed to check that the maximum discharge temperature of 130°C will not be exceeded. Note that high superheat values decrease the compressor application envelope and system performance.

Approvals and certificates

Danfoss VTZ Compressor Drive™ packages comply with the following approvals and certificates.

Certificates are listed on the product datasheets:
http://www.danfoss.com/odsg

CE (European Directive)	CE	All models
UL (Underwriters Laboratories)	c UL us	All models

Programming

For programming and adjusting the CD302 frequency converter see the installation instruction reference 85.10.233.

The various system components shall be selected to cover flow rate and capacity at any expected operating condition. A refrigeration system that includes a variable speed driven compressor generates a refrigerant mass flow that varies in relation to the thermal load. To keep this system working with accurate parameters all components must be able to handle this capacity fluctuation (evaporator, condenser, expansion devices, piping, etc.)

Evaporator

When the evaporator is dimensioned for nominal conditions, it becomes undersized when the compressor speed increases. The evaporating temperature will tend to drop.

To achieve a more energy efficient system it's worthwhile to increase the heat transfer capacity by increasing the external flow. In general, one should adapt the external flow proportionally and simultaneously to the refrigerant mass flow. This implies variable speed for pumps or fans in secondary systems. This principle is similar for low load where the flow of the secondary medium can be reduced to achieve energy savings by reduced motor power consumption.

Condenser

VTZ cooling capacity is closely related to rotational speed. It is recommended to control the condensing temperature in order to limit power consumption rise during heat load increase. Control of condensing temperature has the effect of reducing the compressor power consumption and also leads to increased cooling capacity by increased thermal effect. At the same time motor consumption of condenser pump or fans is also decreased.

We recommend to vary condensing pressure by keeping a constant difference between condensing temperature and ambient temperature. This solution combined with speed control offers the best energy savings. Note however that condensing temperature shall not drop below 20°C.

Expansion valve

When sizing the expansion valve, it must be noted that both pressure difference and refrigerant mass flow in a variable speed system can vary. The expansion valve must be capable of handling these variations without any hunting phenomena. Electronic expansion valves or multi-orifice expansion valves can ensure this function better than conventional thermostatic expansion valves and shall therefore be preferred when designing variable capacity systems.

Defrosting using reverse cycle

In general it is recommended to drive the compressor between 50 and 60 Hz (3000 – 3600 rpm) during defrost. However, the defrost duration may be reduced by increasing the compressor speed. When coming back to the normal working cycle after a defrost, the compressor must run at minimum speed during one or two minutes to minimize the risk for liquid slugging. If the system refrigerant charge is higher than the compressor charge limit it is strongly recommended to use a liquid suction accumulator.

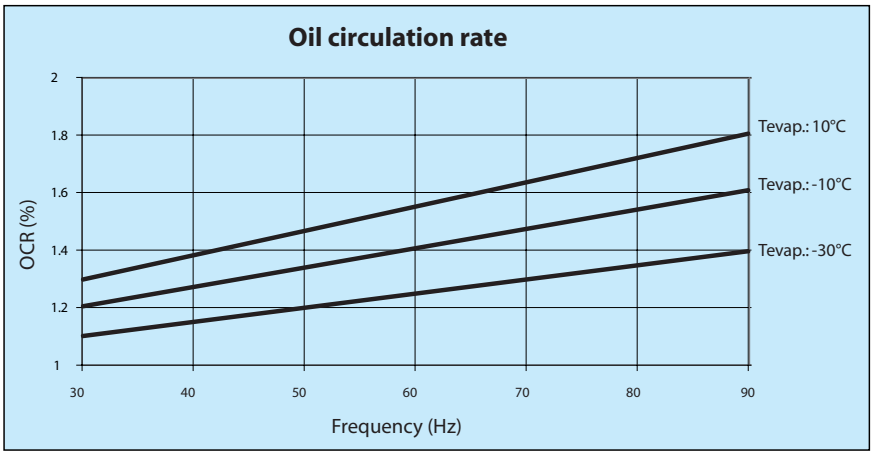
Oil circulation rate and oil level management

The oil circulation rate is proportional to the rotational speed of the compressor. It is therefore an essential parameter when designing a variable speed compressor system. The below graph shows that highest OCR values occur at maximum speed. Oil level in the compressor must be maintained at every operating frequency in order to avoid compressor damage. When uncontrolled amounts of lubricant are in circulation in the heat exchangers, the heat transfer will be reduced. Furthermore it can disturb line control components such as the expansion valve.

The amount of oil circulating in the system can be limited with an oil separator. This component is mandatory for systems with long pipe runs and/or a high refrigerant charge. For compact systems with a system refrigerant charge below the compressor charge limit an oil separator is not always needed but confirmation tests have to be done.

The oil separator selection shall be done based on the manufacturers documentation ensuring adequate oil return to the compressor sump. The oil separator must maintain a correct oil level in the compressor at any working condition. Note that the installation of an oil separator implies topping the oil quantity in the system.

When applying the VTZ variable speed compressor in a rack system, it is recommended to use an individual oil level controller per compressor in combination with a common oil separator and oil reservoir.



Compressor protection

The CD frequency converter does not only control the compressor speed, but it provides effective compressor protection as well.

The CD302 has a built-in over-current protection. When a too high current is detected, for example by working outside the application envelope, the frequency converter immediately adjusts the compressor to a lower speed. The speed can be decreased down to the minimum value as in the setup parameters. When this value is reached, the CD302 stops the compressor. The compressor will re-start automatically after a given delay as in the set-up parameters. When this type of over-current stops has occurred more often than the pre-set maximum (parameter 14.20) the compressor can only be re-started manually.

In case of quasi sudden overloads (locked rotor, liquid slugging...) another protection is activated that can only be reset manually.

The CD302 frequency converter allows over-modulation; the frequency

converter can compensate the motor torque at a drop of up to 10% of mains voltage and continue operation down to 85% of nominal mains voltage.

The CD302 frequency converter allows to manage low and high current. This function automatically adjusts the motor speed to match motor current to nominal values. Note: Current draw to the VTZ compressor remains close to constant for a given refrigeration working load over the full speed range.

Smart Logic Control

The CD frequency converter offers a Smart Logic Control (SLC) functionality. SLC is essentially a sequence of user defined actions executed by the frequency converter when a certain event takes place.

CD302 factory settings involve following control logic:

- Pump-down function; Cut-in pressure is set at 3 bar. Cut-out pressure is set at 1 bar (parameters 13-12.0 & 13-12.1).
- Anti short-cycle function; The minimum duration between 2 starts is set at 5 minutes (parameter 13-30.0).
- Oil return management; A minimum running time at each start. The default setting is 0 (zero) minutes for safety reasons. This parameter can be adjusted depending on the system. A recommended setting is about 30 seconds (parameter 13-20.1).

The CD302 comes by default in configuration mode Speed open loop which means that the SLC functionality is de-activated. To activate SLC and use above mentioned control functions the CD302 configuration mode must be set to Process (parameter 1-00).

The Danfoss product range for the refrigeration and air conditioning industry

Danfoss Refrigeration & Air Conditioning is a worldwide manufacturer with a leading position in industrial, commercial and supermarket refrigeration as well as air conditioning and climate solutions.

We focus on our core business of making quality products, components and systems that enhance performance and reduce total life cycle costs – the key to major savings.

Controls for Commercial Refrigeration

Controls for Industrial Refrigeration

Electronic Controls & Sensors

Industrial Automation

Household Compressors

Commercial Compressors

Sub-Assemblies

Thermostats

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