ENGINEERING
TOMORROW

Application guidelines

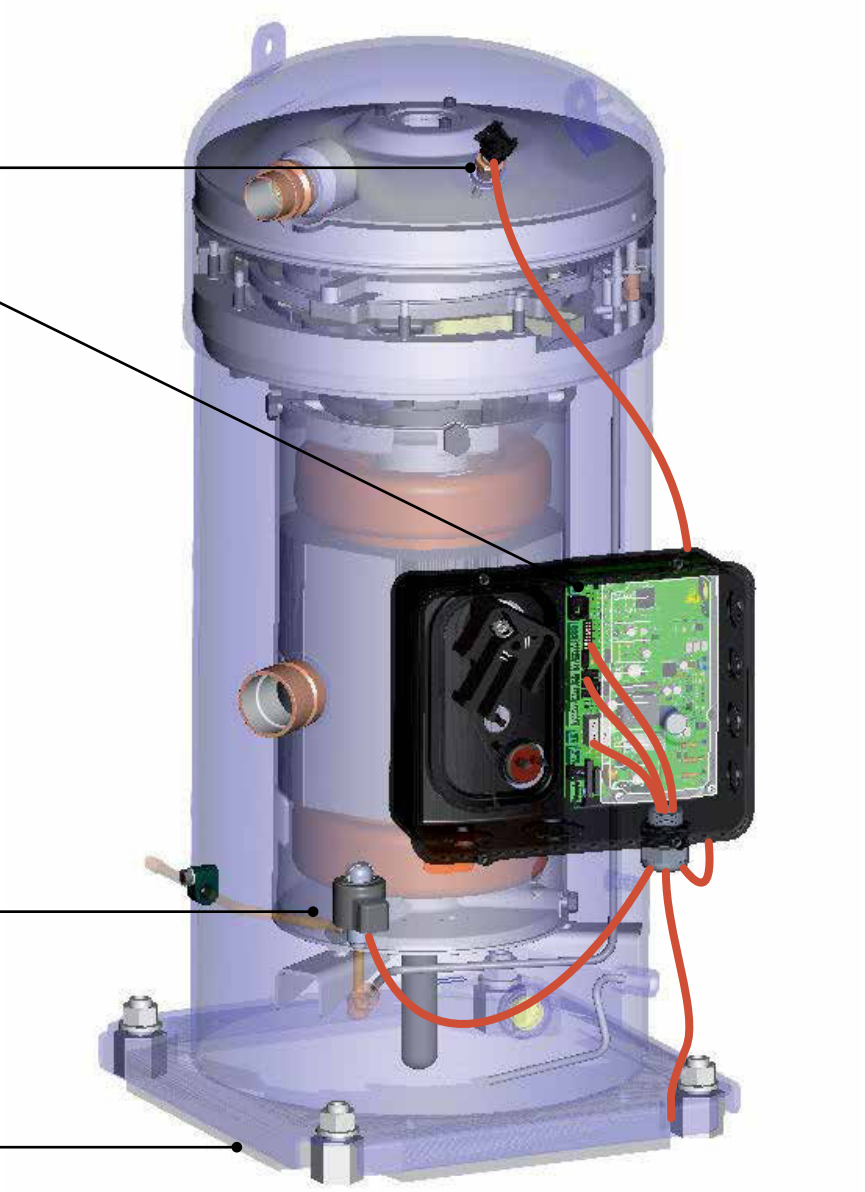
Danfoss scroll compressors
PSH051 to 077

50-60 Hz - R410A

http://danfoss.us.com/

Danfoss PSH scroll compressor is optimized for heat pump applications. Beside scroll elements pressure ratio optimization, PSH includes 2 major new technologies: liquid injection and Operating Control System (OCS).

PSH scroll compressor is also equipped with several prewired devices such as discharge temperature sensor, surface sump heater (SSH) and Liquid Injection Valve (LIV).



Liquid injection is controlled by a discharge gas temperature sensor connected to the OCS.

CAN-Bus connection between manifolded compressors allows the use of only one HP sensor and one LP sensor.

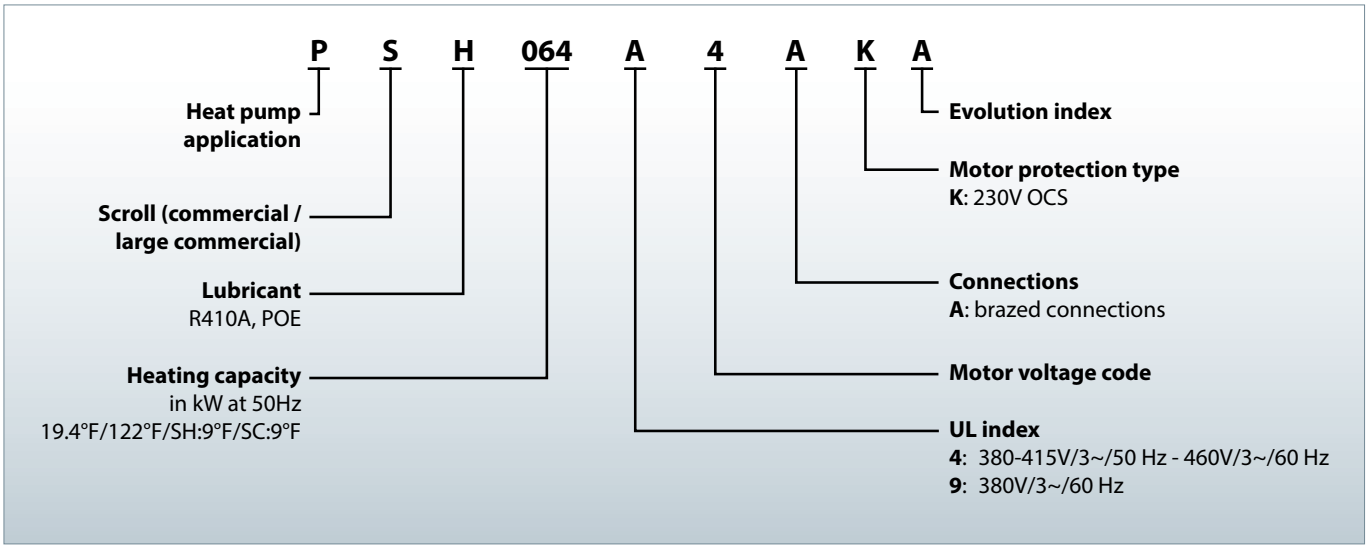
A Modbus connection allows the information exchange between the unit main board (PLC) and the compressor's boards (OCS).

Danfoss PSH scroll compressors for R410A are available as single compressors.

The example below presents the compressor nomenclature which equals to the technical reference as shown on the compressor nameplate.

Code numbers for ordering are listed in section "Ordering information and packaging" at the end of this document.

Compressor nomenclature



Compressor specifications

Model		Nominal heating capacity	Nominal cooling capacity	Power input	Heating EER	EER	Swept volume	Displacement ①	Oil charge	Net weight ②
		Btu/h	Btu/h	kW	Btu/W.h	Btu/W.h	cu.in/rev	cu.ft/h	oz	lb
50Hz	PSH051-4	182038	123437	17.17	10.55	7.20	13.89	1398	227	238
	PSH064-4	223485	152502	21.58	10.31	7.06	17.46	1759	227	336
	PSH077-4	274072	187887	25.98	10.50	7.24	21.03	2119	227	354
60Hz	PSH051-4	218625	148246	20.62	10.55	7.20	13.89	1688	227	238
	PSH064-4	268406	183157	25.91	10.31	7.06	17.46	2122	227	336
	PSH077-4	328034	225464	31.18	10.48	7.24	21.03	2557	227	354

Conditions: Evaporating temperature: 19.4°F Condensing temperature: 122°F Superheat: 9F Subcooling: 9F Refrigerant: R410A

① Displacement at nominal speed: 2900rpm at 50Hz. 3500rpm at 60Hz
② Net weight with oil charge

50 Hz

Cooling

	Tc °F	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)
	Te °F	-20		-10		0		10		20		30		40		50		59	
PSH051-4	70	69 113	9.01	89 010	9.52	112 730	10.15	140 785	10.91	173 584	11.82	211 570	12.92	255 222	14.22				
	85	63 038	10.33	81 672	10.81	103 754	11.38	129 829	12.07	160 239	12.90	195 529	13.89	236 041	15.07	282 321	16.46		
	100	56 621	11.96	73 959	12.42	94 403	12.96	118 430	13.59	146 485	14.35	179 010	15.25	216 416	16.31	259 181	17.57	302 628	18.89
	115	49 625	13.95	65 631	14.40	84 403	14.91	106 416	15.50	132 048	16.20	161 775	17.02	196 075	17.99	235 324	19.13	275 290	20.33
	130	41 809	16.33	56 485	16.79	73 584	17.29	93 481	17.85	116 724	18.50	143 652	19.26	174 778	20.14	210 512	21.19	246 962	22.28
	154							70 444	22.63	89 693	23.23	112 116	23.91	138 123	24.70	168 191	25.61	199 044	26.55
PSH064-4	70	86 928	11.49	111 638	12.11	141 468	12.85	177 065	13.74	219 078	14.82	268 191	16.16	325 085	17.78				
	85	79 522	13.07	102 457	13.71	129 898	14.41	162 560	15.23	201 058	16.19	246 075	17.36	298 259	18.78	358 259	20.49		
	100	71 468	14.95	92 662	15.65	117 850	16.36	147 611	17.14	182 696	18.03	223 686	19.08	271 263	20.33	326 109	21.82	382 218	23.42
	115	62 389	17.16	81 980	17.95	104 949	18.72	131 945	19.51	163 652	20.36	200 717	21.33	243 823	22.45	293 584	23.78	344 608	25.19
	130	51 980	19.71	70 034	20.65	90 887	21.51	115 188	22.35	143 618	23.21	176 860	24.14	215 529	25.18	260 307	26.38	306 348	27.63
	154							85 290	27.94	108 669	28.90	135 939	29.86	167 713	30.85	204 676	31.94	242 901	33.03
PSH077-4	70	107 270	14.05	137 167	14.79	173 140	15.76	216 075	16.99	266 860	18.47	326 314	20.22	395 290	22.24				
	85	97 952	15.90	126 075	16.56	159 693	17.45	199 625	18.57	246 724	19.94	301 911	21.56	366 007	23.44	439 863	25.59		
	100	88 089	18.21	114 232	18.82	145 188	19.64	181 843	20.68	225 051	21.94	275 700	23.45	334 642	25.20	402 696	27.21	472 526	29.25
	115	77 611	21.07	101 502	21.65	129 556	22.42	162 696	23.40	201 741	24.58	247 611	25.99	301 092	27.63	363 140	29.52	426 962	31.43
	130	66 451	24.59	87 816	25.15	112 730	25.89	142 082	26.82	176 724	27.95	217 509	29.28	265 324	30.83	321 058	32.60	378 635	34.40
	154							105 768	34.01	132 799	35.08	164 983	36.32	203 174	37.76	248 259	39.40	295 427	41.06

Heating

	Tc °F	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)
	Te °F	-20		-10		0		10		20		30		40		50		59	
PSH051-4	70	99 863	9.01	121 502	9.52	147 372	10.15	177 986	10.91	213 925	11.82	255 666	12.92	303 754	14.22				
	85	98 294	10.33	118 567	10.81	142 628	11.38	171 024	12.07	204 300	12.90	242 935	13.89	287 509	15.07	338 498	16.46		
	100	97 440	11.96	116 348	12.42	138 635	12.96	164 812	13.59	195 461	14.35	231 024	15.25	272 082	16.31	319 181	17.57	367 099	18.89
	115	97 201	13.95	114 778	14.40	135 324	14.91	159 317	15.50	187 338	16.20	219 863	17.02	257 474	17.99	300 614	19.13	344 676	20.33
	130	97 509	16.33	113 788	16.79	132 594	17.29	154 437	17.85	179 863	18.50	209 352	19.26	243 515	20.14	282 799	21.19	323 003	22.28
	154							147 679	22.63	169 010	23.23	193 754	23.91	222 423	24.70	255 563	25.61	289 659	26.55
PSH064-4	70	124 710	11.49	151 468	12.11	183 720	12.85	222 253	13.74	267 850	14.82	321 365	16.16	383 584	17.78				
	85	122 526	13.07	147 543	13.71	177 304	14.41	212 628	15.23	254 334	16.19	303 174	17.36	360 034	18.78	425 666	20.49		
	100	120 648	14.95	144 164	15.65	171 672	16.36	204 027	17.14	242 014	18.03	286 451	19.08	338 157	20.33	397 918	21.82	459 283	23.42
	115	118 840	17.16	141 058	17.95	166 519	18.72	196 143	19.51	230 648	20.36	270 887	21.33	317 679	22.45	371 809	23.78	427 474	25.19
	130	116 826	19.71	137 952	20.65	161 638	21.51	188 737	22.35	220 000	23.21	256 280	24.14	298 362	25.18	347 099	26.38	397 270	27.63
	154							177 201	27.94	203 754	28.90	234 164	29.86	269 215	30.85	309 761	31.94	351 570	33.03
PSH077-4	70	153 891	14.05	186 212	14.79	225 427	15.76	272 423	16.99	328 123	18.47	393 379	20.22	469 078	22.24				
	85	150 683	15.90	181 024	16.56	217 577	17.45	261 229	18.57	312 867	19.94	373 413	21.56	443 754	23.44	524 778	25.59		
	100	148 464	18.21	176 655	18.82	210 341	19.64	250 444	20.68	297 850	21.94	353 481	23.45	418 225	25.20	492 969	27.21	569 556	29.25
	115	147 543	21.07	173 311	21.65	203 959	22.42	240 307	23.40	283 311	24.58	333 823	25.99	392 765	27.63	461 058	29.52	531 229	31.43
	130	148 055	24.59	171 263	25.15	198 635	25.89	231 058	26.82	269 420	27.95	314 642	29.28	367 577	30.83	429 215	32.60	492 765	34.40
	154							218 601	34.01	249 147	35.08	285 461	36.32	328 430	37.76	378 976	39.40	431 638	41.06

Refrigerant: R410A Frequency: 50 Hz Subcooling: 9°F Superheat: 9°F

60 Hz

Cooling

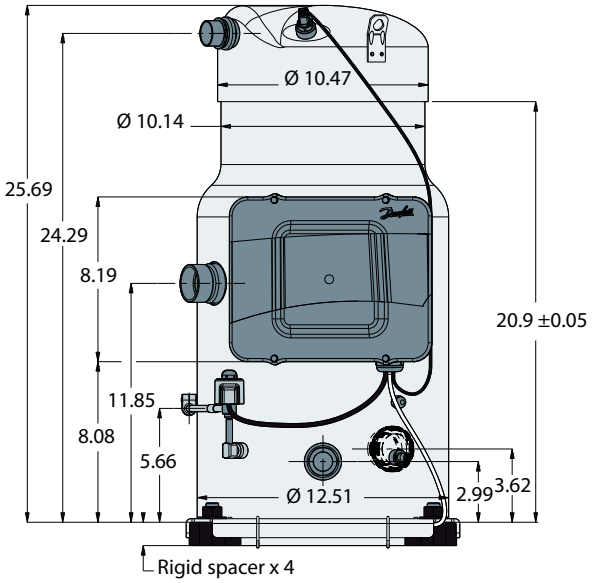
	Tc °F	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)	Cooling (Btu/h)	Pe (kW)
	Te °F	-20		-10		0		10		20		30		40		50		59	
PSH051-4	70	83 003	10.82	106 894	11.44	135 392	12.19	169 078	13.10	208 464	14.20	254 096	15.52	306 519	17.08				
	85	75 734	12.41	98 089	12.98	124 608	13.67	155 904	14.50	192 457	15.50	234 812	16.69	283 515	18.10	339 078	19.77		
	100	68 020	14.37	88 805	14.92	113 379	15.56	142 253	16.32	175 939	17.23	214 983	18.31	259 932	19.59	311 297	21.10	363 447	22.69
	115	59 590	16.75	78 840	17.30	101 399	17.91	127 782	18.62	158 601	19.45	194 300	20.44	235 461	21.60	282 628	22.98	330 648	24.42
	130	50 205	19.61	67 850	20.16	88 362	20.77	112 287	21.44	140 171	22.22	172 526	23.13	209 898	24.19	252 799	25.45	296 621	26.75
	154							84 573	27.18	107 747	27.90	134 676	28.72	165 904	29.66	201 980	30.75	239 044	31.89
PSH064-4	70	104 403	13.79	134 061	14.55	169 898	15.43	212 662	16.50	263 140	17.80	322 116	19.41	390 410	21.36				
	85	95 529	15.69	123 038	16.46	156 007	17.31	195 222	18.29	241 468	19.45	295 529	20.85	358 191	22.55	430 273	24.60		
	100	85 836	17.96	111 297	18.79	141 536	19.65	177 304	20.59	219 386	21.66	268 635	22.91	325 802	24.41	391 672	26.21	459 044	28.13
	115	74 949	20.61	98 464	21.56	126 041	22.49	158 464	23.43	196 553	24.46	241 058	25.62	292 799	26.97	352 594	28.56	413 891	30.25
	130	62 423	23.67	84 096	24.80	109 147	25.84	138 328	26.84	172 491	27.88	212 389	28.99	258 840	30.24	312 594	31.68	367 918	33.19
	154							102 423	33.56	130 546	34.71	163 276	35.86	201 433	37.05	245 836	38.36	291 741	39.66
PSH077-4	70	128 737	16.86	164 608	17.75	207 782	18.92	259 317	20.38	320 239	22.16	391 570	24.26	474 369	26.69				
	85	117 509	19.08	151 297	19.88	191 604	20.94	239 522	22.29	296 075	23.92	362 287	25.87	439 181	28.12	527 850	30.71		
	100	105 700	21.85	137 065	22.58	174 232	23.57	218 225	24.81	270 068	26.33	330 853	28.14	401 536	30.24	483 242	32.65	566 997	35.10
	115	93 140	25.29	121 809	25.98	155 461	26.91	195 222	28.07	242 116	29.50	297 133	31.19	361 331	33.16	435 768	35.42	512 321	37.72
	130	79 761	29.51	105 358	30.19	135 256	31.07	170 478	32.19	212 048	33.53	261 024	35.13	318 396	36.99	385 256	39.12	454 369	41.29
	154							126 894	40.82	159 352	42.09	197 986	43.58	243 823	45.31	297 918	47.28	354 505	49.27

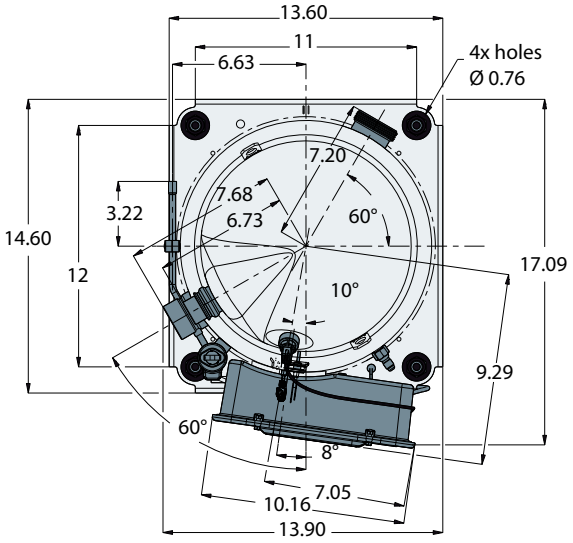
Heating

	Tc °F	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)	Heating (Btu/h)	Pe (kW)
	Te °F	-20		-10		0		10		20	20	30	30	40	40	50	50	59	59
PSH051-4	70	119 932	10.82	145 904	11.44	176 997	12.19	213 788	13.10	256 928	14.20	307 065	15.52	364 812	17.08				
	85	118 055	12.41	142 389	12.98	171 297	13.67	205 392	14.50	245 358	15.50	291 775	16.69	345 290	18.10	406 519	19.77		
	100	117 031	14.37	139 727	14.92	166 485	15.56	197 952	16.32	234 744	17.23	277 474	18.31	326 792	19.59	383 311	21.10	440 887	22.69
	115	116 758	16.75	137 850	17.30	162 526	17.91	191 331	18.62	224 983	19.45	264 061	20.44	309 215	21.60	361 058	22.98	413 959	24.42
	130	117 099	19.61	136 655	20.16	159 215	20.77	185 461	21.44	216 007	22.22	251 468	23.13	292 457	24.19	339 659	25.45	387 918	26.75
	154							177 338	27.18	202 969	27.90	232 696	28.72	267 133	29.66	306 928	30.75	347 884	31.89
PSH064-4	70	149 761	13.79	181 945	14.55	220 648	15.43	266 928	16.50	321 706	17.80	385 973	19.41	460 683	21.36				
	85	147 167	15.69	177 201	16.46	212 969	17.31	255 392	18.29	305 461	19.45	364 130	20.85	432 389	22.55	511 229	24.60		
	100	144 915	17.96	173 140	18.79	206 177	19.65	245 017	20.59	290 648	21.66	344 027	22.91	406 109	24.41	477 884	26.21	551 570	28.13
	115	142 730	20.61	169 386	21.56	200 000	22.49	235 563	23.43	277 031	24.46	325 358	25.62	381 536	26.97	446 553	28.56	513 379	30.25
	130	140 341	23.67	165 700	24.80	194 130	25.84	226 655	26.84	264 232	27.88	307 782	28.99	358 328	30.24	416 860	31.68	477 099	33.19
	154							212 833	33.56	244 710	34.71	281 229	35.86	323 345	37.05	372 014	38.36	422 253	39.66
PSH077-4	70	184 198	16.86	223 003	17.75	270 000	18.92	326 382	20.38	393 140	22.16	471 365	24.26	562 184	26.69				
	85	180 273	19.08	216 689	19.88	260 512	20.94	312 867	22.29	374 778	23.92	447 372	25.87	531 706	28.12	628 874	30.71		
	100	177 577	21.85	211 365	22.58	251 741	23.57	299 863	24.81	356 689	26.33	423 413	28.14	501 058	30.24	590 683	32.65	682 491	35.10
	115	176 348	25.29	207 270	25.98	243 993	26.91	287 611	28.07	339 147	29.50	399 727	31.19	470 410	33.16	552 287	35.42	636 416	37.72
	130	176 826	29.51	204 676	30.19	237 509	31.07	276 382	32.19	322 389	33.53	376 587	35.13	440 102	36.99	513 959	39.12	590 205	41.29
	154							261 195	40.82	297 816	42.09	341 365	43.58	392 901	45.31	453 481	47.28	516 621	49.27

Refrigerant: R410A Frequency: 60 Hz Subcooling: 9°F Superheat: 9°F

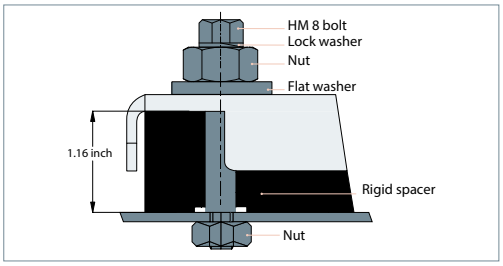
PSH051



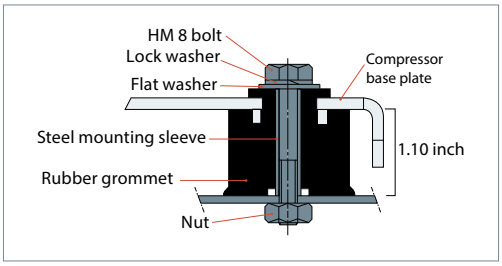


All dimensions in inch

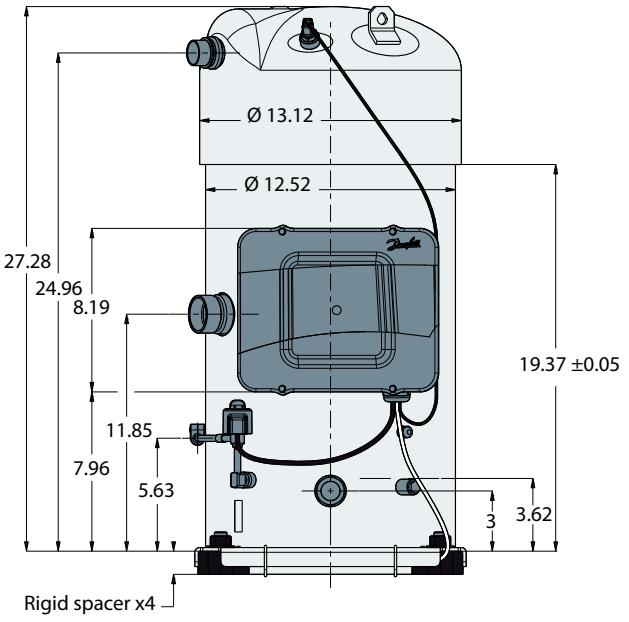
Rigid spacer



Flexible grommet (accessory)

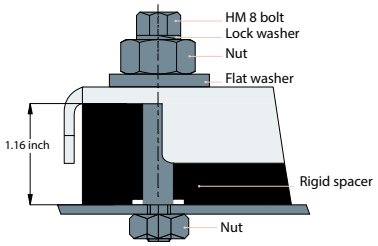


PSH064

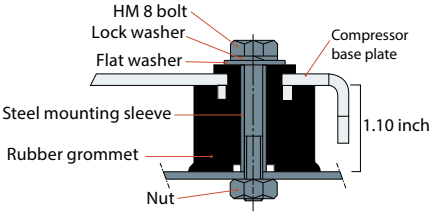


All dimensions in inch

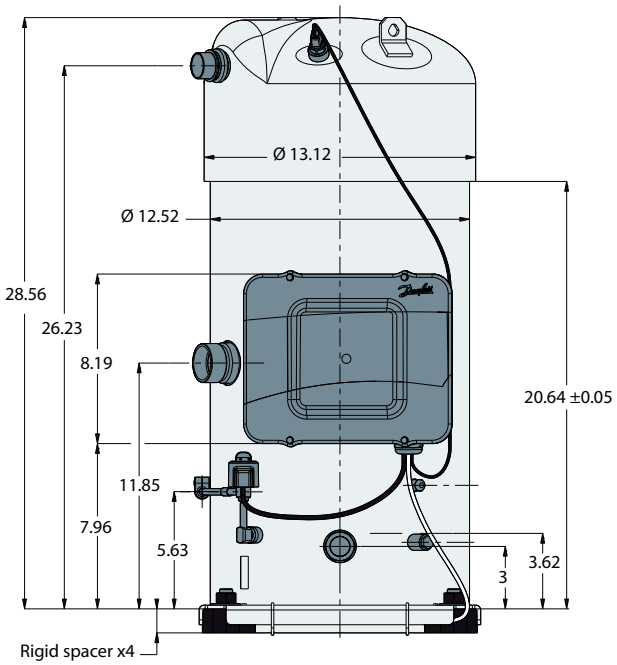
Rigid spacer

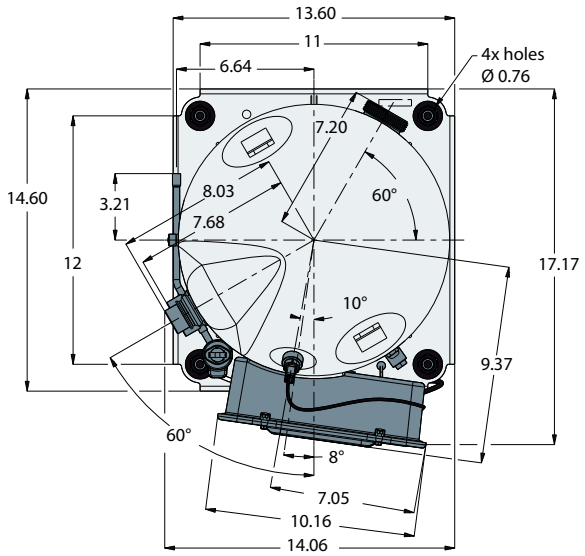


Flexible grommet (accessory)



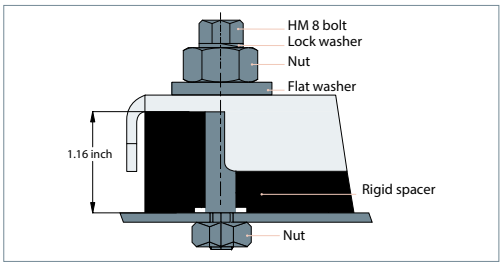
PSH077



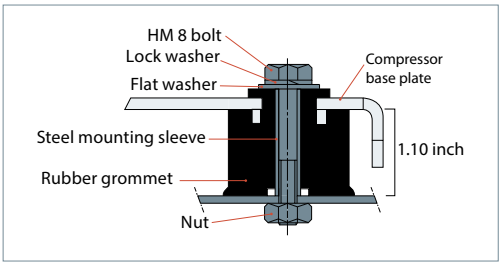


All dimensions in inch

Rigid spacer



Flexible grommet (accessory)



Connection details

	PSH051-064-077
	AJ-AK
Suction and discharge connections	Brazed
Oil sight glass	Threaded
Oil equalization connection	Rotolock 2"1/4
Oil drain connection	1/4" SAE flare
Low pressure gauge port (schrader)	1/4" SAE flare
Liquid Injection Valve connection tube	1/4"ODF

Suction and discharge connections

		Tube ODF
PSH051-064-077	Suction	1"5/8
	Discharge	1"1/8

Oil sight glass

All Danfoss PSH scroll compressors come equipped with a sight glass (1"1/8 - 18 UNF) which may be used to determine the amount and condition of the oil contained within the sump.

Oil equalisation connection

PSH051-064-077 are equipped with a 2"1/4 rotolock connector allowing the use of 2"1/4 - 1"3/8 or 2"1/4 - 1"5/8 sleeve. This connection must be used to mount the oil equalisation line when two or more compressors are mounted in parallel (please refer to section "Parallel mounting" for details).

Oil drain connection

The oil drain connection allows oil to be removed from the sump for changing, testing, etc. The fitting contains an extension tube into the oil sump to more effectively remove the oil. The connection is a female 1/4" SAE flare fitting

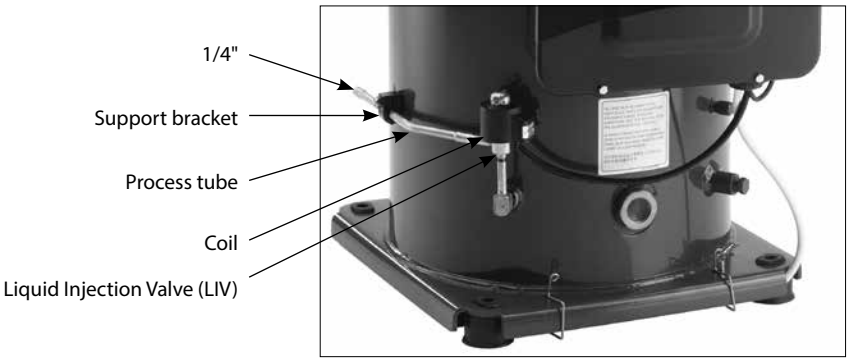
Schrader

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

Liquid injection valve

The liquid injection valve (LIV) comes equipped with process tube, maintained by a bracket, assembled on compressor shell. This process tube is to be connected with a 1/4" piping to the system liquid line.

During commissioning, check that the LIV coil is correctly positioned on the LIV body. One of the lock pins on the coil must fit into one of the dents on the valve body.



Motor voltage

Motor voltage code		Code 4	Code 9
50Hz	Nominal voltage	380-415V~3	-
	Voltage range	357-440V~3	-
60Hz	Nominal voltage	460V~3	380V~3
	Voltage range	414-506V~3	342-418V~3

Voltage unbalance

The operating voltage limits are shown in the table section "Motor voltage". The voltage applied to the motor terminals must lie within these table limits during both start-up and normal operations. The maximum allowable voltage unbalance is 2%. Voltage unbalance causes high amperage over one or several phases, which in turn leads to overheating and possible motor damage. Voltage unbalance is given by the formula:

Vavg = Mean voltage of phases 1, 2, 3.
V1-2 = Voltage between phases 1 & 2.
V1-3 = Voltage between phases 1 & 3.
V2-3 = Voltage between phases 2 & 3.

$$\% \text{ voltage unbalance} = \frac{|Vavg - V1\text{-}2| + |Vavg - V1\text{-}3| + |Vavg - V2\text{-}3|}{2 \times Vavg} \times 100$$

Electrical data

Compressor models		LRA	MCC	Maximum Operating Current	Winding resistance
		A	A	A	Ω
Motor code 4	PSH051	211	60	50	0.57
	PSH064	248	72	64	0.48
	PSH077	319	83	78	0.39
Motor code 9	PSH051	273	66	61	0.38
	PSH064	315	90	79	0.33
	PSH077	399	98	91	0.27

LRA (Locked Rotor Amp)

Locked Rotor Amp value is the highest average current as measured on mechanically blocked compressor tested under nominal voltage. The LRA value can be used as rough estimation for the starting current. However in most cases, the real starting current will be lower. A soft starter can be applied to reduce starting current.

MCC (Maximum Continuous Current)

The MCC is the current at which the motor protection trips under maximum load and low voltage conditions. This MCC value is the maximum at which the compressor can be operated in transient conditions and out of the application envelope. Above this value, the OCS will cut-out the compressor to protect the motor.

Max. operating current

The max. operating current is the current when the compressors operates at maximum load conditions and 10% below nominal voltage (59°F evaporating temperature and 154.4°F condensing temperature). Max. operating current can be used to select cables and contactors.

In normal operation, the compressor current consumption is always less than the Max operating A. value.

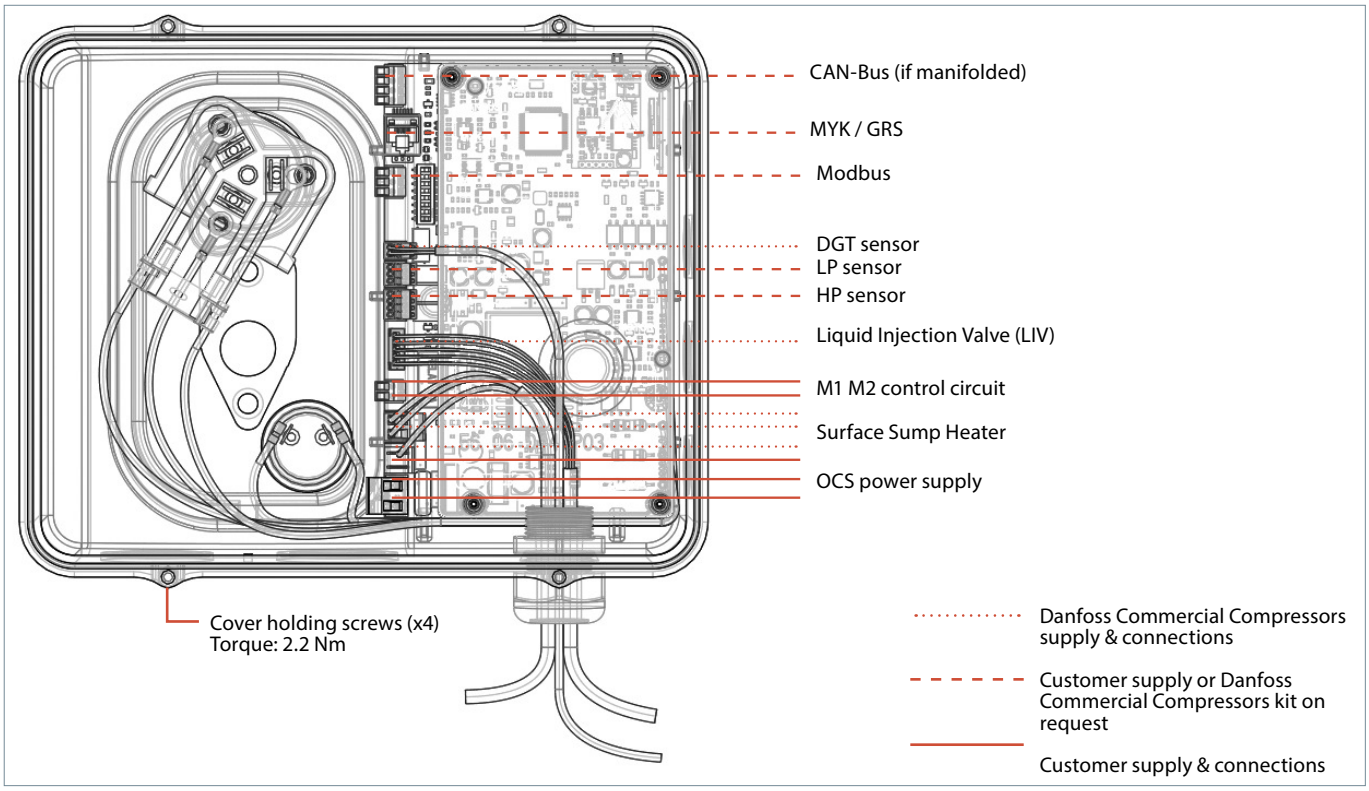
Winding resistance

Winding resistance is the resistance between phases at 77°F (resistance value +/- 7%). Winding resistance is generally low and it requires adapted tools for precise measurement. Use a digital ohm-meter, a "4 wires" method and measure under stabilised ambient temperature. Winding resistance varies strongly with winding temperature ; if the compressor is stabilised at a different value than 77°F, the measured resistance must be corrected with following formula:

$$R_{amb} = R_{77°F} \frac{a + t_{amb}}{a + t_{77°F}}$$

$t_{77°F}$: reference temperature = 77°F
t_{amb}: temperature during measurement (°F)
$R_{77°F}$: winding resistance at 77°F
R_{amb}: winding resistance at tamb
Coefficient a = 234.5

Wiring Connections



Compressor power supply

Electrical supply is connected to the compressor terminals by Ø 3/16" (4.8 mm) screws. The maximum tightening torque is 2.2 ft.lb. Use a 1/4" ring terminal on the power leads.

The compressor must be connected to earth with the 0.20 inch earth terminal screw.

Operating Control System (OCS) power supply

The Operating Control System (OCS) can be supplied with 230V. For 230V OCS, earth connection must be done with a 1/4" faston terminal.

⚠ To avoid personal injury, earth continuity must be checked before switching the power on. Provide separate electrical supply for the OCS so the heater remains energized when the machine is out of service (eg.seasonnal shutdown).

Nominal voltage	Voltage range
230V ~1 50/60Hz	207-254V ~1 50Hz - 180-254V ~1 60Hz

OCS connections

The OCS comes preinstalled within the compressor electrical box.
All needed connectors are plugged in place on the OCS and connector positions are marked on the transparent OCS protection cover.

The compressor comes with prewired OCS connections for:

- discharge gas temperature sensor (DGT)
- surface sump heater (SSH)
- motor protection
- phase monitoring
- liquid injection valve (LIV)

Note that to avoid handling and transportation issues, the discharge gas temperature cable is not connected to the discharge temperature sensor that is pre-installed on the upper shell. This cable has to be connected to the sensor before switching on the power.

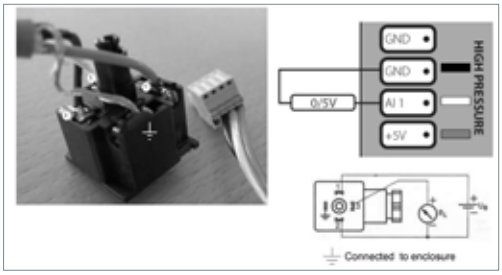
Low pressure and high pressure transmitters connection to the OCS are mandatory for compressor operation (envelope monitoring). Refer to "Pressure transmitter accuracy and range" section.

LP and HP signals can also be transferred via Modbus. Refer to "CAN-Bus and Modbus communication with OCS" section for further information.

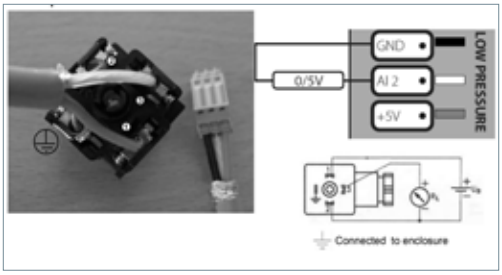
HP and LP sensor connection

Shielded cable is mandatory for HP and LP sensor connections. Cable shield must be connected on sensor side only.

High pressure sensor connection



Low pressure sensor connection



Communication connections

In the case of parallel mounting, CAN-Bus cables must link compressors together in order to allow data exchange between compressors. Connectors are 4 pole 0.14 inch pitch terminal blocks.

In parallel mounting, only one HP transmitter and one LP transmitter are needed per compressor assembly, connected to only one of the OCS, for the complete system.

If needed, the Modbus connection is to be done with a 3 pole 0.14 inch pitch terminal block (supplied on the OCS).

Shielded cables must be used for CAN-Bus and Modbus connections.

A minimum distance of 4 inch between power supply cables and communication cables must be observed in order to avoid electronic interferences and disturbances.

Accessory CAN-Bus cables and Modbus cables are available for tandem and trio assemblies (refer to accessories list for code numbers).

Data readings and recovering can be done thanks to a MMIGRS and a MMIMYK connected on the RJ11 female connection on the OCS (refer to section "Data Management").

MMIGRS and MMIMYK accessories are available (refer to accessories list for code numbers).

General wiring information

The wiring diagrams below are examples for a safe and reliable compressor wiring. In case an alternative wiring logic is chosen, it is imperative to respect the following rules:

M1 M2 contact on OCS must be used for compressor protection (do not use Bus signal).

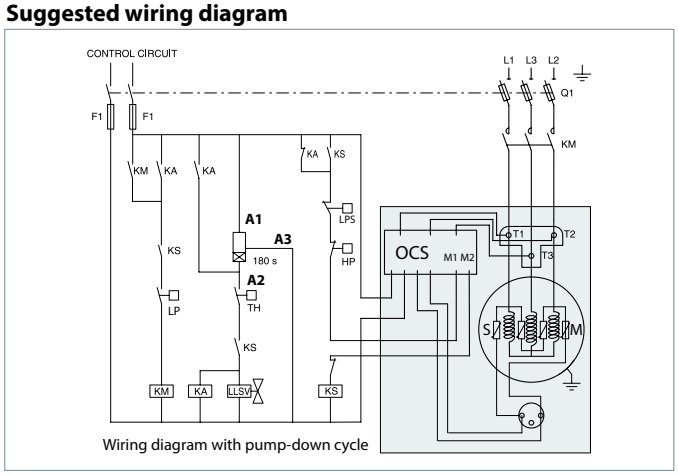
When a safety switch trips, the compressor must stop immediately and must not re-start until the tripping condition is back to normal and the safety switch is closed again. This applies to the LP safety switch, the HP safety switch, the discharge gas thermostat and the motor safety thermostat.

In specific situations, such as winter start operation, an eventual LP control for pump-down cycles may be temporarily bypassed to allow the system to build pressure. But it remains mandatory for compressor protection to apply an LP safety switch. The LP safety switch must never be bypassed.

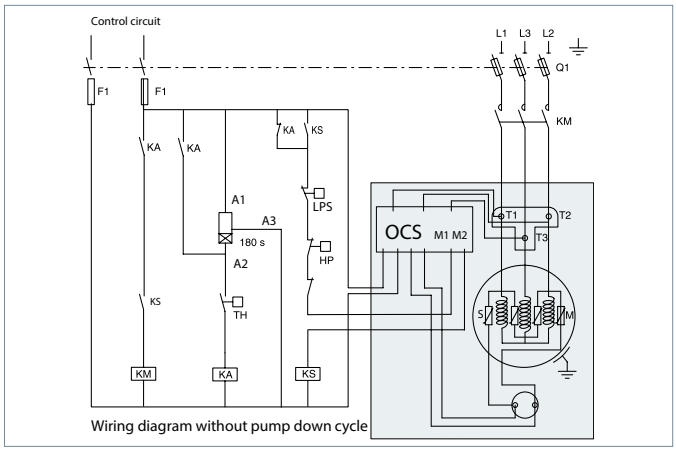
Pressure settings for the LP and HP safety switch and pump-down listed in table from section "Low pressure".

When ever possible (ie. PLC control), it is recommended to limit the possibilities of compressor auto restart to less than 3 to 5 times during a period of 12 hours when caused by motor protection or LP safety switch tripping. This control must be managed as a manual reset device.

Suggested wiring diagram



Wiring diagram with pump-down cycle



Wiring diagram without pump down cycle

Legend

Fuses	F1
Compressor contactor	KM
Control relay	KA
Safety lock out relay	KS
Optional short cycle timer (3 min)	180 s
External overload protection	F2
Pump-down pressure switch	LP
High pressure safety switch	HP
Control device	TH
Liquid line solenoid valve	LLSV
Fused disconnect	Q1
Compressor motor	M
Thermistor chain	S
Safety pressure switch	LPS

Electrical box knock-out dimensions

Six different knockouts are available for power supply or accessories connections.
One double knockout for power supply:
Ø1.72" (43.7mm) or Ø1.36" (34.5mm)
One triple knockout for power supply:
Ø1.59" (40.5mm) or Ø1.27" (32.5mm) or
Ø1" (25.4mm)
Two double knockouts for accessories:
Ø1" (25.4mm) or Ø0.78" (20mm)
Two double knockouts for accessories:
Ø0.88" (22.5mm) or Ø0.65" (16.5mm)

IP rating

The compressor terminal box according to IEC529 is IP54 for all models when correctly sized IP54 rated cable glands are used.
First numeral, level of protection against contact and foreign objects
5 - Dust protected
Second numeral, level of protection against water
4 - Protection against water splashing

Electrical box temperature

The temperature inside the terminal box must not exceed 149°F. Above 149°F, the OCS may not operate properly. Any compressor damaged related to this will not be covered by Danfoss warranty.

Consequently, if the compressor is installed in an enclosure, precautions must be taken to avoid that the temperature around the compressor and in the terminal box rise too much. The installation of ventilation on the enclosure panels may be necessary.

In the same manner, cables must be selected in a way to insure that terminal box temperature does not exceed 149°F.

Approvals and certificates

PSH scroll compressors comply with the following approvals and certificates.

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

CE 0062 or CE 0038 or CE0871 (European Directive)	CE	All PSH models
UL (Underwriters Laboratories)	c UL us	All 60 Hz PSH models
Other approvals / certificates		Contact Danfoss

Pressure equipment directive 2014/68/EU

Products	PSH051	PSH064	PSH077
Refrigerating fluids	Group 2	Group 2	Group 2
Category PED	II	II	III
Evaluation module	D1	D1	H
Maximum / Minimum temperature - Ts	-31°F < Ts < 125.6°F	-31°F < Ts < 123.8°F	-31°F < Ts < 123.8°F
Maximum allowable pressure (LP side) - Ps	451 psig	438 psig	438 psig
Declaration of conformity	Contact Danfoss		

Internal free volume

Products	Internal free volume without oil (inch^3)
PSH051	1891
PSH064	1989
PSH077	2093

Low voltage directive 2014/35/EU

Products	PSH051 to 077
Declaration of conformity	Contact Danfoss

Machines directive 2006/42/EC

Products	PSH051 to 077
Manufacturer's declaration of incorporation	Contact Danfoss

Electromagnetic compatibility directive 2014/30/EU

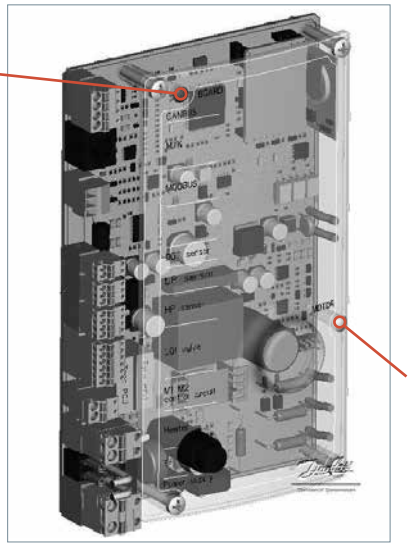
PSH compressors with their OCS are in conformance with the requirements of the following standards:

- EN61000-6-2: immunity for industrial environments
- EN61000-6-4: emission standard for industrial environments

Application guidelines	Operating conditions	
Refrigerant and lubricants **R410A**	PSH compressors are to be used with R410A refrigerant, with polyolester oil.	
	• R410A's superior thermodynamical properties compared to R22 and R407C refrigerants allow for today's massive – and necessary – switch to high efficiency systems. • Zero Ozone Depletion Potential (ODP): R410A doesn't harm the ozone layer. • Global warming potential (GWP): R410A shows a relatively high warming potential. However, the GWP index denotes direct warming effect, which is relevant only in case of release to the atmosphere. A more accurate index is T.E.W.I., for Total Equivalent Warming Impact, which takes into account indirect contributions due to running energy costs.	• Because of the higher system efficiency it allows to achieve, R410A is in this regard the best refrigerant. • As a near-azeotropic mixture, refrigerant R410A behaves like an homogeneous substance, whereas other zeotropic mixtures such as R407C and other blends suffer a temperature glide during phase change that lessens thermal efficiency and makes them difficult to transfer from a container to another. • Reduced refrigerant mass flow, permitted by a higher heat capacity, induce a lower sound level of the installation as well as more compact and lighter systems.
POE oil	Polyolester oil (POE) is miscible with HFC's (while mineral oil is not), but has to be evaluated regarding lubrication ability in compressors. POE oil has better thermal stability than refrigerant mineral oil.	POE is more hygroscopic and also holds moisture tighter than mineral oil. It also chemically reacts with water leading to acid and alcohol formation.
Motor supply	PSH scroll compressors can be operated at nominal voltages as indicated in the section "Motor voltage". Under-voltage and over-voltage	operation is allowed within the indicated voltage ranges. In case of risk of under-voltage operation, special attention must be paid to current draw.
Compressor ambient temperature	PSH compressors can be applied from -31°F to 123.8°F ambient temperature, when charged with refrigerant. The compressors are designed	as 100% suction gas cooled without need for additional fan cooling. Ambient temperature has very little effect on the compressor performance.
High ambient temperature	In case of enclosed fitting and high ambient temperature it's recommend to check the temperature of power wires and conformity to their insulation specification. In case of safe tripping by the internal compressor overload	protection the compressor must cool down before the overload will reset. A high ambient temperature can strongly delay this cool-down process.
Low ambient temperature	Although the compressor itself can withstand low ambient temperature, the system may require specific design features to ensure safe	and reliable operation. See section "Specific application recommendations".

Compressor protection

2 status LEDs are present on OCS:



LED1 displays the board general status with the following blinking codes

LED 1 Status display	Blinking sequence	Status	Reset
●●●●●●●●●	continuous on	OCS powered and stable	NA
●●●○○●●●○○	slow blinking 1.5secON/1secOFF	Warning without requirement for immediate action.	Come back to stable status by automatic or manual reset.
●○●○●○●○●○	fast blinking 0.5secON/0.5secOFF	**ALARM**, requires maintenance intervention	Come back to stable status by specialist intervention

LED 2 displays the motor protection status. Compressor models PSH051-064-077 are delivered with a pre installed motor protection.

This device provides efficient and reliable protection against overheating, overloading as well as phase loss/reversal.

Overheating/overloading protection

The motor protection is effective thanks to PTC sensors embedded in the motor winding and OCS control. The close contact between sensors and windings ensures a very low level of thermal inertia.

The motor temperature is constantly measured by a PTC thermistor loop connected to the OCS.

If any thermistor exceeds its response temperature, its resistance increases above the trip level (4,500 Ω) and the output relay then trips – i.e. contacts M1-M2 are open.

After cooling below the response temperature (resistance < 2,750 Ω), a 5 minutes time delay is activated. After this delay has elapsed, the relay is once again pulled in – i.e. contacts M1-M2 are closed. The time delay may be cancelled by means of resetting the mains.

LED 2 Status display	Blinking sequence	Status
●●●●●●●●●●●●	continuous on	Ready for starting
●○○○●○○○●○○○● ●○○○○○○○●○○○○	0.1secON/ 0.3secOFF for 5 min 0.1secON/0,7secOFF.	**ALARM 22**: Motor overheating **ACTION**: STOP COMPRESSOR **RESTART**: 5min Delay after motor cooling.

Phase sequence and reverse rotation protection

Use a phase meter to establish the phase orders and connect line phases L1, L2 and L3 to terminals T1, T2 and T3, respectively. The compressor will only operate properly in a single direction, and the motor is wound so that if the connections are correct, the rotation will also be correct.

OCS provides protection against phase reversal and phase loss at start-up.

Apply the recommended wiring diagrams from the section "Suggested wiring diagram logic". The circuit should be thoroughly checked in order to determine the cause of the phase problem before re-energizing the control circuit.

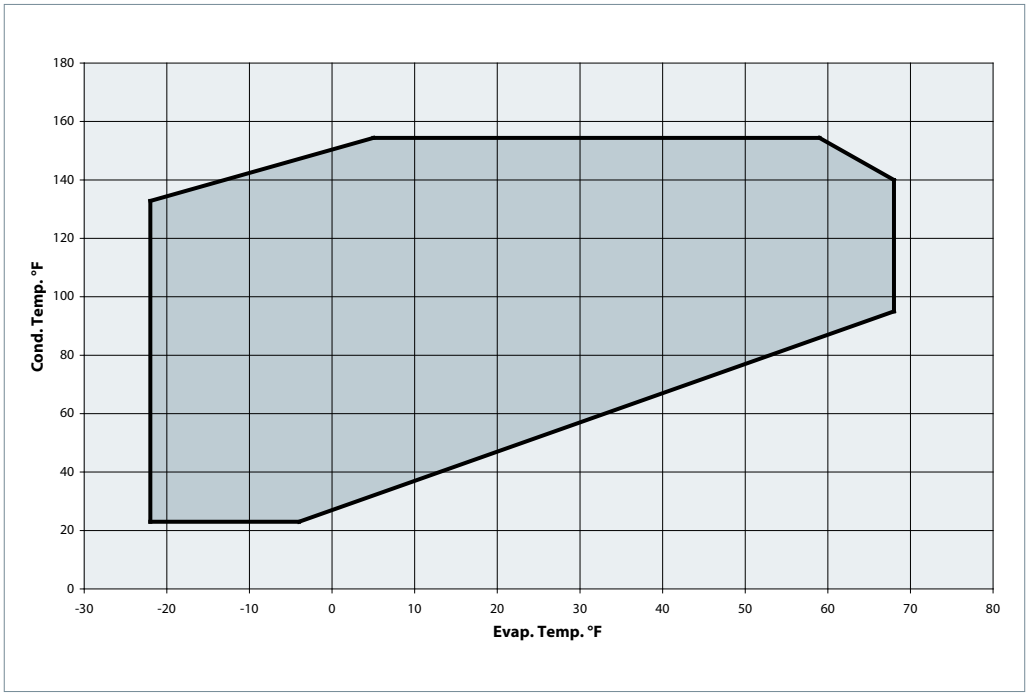
The phase sequencing and phase loss monitoring functions are active during a 5 seconds window 1 second after compressor start-up (power on L1-L2-L3)

LED 2 Status display	Blinking sequence	Status
●●○○●●○○○○	0.2secON/0.2secOFF 0.2secON/0.4secOFF	**ALARM 25** :Phase reverse error **ACTION**: STOP COMPRESSOR **RESTART**: Come back to stable status by manual reset
●●●●●○○○○○	0.5secON/0.5secOFF	**ALARM 24** :Phase loss error **ACTION**: STOP COMPRESSOR **RESTART**: Come back to stable status by manual reset

Application envelope

The operating envelope for PSH scroll compressors is given in the figure below, where the condensing and evaporating temperatures represent the range for steady-state operation. The operating limits serve to define the envelope within which reliable operations of the compressor are guaranteed:

- Maximum discharge gas temperature: 284°F (measured by DGT sensor),
- A suction superheat below 9°F is not allowed due to the risk of liquid flood back,
- Maximum suction superheat of 36°F
- A subcooling above 9°F is recommended to ensure proper liquid injection.
- Minimum and maximum evaporating and condensing temperatures as per the operating envelopes.



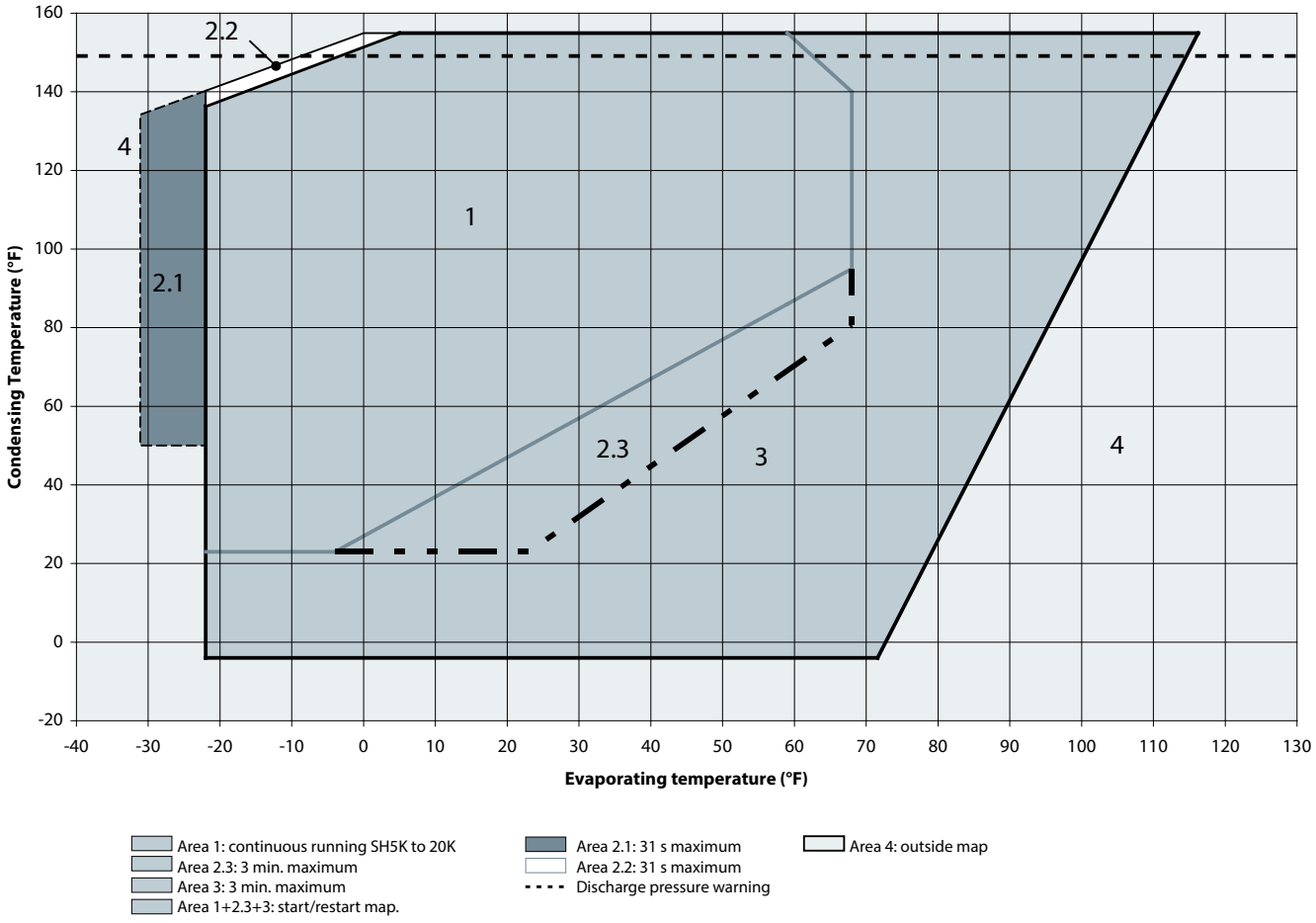
Transient conditions

The OCS controls the compressor operation by monitoring high pressure, low pressure and discharge temperature.

Alarms are displayed when the compressor exceeds the limits and the control circuit M1-M2 is opened if normal operation is not recovered within predefined delays (see table below).

Compressor start up is allowed only in starting areas 1, 2.3 and 3.

During start-up or defrost, the compressor may operate outside this envelope for short periods. Transient conditions (areas 2.1, 2.2, 2.3, 3) are allowed and also monitored by the OCS (see table below for details).



Alarms displayed by OCS and related taken actions

Conditions	ACTION before condition runs out	Delay	ACTION once condition has run out	Cumulated time	ACTION once the boundary condition has run out
Area 1	**no action**	∞	no action	∞	NA
Area 2.1	**WARNING W30**: "low suction pressure, stop in 31 sec"	31s	**ALARM A44**: "low suction pressure, compressor stopped" **ACTION**: stop the compressor **RESTART**: back to normal range then automatic reset and manual reset after 4 repeated occurrences in 24h.	250h	**WARNING W45**: "250h low suction pressure. Max duration exceeded"
Area 2.2	**WARNING W46**: "High compression ratio, stop in 31sec"	31s	**ALARM A31**: "High compression ratio, compressor stopped" **ACTION** : stop the compressor **RESTART**: back to normal range then automatic reset and manual reset after 4 repeated occurrences in 24h.	336h	**WARNING W32**: "336h high compression ratio. Max duration exceeded"
Area 2.3	**WARNING W33**: "Low pressure difference, stop in 3min"	3 min	**ALARM A34**: "Low pressure difference, compressor stopped" **ACTION** : stop the compressor **RESTART**: value back to normal range then automatic reset and manual reset after 4 repeated occurences in 24h.	2100h	**WARNING W35**: "2100h low pressure difference. Max. duration exceeded"
Area 3	**WARNING W50**: "Compressor back to starting area, stop in 3 min"	3 min	**ALARM A36**: "compressor outside envelope, compressor stopped" **ACTION**: stop the compressor **RESTART**: back to normal range then automatic reset and manual reset after 4 repeated occurrences in 24h.	∞	NA
Area 4	**ALARM A36**: "compressor outside envelope, compressor stopped" **ACTION: STOP THE COMPRESSOR RESTART:** back to normal range then automatic reset and manual reset after 4 repeated occurrences in 24h.	0s	no action	0s	NA
Area 3 AND [power switched on]	**WARNING W38** "compressor start outside envelope, stop in 3min" **UNIT ACTION: GO TO THE OPERATING ENVELOPE**.	3 min	**ALARM A39**: "compressor start outside envelope, compressor stopped" **ACTION** : stop the compressor **RESTART**: back to normal range then automatic reset and manual reset after 2 repeated occurrences in 1h.	7500h	**WARNING W40**: "7500h starting mode-Max duration exceeded"
Area 4 AND [power switched on]	**ALARM A41** "no start because pressure out of range" **ACTION** :no start	0s	no start	0s	no start
P disch > 604.8 psig	**WARNING W47**: "Discharge pressure close to HPS limit" **ACTION : UNLOAD THE UNIT**	∞	no action	∞	NA

Pressure transmitter accuracy and range

The OCS functionalities use the evaporating pressure and condensing pressure signals, and may be directly impacted by pressure transmitters accuracy.
To fully benefit from OCS functionalities (reliability features, overall application envelope with transient conditions) it is recommended to use ratiometric pressure transmitters (0-5V) with:

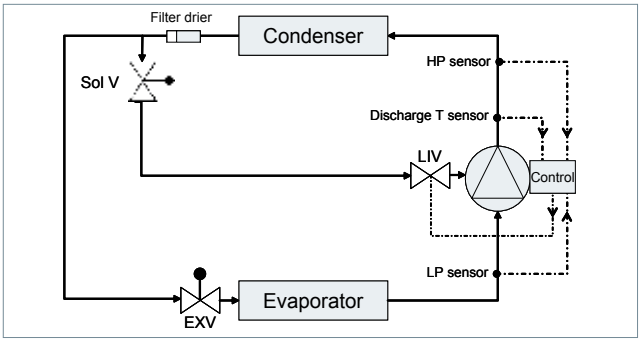
- accuracy lower than ±16.68 psi a on high pressure side, range 0-725 psi a
- accuracy lower than ±4.35 psi a on low pressure side, range 0-508 psi a.

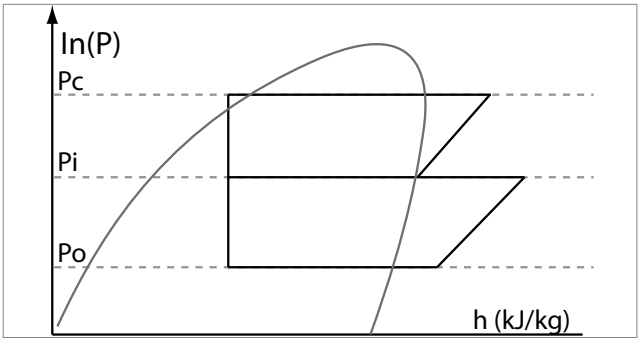
High pressure and low pressure transmitter (sensor + connector) accessories are available (refer to accessories list for code numbers).

Liquid injection

PSH compressors require liquid injection to maintain sufficiently low discharge gas temperature within the entire operating envelope. Liquid refrigerant is directly injected into the scroll set.
PSH compressors are provided with a liquid injection connection. Liquid pick-up has to be done at the bottom side of the liquid line piping and **downstream the filter drier**.

The Liquid Injection Valve regulates the liquid mass flow rate according to the discharge temperature.
Liquid injection is active only for evaporating temperature below 32°F and discharge temperature above 284°F.
A minimum 9°F subcooling is necessary to ensure correct liquid injection.





The Liquid Injection Valve (LIV) is a ETS6 stepper valve. This valve is closed when the compressors is idle.

Liquid injection valve accessory is available (refer to accessories list for code numbers).

An additional solenoid valve has to be installed in case of power shortage to prevent from liquid to come back to the compressor. Only one solenoid valve per unit is required. This solenoid valve must be a normally closed (NC) valve and a direct operation valve.

Discharge temperature protection

If discharge gas temperature exceeds 302°F and in case of liquid injection issue (not enough sub-cooling for example), the OCS will display a warning. The unit has 5 minutes to decrease the temperature below 302°F otherwise control circuit M1-M2 will be opened.

If discharge gas temperature reaches 320°F, the control circuit M1-M2 will open.

Discharge gas temperature sensor accessory (sensor + cable) is available (refer to accessories list for code numbers).

Conditions	ACTION before condition running out	Delay	ACTION once condition has running out	Cumulated time	ACTION once the boundary condition has running out
302°F ≥ discharge temp. < 320°F	**WARNING W27**: "max. discharge temp., stop in 5min"	5min.	**ALARM A28**: "max. discharge temp. , compressor stopped" **ACTION** : stop the compressor **RESTART**: back to normal range (≤293°F) then automatic reset and manual reset after 4 repeated occurrences in 24h.	1500h	**WARNING W29**: "1500h above max. disch. temp., change oil"
Discharge temp. ≥ 320°F	**ALARM A28**: "max. discharge temp. , compressor stopped"	0s	no action	0s	NA

Malfunction protection

The OCS also provides information about below listed malfunctions.

Maintenance operations should include an OCS diagnosis analysis, in order to check the warnings and alarms status history provided by the OCS.

Component	Detection Criteria(s)	Alarm	Action
Crankcase heater	Resistance out of operating range OR Current out of range	**WARNING W43**: "Crankcase heater dysfunction".	No action
Discharge Temperature sensor (1 on each compressor)	Resistance out of operating temperature range	**ALARM A42**: "Discharge Temperature sensor error"	STOP the compressor
Pressure transducers LP (1 on compressor OR via comm. bus)	Voltage out of sensor operating pressure range [0,1;4,9]V OR broadcasting not available via CAN-Bus	**ALARM A15**: "Low Pressure transmitter error".	Auto search for alternative sensor on the manifold, else STOP the compressor. RESTART sequence value back to normal range, then automatic reset.
Pressure transducers HP (1 on compressor OR via comm. bus)	Voltage out of sensor operating pressure range [0,1;4,9]V OR broadcasting not available via CAN-Bus	**ALARM A16**: "High Pressure transmitter error".	Auto search for alternative sensor on the manifold, else STOP the compressor. RESTART sequence value back to normal range, then automatic reset.
Motor PTC	Resistance out of operating range	**ALARM A20**: "PTC is open".	STOP the compressor (open Switch). RESTART sequence value back to normal range, then automatic reset.
CAN-Bus Compressor1 ←→ Compressor2 or Mainboard	Timeout 10s	**WARNING W21**: "Communication bus disabled"	No action
Modbus bus Compressor1 ←→ MAINBOARD	Timeout 1min	**WARNING W21**: "Communication bus disabled"	No action

High and low pressure protection

The OCS will display alarms when the compressor is running outside the operating envelope. The compressor will be stopped when it does not come back to normal running conditions within a defined delay.

High pressure

A high-pressure (HP) safety switch is required to shut down the compressor should the discharge pressure exceed the values shown in the table section "System pressure test". The high-pressure switch can be set to lower values depending on the application and ambient conditions. The HP switch must either be placed in a lockout circuit or consist of a manual reset device to prevent cycling around the high-pressure limit. If a discharge valve is used, the HP switch must be connected to the service valve gauge port, which can not be isolated.

High pressure safety switch test

High-pressure safety switch shall be tested on the unit and this test may be in conflict with OCS reliability protection in the case of HP switch setting is higher than "Pdisch_limit" (663 psi(a)). During this test, the alarm A36 and consecutively the opening of M1-M2 switch shall not be considered to validate the HP switch setting.

Internal pressure relief valve

The PSH077 incorporates an internal relief valve set to open between the internal high and low pressure sides of the compressor when the pressure differential between the discharge and suction pressures surpasses 615 to 711 psig. This safety feature prevents the compressor from developing dangerously high pressures should the high pressure cut-out, for whatever reason, fail to shut down the compressor.

Low pressure

Deep vacuum operations of a scroll compressor can cause internal electrical arcing and scroll instability. Danfoss PSH Scroll compressors exhibit high volumetric efficiency and may draw very low vacuum levels, which could induce such a problem. Low back pressure protection is integrated in OCS function, so no additional protection is needed.

LP switch settings for pump-down cycles with automatic reset are listed in the table below.

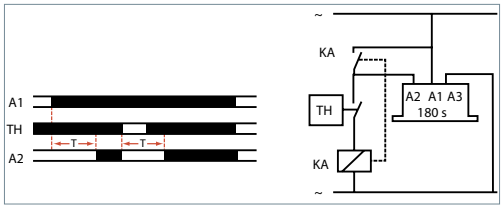
Pressure settings		R410A
Working pressure range high side	psig	84 - 648
Working pressure range low side	psig	25 - 194
Maximum high pressure safety switch setting	psig	669
Minimum low pressure pump-down switch setting *	psig	25

* Recommended pump-down switch settings: 21 psig below nominal evap. pressure with minimum of 25 psig

The low pressure pump down switch setting must always be within the operating envelope, for example 25 psig for R410A. The compressor can be operated full time under such condition.

Cycle rate limit

Danfoss recommends a restart delay timer to limit compressor cycling. The timer prevents reverse compressor rotation, which may occur during brief power interruptions. The system must be designed in a way that guarantees a minimum compressor running time of 2 minutes so as to provide for sufficient motor cooling after start-up along with proper oil return. Note that the oil return may vary since it depends upon system design. There must be no more than 12 starts per hour, a number higher than 12 reduces the service life of the motor-compressor unit. A three-minute (180-sec) time out is recommended.



Please contact Danfoss Technical Support for any deviation from this guideline.

Data storage displayed by OCS

The OCS is able to record data for operating checking, maintenance, inspection. Data can be displayed by Modbus, CAN-Bus or MMIMYK/ MMIGRS interfaces.

There are 4 types of data available:
- Traceability data
- Operation parameter recording
- Alarms, warnings and events
- Event counter

Alarms regarding motor protection and operating envelope monitoring are displayed.

Traceability data

In order to ensure traceability the information below are pre-set
- compressor serial number CSN
- Software version
- Board reference
- Board serial number
- Temperature unit (in °F by default)
- Pressure unit

Operation parameter recording

The following parameters are recorded for the 3 last years:

Parameters	Abbreviation	Value frame	Indicative Range	Unit
Condensing pressure	Pc	00,0	0-50	Bar or gauge
Evaporating pressure	Pe	00,0	0-30	Bar or gauge
Discharge temperature	DGT	000	-31 / +338°F	°F
Surface sump heater	SSH	0 for OFF - 1for ON	0-1	NA
Clock	NA	YY/MM/DD_HH:MM:SS	NA	NA
Liquid injection valve opening degree	OD	00,0	0-100	% PID regulator Data (valve opening)
Compressor On	Cpr	0 for OFF – 1 for ON	0-1	NA

Alarms, warning and events

A buffer storage for alarms, warning and events will follow First-In First-Out (FIFO) rules. A total capacity of 3000 lines is available.

Event counter

A definite storage file running as a counter will record the following data:
- Each alarm
- Each event
- Surface sump heater on/off
- Compressor on/off
- Liquid injection valve closing

The storage period is minimum 3 years for each data.

MMIGRS and MMIMYK are electronic user interfaces used to communicate with OCS.

MMIMYK and MMIGRS Electronic controllers

MMIGRS is a remote LCD screen display. It allows reading of variable data and parameters (instantaneous values).

MMIGRS address is NodeID 126 by default.

MMIGRS panel mounting accessory is available (refer to accessories list for code number).

For MMIGRS instructions, see document: DKRCC.PI.RJO.C2.1U

MMIMYK can be used to download programs on OCS and allows data storage recovery.

MMIMYK address is NodeID 127 by default.

MMIMYK accessory is available (refer to accessories list for code number).

For MMIMYK instructions, see document: DKRCC.PI.RJO.B1.1U

RJ11 connection cable is available as accessories. Refer to code number in section "Accessories".

Data read-out

Data can be read by connecting MMIGRS to the OCS via RJ11 cable. Select the address of the compressor for data reading. Then:

- "Status/Read out" menu : Parameters can be read on the screen.
- "Alarms/Active alarms" menu displays active alarms.
- "Alarms/Alarm log" menu displays 40 last alarms and warnings, since last OCS power-off.
- "Service" menu displays various information about real time clock software revision, bios revision, OCS serial number, compressor serial number.

Data storage recovery

Both MMIGRS and MMIMYK are needed to recover data

- MMIGRS initiates data storage transfer: Connect MMIGRS to OCS via RJ11 cable. "Parameter/General/Set up/log transmit" menu allows to choose between different types of data transfer and to transfer data from OCS to a SD card.

Data transfer type	Log frequency	File name
L01	Each 5 sec.	005FFF01
L12	Each 20 sec.	005FFF02
L24	Each 5 min.	005FFF03
EVNT	Each time alarm or warning occur or reset	005FFF03

Disconnect MMIGRS

- MMIMYK recovers data: Connect MMIMYK to the OCS via RJ11 cable. Power-off the OCS. Power-on it. Data will be transferred to a file in SD card. This file can be translated in .csv file thanks to a specific application.

Please contact Danfoss Technical Support for any additional information.

General hardware network and communication protocol

CAN-Bus and RS485 hardware network must follow the recommendations described in the document DKRCC.PS.RIO.F1.02.

CAN-Bus and Modbus RS485 Communication protocol parameters are as follow:
a. CANOPEN: nodeID: 1, baudrate: 50K

b. Modbus RS485: ID: none, baudrate: 9600, databits: 8, partity: NONE, stop bits: 1.

Compressor address set-up for CAN-Bus and Modbus

Compressor NodeID must be changed to have individual address. There are two ways to change the compressor address:

- Dipswitches on OCS (recommended).
- NodeID from MMIMYK

Dipswitches

Dipswitches on OCS are set at 0 by default and have to be changed following the recommendation below:
Before changing the compressor address on dipswitches, the OCS must be powered-off.
A valid NodeID has to be set as binary code.

The 4 first dipswitches (1 to 4) are for compressor identifiant, the 3 last dipswitches (5 to 7) are for circuit/rack identification.
Below tables give examples.
The dipswitch address is read as NodeID at power-up and changed if address is valid (1 to 125).

Dipswitches on OCS								address
Compressor				Circuit				
1	2	3	4	5	6	7	8	
								default

Example 1: 1 circuit, 3 compressors

Compressor 1								
1								1
Compressor 2								
	1							2
Compressor 3								
1	1							3

Example 2: 2 circuits, 2 compressors per circuit

Compressor 1				Circuit A				
1				1				17
Compressor 2				Circuit A				
	1			1				18
Compressor 1				Circuit B				
1					1			33
Compressor 2				Circuit B				
	1				1			34

Example 3: 2 circuits, 3 compressors per circuit

Compressor 1				Circuit A				
1				1				17
Compressor 2				Circuit A				
	1			1				18
Compressor 3				Circuit A				
1	1			1				19
Compressor 1				Circuit B				
1					1			33
Compressor 2				Circuit B				
	1				1			34
Compressor 3				Circuit B				
1	1				1			35

NodeID

NodeID can be changed with a MMIMYK connected to OCS with a RJ11 cable. CAN-Bus must be deconnected and NodeID has to be set separately on each compressor.
Check that MMIMYK communicates properly with the compressor OCS.

NodeID can be changed through menu Program/ Config Node/NodeID.
⚠ If NodeID is changed by MMIMYK, the dipswitch setting on OCS will not show the active NodeID.

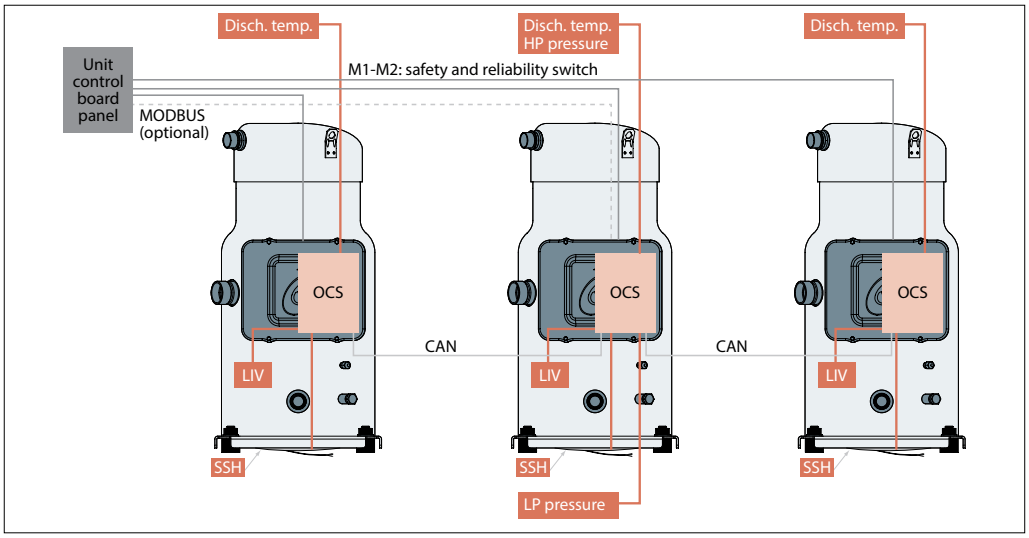
CAN-Bus and Modbus communication with OCS

The CAN-Bus connection will allow:

- sharing LP and HP pressure sensors in the rack
- Surface sump heater (SSH) consumption management

The Modbus connection will allows:

- sharing LP and HP pressure sensors with the unit
- identification of compressor address for diagnosis.
- alarm reading



Pressure signals must be entered to OCS. There are 2 options:

1. The preferred option is to connect the pressure transmitters on one of the OCS of the compressors rack. This ensures a fast reactivity regarding compressors protection, with a polling time of 1 second.
   The other OCS of the compressors rack will receive pressure information via broadcasting through the CAN connection. In this case, the unit controller can access to the pressure information through Modbus:
   - Unit type is psi absolute
   - scaled x10000 (174000 equals 174 psi absolute)
   - valid range 0.0 – 2900 psi absolute

2. The pressure signals can also be transmitted from the unit controller through Modbus communication.
   In this case, the LP and HP pressures should be written in the following registers of the OCS connected to the unit.

Signal	Register (long)		High word		Low word	
	Hex.	Dec.	Hex.	Dec.	Hex.	Dec.
Pc	0x1F4	500	0x1F4	500	0x1F5	501
Pe	0x1F6	502	0x1F6	502	0x1F7	503

The signal content is as in following exemple:
Pc = 23.5678 bar absolute
Scaled value: 23.5678*10000 = 235678 (same in hexadecimal form: 0x0003989E)
Low word: 0x989E (decimal value = 39070)
High word: 0x0003 (decimal value = 3)
This OCS will broadcast these pressures to all the other OCS of the compressor rack. A transmission period of max 2 seconds is recommended.

OCS will detect Modbus communication timeout after 3 seconds. In this case:

- If a backup transmitter is connected to another OCS board, then the local signal will be used and this backup transmitter will start broadcasting.
- If no backup transmitter is present in the rack, all compressors will be stopped.

Measurements

Variable		Register	
Description:	Note	Hex	Dec
AI_Pc_x10	Measured condensing pressure	0x3900	14592
AI_Pe_x10	Measured evaporating pressure	0x3901	14593
Tc_x10	Calculated condensing temperature	0x3902	14594
Te_x10	Calculated evaporatinging temperature	0x3903	14595
Liq_Ctrl_ref_x10	Injection control temperature	0x3906	14598
Liq_Ctrl_error_x10	Injection control error	0x3907	14599
Liq_valve_OD_x10	Valve opening degree %	0x3908	14600
Map_pos	Possition on operating envelope area	0x3909	14601
MaxDischargeTemp_log	Max. discharge temperature time counter	0x390A	14602
MinSucPressure__log	Min. suction pressure time counter	0x390B	14603
HighPressureRatio_log	High pressure ratio time counter	0x390C	14604
LowPressureDiff_log	Low pressuredifference time counter	0x390D	14605
MaxTimeStartMode_log	Max. time start mode time counter	0x390E	14606
DO_Start	Relay output status for Contactor switch	0x390F	14607
DO_SurfaceSumpHeater	Relay output status for Sumpheater	0x3910	14608
DI_status	bit 6: DI_SSH_failure bit 5: DI_wrong_phase_sequence bit 4: - not used bit 3: - not used bit 2: DI_Phase_loss bit 1: DI_compr_Stopped bit 0: DI_PTC_alarm	0x3912	14610
PTC_resistance_x4	PTC measurement [ohm] (when compressor is off)	0x3913	14611
SSH_mA_V	SSH measured value SSH ON: [mA], SSH OFF: [Volt]	0x3914	14612
ComprRunStatus	0: stopped 1: running	0x3915	14613

Alarms and warning

Variable		Register	
Description	Note	Hex	Dec.
Warning W09	W09 Wait 6hrs SSH on or jog before start	0x3207	12807
Warning W13	W13 Cps start before 6hrs SSH on	0x320D	12813
Alarm A15	A15 Low Pressure transmitter error	0x320F	12815
Alarm A16	A16 High Pressure transmitter error	0x3210	12816
Alarm A20	A20 PTC is open	0x3214	12820
Warning W21	W21 Communication bus disabled	0x3215	12821
Alarm A22	A22 Compressor overloaded/PTC tripping	0x3216	12822
Alarm A24	A24 Phase loss sequence	0x3218	12824
Alarm A25	A25 Wrong phase sequence	0x3219	12825
Warning W26	W26 OCS excessive temperature	0x321A	12826
Warning W27	W27 Max discharge temp. , stop in 5 min	0x321B	12827
Alarm A28	A28 Max discharge temp. , cpr stopped	0x321C	12828
Warning W29	W29 1500h above max disch.temp. - change oil	0x321D	12829
Warning W30	W30 Low suction pressure, stop in 31 sec	0x321E	12830
Alarm A31	A31 High compression ratio, cpr stopped	0x321F	12831
Warning W32	W32 336h High compres. ratio, Max duration ex	0x3220	12832
Warning W33	W33 Low pressure difference, stop in 3 min	0x3221	12833
Alarm A34	A34 Low pressure difference, cpr stopped	0x3222	12834
Warning W35	W35 2100h Low pressure diff., Max duration ex	0x3223	12835
Alarm A36	A36 Compressor outside envelop, cpr stopped	0x3224	12836
Warning W38	W38 Cpr start outside envelop, stop in 3 min	0x3226	12838
Alarm A39	A39 Cpr start outside envelop, cpr stopped	0x3227	12839
Warning W40	W40 7500 h outside start envelop-duration exed	0x3228	12840
Alarm A41	A41 No start because pressure outside range	0x3229	12841
Alarm A42	A42 Discharge Temperature sensor error	0x322A	12842
Warning W43	W43 Crankcase heater dysfunction	0x322B	12843
Alarm A44	A44 low suction pressure, cpr stopped	0x322C	12844
Warning W45	W45 250h low suction pressure-max duration ex	0x322D	12845
Warning W46	W46 High compression ratio, stop in 31 sec	0x322E	12846
Warning W47	W47 Disch. Pressure close to HPS limit	0x322F	12847
Alarm A48	A48 Liquid Injection Coil error	0x3230	12848
Warning W50	W50 Comp, back to starting area, stop in 3 min	0x3202	12802

General

Successful application of scroll compressors is dependent on careful selection of the compressor for the application. If the compressor is not correct for the system, it will operate beyond the limits given in this manual. Poor performance, reduced reliability, or both may result.

Essential piping design considerations

The working pressure in systems with R410A is about 60% higher than in systems with R22 or R407C. Consequently, all system components and piping must be designed for this higher pressure level.

Proper piping practices should be employed to ensure adequate oil return, even under minimum load conditions with special consideration given to the size and slope of the tubing coming from the evaporator. Tubing returns from the evaporator should be designed so as not to trap oil and to prevent oil and refrigerant migration back to the compressor during off-cycles.

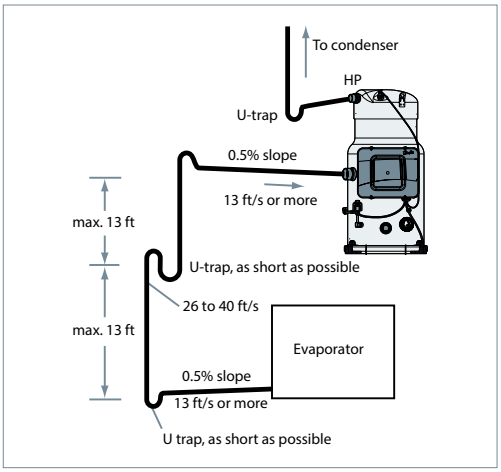
In systems with R410A, the refrigerant mass flow will be lower compared to R22/R407C systems. To maintain acceptable pressure drops and acceptable minimum gas velocities, the refrigerant piping must be reduced in size compared to R22 / R407C systems. Take care not to create too high pressure drops or since in R410A systems the negative impact of high pressure drops on the system efficiency is stronger than in R22/R407C systems.

Piping should be designed with adequate three-dimensional flexibility. It should not be in contact with the surrounding structure, unless a proper tubing mount has been installed. This protection proves necessary to avoid excess vibration, which can ultimately result in connection or tube failure due to fatigue or wear from abrasion. Aside from tubing and connection damage, excess vibration may be transmitted to the surrounding structure and generate an unacceptable noise level within that structure as well. For more information on noise and vibration, see section "Sound and vibration management".

Suction lines

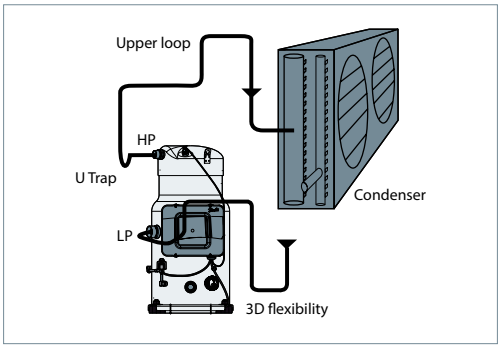
If the evaporator lies above the compressor, as is often the case in split or remote condenser systems, the addition of a pump-down cycle is strongly recommended. If a pump-down cycle were to be omitted, the suction line must have a loop at the evaporator outlet to prevent refrigerant from draining into the compressor during off-cycles.

If the evaporator were situated below the compressor, 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.



Discharge lines

When the condenser is mounted at a higher position than the compressor, a suitably sized "U"-shaped trap close to the compressor is necessary to prevent oil leaving the compressor from draining back to the discharge side of the compressor during off cycle. The upper loop also helps avoid condensed liquid refrigerant from draining back to the compressor when stopped.



Heat exchangers

To obtain optimum efficiency of the complete refrigerant system, optimised R410A heat exchangers must be used. R410A refrigerant has good heat transfer properties: it is worthwhile designing specific heat exchangers to gain in size and efficiency.

An evaporator with optimised R410A distributor and circuit will give correct superheat at outlet and optimal use of the exchange surface. This is critical for plate evaporators that have generally a shorter circuit and a lower volume than shell & tubes and air cooled coils.

For all evaporator types a special care is required for superheat control leaving the evaporator and oil return.

A sub-cooler circuit in the condenser that creates high sub cooling will increase efficiency at high condensing pressure. In R410A systems the positive effect of sub cooling on system efficiency will be significantly larger than in R22/R407C systems.

Furthermore, for good operation of the expansion device and to maintain good efficiency in the evaporator it is important to have a high degree of liquid sub cooling. Without adequate sub cooling, flash gas will be formed at the expansion device resulting in a high degree of vapour at the evaporator inlet leading to low efficiency.

Off-cycle migration

Off-cycle refrigerant migration is likely to occur when the compressor is located at the coldest part of the installation, when the system uses a bleed-type expansion device, or if liquid is allowed to migrate from the evaporator into the compressor sump by gravity. If too much liquid refrigerant accumulates in the sump it will saturate the oil and lead to a flooded start: when the compressor starts running again, the refrigerant evaporates abruptly under the sudden decrease of the bottom shell pressure, causing the oil to foam. In extreme situations, this might result in liquid slugging (liquid entering the scroll elements), which must be avoided as it causes irreversible damage to the compressor.
Danfoss PSH scroll compressors can tolerate occasional flooded starts as long as the total system charge does not exceed the maximum compressor refrigerant charge.

A suitable test to evaluate the risk of off-cycle migration is the following:

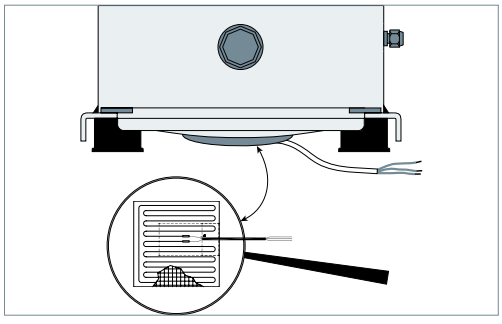
- Stabilize the non running system at 41°F ambient temperature,
- Raise the ambient temperature to 68°F and keep it for 10 minutes,
- Start the compressor and monitor sump temperature, sight glass indication and sound level.

The presence of liquid in the crankcase can be easily detected by checking the sump level through the oil sight glass. Foam in the oil sump indicates a flooded start.
A noisy start, oil loss from the sump and sump cool down are indications for migration.
Depending on the amount of migration graduate measures shall be taken:

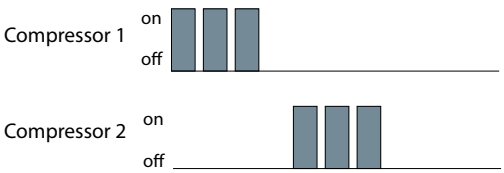
- **Sump heater (pre-installed)**
- **Liquid line solenoid valve**
- **Pump down cycle**

Sump heater

The surface sump heaters are designed to protect the compressor against off-cycle migration of refrigerant.



At initial start-up or after power shortage, it is recommended to energize surface sump heater to remove refrigerant 6 hours in advance. A quicker start-up is possible by "jogging" the compressor to evacuate refrigerant in the compressor. Start the compressor for 1 second, then wait for 1 to 2 minutes. This operation must be repeated for each compressor individually:



Application guidelines	System design recommendations	
	Compressor 3 on / off 	After 3 or 4 jogs the compressor can be started. Then, optimum management of the Surface Sump Heater (SSH) is provided by the operating Control System (OCS).
Liquid line solenoid valve (LLSV)	A LLSV may be used to isolate the liquid charge on the condenser side, thereby preventing against charge transfer or excessive migration to the compressor during off-cycles. The quantity of	refrigerant on the low-pressure side of the system can be further reduced by using a pump-down cycle in association with the LLSV.
Pump-down cycle	A pump-down cycle represents one of the most effective ways to protect against the off-cycle migration of liquid refrigerant. Once the system has reached its set point and is about to shut off, the LLSV on the condenser outlet closes. The compressor then pumps the majority of the refrigerant charge into the condenser and receiver before the system stops on the low pressure pump-down switch. This step reduces the amount of charge on the low side in order to prevent off-cycle migration. The recommended low-pressure pump-down switch setting is 22 psig below the nominal evaporating pressure. It shall not be set lower than 25 psig. For suggested wiring diagrams, please see section "Suggested wiring diagrams". **Tests for pump down cycle approval**: • As the pump-down switch setting is inside the application envelope, tests should be carried out to check unexpected cut-out during transient conditions (ie. defrost – cold starting). When unwanted cut-outs occur, the low pressure pump-down switch can be delayed. In this case a low pressure safety switch without any delay timer is mandatory.	• While the thermostat is off, the number of pressure switch resets should be limited to avoid short cycling of the compressor. Use dedicated wiring and an additional relay which allows for one shot pump-down. The pump-down allows to store all the refrigerant in the high pressure side circuit. On unitary or close-coupled systems, where the system refrigerant charge is expected to be both correct and definable the entire system charge may be stored in the condenser during pump-down if all components have been properly sized. Other application needs a liquid receiver to store the refrigerant. Receiver dimensioning requires special attention. The receiver shall be large enough to contain part of the system refrigerant charge but it shall not be dimensioned too large. A large receiver easily leads to refrigerant overcharging during maintenance operation.
Liquid flood back	During normal operation, refrigerant enters the compressor as a superheated vapour. Liquid flood back occurs when a part of the refrigerant entering the compressor is still in liquid state. Danfoss PSH scroll compressors can tolerate occasional liquid flood back. However system	design must be such that repeated and excessive flood back is not possible. A continuous liquid flood back will cause oil dilution and, in extreme situations lead to lack of lubrication and high rate of oil leaving the compressor.
	Liquid flood back test - Repetitive liquid flood back testing must be carried out under expansion valve threshold operating conditions: a high pressure ratio and minimum evaporator load, along with the measurement of suction superheat, oil sump temperature and discharge gas temperature.	**During operations**, liquid flood back may be detected by measuring either the oil sump temperature or the discharge gas temperature. If at any time during operations, the oil sump temperature drops to within 18°F or less above the saturated suction temperature, or should the discharge gas temperature be less than 63°F

above the saturated discharge temperature, this indicates liquid flood back.

Continuous liquid flood back can occur with a wrong dimensioning, a wrong setting or malfunction of the expansion device or in case of evaporator fan failure or blocked air filters.

A suction accumulator providing additional protection as explained hereunder can be used to solve light continuous liquid flood back.

Suction accumulator: a suction accumulator offers protection against refrigerant flood back at start-up, during operations or defrosting by trapping the liquid refrigerant upstream from the compressor. The suction accumulator also protects against off-cycle migration by providing additional internal free volume to the low side of the system.

A suction accumulator must be carefully dimensioned, taking into account the refrigerant charge as well as the gas velocity in the suction line.

The accumulator should not be sized for less than 50 % of the total system charge. Tests must be conducted to determine the actual refrigerant holding capacity needed for the application.

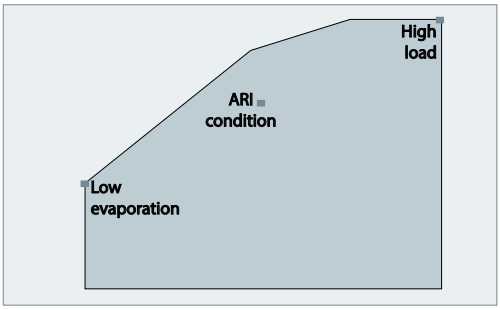
Depending on the operating conditions it may happen that the recommended connections of the accumulator are one size smaller than the suction line.

Oil equalisation

Suction gas in a hermetic compressor flows via the oil sump which makes it more difficult to maintain equal pressure in the sumps of parallel compressors. Since oil equalisation usually depends on equal sump pressures this is a point of special attention. Danfoss Commercial Compressors has developed specially adapted oil equalisation systems which ensure proper oil balancing between the manifold compressors but it is always recommended to carry out some tests to validate effective operation and oil equalisation of compressors in parallel installation at any operating conditions of final application.

Test conditions

Tests shall be done at three points in final application envelope:
- ARI-based conditions
- Low evaporation (SH18°F): low flow rate / pure oil/ low oil level
- High load (SH18°F): high flow rate/ diluted oil/ high oil level



Test sequences

- Continuous for all compressors: 100% charge (all compressors continuous running)
- Continuous with partial charge: all partial charges configuration must be tested
- On/Off test: after 2 minutes shutdown of any compressor, the oil level has to retrieve a proper oil level within 1 minute when the compressor is switched back on.
- Transient 100% load: in transient condition such as end of defrost with temporary liquid flood back, check that oil return to normal level.

Oil level criteria

- The oil level of running compressors must be visible or full in the sight glass of running compressors at all operating conditions described before.
- The oil level of idle compressors may disappear in the oil sight glass.
- The oil level must retrieve a visible level in all compressors after the unit is stopped.
- Oil level top up might be necessary to retrieve a visible oil level in the sight glasses. Always use a Danfoss oil from new can (see section accessories).
- On units working 100% load continuously, a compressor oil level might decrease. In order to avoid any loss of oil, regular unit stops might be needed to re equilibrate oil levels in the compressors.

Application guidelines	Specific application recommendations

Low ambient application

Low ambient start-up

Under cold ambient conditions (<32°F), upon start-up the pressure in the condenser may be so low that a sufficient pressure differential across the expansion device cannot be developed to properly feed the evaporator.
As a result, the compressor may go into a deep vacuum, which can lead to compressor failure due to internal arcing and instability in the scroll wraps. Under no circumstances should the compressor be allowed to operate under vacuum. The low-pressure control must be set in accordance with the table section "Low pressure" in order to prevent this from happening.

Early feeding of the evaporator and management of the discharge pressure could help to attenuate these effects.

Low pressure differentials can also cause the expansion device to "hunt" erratically, which might cause surging conditions within the evaporator, with liquid spillover into the compressor. This effect is most pronounced during low load conditions, which frequently occur during low ambient conditions.

Low ambient operations

The Danfoss PSH scroll compressor requires a minimum pressure differential of 87 to 102 psig between the suction and discharge pressures to force the orbiting scroll down against the oil film on the thrust bearing. Anything less than this differential and the orbiting scroll can lift up, causing a metal-to-metal contact.
It is therefore necessary to maintain sufficient discharge pressure in order to ensure this pressure differential. Care should be taken during low ambient operations when heat removal from air-cooled condensers is greatest and head pressure control may be required for low ambient temperature applications. Operation under low pressure differential may be observed by a significant increase in the sound power level generated by the compressor.
It is recommended that the unit be tested and monitored at minimum load and low ambient conditions as well. The following considerations should be taken into account to ensure proper system operating characteristics.

Expansion device: The expansion device should be sized to ensure proper control of the refrigerant flow into the evaporator. An oversized valve may result in erratic control. This consideration is especially important in manifolded units where low load conditions may require the frequent cycling of compressors. This can lead to liquid refrigerant entering the compressor if the expansion valve does not provide stable refrigerant super-heat control under varying loads.

The superheat setting of the expansion device should be sufficient to ensure proper superheat levels during low loading periods. A minimum of 9°F stable superheat is required.

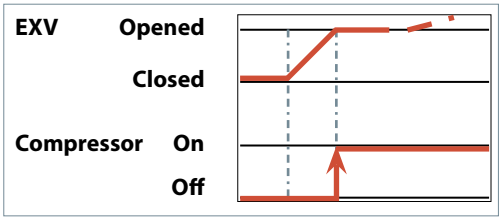
Head pressure control under low ambient conditions: Several possible solutions are available to prevent the risk of compressor to vacuum and low pressure differential between the suction and discharge pressures.

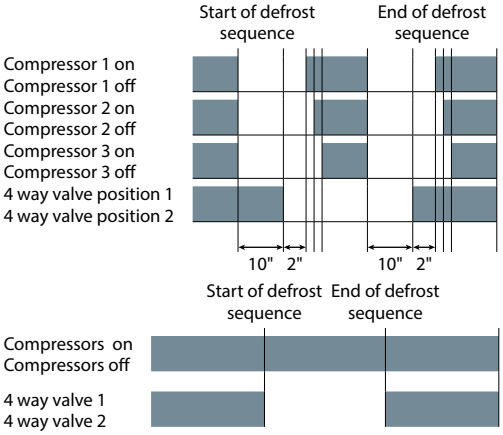
In air-cooled machines, cycling the fans with a head pressure controller will ensure that the fans remain off until the condensing pressure has reached a satisfactory level. Variable speed fans can also be used to control the condensing pressure. In water-cooled units, the same can be performed using a water regulator valve that is also operated by head pressure, thereby ensuring that the water valve does not open until the condensing pressure reaches a satisfactory level.

The minimum condensing pressure must be set at the minimum saturated condensing temperature shown in the application envelopes.

Under very low ambient conditions, in which testing has revealed that the above procedures might not ensure satisfactory condensing and suction pressures, the use of a head pressure control valve is recommended. Note: This solution requires extra refrigerant charge, which can introduce other problems. A non-return valve in the discharge line is recommended and special care should be taken when designing the discharge line.

For further information, please contact Danfoss.

Application guidelines	Specific application recommendations	
Low load operation	The compressors should be run for a minimum period in order to ensure that the oil has sufficient time to properly return to	the compressor sump and that the motor has sufficient time to cool under conditions of lowest refrigerant mass flows.
Brazed plate heat exchangers	A brazed plate heat exchanger needs very little internal volume to satisfy the set of heat transfer requirements. Consequently, the heat exchanger offers very little internal volume for the compressor to draw vapour from on the suction side. The compressor can then quickly enter into a vacuum condition. It is therefore important that the expansion device be sized correctly and that a sufficient pressure differential across the expansion device be available to ensure adequate refrigerant feed into the evaporator. This aspect is of special concern when operating the unit under low ambient and load conditions. For further information on these conditions, please refer to the previous sections.	Due to the small volume of the brazed plate heat exchanger, no pump-down cycle is normally required. The suction line running from the heat exchanger to the compressor must be trapped to avoid refrigerant migration to the compressor. When using a brazed plate condenser heat exchanger, a sufficient free volume for the discharge gas to accumulate is required in order to avoid excess pressure build-up. At least 3.28 ft of discharge line are necessary to generate this volume. To help reduce the gas volume immediately after start-up even further, the supply of cooling water to the heat exchanger may be opened before the compressor starts up so as to remove superheat and condense the incoming discharge gas more quickly.
Electronic expansion valve	The use of an electronic expansion valve requires a specific compressor start / stop control. A specific compressor start sequence control has to be set when an electronic expansion valve (EXV) is used. The sequence must be adjusted according to the EXV step motor speed to allow time for the EXV to open before the compressor starts to avoid running under vacuum conditions.	The EXV should be closed at compressor stop not to let refrigerant in liquid phase entering the compressor. Ensure that the EXV closes when the supply voltage to the controller is interrupted (ie power cut off) by the use of a battery back up. 
Reversible heat pump systems	Transients are likely to occur in reversible heat pump systems, i.e. a changeover cycle from cooling to heating, defrost or low-load short cycles. These transient modes of operation may lead to liquid refrigerant carry-over (or flood back) or excessively wet refrigerant return conditions. As such, reversible cycle applications require specific precautions for ensuring a long compressor life and satisfactory operating characteristics. Regardless of the refrigerant	charge in the system, specific tests for repetitive flood back are required to confirm whether or not a suction accumulator needs to be installed. The following considerations cover the most important issues when dealing with common applications. Each application design however should be thoroughly tested to ensure acceptable operating characteristics.
Discharge line and reversing valve	The Danfoss PSH scroll compressor is a high volumetric machine and, as such, can rapidly build up pressure in the discharge line if gas in the line becomes obstructed even for a very short period of time which situation may occur with slow-acting, reversing valves in heat pumps. Discharge pressures exceeding the operating envelope may result in nuisance high-pressure	switch cutouts and place excess strain on both the bearings and motor. To prevent such occurrences, it is important that a 3.2 ft minimum discharge line length be allowed between the compressor discharge port and the reversing valve or any other restriction. This gives sufficient free volume for the discharge

Application guidelines	Specific application recommendations	
	gas to collect and to reduce the pressure peak during the time it takes for the valve to change position. At the same time, it is important that the selection and sizing of the reversing or 4-way valve ensure that the valve switches quickly	enough to prevent against too high discharge pressure and nuisance high-pressure cutouts. Check with the valve manufacturer for optimal sizing and recommended mounting positions.
Defrost and reverse cycle	The Danfoss PSH scroll compressor has the ability to withstand a certain amount of liquid refrigerant dynamic slug. When compressors are installed in parallel, in order to limit liquid amount handled per compressor when beginning and ending defrost, it is recommended to avoid running part load (keep all compressors running or keep them stopped when moving 4-way valves). In order to limit liquid amount handled per compressor when beginning & ending defrost, one of the 2 defrost cycle logics are required: • stop all compressors before moving the 4 way valve: ‣ first stop compressors ‣ wait for 10 seconds ‣ move the 4 way valve ‣ wait for 2 seconds ‣ restart the compressors with a max. 0.5 second delay between 2 successive starts or • keep all compressors running during defrost cycle	Defrost cycle logic must respect all system components recommendations, in particular 4 way valve Max. Operating Pressure Differential.  EXV can also be opened when compressors are stopped and before 4 way valve is moving in order to decrease pressure difference. Opening degree and time have to be set in order to keep a minimum pressure difference for 4 way valve moving. Each application design however should be thoroughly tested to ensure acceptable operating characteristics.
Suction line accumulator	The use of a suction line accumulator is strongly recommended in reversible-cycle applications. This because of the possibility of a substantial quantity of liquid refrigerant remaining in the evaporator, which acts as a condenser during the heating cycle. This liquid refrigerant can then return to the compressor, either flooding the sump with refrigerant or as a dynamic liquid slug when	the cycle switches back to a defrost cycle or to normal cooling operations. Sustained and repeated liquid slugging and flood back can seriously impair the oil's ability to lubricate the compressor bearings. This situation can be observed in wet climates where it is necessary to frequently defrost the outdoor coil in an air source heat pump. In such cases a suction accumulator becomes mandatory.
Water utilizing systems	Apart from residual moisture in the system after commissioning, water could also enter the refrigeration circuit during operation. Water in the system shall always be avoided. Not only because it can shortly lead to electrical failure, sludge in sump and corrosion but in particular because it can cause serious safety risks. Common causes for water leaks are corrosion and freezing. Corrosion: Materials in the system shall be compliant with water and protected against corrosion.	Freezing: When water freezes into ice its volume expands which can damage heat exchanger walls and cause leaks. During off periods water inside heat exchangers could start freezing when ambient temperature is lower than 32°F. During on periods ice banking could occur when the circuit is running continuously at too low load. Both situations should be avoided by connecting a pressure and thermostat switch in the safety line.

Starting sound level

During start-up transients it is natural for the compressor sound level to be slightly higher than during normal running. PSH scroll compressors exhibit very little increased start-up transient sound. If a compressor is miswired, the compressor will run in reverse. Reverse compressor rotation is characterized by an objectionable sound. To correct reverse rotation, disconnect power and switch any two of the three power leads at the unit contactor.

Never switch leads at the compressor terminals.

Running sound level

Bottom insulation delivered together with the compressor incorporates sound proofing materials and offer excellent high and low frequency attenuation.

As an option, compressor acoustic hoods have been developed to meet specific extra-low noise requirements.

	Sound power dB(A)	Sound power dB(A)	
		50Hz	60Hz
Compressor	PSH051	84	87.5
	PSH064	87	90
	PSH077	84	88.5
Tandem	PSH104	87	90.5
	PSH115	88.8	91.9
	PSH130	90	93
	PSH128	87	91
	PSH141	88.8	92.3
	PSH154	87	91.5
Trio	PSH153	88.8	92.3
	PSH152	91.8	94.8
	PSH231	88.8	93.3

Stopping sound level

PSH compressors are equipped with a discharge valve which closes at compressor shut down and thus prevents the compressor from running backwards.

This reduces the stopping sound to a metallic click caused by the closing valve.

When the pressure difference or gas flow at shut down should be very low, this can delay the discharge valve from closing and lead to a longer noise duration.

Compressor handling and storage

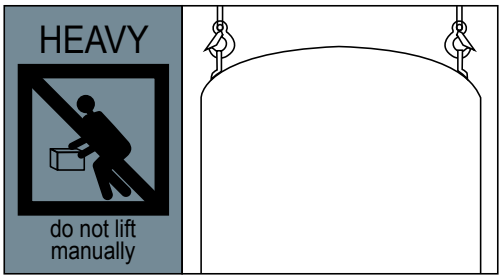
Each Danfoss PSH scroll compressor is equipped with two lift rings on the top shell. Always use both these rings when lifting the compressor. Use lifting equipment rated and certified for the weight of the compressor. A spreader bar rated for the weight of the compressor is highly recommended to ensure a better load distribution. The use of lifting hooks closed with a clasp and certified to lift the weight of the compressor is also highly recommended. Always respect the appropriate rules concerning lifting objects of the type and weight of these compressors. Maintain the compressor in an upright position during all handling manoeuvres (maximum of 15° from vertical).

⚠ Never use only one lifting lug to lift the compressor. The compressor is too heavy for the single lug to handle, and the risk is run that the lug could separate from the compressor with extensive damage and possible personal injury as a result.

Store the compressor not exposed to rain, corrosive or flammable atmosphere and between -31°F and 124°F when charged with R410A and between -31°F and 158°F when charged whith nitrogen from factory.

⚠ When the compressor is mounted as part of an installation, never use the lift rings on the compressor to lift the installation. The risk is run that the lugs could separate from the compressor or that the compressor could separate from the base frame with extensive damage and possible personal injury as a result.

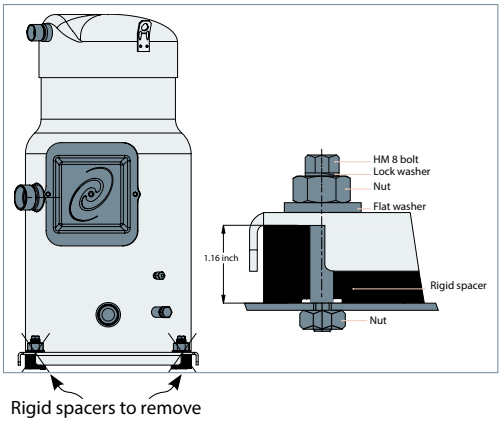
Never apply force to the terminal box with the intention of moving the compressor, as the force placed upon the terminal box can cause extensive damage to both the box and the components contained inside.



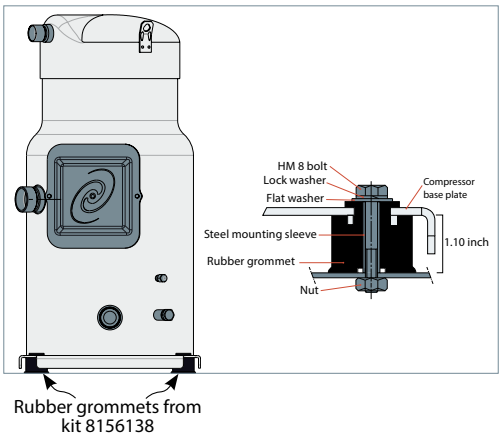
Compressor mounting

Maximum inclination from the vertical plane while operating must not exceed 3 degrees. Compressors are delivered with pre mounted rigid spacers dedicated to parallel mounting. If used in single applications, the compressor must be mounted with the flexible grommets as available in accessory conversion kit 8156138. The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established. The grommets attenuate to a great extent the transmission of compressor vibrations to the base frame.
The required bolt size for the PSH051-064-077 compressors is HM8-55. This bolt must be tightened to a torque of 15 lbf.ft.

1 manifoldable compressor with rigid spacers



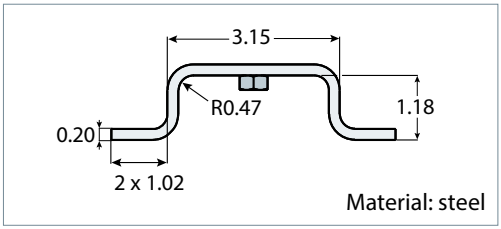
1 single compressor with rubber grommets



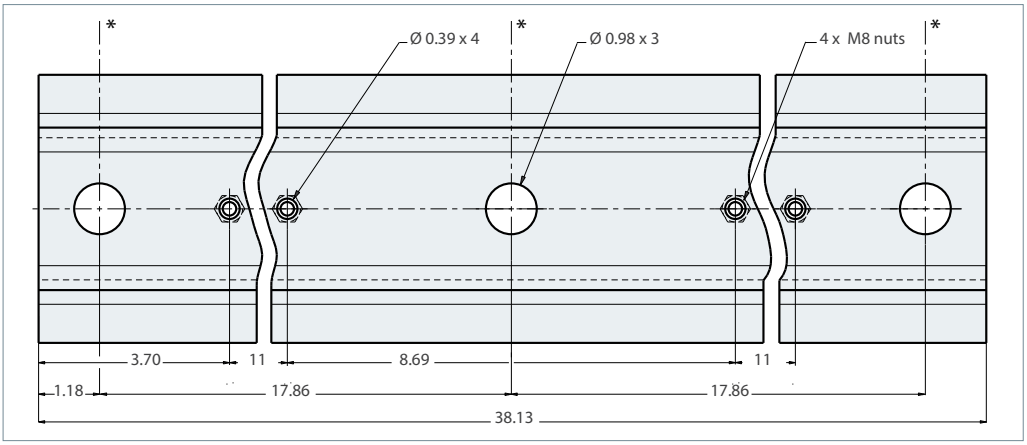
Parallel mounting

Compressors PSH051-064-077 come delivered with rigid mounting spacers already installed on the compressor. They must be used in this configuration for parallel mounting.

Recommended rails configuration: Danfoss Commercial Compressors does not supply the rails described here.

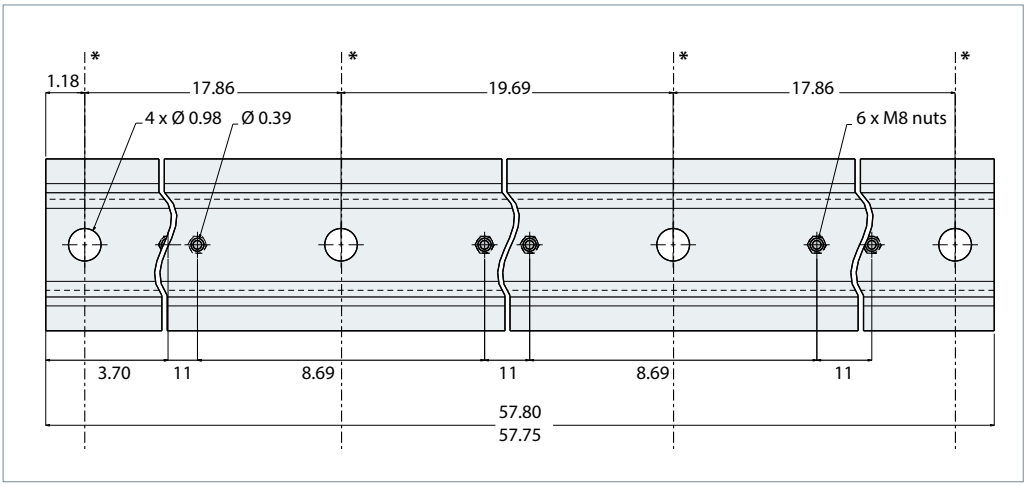


Tandem rails configuration



*: Unit Frame must include a sufficiently strong structure at these positions to support tandem rails.

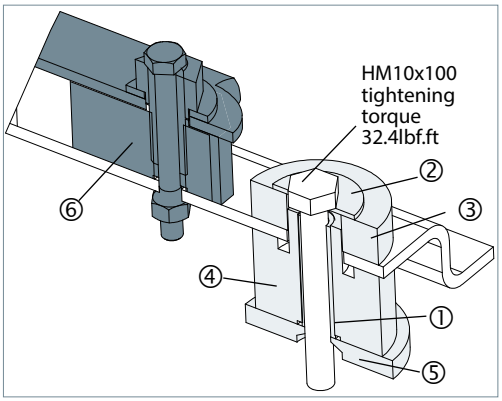
Trio rails configuration



*: Unit Frame must include a sufficiently strong structure at these positions to support trio rails.

Parallel mounting feet

For parallel mounting, rubber grommets and spacer must be installed below the rails.



These parts are included in the tandem of trio accessory kit code number 7777xxx described below.

① Grommet sleeve
② Flat washer
③ Rubber washers
④ Tandem grommet
⑤ & ⑥ Rigid spacers
⑦ Tandem rail

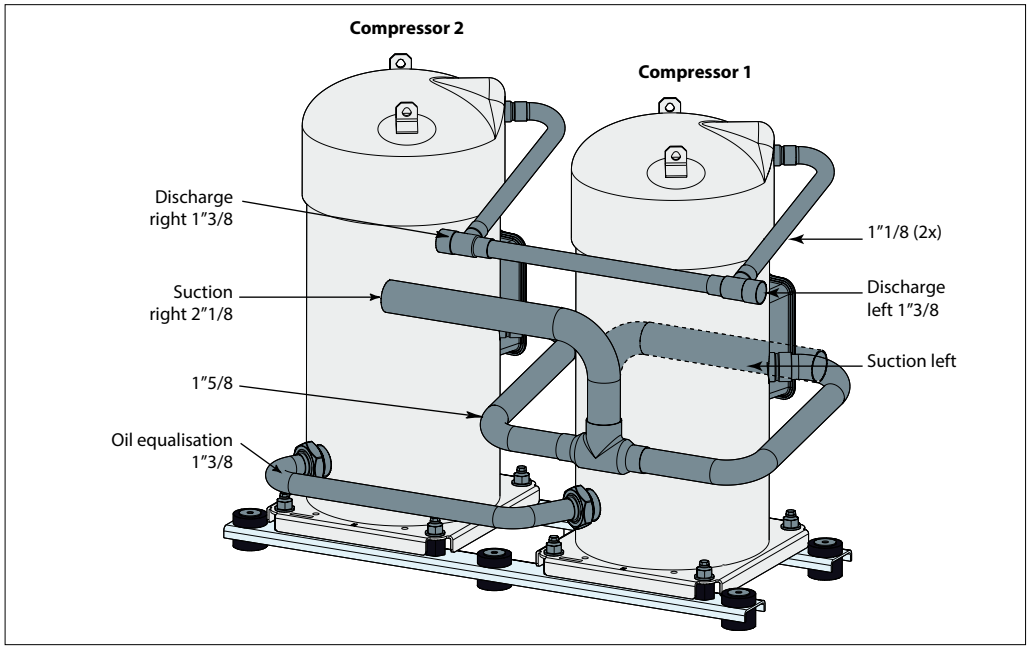
Included in kit 7777xxx
Supplied with the compressor
Not supplied

Tandem kit code numbers

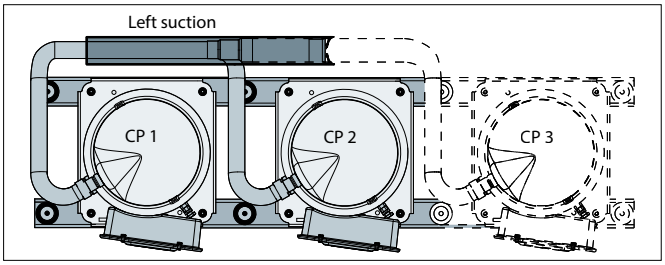
When different compressor models are installed in parallel, in order to balance compressor sump pressures, it is necessary to use a suction washer in one of the compressor. This suction washer is supplied within kits described below. It must always be installed on compressor 1.

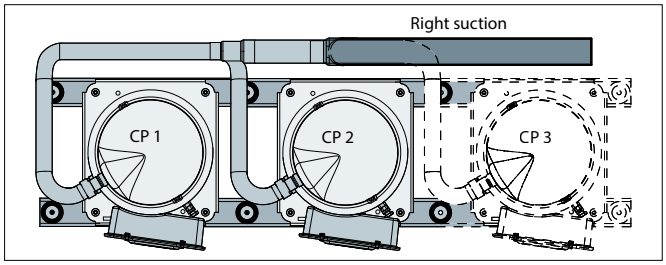
Tandem model	Compressor 1	Compressor 2	Suction washer (restrictor) kit			Outline drawing
			Code nb for ordering	Reference	Diameter (in)	
PSH104	PSH051	PSH051	7777041	Not needed		8556121
PSH115	PSH051	PSH064	7777037	5311570P01	1.22	8556148
PSH130	PSH064	PSH064	7777041	Not needed		8556122
PSH128	PSH051	PSH077	7777048	5311579P05	1.14	8556148
PSH141	PSH064	PSH077	7777037	5311579P01	1.22	8556148
PSH154	PSH077	PSH077	7777041	Not needed		8556123

Tandem piping design recommendations, applicable to all tandem configurations.



Trio kit code numbers





Trio model	Cp 1	Cp 2	Cp 3	Suction side	Suction washer (restrictor) kit				Outline drawing
					Code nb for ordering	Reference	Diameter (in)	Washer in suction of	
PSH153	PSH051	PSH051	PSH051	Left	7777040	5311579P02	1.30	Cp3	8556146
				Right	7777039	5311579P03	1.36	Cp1 & cp3	
PSH192	PSH064	PSH064	PSH064	Left	7777040	5311579P02	1.30	Cp3	8556147
				Right	7777039	5311579P03	1.36	Cp1 & cp3	
PSH231	PSH077	PSH077	PSH077	Left	7777040	5311579P02	1.30	Cp3	8556147
				Right	Not needed				

Tandem and trio piping design

For each tandem and trio configuration specific outline drawings are available as indicated on the previous pages. These drawings must always be respected.
No changes shall be made to the indicated tubing diameter and fitting types.
Minimum straight length indicated on drawings must be respected.

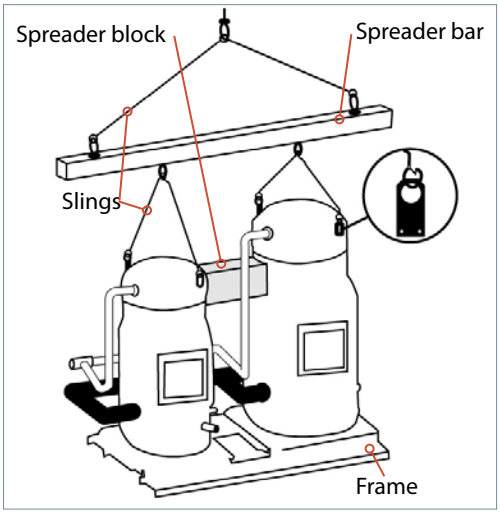
The oil equalisation line shall be made of copper tube and assembled in such a way that it does not extend above the connection height and must be horizontal so as not to trap oil.

Oil equalisation fitting must not be heated during installation and servicing. This could damage to the compressor and impact oil equalisation balancing.

Tandem and trio Handling

Danfoss Commercial Compressors recommends using the lift and handling devices, as shown in picture beside, and that the following procedure be used to prevent damage.

- Two lift rings are provided on each compressor. Use all four rings.
- Maximum loads authorized per sling and for the hoist hook must not be lower than the weight of the assembly.
- The minimum spreader bar length must be at least equal to the centre distance between the two compressors to prevent bending the frame.
- When lifting, use a spreader block between the compressors to prevent any unit frame damage.
- When the tandem unit is already mounted into an installation, never lift the complete installation by using the lift rings on the compressors.



Compressor holding charge

Each compressor is shipped with a nominal dry nitrogen holding charge between 4.35 and 10.15 psig and is sealed with elastomer plugs.
⚠ Before the suction and discharge plugs are removed, the nitrogen holding charge must be released via the suction schrader valve to avoid an oil mist blowout. Remove the suction plug first and the discharge plug afterwards. The plugs shall be removed only just before connecting the compressor to the installation in order to avoid moisture from entering the compressor. When the plugs are removed, it is essential to keep the compressor in a upright position so as to avoid oil spillage.

System cleanliness

The refrigerant compression system, regardless of the type of compressor used, will only provide high efficiency and good reliability, along with a long operating life, if the system contains solely the refrigerant and oil it was designed for. Any other substances within the system will not improve performance and, in most cases, will be highly detrimental to system operations.

The presence of non-condensable substances and system contaminants such as metal shavings, solder and flux, have a negative impact on compressor service life. Many of these contaminants are small enough to pass through a mesh screen and can cause considerable damage within a bearing assembly.

The use of highly hygroscopic polyolester oil in R410A compressors requires that the oil be exposed to the atmosphere as short as possible.

System contamination is one of main factors affecting equipment reliability and compressor service life. It is important therefore to take system cleanliness into account when assembling a refrigeration system.

During the manufacturing process, circuit contamination may be caused by:

- Brazing and welding oxides,
- Filings and particles from the removal of burrs in pipe-work,
- Brazing flux,
- Moisture and air.

Consequently, when building equipment and assemblies, the precautions listed in the following paragraphs must be taken.

Tubing

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 on next pages. Never drill holes into parts of the pipe-work where filings and particles can not be removed.

Brazing and soldering

Do not bend the compressor discharge or suction lines or force system piping into the compressor connections, because this will increase stresses that are a potential cause of failure. Recommended brazing procedures and material, are described section “Compressor connection”.

Copper to copper Connections

When brazing copper-to-copper connections, the use of copper/phosphorus brazing alloy containing 5% silver or more with a melting temperature of below 1472°F is recommended. No flux is required during brazing.

Dissimilar metals Connection

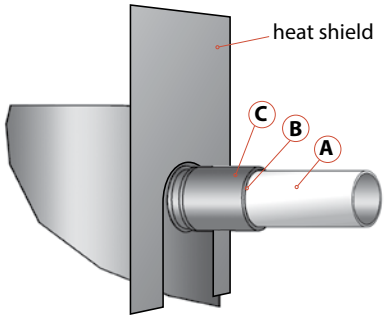
When manipulating dissimilar metals such as copper and brass or steel, the use of silver solder and anti-oxidant flux is necessary.

Compressor connection

When brazing the compressor fittings, do not overheat the compressor shell, which could severely damage certain internal components due to excessive heating. Use of a heat shield and/or a heat-absorbent compound is highly recommended. Due to the relatively sizable tubing and fitting diameters a double-tipped torch using acetylene is recommended for brazing operation on PSH compressors.

For brazing the suction and discharge connections, the following procedure is advised:

- Make sure that no electrical wiring is connected to the compressor.
- Protect the terminal box and compressor painted surfaces from torch heat damage (see diagram).
- Remove the Teflon gaskets when brazing rotolock connectors with solder sleeves.
- Use only clean refrigeration-grade copper tubing and clean all connections.
- Use brazing material with a minimum of 5% silver content.
- Purge nitrogen or CO2 through the compressor in order to prevent against oxidation and flammable conditions. The compressor should not be exposed to the open air for extended periods.
- Use of a double-tipped torch is recommended.
- 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, but not into the compressor.
- 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 or compressor. Flux is acidic and can cause substantial damage to the internal parts of the system and compressor.

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

⚠ Before eventual unbrazing 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.

System pressure test

Always use an inert gas such as nitrogen for pressure testing. Never use other gasses such as oxygen, dry air or acetylene as these may form an inflammable mixture. Do not exceed the following pressures

	PSH051	PSH064-077
Maximum compressor test pressure (low side)	497 psig	483 psig
Maximum compressor test pressure (high side)	706 psig	
Maximum pressure difference between high & low side of the compressor	508 psig	

Pressurize the system on HP side first then LP side to prevent rotation of the scroll. Never let the pressure on LP side exceed the pressure on HP side with more than 73 psig.

In order to insure LIV integrity, never let the pressure on HP side exceed the pressure on LP side with more than 508 psig.

On PSH051-064-077 models which have an internal non return valve in discharge fitting or if an external non return valve is present on the discharge line, we advise to pressurize the system not quicker than 70 psig/s to allow pressure equalization between LP and HP side over scroll elements.

Leak detection

Leak detection must be carried out using a mixture of nitrogen and refrigerant or nitrogen and helium, as indicated in the table below. 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.

Leak detection with refrigerant	Leak detection with a mass spectrometer
Nitrogen & R410A	Nitrogen & Helium

Note 1: Leak detection with refrigerant may be forbidden in some countries. Check local regulations.
Note 2: The use of leak detecting additives is forbidden as they may affect the lubricant properties.

Vacuum evacuation and 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.

For these reasons it's important to perform a vacuum dehydration on the system to remove all residual moisture from the pipe-work after assembly;

PSH compressors are delivered with < 100 ppm moisture level. The required moisture level in the circuit after vacuum dehydration must be < 100 ppm for systems with a PSH.

- Never use the compressor to evacuate the system.
- Connect a vacuum pump to both the LP & HP sides.
- Evacuate the system to a pressure of 0.02 in Hg (500 µm Hg) absolute.

Do not use a megohm meter nor apply power to the compressor while it's under vacuum as this may cause internal damage.

Filter driers

A properly sized & type of drier is required. Important selection criteria include the driers water content capacity, the system refrigeration capacity and the system refrigerant charge. The drier must be able to reach and maintain a moisture level of 50 ppm end point dryness (EPD).

For new installations with PSH compressors with polyolester oil, Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier. Molecular sieve filter driers with 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 under sized. When selecting a drier, always take into account its capacity (water content capacity), the system refrigeration capacity and the system refrigerant charge.

After burn out, remove & replace the liquid line filter drier and install a Danfoss type DAS burnout drier of the appropriate capacity. Refer to the DAS drier instructions and technical information for correct use of the burnout drier on the liquid line.

Refrigerant charging

For the initial charge the compressor 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.

This initial charging operation must be done in liquid phase. The best location is on the liquid line between the condenser outlet and the filter drier. Then during commissioning, when needed, a complement of charge can be done in liquid phase: slowly throttling liquid in on the low pressure side as far away as possible from the compressor suction connection while compressor is running. The refrigerant charge quantity must be suitable for both summer and winter operations.

Vacuum or charge from one side can seal the scrolls and result in a non-starting compressor. When servicing, always ensure that LP/HP pressures are balanced before starting the compressor.

Be sure to follow all government regulations regarding refrigerant reclamation and storage.

For more detailed information see "Recommended refrigerant system charging practice" news bulletin FRCC.EN.050.

Refrigerant charge limit

Danfoss PSH compressors can tolerate liquid refrigerant up to a certain extend without major problems. However, excessive liquid refrigerant in the compressor is always unfavourable for service life. Besides, the installation cooling capacity may be reduced because of the evaporation taking place in the compressor and/or the suction line instead of the evaporator. System design must be such that the amount of liquid refrigerant in the compressor is limited.

In this respect, follow the guidelines given in the section:"Essential piping design recommendations" in priority.

Use the tables below to quickly evaluate the required compressor protection in relation with the system charge and the application.

	Model	Refrigerant charge limit in the compressor (lb)
Compressor	PSH051-064	29.8
	PSH077	32
Tandem	PSH104	38.6
	PSH115	38.6
	PSH130	38.6
	PSH128	38.6
	PSH141	38.6
	PSH154	38.6
Trio	PSH153	50.7
	PSH192	50.7
	PSH231	54

	BELOW charge limit	ABOVE charge limit
Cooling only systems, Packaged units	✓ No test or additional safeties required	REQ Refrigerant migration and floodback test
Cooling only systems with remote condensor and split system units	REC Refrigerant migration and floodback test	REQ Refrigerant migration and floodback test REC Liquid receiver (in association with LLSV and pump down)
Reversible heat pump system	REQ Specific tests for repetitive floodback REQ Defrost test	

REC Recommended REQ Required ✓ No test or additional safeties required

Insulation resistance and dielectric strength

Insulation resistance on motor pins and thermistor connections must be higher than 1 megohm when measured with a 500 volt direct current megohm tester.

Never perform insulation resistance test on OCS power leads.

Each compressor motor is tested at the factory with a high potential voltage (hi-pot) that exceeds the UL requirement both in potential and in duration. Leakage current is less than 5 mA.

It is not recommended to repeat high voltage test (hi-pot) on motor. If this test must be carried out anyway, it is mandatory to disconnect the OCS to prevent any damages or destruction.

PSH scroll compressors are configured with the pump assembly at the top of the shell, and the motor below. As a result, the motor can be partially immersed in refrigerant and oil. The presence of refrigerant around the motor windings will result in lower resistance values to ground and higher leakage current readings. Such readings do not indicate a faulty compressor.

In testing insulation resistance, Danfoss recommends that the system be first operated briefly to distribute refrigerant throughout the system.

Following this brief operation, retest the compressor for insulation resistance or current leakage.

Never reset a breaker or replace a fuse without first checking for a ground fault (a short circuit to ground).

Commissioning

The system must be monitored after initial start-up for a minimum of 60 minutes to ensure proper operating characteristics such as:

- Proper metering device operation and desired superheat readings
- Suction and discharge pressure are within acceptable levels
- Correct oil level in compressor sump indicating proper oil return
- Low foaming in sight glass and compressor sump temperature 18°F above saturation temperature to show that there is no refrigerant migration taking place
- Acceptable cycling rate of compressors, including duration of run times
- Current draw of individual compressors within acceptable values (max operating current)
- No abnormal vibrations and noise.

Oil level checking and top-up

In installations with good oil return and line runs up to 65.6 ft, no additional oil is required. If installation lines exceed 65.6 ft, additional oil may be needed. 1 or 2% of the total system refrigerant charge (in weight) can be used to roughly define the required oil top-up quantity but in any case the oil charge has to be adjusted based on the oil level in the compressor sight glass.

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.

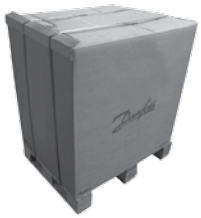
The oil level can also be checked a few minutes after the compressor stops. When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

Always use original Danfoss POE oil 160SZ from new cans.

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. See News bulletin "Lubricants filling in instructions for Danfoss Commercial Compressors".

Packaging

Single pack



Compressor model	Length (in)	Width (in)	Height (in)	Gross weight (lb)
PSH051	30.3	23.6	35.4	260
PSH064	30.3	23.6	35.4	361
PSH077	30.3	23.6	35.4	378

Industrial pack

Compressor model	Nb	Length (in)	Width (in)	Height (in)	Gross weight (lb)	Static stacking pallets
PSH051	6	45.3	38	30.2	1532	2
PSH064	4	45.3	38	30.2	1451	2
PSH077	4	45.3	38	31.5	1518	2

Ordering information

Danfoss PSH scroll compressors can be ordered in either industrial pack or single packs. Please use the code numbers from below tables for ordering.

Compressors PSH051-064-077 are delivered with pre-mounted rigid spacers dedicated to parallel mounting. For use in single applications, the rigid spacers must be replaced by flexible grommets which are available as accessory kit 8156138, see section “Accessories”.

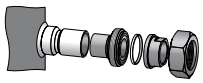
Single pack

Compressor model	OCS supply voltage	Code number	
		Motor code 4	Motor code 9
PSH051	230 V AC	120H0864	120H0904
PSH064		120H0866	120H0906
PSH077		120H0868	120H0908

Industrial pack

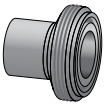
Compressor model	OCS supply voltage	Code number	
		Motor code 4	Motor code 9
PSH051	230 V AC	120H0863	120H0903
PSH064		120H0865	120H0905
PSH077		120H0867	120H0907

Valves, adapters, connectors & gaskets for use on suction and discharge connections



Solder sleeve adapter sets

Type	Code n°	Description	Application	Packaging	Pack size
	7765028	Solder sleeve adapter set (2"1/4 rotolock, 1"5/8 ODF) (1"3/4 rotolock, 1"1/8 ODF)	PSH051-064-077	Multipack	6



Rotolock adapters

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0364	Rotolock adapter (1"3/4 Rotolock, 1"1/8 ODF)	Models with 1"1/8 ODF	Multipack	10
	120Z0432	Rotolock adapter (2-1/4" Rotolock, 1"5/8 ODF)	Models with 1"5/8 ODF	Multipack	10

Gaskets and gasket sets

Type	Code n°	Description	Application	Packaging	Pack size
G07	8156132	Gasket, 1"3/4	Models with 1"3/4 rotolock connection	Multipack	10
G07	7956003	Gasket, 1"3/4		Industry pack	50
G08	8156133	Gasket, 2"1/4	Models with 2"1/4 rotolock connection	Multipack	10
G08	7956004	Gasket, 2"1/4		Industry pack	50

Solder sleeves

Type	Code n°	Description	Application	Packaging	Pack size
P02	8153004	Solder sleeve, P02 (1"3/4 Rotolock, 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	10
P03	8153006	Solder sleeve, P03 (2"1/4 Rotolock, 1"5/8 ODF)	Models with 2"1/4 rotolock connection	Multipack	10

Rotolock nuts

Type	Code n°	Description	Application	Packaging	Pack size
	8153124	Rotolock nut, 1"3/4	Models with 1"3/4 rotolock connection	Multipack	10
	8153126	Rotolock nut, 2"1/4	Models with 2"1/4 rotolock connection	Multipack	10

Rotolock service valves and valve sets (without gasket)

Type	Code n°	Description	Application	Packaging	Pack size
V02	8168028	Rotolock valve, V02 (1"3/4 Rotolock, 1"1/8 ODF)	Models with 1"3/4 rotolock connection	Multipack	6
V02	7968009	Rotolock valve, V02 (1"3/4 Rotolock, 1"1/8 ODF)		Industry pack	24
V03	8168026	Rotolock valve, V03 (2-1/4" Rotolock, 1"5/8 ODF)	Models with 2"1/4 rotolock connection	Multipack	6
V03-V02	7703383	Valve set, V03 (2-1/4"~1"5/8), V02 (1"3/4~1"1/8)	PSH051-064-077	Multipack	4

Surface sump heaters

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0360	Surface sump heater + Bottom insulation, 56 W, 24 V, CE, UL	PSH051-064-077	Multipack	6
	120Z0376	Surface sump heater + Bottom insulation, 56 W, 230 V, CE , UL		Multipack	6

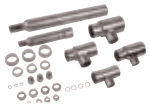
3 phase soft start equipment

Type	Code n°	Description	Application	Packaging	Pack size
MCI50CM	037N0401	Electronic soft start kit, MCI 50 CM	PSH051-064-077	Single pack	1

Tandem kits

Type	Code n°	Description	Application	Packaging	Pack size
	7777041	Suction washer, rigid spacer, sleeve for oil connect	PSH even tandem	Single pack	1
	7777037	Suction washer, rigid spacer, sleeve for oil connect	PSH051+064, PSH064+077	Single pack	1
	7777048	Suction washer, rigid spacer, sleeve for oil connect	PSH051+077	Single pack	1

Trio kits



Type	Code n°	Description	Application	Packaging	Pack size
	7777039	Suction washer, rigid spacer, sleeve for oil connect	PSH trios (right suction)	Single pack	1
	7777040	Suction washer, rigid spacer, sleeve for oil connect	PSH trios (left suction)	Single pack	1

Acoustic hoods and spare parts

Acoustic hoods

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0579	Acoustic hood for scroll compressor	PSH051-064-077	Single pack	1

Bottom insulation

Type	Code n°	Description	Application	Packaging	Pack size
	120Z0353	Bottom insulation for scroll compressor	PSH051-064-077	Single pack	1

Mounting kits

Type	Code n°	Description	Application	Packaging	Pack size
	8156138	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers	PSH051-064-077	Single pack	1
	120Z0495	Mounting kit for 1 scroll compressor including 4 rigid spacers	PSH051-064-077	Single pack	1

Application guidelines

Terminal boxes, covers & T-block connectors

Type	Code n°	Description	Application	Packaging	Pack size
	8173021	T block connector 2.36 x 2.95 inch	PSH051-064-077	Multipack	10
	120Z0483	Terminal box with 230V OCS	PSH051	Single pack	1
	120Z0563	Terminal box with 230V OCS	PSH064	Single pack	1
	120Z0565	Terminal box with 230V OCS	PSH077	Single pack	1
	120Z0485	Terminal box cover	PSH051-064-077	Single pack	1
	120Z0486	OCS connectors For OCS version	PSH051-064-077	Single pack	1

Lubricants / oils

Type	Code n°	Description	Application	Packaging	Pack size
160SZ	7754023	POE lubricant, 160SZ, 0.27 gallon can	PSH051-064-077	Multipack	12
160SZ	120Z0571	POE lubricant, 160SZ, 0.66 gallon can		Multipack	4

Miscellaneous

Type	Code n°	Description	Application	Packaging	Pack size
	8156129	Gasket for oil sight glass (white teflon)	PSH051-064-077	Multipack	10
	7956005	Gasket for oil sight glass (white teflon)	PSH051-064-077	Industry pack	50
	8154001	Danfoss CC blue spray paint	PSH051-064-077	Single pack	1

Sensors & cables

Type	Code n°	Description	Application	Packaging	Pack size
	060G5707	HP sensor	PSH051-064-077	Single pack	1
	060G0090 060G0008	LP sensor		Single pack	1
	120Z0482	DGT sensor with cable		Single pack	1
	061L4223	Liquid Injection Valve coil with cable		Single pack	1
	120Z0487	Liquid Injection Valve		Single pack	1
	120Z0478	Can Bus cable with cable glands	PSH tandem assembly	Single pack	1
	120Z0479	Can Bus cable with cable glands	PSH trio assembly	Single pack	1

Communication tools

Type	Code n°	Description	Application	Packaging	Pack size
080G0073		MMIMYK	PSH051-064-077	Single pack	1
080G0294		MMIGRS		Single pack	1
080G0075		RJ11 cable		Single pack	1

Previous Version	Current Version
• Page 18: Pressure equipment directive **2014/68/EU**	• Page 18: Updated Pressure equipment directive **2014/68/EU**
• Page 26: Pressure settings	• Page 26: Updated pressure settings
• Page 48: Maximum compressor test pressure (high side) : **696** psig	• Page 48: Maximum compressor test pressure (high side) : **706** psig

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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 spread across three continents.

Danfoss Turbocor Compressors

Danfoss Inverter Scrolls

Danfoss Scrolls

Danfoss Optyma Condensing Units

Danfoss Maneurop Reciprocating Compressors

Danfoss Light Commercial Refrigeration Compressors

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.

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