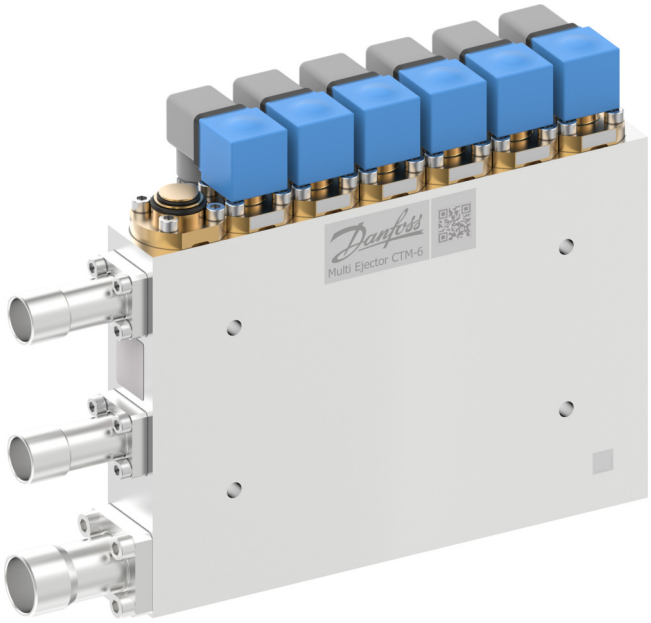
ENGINEERING TOMORROW

Data Sheet

CTM Combi ejector
Type **CTM 6 Combi**

Combination of High Pressure lift and Liquid Ejector



Danfoss Multi Ejector Solution™ makes CO_2 refrigeration systems economically competitive with the HFC systems at all ambient temperatures by improving COP in comparison to standard booster and parallel compressor systems. CO_2 systems with Multi Ejector Solution™ can be installed in any climate delivering lower energy consumption than i.e. R404A. It removes the CO_2 equator entirely.

CTM 6 Combi consists of High Pressure and Liquid Ejectors built into one Multi Ejector block. This solution is designed for CO_2 transcritical systems to lift gas and liquid from MT suction accumulator and mix it with the gas coming from the gas cooler at medium pressure level.

Features

First Cost savings

- Reliable and robust design confirmed in field tests
- Fully integrated solution not requiring any additional components like check valves or motorized ball valves.
- Fully serviceable - wide range of spare parts and accessories.
- Easily accessible strainer / filter for fast maintenance.

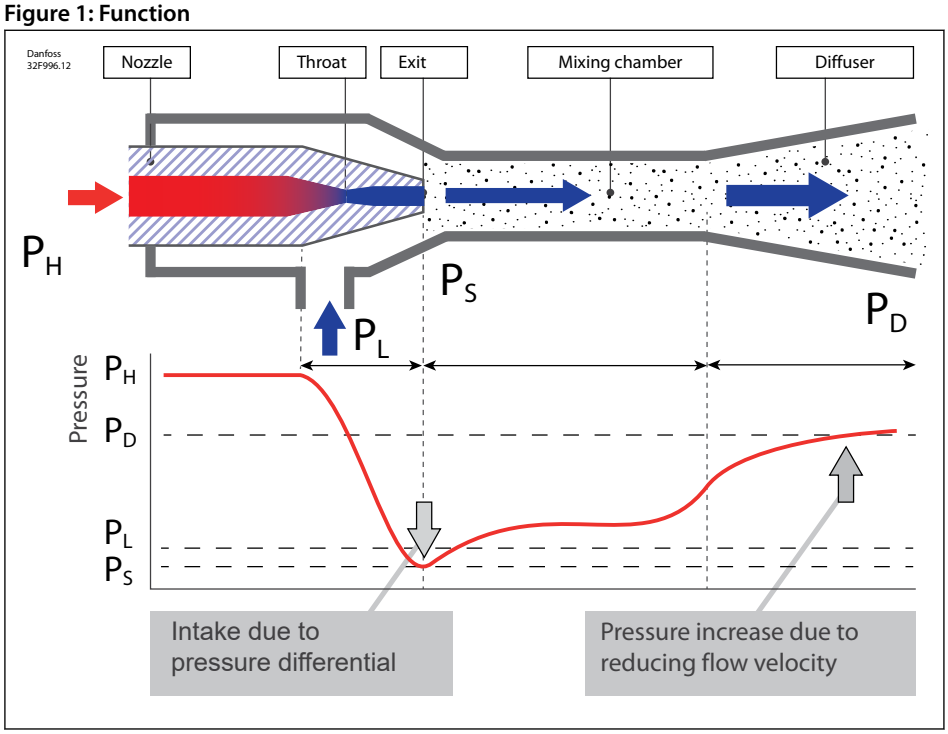
Fast Pay Back – Energy saving

- Improved COP, enhanced operation of parallel compressors system and required lower swept volume to the MT compressors , resulting in lower energy consumption.
- Savings for end users.
- Due to higher suction pressure, Liquid Ejectors, together with Adaptive Liquid Control (ALC), enables lower energy consumption and better utilization of evaporators, resulting in operational savings.
- Fast payback – lower energy consumption
  - Higher efficiency on the systems, leads to short payback time.
- The combination of Multi Ejector Combi and Danfoss CALM controllers ensure an easy setup and commissioning, robust control of the system that ensures many years of problem free operation.

Function

The Multi Ejector function is shortly described below.

Figure 1: Function



An ejector is a device that uses expansion energy to compress another fluid. In this case with the transcritical system there is up to 20% of the compressor work that can theoretically be recovered in the expansion.

In this case with the Multi Ejector system the work is coming from the CO2 leaving the gas cooler. The high pressure CO2 (HP) is entering the nozzle where the expansion is taking place. At the exit of the nozzle the speed is very high and as a consequence of that the pressure is low.

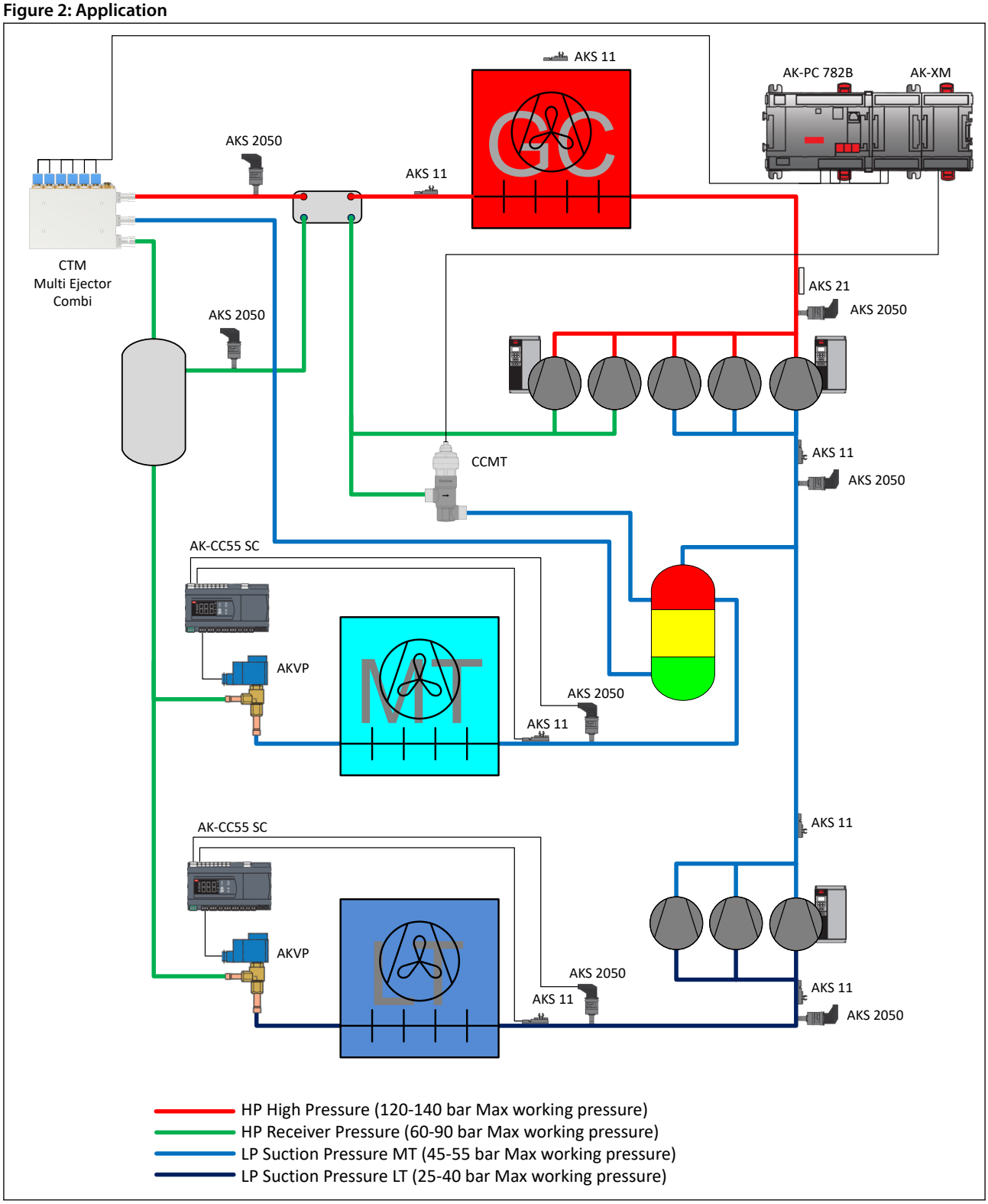
This low pressure is used to drag vapourand liquid from the MT suction (PL). From there the two flows are mixed in the mixing chamber where the pressure will be lower than at the drive inlet due to the mixing of vapour from a higher pressure.

After the mixing the flow enters the diffuser where the flow is slowed down. The shape of the diffuser enables the conversion from kinetic energy (velocity) to potential energy (pressure). After the diffuser the flow is returned to the receiver.

Application

The Multi Ejector is designed to lift a part of the gas and liquid from MT suction and mix it with the gas coming from the gas cooler at medium pressure level. Pre-compressed gas is taken from the receiver to IT compressor which works more efficiently due to lower pressure lift required.

Figure 2: Application



Product specifications

Technical data

Table 1: Technical data

Refrigerant	R744 with oil
Maximum working pressure	140 bar / 2031 psi
Max. test pressure	1.43 x 140 bar / 1.43 x 2031 psi
Max. OPD	90 bar / 1305 psi (for single-voltage coil, 50 Hz)
Min. OPD	< 0.1 bar / 1.45 psi
Max. pres. dif. E and C connections	20 bar / 290 psi
Media temp. range	-10 °C – +50 °C / +14 °F – 122 °F
Ambient temp. range	-10 °C – +50 °C / +14 °F – 122 °F
Humidity	0 – 100% R.H. (0-97% R.H. non-condensation condition if IP level is below IPX5).

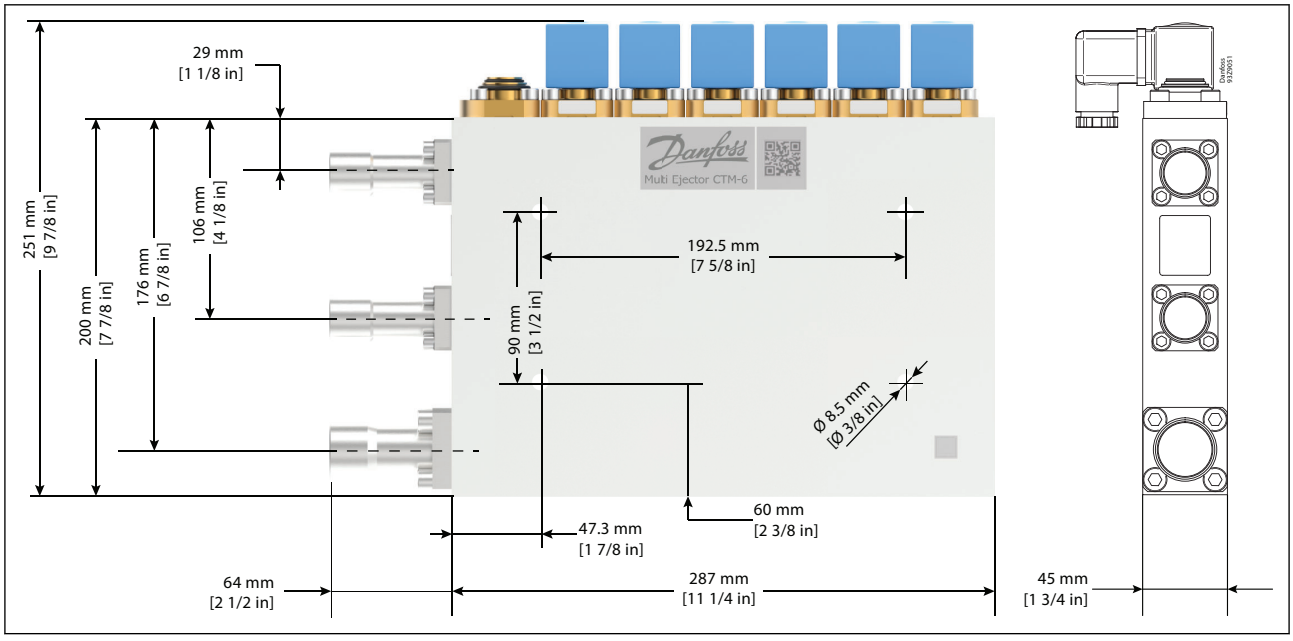
Material specification

Table 2: Material specification

Housing	Aluminium AW-6082 T6
Connections	Stainless steel AISI 304
Ejectors	Brass
Screws	Stainless steel A2-70

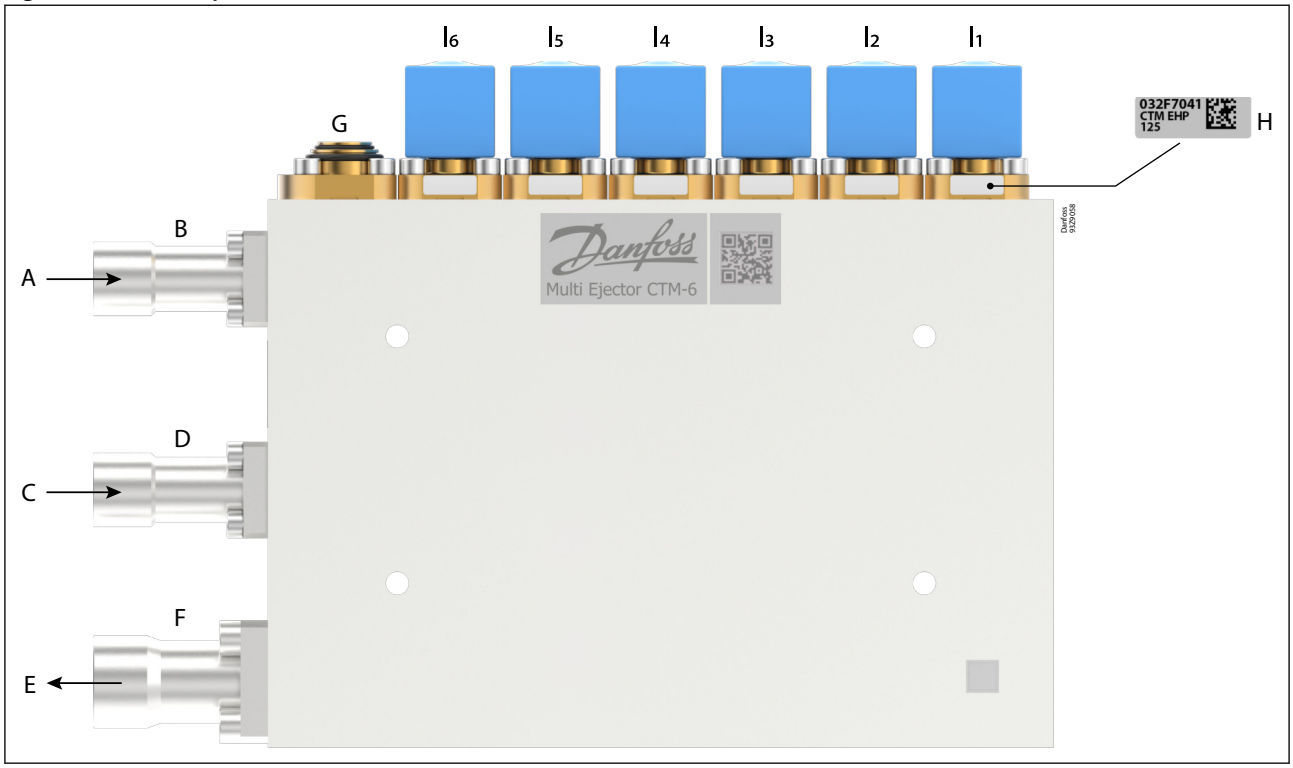
Dimensions

Figure 3: Dimensions



Connector positions

Figure 4: Connector positions



A	Gas cooler outlet - inlet connector Combi brazing 7/8 inch ODF - weld 3/4 inch (EN10220)
B	High pressure inlet
C	Suction connector. MT evaporator outlet - inlet connector. Combi brazing 7/8 inch ODF - weld 3/4 inch (EN10220)
D	Suction inlet
E	Common outlet connector - Receiver Combi brazing 1 1/8 inch ODF - weld 1 inch (EN10220)
F	Receiver
G	Strainer
H	Label
I	Ejector

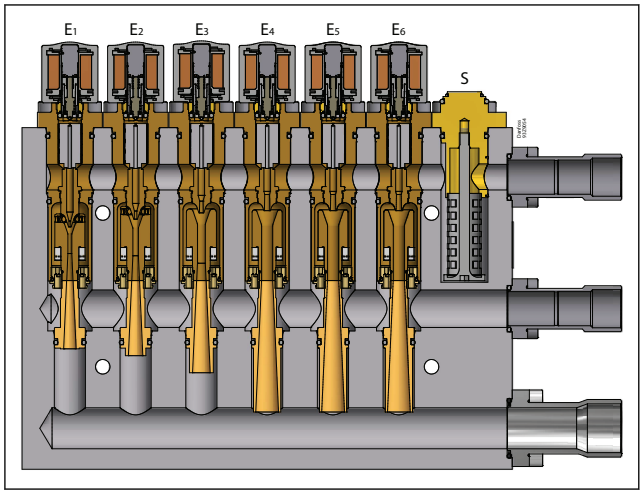
Mounting order of ejectors:

Liquid ejectors (ELE) and then high pressure ejectors (EHP) with the highest capacities (longest ejectors) must be placed closest to the suction connector C. Any blank ejector must be placed closest to the suction connector C.

Ordering

Valve configuration

Figure 5: Valve configuration



E	Ejector
S	Strainer

Table 3: Valve configuration

Type	Code no.	Product name	Ejector 1	Ejector 2	Ejector 3	Ejector 4	Ejector 5	Ejector 6
CTM 6	032F5675	CTM Combi HP 1875 LE 400	CTM EHP 125	CTM EHP 250	CTM EHP 500	CTM EHP 1000	CTM ELE 200	CTM ELE 200
	032F5676	CTM Combi HP 2875 LE 200	CTM EHP 125	CTM EHP 250	CTM EHP 500	CTM EHP 1000	CTM ELE 200	CTM ELE 200
	032F5677	CTM Combi HP 2875 LE 400	CTM EHP 125	CTM EHP 250	CTM EHP 500	CTM EHP 1000	CTM ELE 200	CTM ELE 200

Multi Ejector

Table 4: Ordering Multi Ejector

Type	HP ejectors		LE		Code no. Single pack
	Capacity - Mass flow [1]	Capacity - Mass flow [2]	Capacity - Mass flow [3]	Capacity - Mass flow [4]	
	[kg/h]	[lb/h]	[kg/h]	[lb/h]	
CTM Combi HP 1875 LE 400	1875	4134	400	882	032F5675
CTM Combi HP 2875 LE 200	2875	6340	200	441	032F5676
CTM Combi HP 2875 LE 400	2875	6340	400	882	032F5677

[1] R744 at 90 bar / 35 °C
[2] R744 at 1305 psi / 95 °F
[3] R744 at 40 bar / 5 °C
[4] R744 at 580 psi / 40 °F

HP = High Pressure lift, LE = Liquid Ejector
The above code numbers are without coils which should be ordered separately – see coil ordering below.

Spare parts

Figure 6: Gas Ejectors

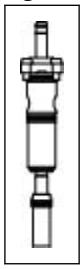


Table 5: Gas Ejectors

Gas Ejectors					
Part	Type	Capacity - HP Mass flow		Description	Code no. Single pack
		([kg/h]1)	([lb/h]2)		
HP Ejectors	CTM EHP 250	250	551	1. Completely assembled ejector with O-rings already mounted	032F9103
	CTM EHP 500	500	1102		032F9104
	CTM EHP 1000	1000	2204		032F9105
Blank ejector	CTM blank ejector	-	-	1. Completely assembled blank ejector with O-rings already mounted	032F9112

Figure 7: Liquid Ejectors

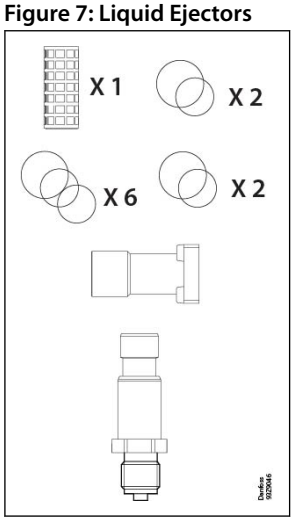


Table 6: Liquid Ejectors

Liquid Ejectors					
Part	Type	Capacity - HP Mass flow 1)		Description	Code no. Single pack
		([kg/h]3)	([lb/h]4)		
Liquid Ejectors	CTM ELE 200	200	441	1. Completely assembled ejector with O-rings already mounted	032F9110
	CTM ELE 400	400	882		032F9111

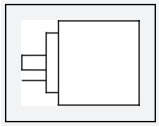
Table 7: Liquid Ejectors

Part	Type	Description	Code no. Single pack
Strainer	CTM strainer	1. Mesh only 2. 2 sets of 2 O-rings	032F9113
O-rings	CTM O-rings	1. 2 sets of 2 O-rings for strainer 2. 6 sets of 3 O-rings for ejectors	032F9114
Connectors	DN 20	Connector + O-ring	032F9116
	DN 25	Connector + O-ring	032F9117

Accessories

Coils

Table 8: DIN spade connection

Image	Type	Voltage	Frequency / Power consumption				Code no. Single pack
		[V]	[Hz]	[W]	[Hz]	[W]	with DIN plug (1)
	AS230CS	230	50	8	60	7	042N7601
	AZ120CS	110 - 120	50	8.5	60	7	042N4202

(1) The three pins on the coil can be fitted with spade tabs, 6.3 mm wide (to DIN 46247). The two current carrying pins can also be fitted with spade tabs, 4.8. mm wide. Max. lead cross section: 1.5 mm^2. Voltage variation: V AC -15% - 10%, If DIN plug is used (DIN 43650) the leads must be connected in the socket. The socket is fitted with a Pg 11 screwed entry for 6 – 12 mm.

Plug for DIN spade connection

Table 9: Plug for DIN spade connection

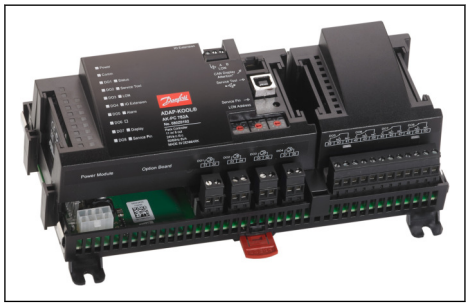
Image	Type	Voltage [V]	Frequency	Code no. Single pack
	DIN plug (LED)	230	50 / 60	042N0265 (1)
	DIN plug	Max. 250	50 / 60	042N1256

(1) Only for AS230CS.

Danfoss ADAP-KOOL®

Pack controller AK-PC 782A/B

Figure 8: AK-PC 782A/B



Danfoss offers a wide range of market leading Pack Controllers. Being the flag ship and best in class controller for transcritical CO2 packs controls, the AK-PC 782A offers the highest possible efficiency with the Multi Ejector, CTM. The complete application control features:

- Complete booster pack control of up to 3 suction groups (max. 12 compressors) and high pressure system
- Significant savings with heat recovery for tap water and heat reclaim
- Extensive control of oil flow and pressurization
- Best in class safety monitoring and fail-safe functions
- Minimal energy consumption while ensuring optimal food quality
- Auto-configured, easy-to-use graphical representation with Danfoss System Manager
- Independent, customised control and monitoring of auxiliary function

Case controllers AK-CC55

Figure 9: AK-CC55

Danfoss AK-CC55 case controllers manage refrigerated display cases, cold rooms, or refrigeration cabinets. Controlling Electronic Expansion Valves (EEV), they optimize evaporator utilization and energy consumption using the Minimum Stable Superheat (MSS) or new Adaptive Liquid Control (ALC) algorithm, giving you the best possible refrigeration capacity from the energy consumed and ensuring food safety.

AK-SM 8xxA system manager

Figure 10: AK-SM 8xxA system manager

The Danfoss AK-System Manager (AK-SM) is a modern solution for the food retail markets. The AK-SM uses the latest technology to provide the maximum benefit to the end user, both in terms of energy saving optimization, control options and user friendly access.

AK-SM ensures a shift mode of operation in AK-CC case controllers:
Minimum Stable Superheat (MSS) or Adaptive Liquid Control (ALC) based on feedback from pack controller AK-PC.

CO2 Adaptive Liquid Management (CALM)

The solution allows full utilization of the evaporator surface in display cases and cold rooms, improving energy savings with CO2 refrigeration in any store. CALM is a complete solution; in addition to intelligent pack and case controllers and a system manager, it includes two ground-breaking Danfoss innovations: The Liquid Ejector and the Adaptive Liquid Control (ALC) case controller algorithm.

Adaptive Liquid Control (ALC)

As the Liquid Ejector protects compressors by removing liquid from the suction side, the Adaptive Liquid Control (ALC) case controller algorithm can safely increase evaporator utilization by injecting more refrigerant, thereby increasing the evaporation temperature and controlling superheat close to zero. As a result, evaporator performance is optimized, the suction pressure is increased, and the compressors consume less energy.

Temperature sensors and pressure transmitters

Figure 11: Temperature sensors and pressure transmitters

Danfoss offers a comprehensive range of sensors for temperature and pressure sensors developed to meet the requirements of the entire pack application.

The sensor range delivers the following key features and benefits:

- Long term reliability minimize system downtime.
- Robust construction protects against mechanical shock and vibration.
- Temperature sensor design ensures fast response time and precise measurement.
- Hermetically sealed pressure element ensures no leakage.
- Pulse snubber ensures protection against liquid hammering, cavitation or pressure peaks.

Disclaimer

Figure 12: Disclaimer

WARNING:
The CTM Multi Ejector valve is approved for use only with Danfoss pack controller type AK-PC 78x, AK-CC55 and system manager AK-SM 8xxA.

DISCLAIMER

Danfoss expressly disclaims, and any responsibility or liability, whether based on contract, breach of warranty, tort, statute or otherwise, shall be excluded, if the CTM Multi Ejector valve is used with any controller other than a Danfoss controller type AK-PC 78x, AK-CC55 and AK-SM 8xxA. For further information on AK-PC, AK-CC and AK-SM, please see separate document.

Certificates, declarations and approvals

The list contains all certificates, declarations, and approvals for this product type. Individual code number may have some or all of these approvals, and certain local approvals may not appear on the list.

Some approvals may change over time. You can check the most current status at danfoss.com or contact your local Danfoss representative if you have any questions.

Approvals

Approvals

- Pressure Equipment Directive 2014/68/EU (PED)
- UL Recognized

Table 10: Approvals (Coils)

AS230CS	LLC CDC TYSK; The Low Voltage Directive 2014/35/EU (LVD); Electromagnetic Compatibility Directive 2014/30/EU (EMC)
AZ120CS	C UR US; LLC CDC TYSK; The Low Voltage Directive 2014/35/EU (LVD); Electromagnetic Compatibility Directive 2014/30/EU (EMC)

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