ENGINEERING
TOMORROW

Application Guide

Scroll compressors
VCH115

for MC and CRAC | Single, R410A

www.danfoss.com

Contents

Safety and warnings

Danfoss scroll compressors are designed and manufactured with state of the art technology. There is an added emphasis placed on safety and reliability. Critical instructions are highlighted with the following icons:

This icon indicates instructions to avoid safety risk.

This icon indicates instructions to avoid reliability risk.

The purpose of this guideline is informational, with the intent to educate customers as to how the compressors should properly function. If you need any additional assistance, please contact Danfoss Technichal Support. In any case, Danfoss manufacturing accepts no liability as a result of misuse or improper integration of the compressor unit.

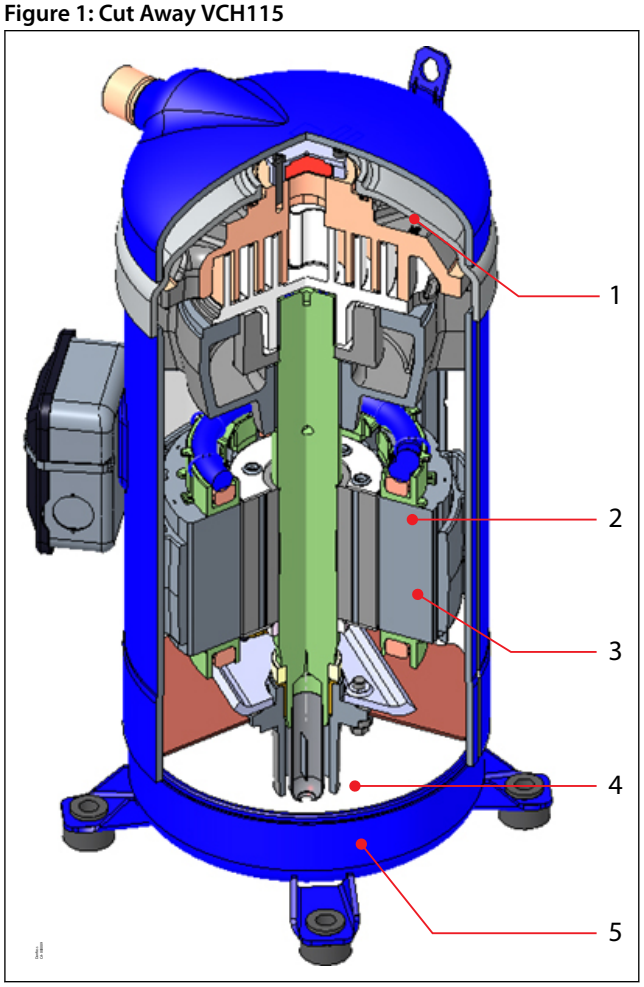
Introduction

Product description

Danfoss scroll compressor VCH115 for R410A is optimized for China, Modular chiller(MC) and Computer room air conditioning(CRAC) application.

Cut Away VCH115

Figure 1: Cut Away VCH115

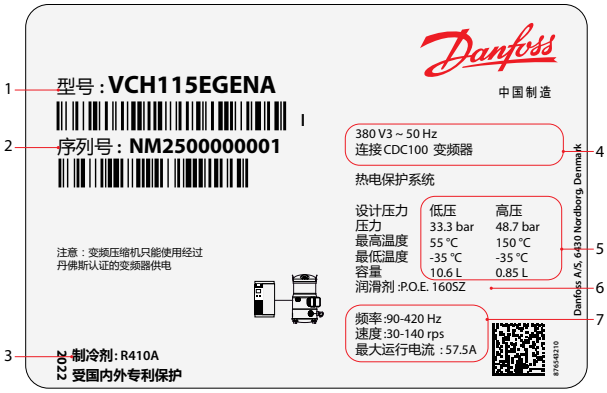


1	Optimize scroll sets PR and optimize efficiency for MC and CRAC
2	Optimize structure design, reduce compressor acoustic at high speed
3	New designed high efficiency motor, improve efficiency at Part- load condition
4	Oil strainer reduce the oil stirring when compressor running
5	Compact compressor outline design, beneficial for system unit layout

Product identification

Name Plate

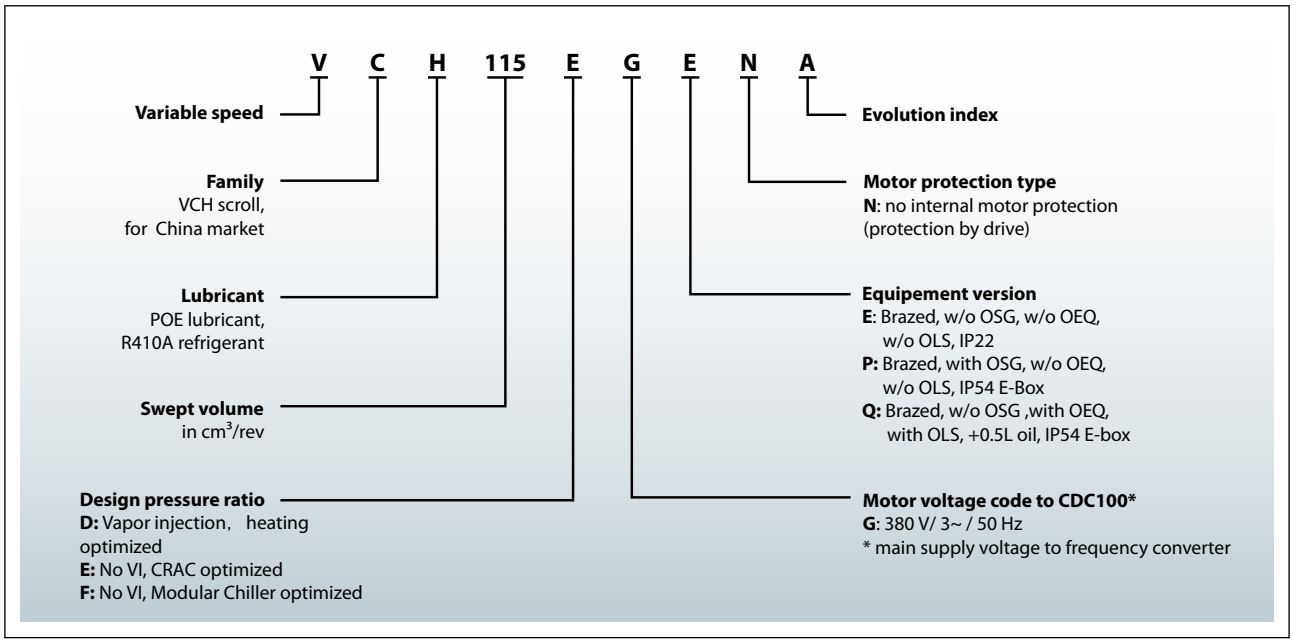
Figure 2: Name Plate



1	Model number
2	Serial number
3	Refrigerant
4	Supply voltage to CDC frequency converter
5	Housing service pressure
6	Factory charged lubricant
7	Compressor frequency & Max operating current

Nomenclature

The example below presents the compressor nomenclature which equals the technical reference as shown on the compressor nameplate. Code numbers for ordering are listed in section Ordering.



Compressors serial number

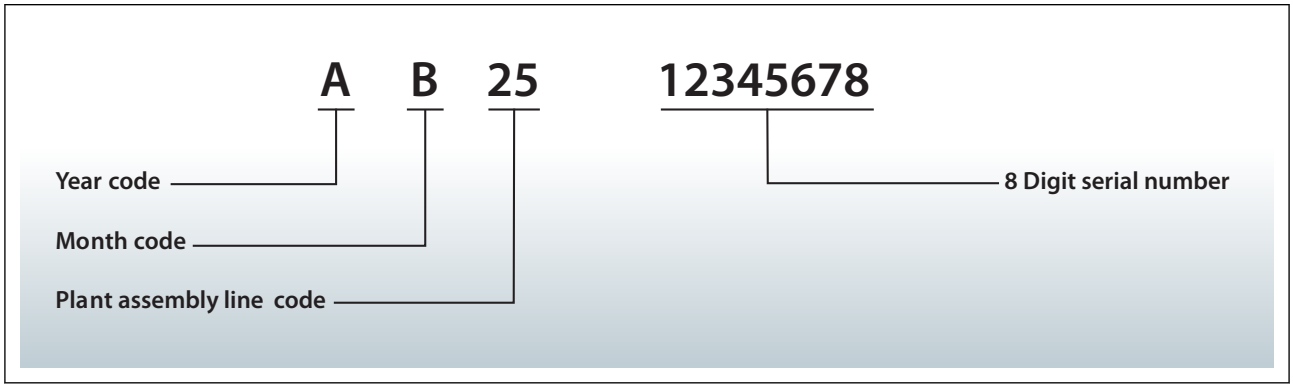


Table 1: Serial number code legend table

Year code		Month code		Plant assembly line code	
Year	Code	Month	Code	Plant	Code
1990, 2010	A	January	A	Trévoux, France	11
1991, 2011	B	February	B		
1992, 2012	C	March	C		
1993, 2013	D	April	D	Wuqing ,China	25
1994, 2014	E	May	E		
1995, 2015	F	June	F		
1996, 2016	G	July	G		
1997, 2017	H	August	H		
1998, 2018	J	September	J		
1999, 2019	K	October	K		
2000, 2020	L	November	L		
2001, 2021	M	December	M		
2002, 2022	N				
2003, 2023	P				
2004, 2024	Q				
2005, 2025	R				
2006, 2026	S				
2007, 2027	T				
2008, 2028	U				
2009, 2029	V				

Internal free volume

Table 2: Internal free volume

Products	Internal free volume at LP side without oil	
	litre	cu.inch
VCH115	10.6	647

Refrigerants

General Information

When choosing a refrigerant, different aspects must be taken into consideration:
- Legislation (now and in the future)
- Safety
- Application envelope in relation to expected running conditions
- Compressor capacity and efficiency
- Compressor manufacturer recommendations & Guidelines

Additional points could influence the final choice:
- Environmental considerations
- Standardization of refrigerants and lubricants
- Refrigerant cost
- Refrigerant availability

R410A

R410A is a HFC blend (R32: 50%; R125: 50%) with a zero Ozone Depletion Potential (ODP=0) and a Global Warming Potential of 1924/AR5 (2088/AR4). It is a near-azeotropic mixture with a temperature glide less than 0.2 K.

With its high net refrigeration effect coupled to a high density, the R410A has appeared in last decade to be the preferred refrigerant for use in commercial air conditioners and heat pumps.

Technical specification

Compressor size

Compressor can be sized on peak load, for best applied cost, or optimal efficiency. For optimal efficiency, see our performance details in Coolselector software.

For regular updates and detailed capacities, please refer to Coolselector®2.

Compressor specification

Table 3: Compressor specification

Compressor model	Swept volume		Displacement										Oil charge		Net weight	
			30 rps		60 rps		90 rps		120 rps		140 rps					
	cm^3/rev	cu.in/rev	m^3/h	cu.ft/h	m^3/h	cu.ft/h	m^3/h	cu.ft/h	m^3/h	cu.ft/h	m^3/h	cu.ft/h	dm^3	oz	kg	lbs
VCH115EGE/ VCH115FGE	115	7.01	12.42	438	24.84	877	37.26	1315	49.68	1754	57.96	2046	3.3	128	62	136
VCH115EGP/ VCH115FGP																
VCH115EGQ	115	7.01	12.42	438	24.84	877	37.26	1315	49.68	1754	57.96	2046	3.8	148	62.5	138

Sound and vibration data

Typical sounds and vibrations in systems can be broken down into the following three categories:
- Sound radiation (through air)
- Mechanical vibrations (through parts and structure)
- Gas pulsation (through refrigerant)

The following sections focus on the causes and methods of mitigation for each of the above sources.

Sound level and acoustic hood

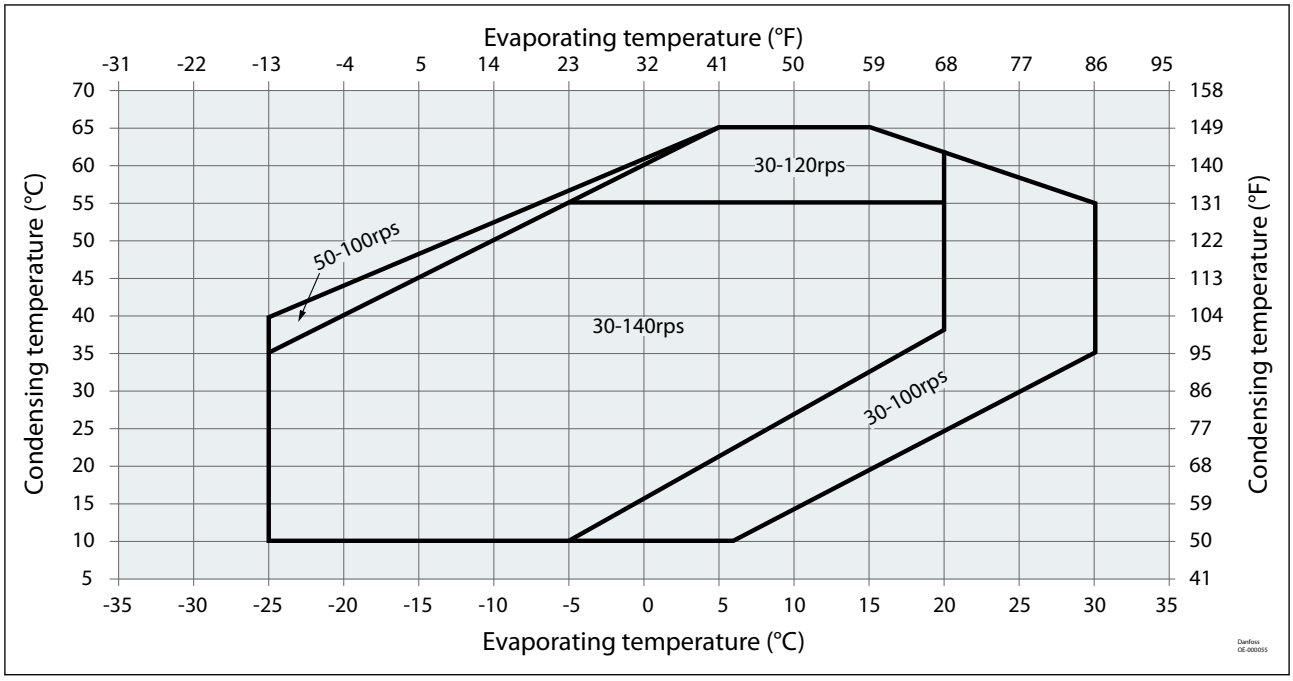
Model	Frequency RPS	Without accoustic hood (dBA)	Acoustic hood code
VCH115EGE/VCH115FGE	90	82	120Z0850
VCH115EGP/VCH115FGP	90	82	120Z0930
VCH115EGQ			

NOTE:
Nominal sound power for reference at ARI A/C (7.2°C/54.4°C/11.1°C/8.3°C) (45°F/130°F/20°F/15°F) conditions measured in free space.
- Max. tolerance +3dBA for individual compressor.
- With acoustic hood in the table, acoustic can decrease 5~7dBA.

Operating envelope data

VCH115EG operating envelope

Figure 3: VCH115EG envelope map



NOTE:
The solid line envelope is valid for a suction superheat with 5K at nominal voltage.

Higher suction superheat may lead to discharge temperature above 135° and map shrinkage.

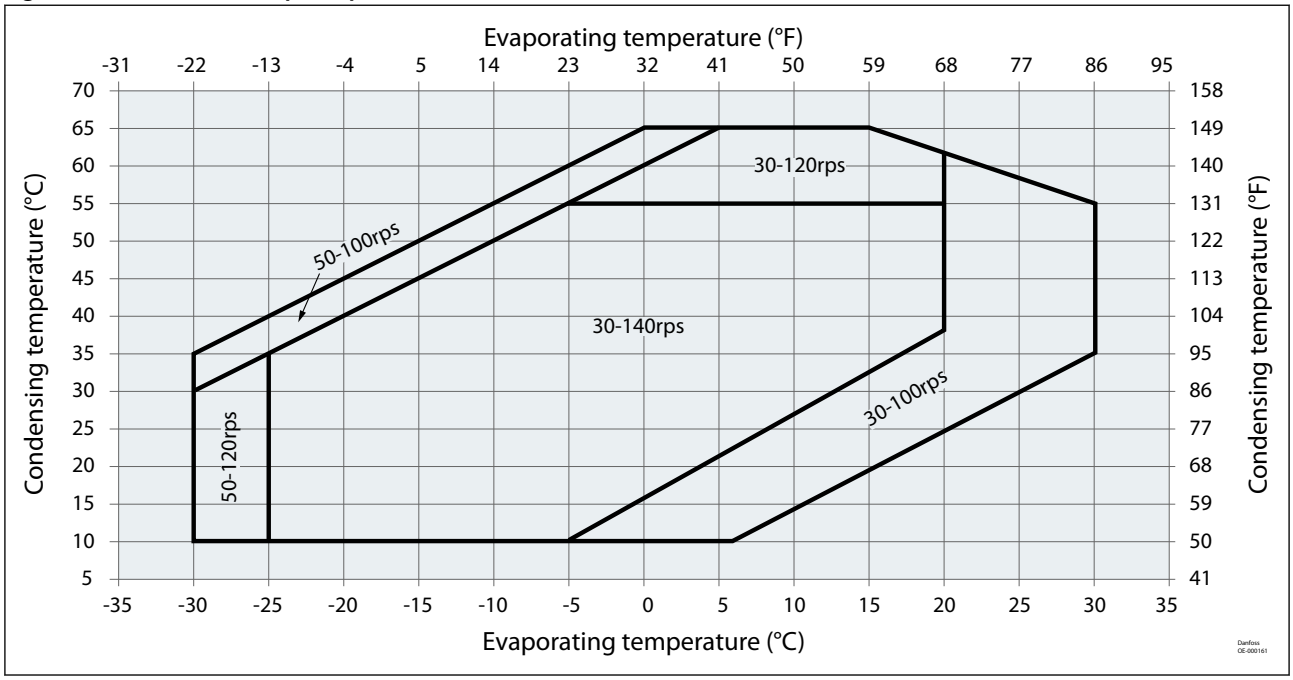
Pressure settings

Table 4: Pressure settings

Pressure settings	R410A	
	bar (g)	psi (g)
Working pressure range low side	2.3~17.8	33~258
Working pressure range high side	9.8~41.6	142.3~603.6
Maximum high pressure safety switch setting	44	638
Minimum low pressure safety switch setting	2	29

VCH115FG operating envelope

Figure 4: VCH115FG envelope map



NOTE:

The solid line envelope is valid for a suction superheat with 5K at nominal voltage.

Higher suction superheat may lead to discharge temperature above 135° and map shrinkage.

Pressure settings

Table 5: Pressure settings

Pressure settings	R410A	
	bar (g)	psi (g)
Working pressure range low side	2.3~17.8	33~258
Working pressure range high side	9.8~41.6	142.3~603.6
Maximum high pressure safety switch setting	44	638
Minimum low pressure safety switch setting	1.43	20.74

Dimensions

VCH115EGENA/VCH115FGENA

Figure 5: Outline drawing

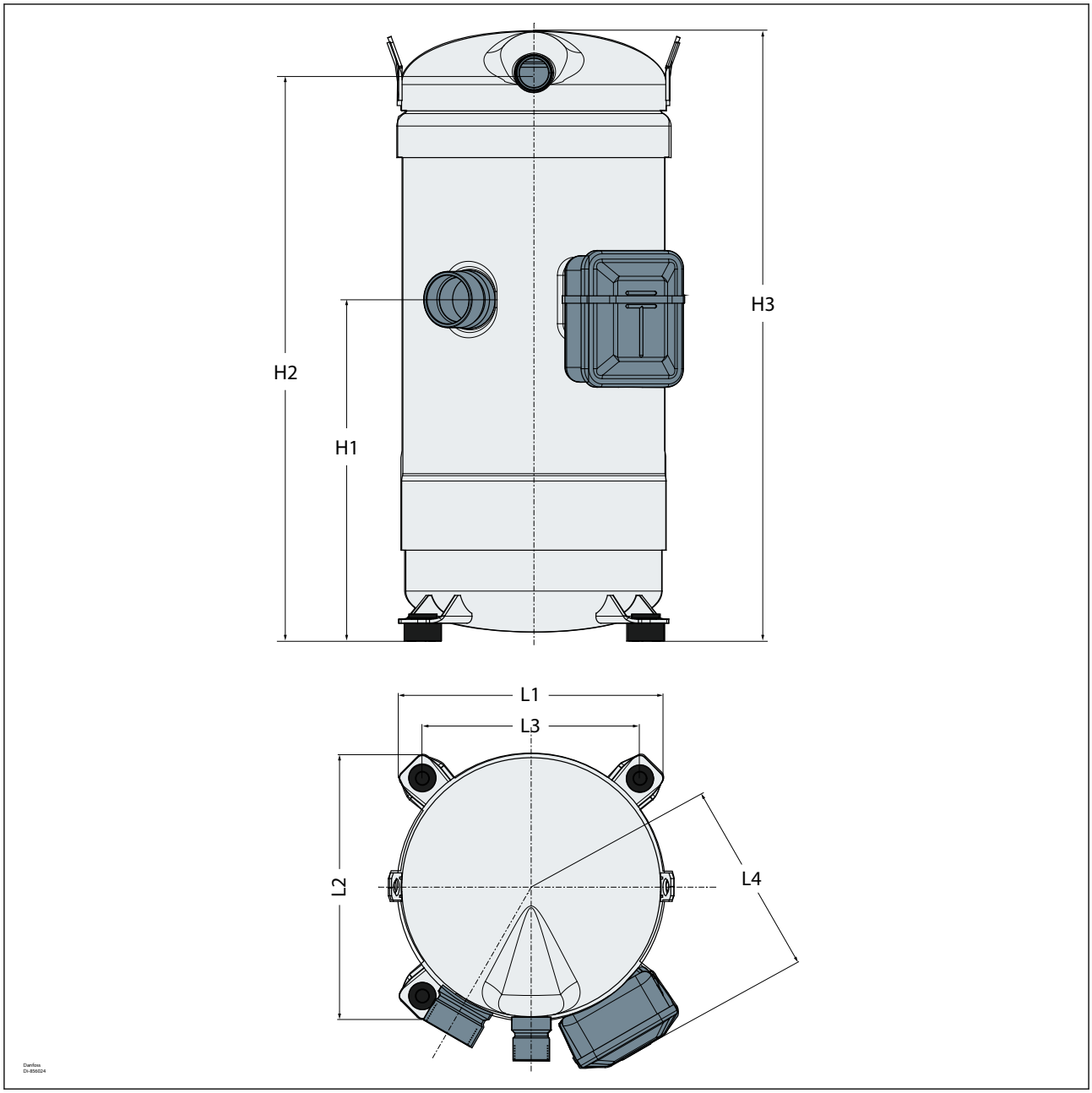


Table 6: Dimensions for VCH115EGENA/VCH115FGENA

Compressor model	D		H1		H2		H3		L1		L2		L3		L4		Outline drawing number
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	
VCH115EGENA/ VCH115FGENA	224.3	8.83	291.4	11.47	485.4	19.11	520.9	20.51	231	9.09	231	9.09	190.5	7.5	171.1	6.74	8560248

Also refer Grommets and Wiring connections

VCH115EGPNA/VCH115FGPNA

Figure 6: Outline drawing

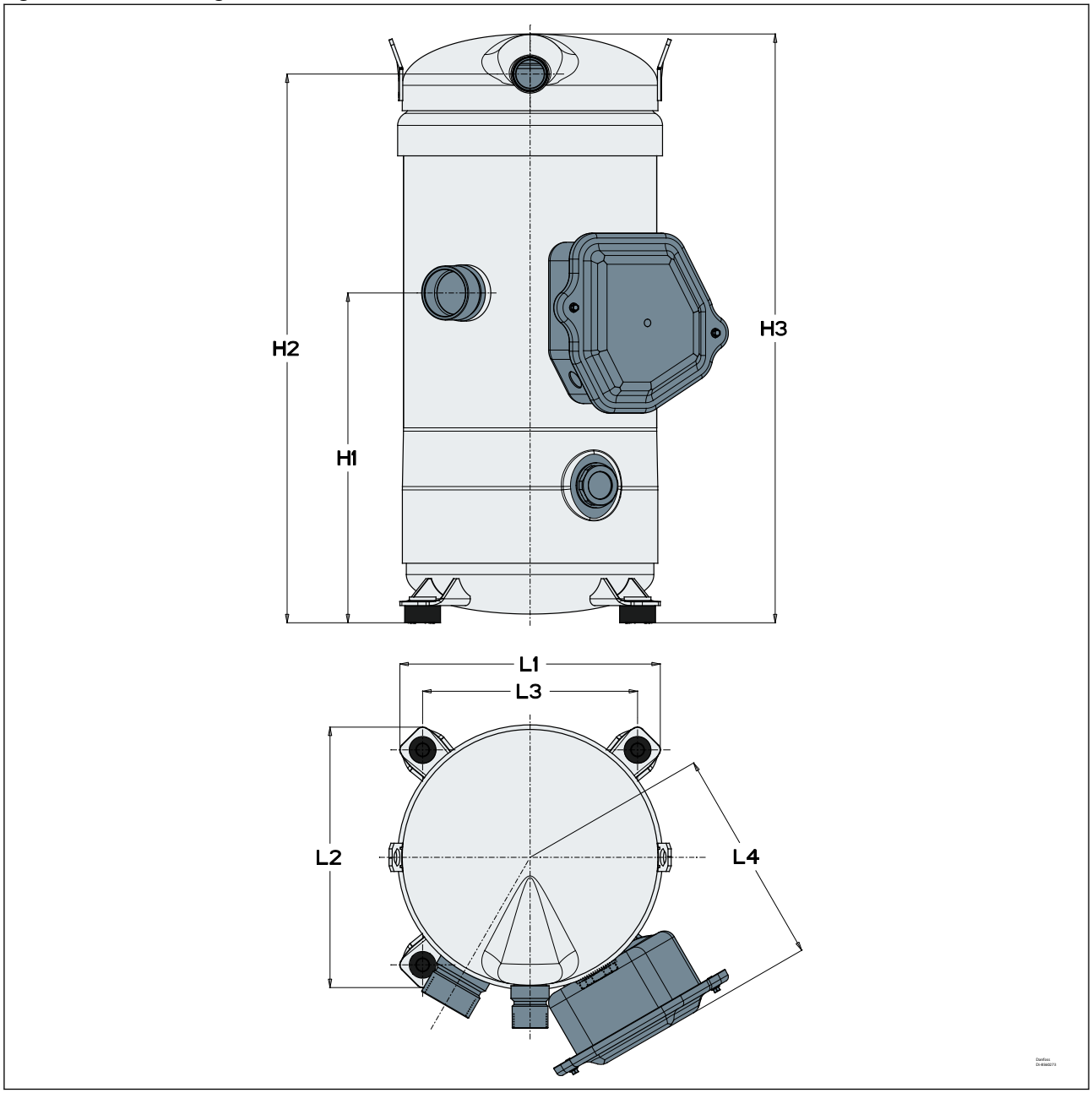


Table 7: Dimensions for VCH115EGPNA/VCH115FGPNA

Compressor model	D		H1		H2		H3		L1		L2		L3		L4		Outline drawing number
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	
VCH115EGPNA/ VCH115FGPNA	224.3	8.83	291.4	11.47	485.4	19.11	520.9	20.51	231	9.09	231	9.09	190.5	7.5	191.7	6.74	8560273

Also refer Grommets and Wiring connections

VCH115EGQNA

Figure 7: Outline drawing

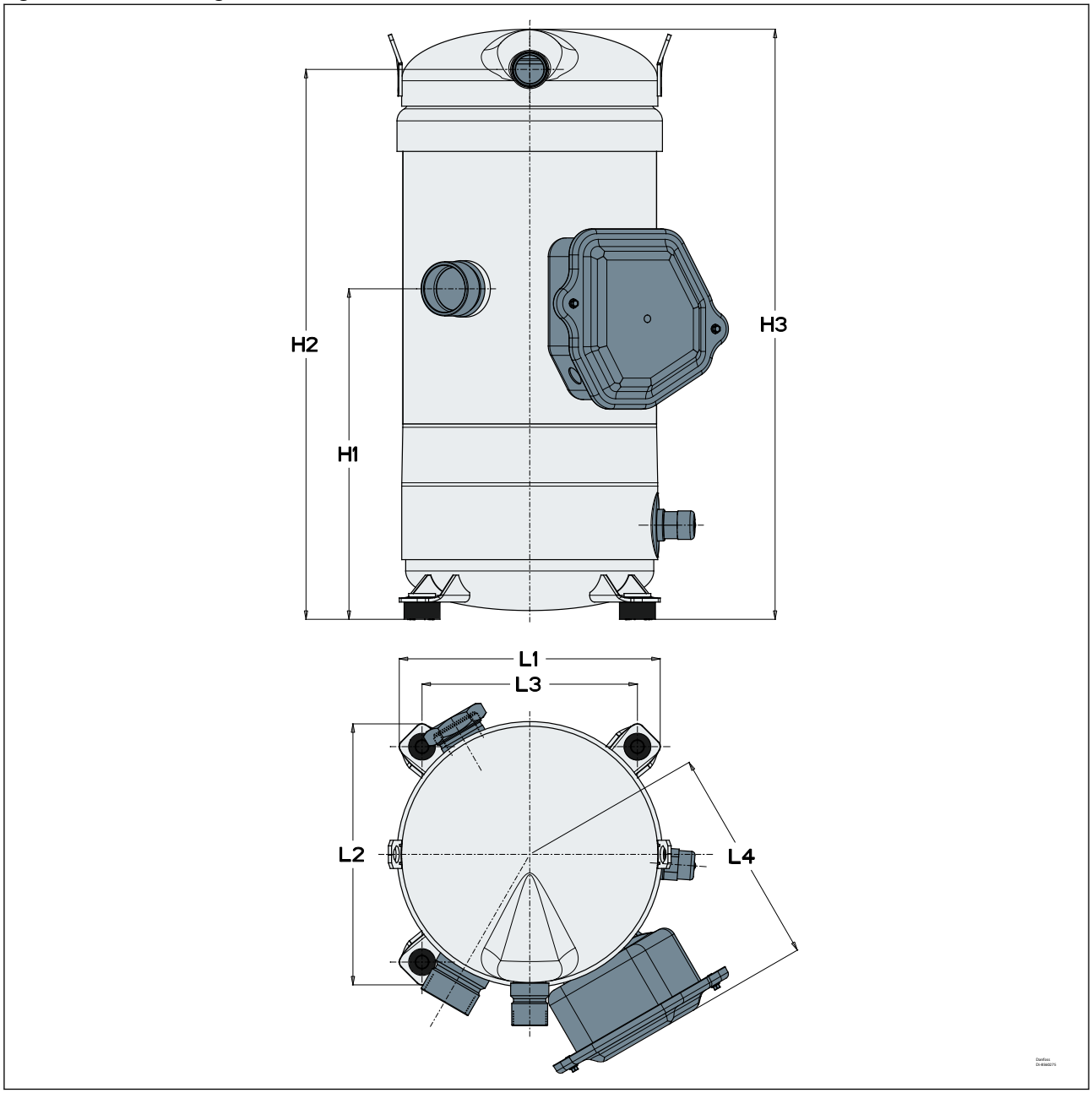


Table 8: Dimensions for VCH115EGQNA

Compressor model	D		H1		H2		H3		L1		L2		L3		L4		Outline drawing number
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	
VCH115EGQNA	224.3	8.83	291.4	11.47	485.4	19.11	520.9	20.51	231	9.09	231	9.09	190.5	7.5	191.7	6.74	8560275

Also refer Grommets and Wiring connections

Mechanical connections

Connection Details

Table 9: Connection Details

Connection Details	VCH115
Suction connection	1"5/8
Discharge connection	1"1/8
Outline	1

Figure 8: Outline drawing 1

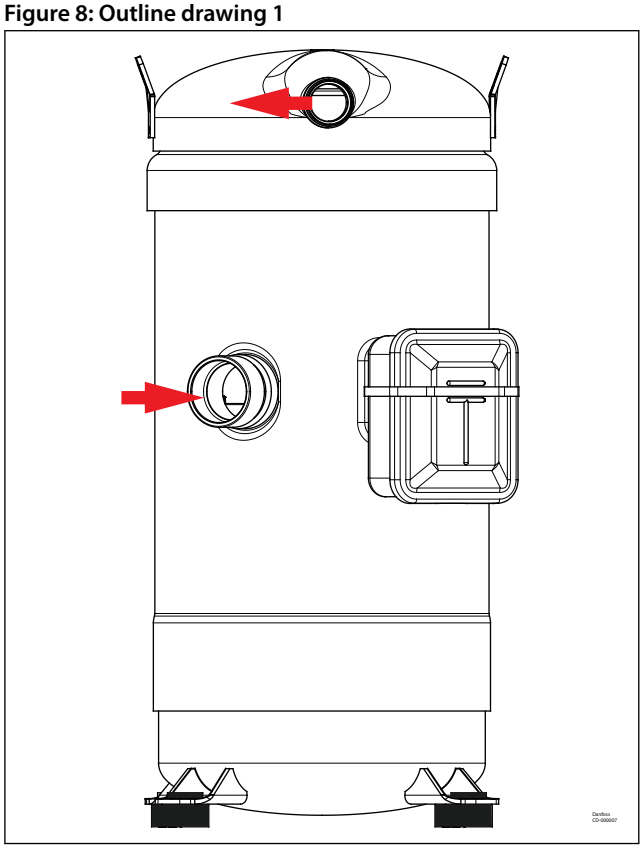


Table 10: Brazed connection

Compressor models	Brazed	
	connection	size
VCH115	Suction	1"5/8
	Discharge	1"1/8

VCH compressor is all delivered with suction and discharge brazed connections only. They are copper-plated steel connections.

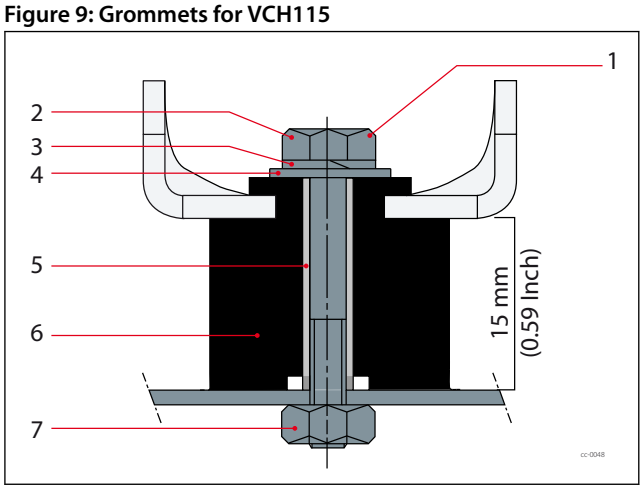
Design compressor mounting

Grommets

Compressors must be mounted with flexible grommets and metal sleeve delivered with compressor. The grommets attenuate the transmission of compressor vibrations to the base frame. The grommets must be compressed until contact between the flat washer and the steel mounting sleeve is established.

The required bolt size for the VCH115 compressor is HM8-40. This bolt must be tightened to a torque of 15 Nm (11 ft/lbs.).

Figure 9: Grommets for VCH115



1	Tightening torque 15 Nm
2	HM 8 bolt
3	Lock washer
4	Flat washer
5	Steel mounting sleeve
6	Rubber grommet
7	Nut

Max inclination

During operation, the maximum inclination from the vertical plane must not exceed 3 degrees.

System design generalities

Compressor capacity and modulation

Usually, compressors are selected to cover peak load cooling/heating capacities between 70-140 rps.

Modulation (difference between minimum speed and maximum speed) is a very important point for unit design. The larger the modulation number, the challenging the unit design will be. This would consequently increase unit cost.

The minimum compressor speed must be defined according to unit need. It often makes sense to set unit minimum speed higher than minimum compressor speed qualified by Danfoss.

Differences between variable speed and fix in speed unit design

Variable speed compressors were created with state of the art technology with the intent to be efficient and precise. Speed variations have led to challenges that must be addressed by unit design.

Variable speed compressor is a great technology to design efficient and precise unit, however, speed variation leads to challenges that must be addressed by unit design. The first challenge is linked to part of the load operation. Unit design must ensure that oil is returning back to the compressor, even while it is at the lowest speed. The expansion device must also ensure safe superheat across speed range. The second challenge is due to variation of speed itself.

On the opposite hand, on a variable speed system, compressor speed is permanently changing according to load. Consequently, expansion valve must adapt quickly enough to guaranty proper superheat control during transient.

Variation of compressor speed can also lead its own challenges for vibrations. While in fix speed, only one frequency is excited by the compressor. In variable speed, the whole compressor frequency range may excite the system. The chance of going through resonant frequency is then more greatly increased. The following chapters give details advices to integrate variable speed compressor in a unit. Designing a variable speed unit requires to go through all of them to define necessary safeties and qualifications.

Compressor and drive control → Superheat Management → Oil return management → Operating envelope → compressor Mechanical installation → Sound and vibrations management → Drive installation

Electrical connections

Wiring connections

Electrical power is connected to the compressor terminals by #10-32 UNF 2A screws. The maximum tightening torque is 3 Nm. Use a 1/4" ring terminal on the power leads.

⚠ A special Plug should be used on the E-Box before connecting the electric wire to protect against accidental contact with electrical parts inside and protect against the wire and E-Box hard contacting.

The special Plug is in the accessory list, customer can book it independently. It is also OK that customer make the plug by themself.

Motor protection

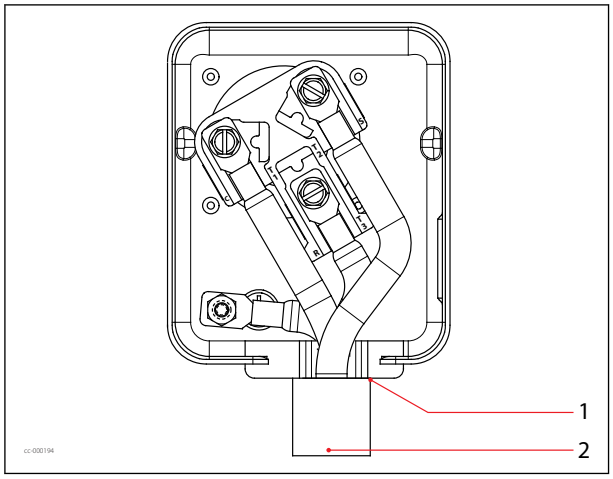
VCH scroll compressors are not equipped with an internal motor protector. Motor protection is provided by the variable speed drive. All parameters are factory preset in order to guaranty locked rotor or overload current protection.

When a warning situation is reached in the current control, the CDC100 frequency converter will automatically reduce the compressor speed in order to keep the motor current of the compressor below the maximum allowed.

VCH115EGE/VCH115FGE

The terminal box is provided with a Ø36mm (Ø1.4 inch) U hole for power supply.

Figure 10: Terminal box for VCH115 IP22 version

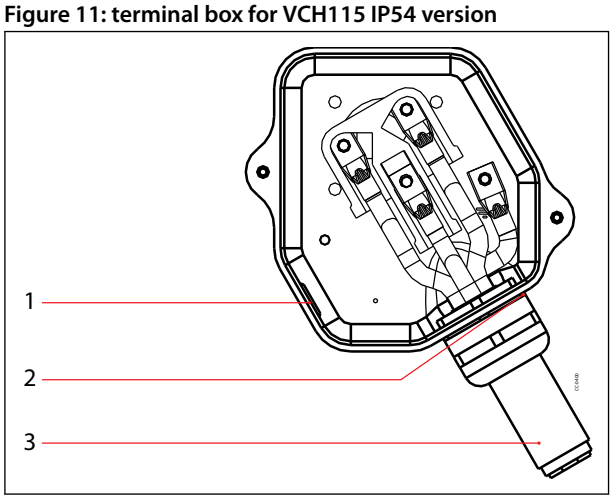


1	Ø 36 mm (1.4 inch) hole
2	Power supply

VCH115EGP, VCH115EGQ, ,VCH115FGP

The terminal box is provided with a φ 40.5mm (φ1.59 inch) hole (ISO40) for power supply and a φ 16.5mm (φ0.65 inch) knockout (ISO16).

Figure 11: terminal box for VCH115 IP54 version



1	Ø 16.5mm (φ0.65inch) knockout
2	Ø 40.5mm (φ1.59inch) hole
3	Power supply

Electrical specifications

IP rating

The compressor terminal box IP rating according to GBT4208 is IP22 after installing the U Plug 120Z0852 on the E-Box.

Element	Numerals or letters	Meaning for the protection of equipment
First characteristic numeral Against ingress of solid foreign objects	0	(non-protected)
	1	≥ 50 mm diameter
	2	≥ 12.6 mm diameter
	3	≥ 2.5 mm diameter
	4	≥ 1.0 mm diameter
	5	dust protected
	6	dust tight
Second characteristic numeral Against ingress of water with harmful effects	0	(non-protected)
	1	vertically dripping
	2	dripping (15° tilted)
	3	spaying
	4	splashing
	5	jetting
	6	powerful jetting
	7	temporary immersion
	8	continuous immersion

MCCB / FUSE / Contactor

Danfoss recommends using the fuses/circuit breakers to protect service personnel and property in case of component break-down in the frequency converter.

Table 11: MCCB / FUSE / Contactor

Model		Power	model	MCCB	Contactor	gG fuse	Recommended circuit breaker
						Maximum fuse	IP20
		[kW]		[A]	[A]	[A]	Moeller type
3 × 380 V	VCH115	30	CDC100	100	100	80	NZMB1-A100

Compressors 3 phase electrical characteristics

Table 12: Compressors 3 phase electrical characteristics

Volt	Compressor	RW(1)	MOC
		(Ohm)	(A)
380V	VCH115	0.037	57.5A

[1] Winding resistance per winding (in CDC100 parameter list)

NOTE:
Parameter 1-30 in the frequency converter settings reflects the winding resistance per winding. This is not the same value as measured at the motor terminals.

MOC (Max Operating Current)

Max. operating current is the max. continuous current output from drive to compressor within operating map.

MOC is tested at max. load condition with nominal voltage.

MOC is printed on the nameplate, it can be used to select cable and contactor for customer by adding some safety coefficient.

Phase sequence and reverse rotation protection

The compressor will only operate properly in a single direction. If electrical connections are done correctly between the drive and the compressor terminals (compressor T1/T2/T3 and drive terminals U, V & W matching), the drive will provide correct phase supply to the compressor, and reverse rotation will be not possible:

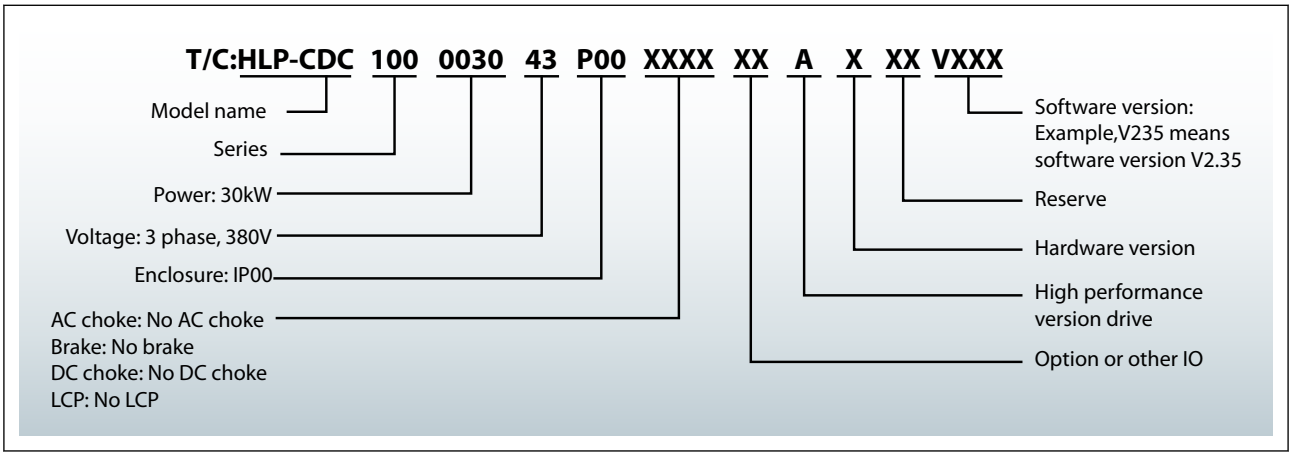
- CDC100 terminal U to VCH terminal T1
- CDC100 terminal V to VCH terminal T2
- CDC100 terminal W to VCH terminal T3

If compressor T1/T2/T3 and drive U, V & W terminals are not matching, the compressor can operate in a reverse rotation. This results in excessive noise and no pressure differential between suction and discharge, and suction line warming rather than immediate cooling. The compressor can be rapidly damaged in these conditions. Reverse rotation of the compressor for only a few seconds can quickly cause irreversible damage to the scroll sets. Before starting always review the wiring and be prepared to shutoff immediately in case of noise. If reverse rotation symptoms occur, shut the compressor down and connect the phases to their proper terminals. Allow the compressor to run and then check amps at operating condition versus Danfoss published performance data to see if there was damage.

Frequency converter

Product identification

Frequency converter nomenclature



Technical specification

Frequency converter technical specifications

Table 13: Frequency converter technical specifications

Features	Description
Mains supply voltage	T4: 380 V ±10% (3-phase)
Supply frequency	50 Hz
Output voltage	0 - 100 % of supply voltage
Inputs	2 STO
Protection functions	Over-current protection, low / high current handling
Compressor functions	Motor protection, compressor ramp up/down control

NOTE:
This compressor is equipped with a six poles electrical motor so the applied frequency from the inverter will be 90 Hz for 30 rps (1800 rpm) up to 420 Hz for 140 rps (8400 rpm). Please refer to the table below

Table 14: Compressor and frequency converter combinations

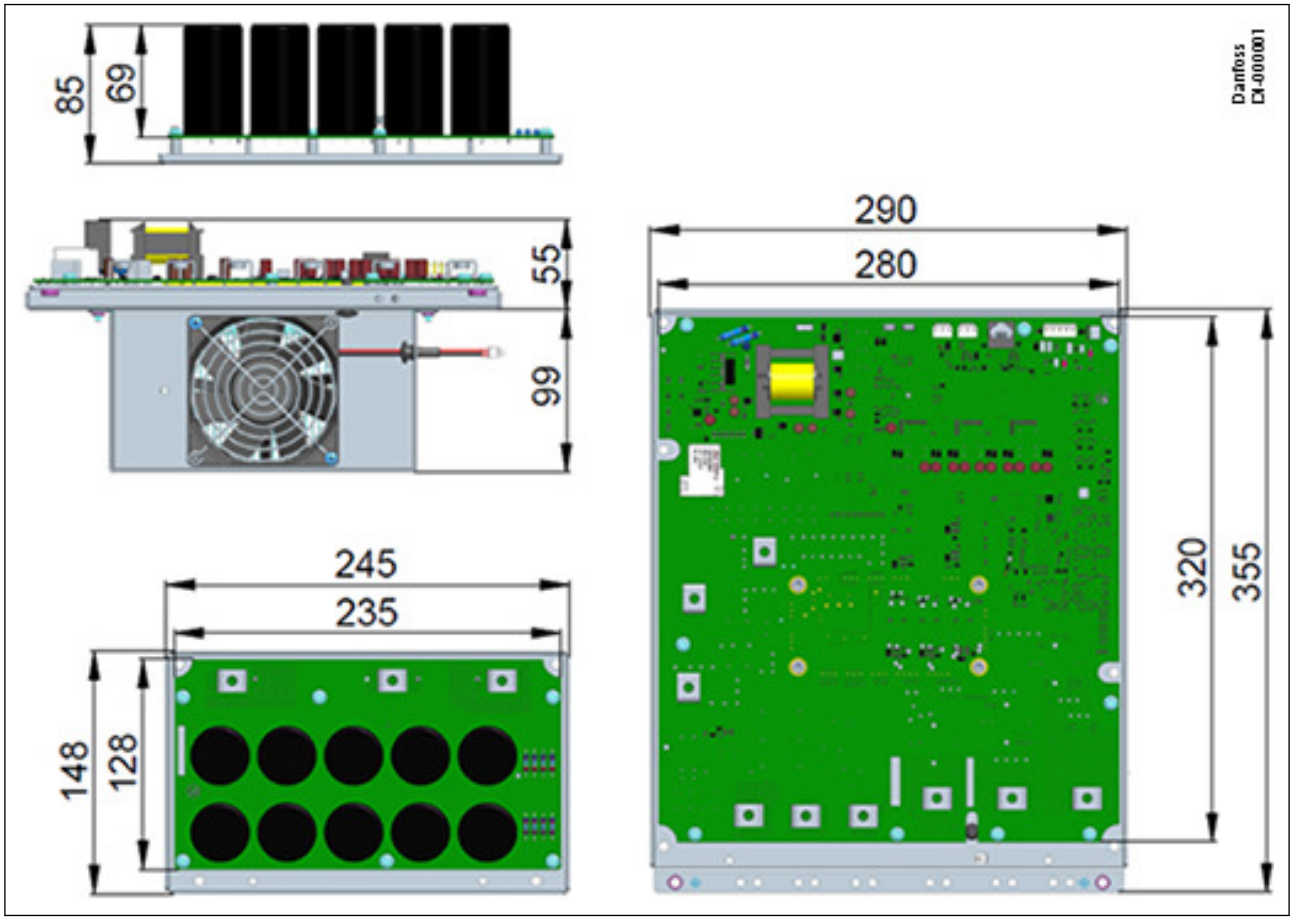
Compressor speed			Drive output frequency
min./max.	rps	rpm	Hz
min.	30	1800	90
max.	140	8400	420

Dimensions

CDC100 Frequency converter dimensions

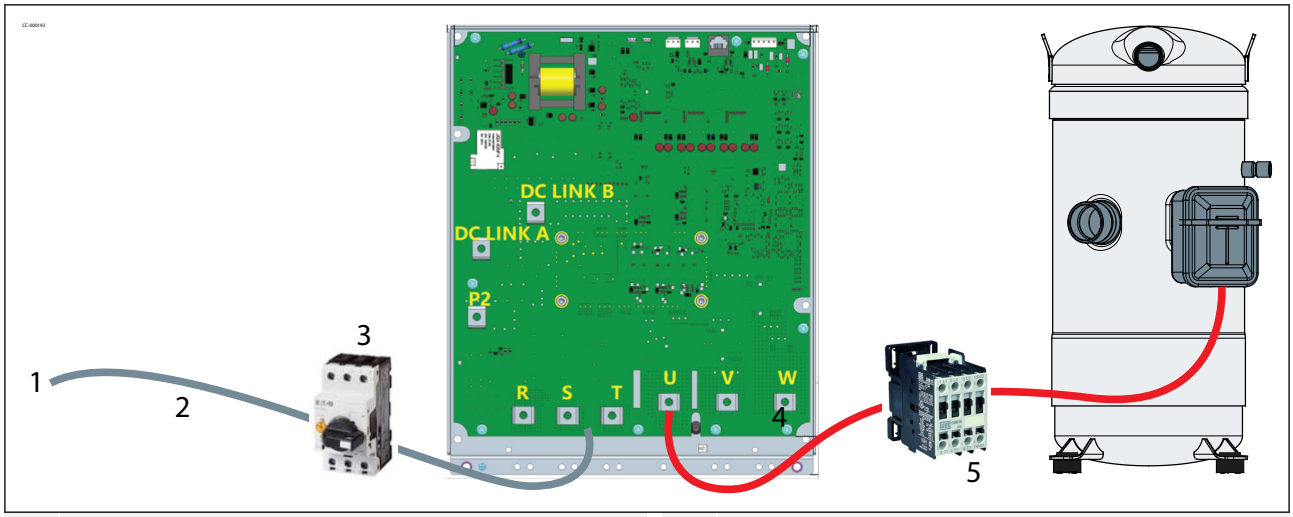
Frequency converter dimensions depend on supply voltage, IP rating and power. The table below gives an overview of the overall dimensions.

Figure 12: External and Installation Dimensions



Electrical connections

Wire sizes



1	Power input	**4**	From drive to to compressor
2	From network to drive	**5**	contactor
3	Circuit breaker		

Table 15: Maximum wiring sizes for the motor compressor power supply cables

Voltage range	From network to frequency converter			From frequency converter to compressor		
	Type	mm²	AWG	Type	mm²	AWG
380 V	CDC100-30kW	22	4	VCH115-G	22	4

NOTE:
The wire size values are the maximum size the converter can accept. The required cable size should be specified by the OEM depending on the unit design, ambient temperature, the wire material, current, etc...

Electrical specifications

Supply voltage

Table 16: Mains voltage range of drive

Voltage code	Mains voltage range of drive
G	380 (±10%)/ 3ph/ 50Hz

Never connect the VCH115 compressor directly to the mains power supply in case of frequency converter defect.

Drive voltage imbalance

The maximum allowable voltage imbalance between each phase is 3%. Voltage imbalance causes high amperage over one or several phases, which in turn leads to overheating and possible drive damage.

Fuses / circuit breakers

The CDC100 frequency converter generates by design a compressor soft start.

Current inrush will not exceed the frequency converter maximum current.

Basically seen from the mains, the inrush peak reaches a level which is only a few percent more than the rated nominal current.

Drive installation

Installation environment requirements

- Ambient temperature in the range of -30°C~ 70°C, > 55 °C derating.
- Drive should be installed on surface of flame retardant object, with adequate surrounding space for heat dissipation.
- Installation should be performed where vibration is less than 2g.
- Avoid from moisture and direct sunlight.
- Do not expose to an atmosphere with flammable gases, corrosive gases, explosive gases or other harmful gases.
- Protect the cooling fan by avoiding oil, dust and metal particles.
- Prevent drilling residues, wire ends and screws falling into drive.

Drive ambient temperature

CDC100 drive can operate at 55˚C with maximum load; between 55 ˚C and 70 ˚C with 80% maximum load. Do not exceed the maximum temperature limit.

The drive could operate lower to -30˚C with proper operation, such as inside the cabinet, install the space heater. LCP operating temperature is -10 - 50 ˚C.

High Ambient Temperature

Test at the units at highest ambient maximum load is recommended. Look for over temperature alarms. Guidelines that support high ambient temperature:

- Ensure clearance limits above and below the drive for air circulation are respected.
- The drive must be installed on a panel wall or on a back plate to ensure proper cooling.
- Do not place the drive under direct sunlight.
- Insulation inside the electrical panel can reduce impact of sun radiation.
- Additional air conditioning of the cabinet may be required.

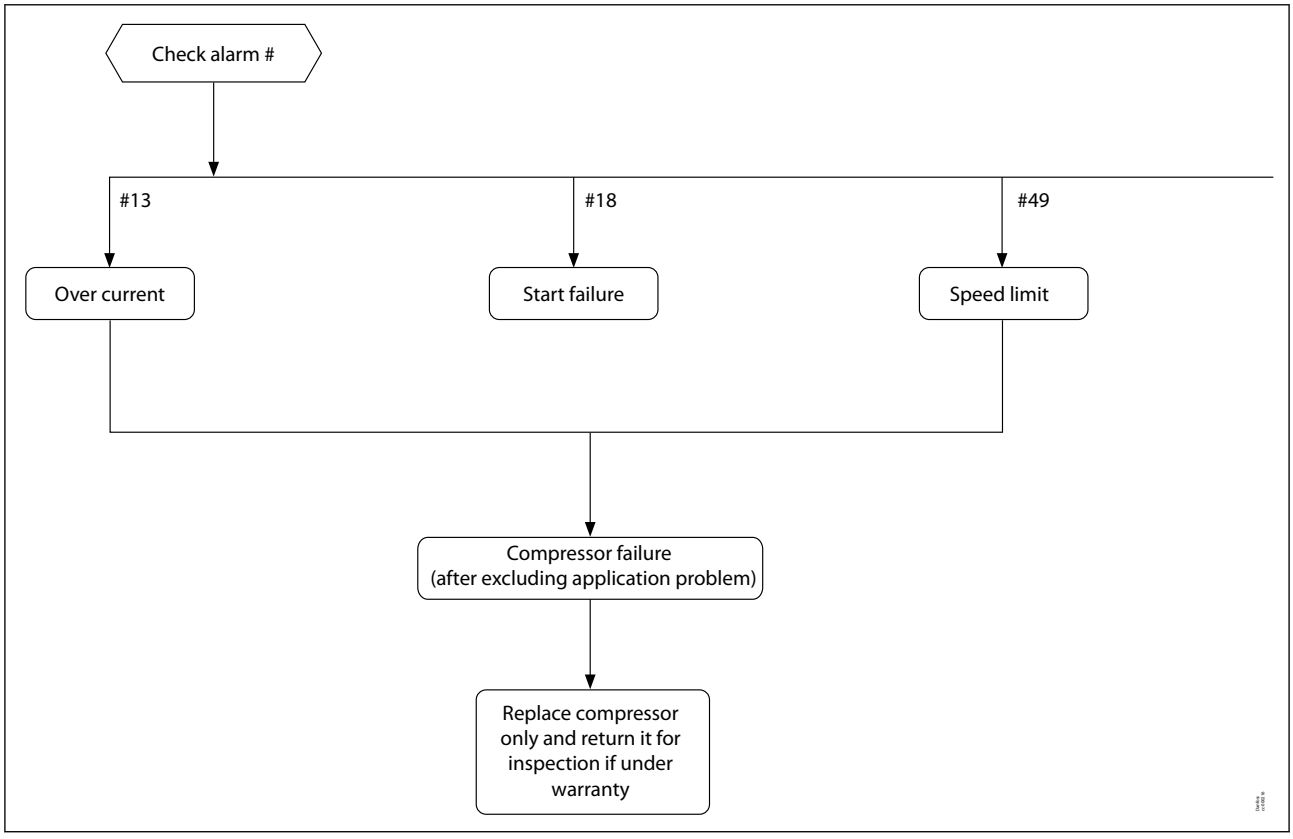
The frequency converter has built-in temperature sensors and reacts immediately to critical values via hard-coded limits. In case of over-temperature inside the frequency converter, it automatically derates the speed and the maximum allowed output current to reduce the internal heat. This can cause the compressor to trip.

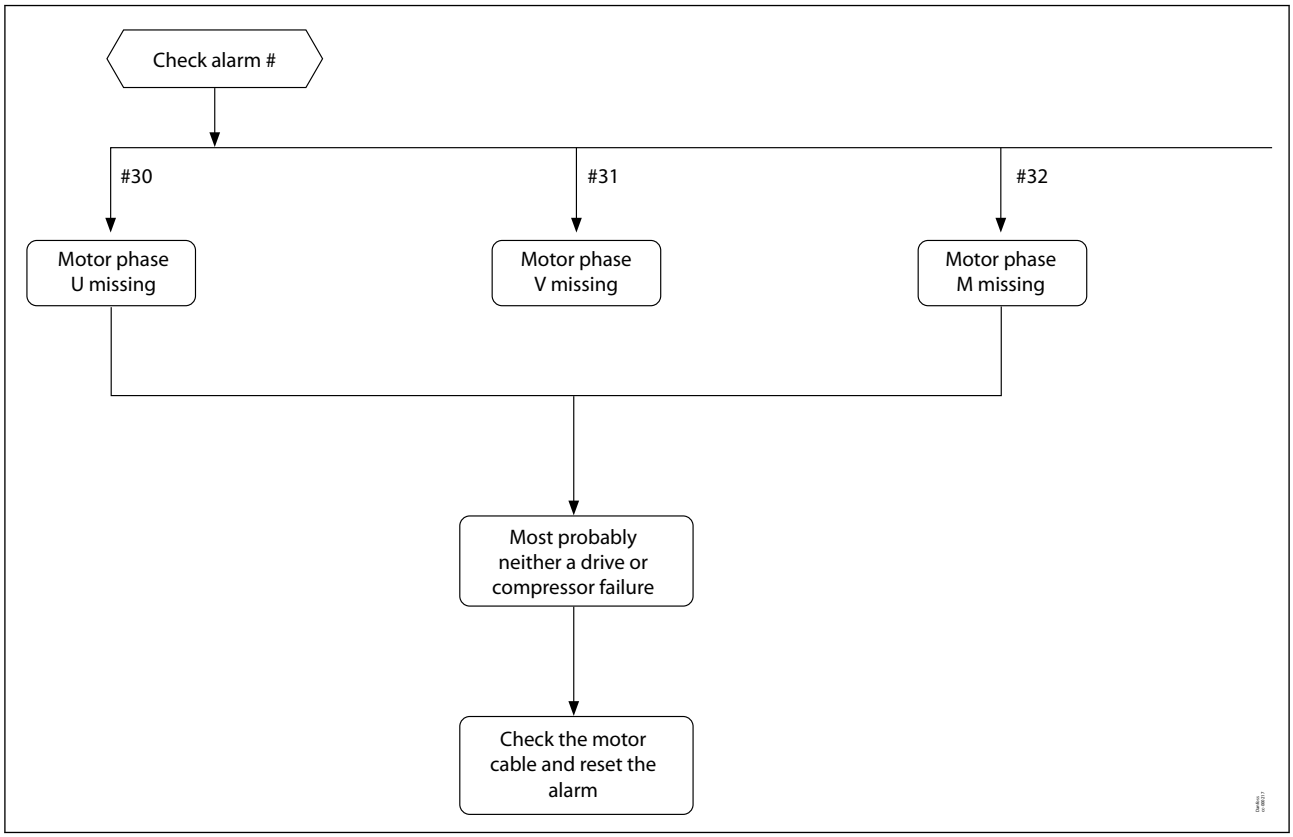
Temperature during storage/transport: -35~70°C

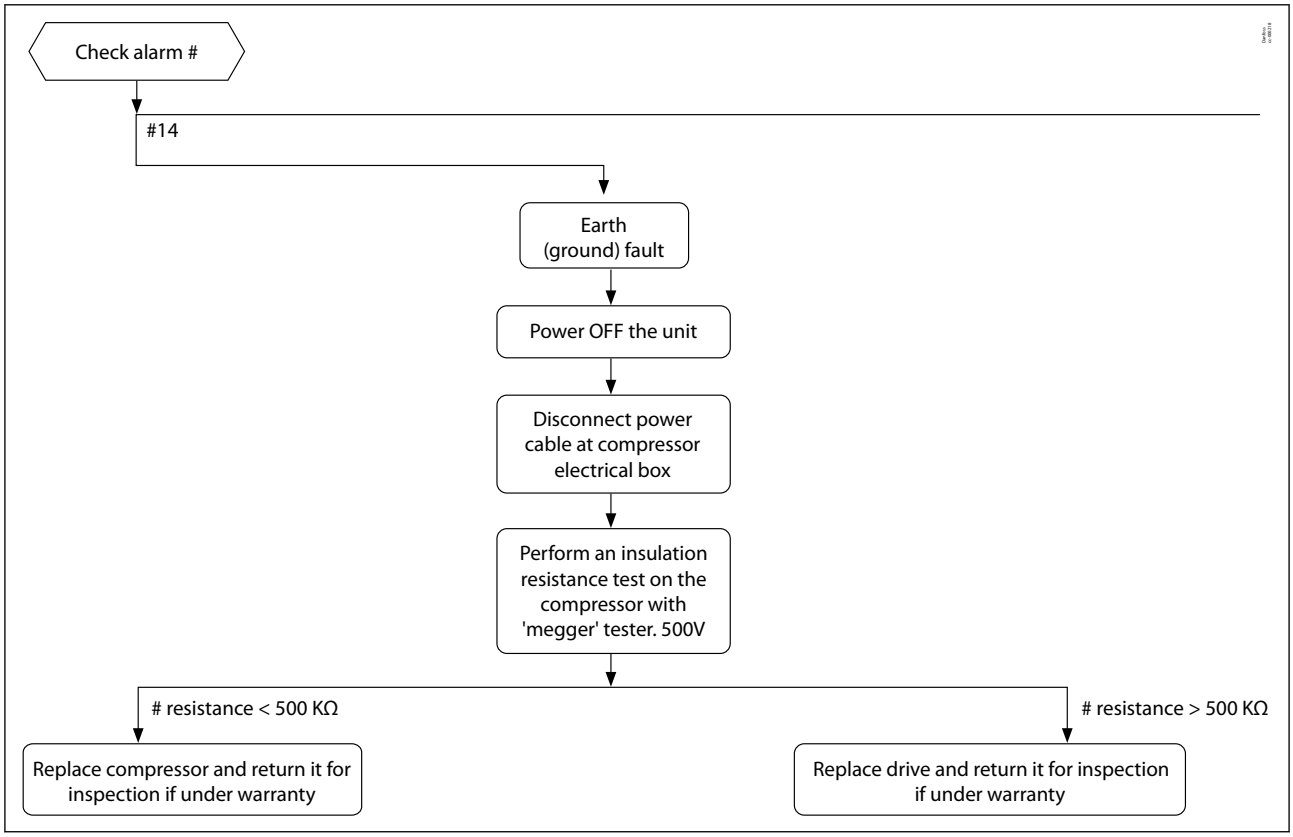
Introduction to EMC standard

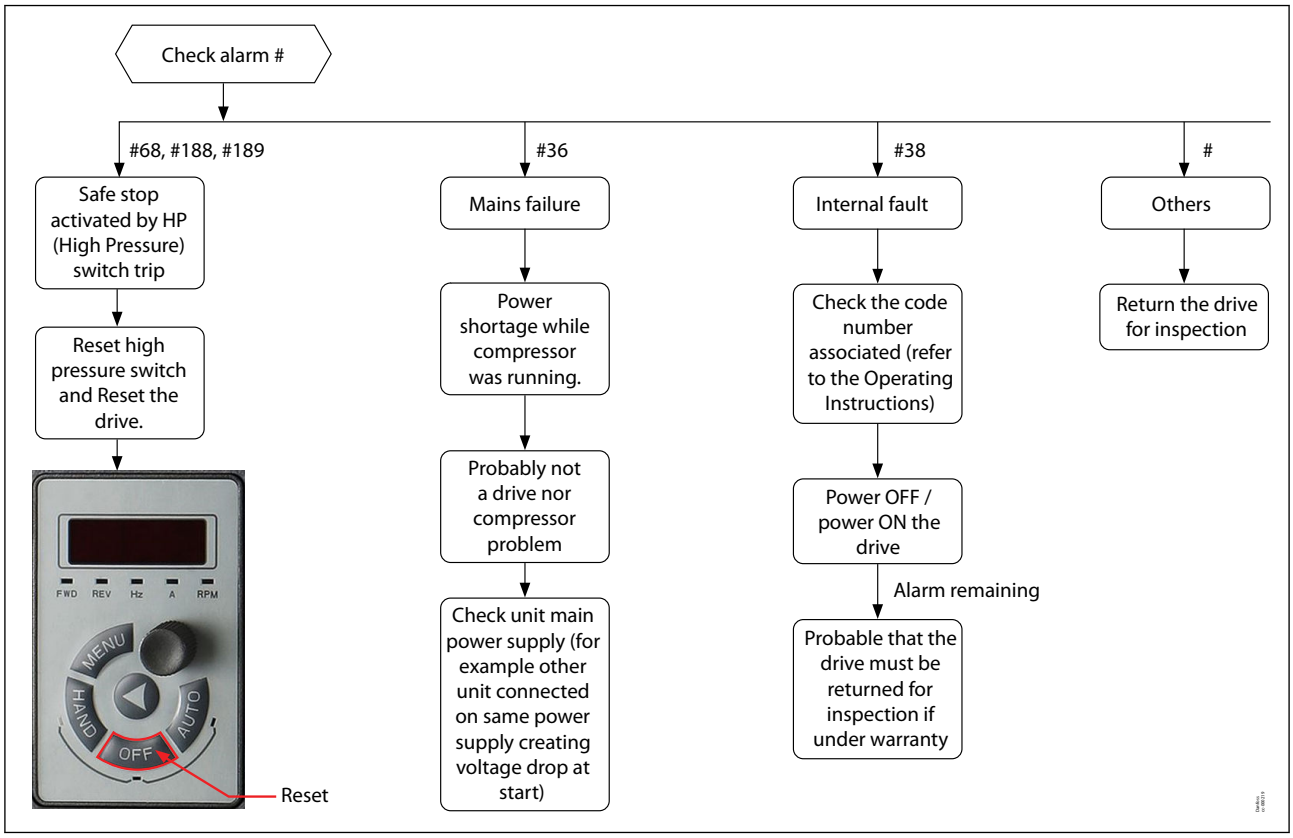
When equipped with RFI board ,CDC100 drive satisfies the requirements of standard IEC/EN61800-3: 2004 (Adjustable speed electrical power drive systems part 3: EMC requirements and specific test methods).

Troubleshooting



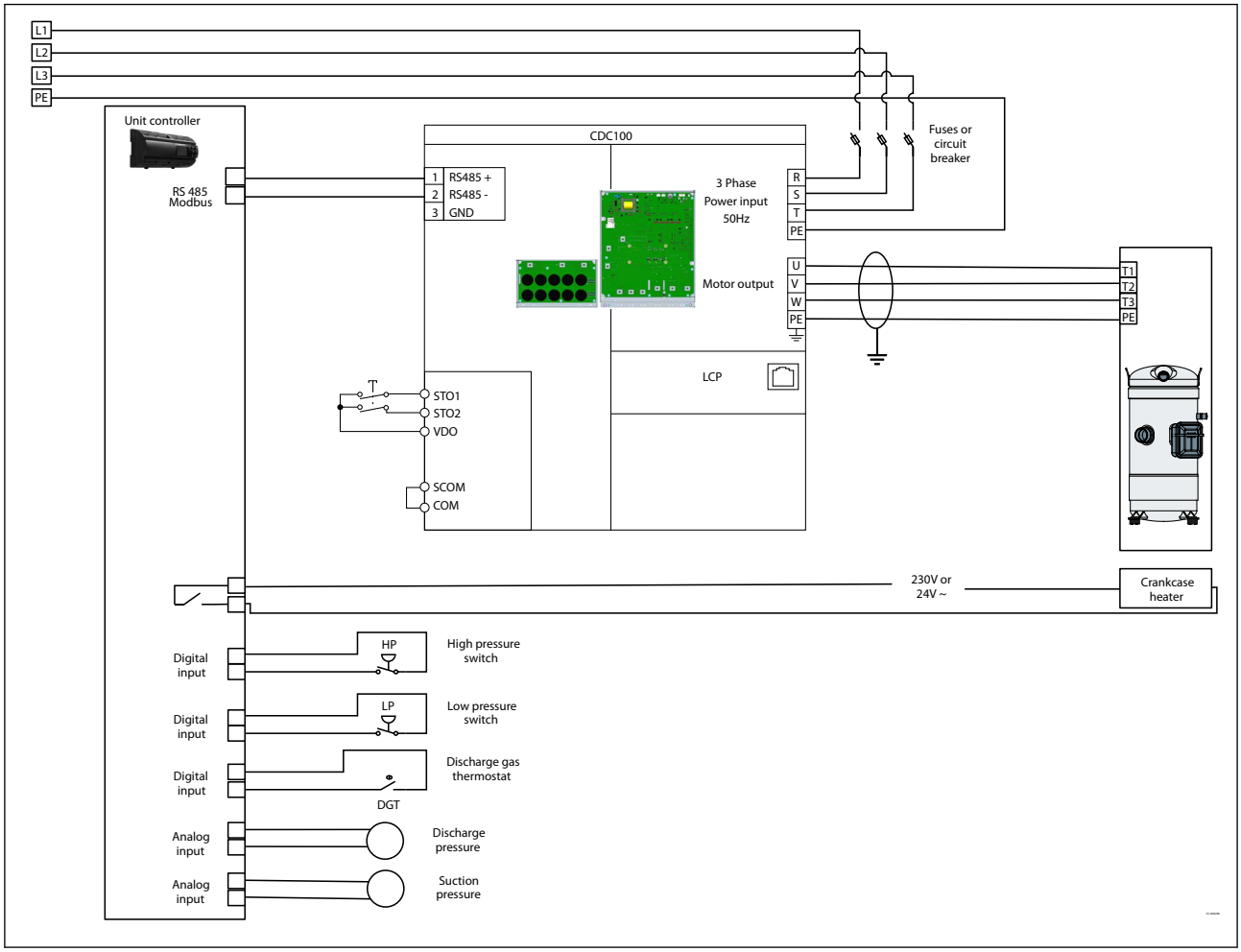

Check alarm #
#30
#31
#32
Motor phase U missing
Motor phase V missing
Motor phase M missing
Most probably neither a drive or compressor failure
Check the motor cable and reset the alarm


Check alarm #
#14
Earth (ground) fault
Power OFF the unit
Disconnect power cable at compressor electrical box
Perform an insulation resistance test on the compressor with 'megger' tester. 500V
resistance < 500 KΩ
resistance > 500 KΩ
Replace compressor and return it for inspection if under warranty
Replace drive and return it for inspection if under warranty


Check alarm #
#68, #188, #189
Safe stop activated by HP (High Pressure) switch trip
Reset high pressure switch and Reset the drive.
FWD
REV
Hz
A
RPM
MENU
HAND
AUTO
OFF
Reset
#36
Mains failure
Power shortage while compressor was running.
Probably not a drive nor compressor problem
Check unit main power supply (for example other unit connected on same power supply creating voltage drop at start)
#38
Internal fault
Check the code number associated (refer to the Operating Instructions)
Power OFF / power ON the drive
Alarm remaining
Probable that the drive must be returned for inspection if under warranty
#
Others
Return the drive for inspection

Compressor and drive control

Typical control architecture



STO function

If STO function is configured, internal power supply can be used, as shown in Figure 13: Internal Power supply or external 24 V power supply Can be used, as shown in Figure 14: External Power supply.

Figure 13: Internal Power supply

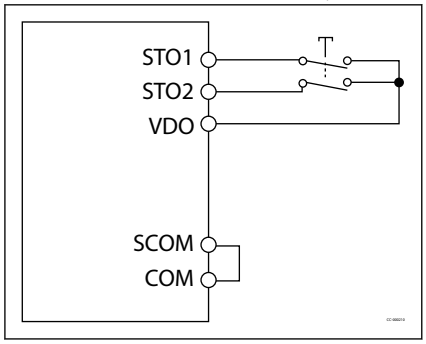
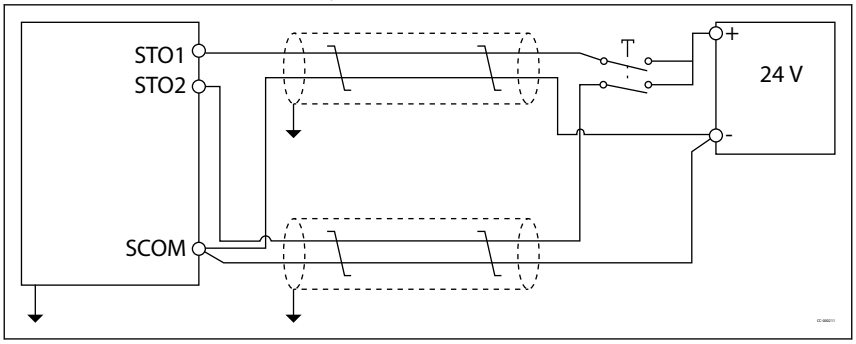


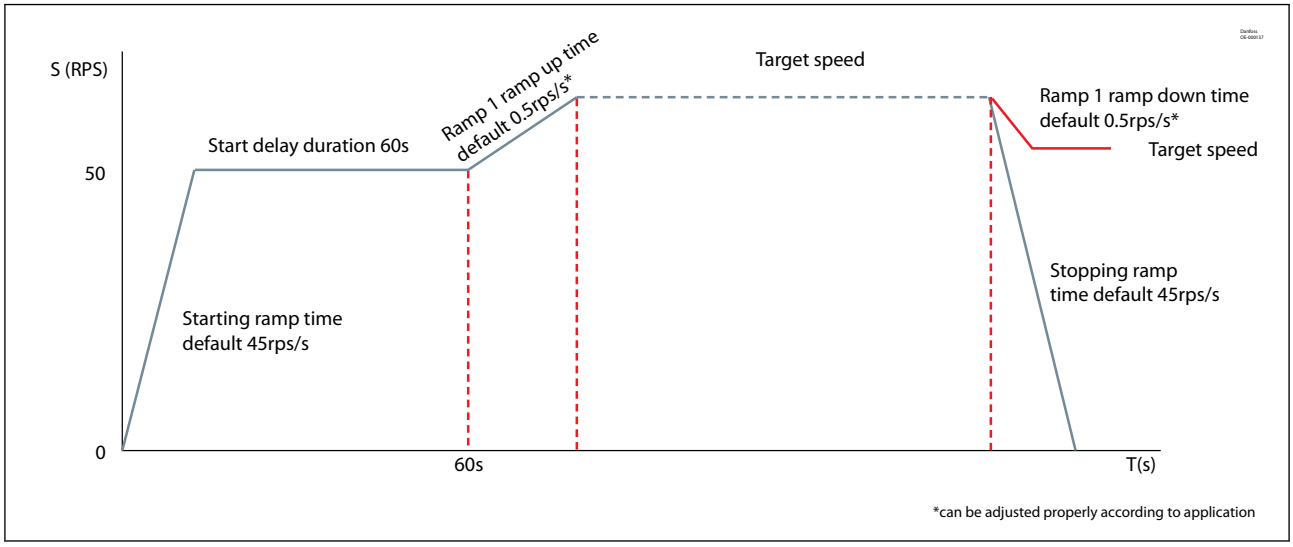
Figure 14: External Power supply



Compressor start and stop, speed control

R Speed limit guarantees compressor reliability and must be respected. In drive control logic, default setting values have been qualified by Danfoss. It is not recommended to change default values.

Figure 15: Start/Stop/Ramp setting



S (RPS)	Speed
T(s)	Time

Short cycle protection

Minimum run time is necessary to ensure proper oil return to the compressor. A 3 minute minimum run time is usually recommended but some systems may require more time to establish proper superheat and stable oil return. Additionally, compressor must not exceed a maximum of 12 starts per hour. 12 starts per hour must not be considered as an average, this is the maximum number of starts acceptable to keep a good regulation accuracy during low load. Short cycle protection can be done either by the drive or the unit controller. The following table describes the parameters to adjust depending on which short cycle protection is selected.

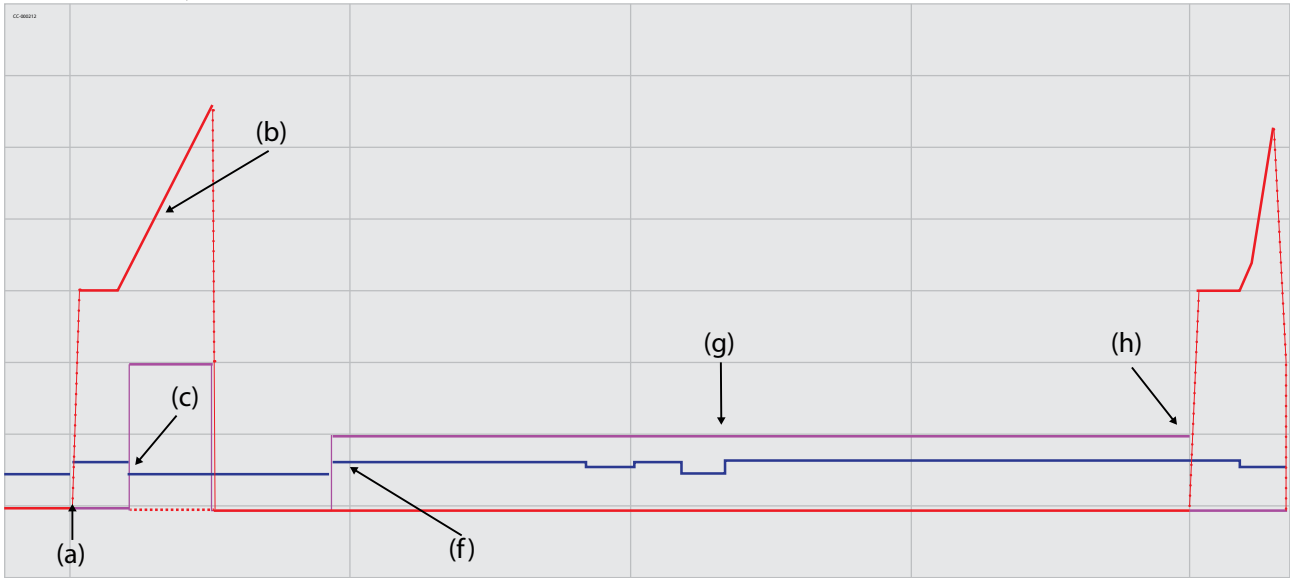
Table 17: Short cycle protection

Drive parameters		Description	Value	Default
Short cycle protection is done by unit controller				
28.00	Short cycle protection	Short cycle protection done in unit controller: (preferred option)	Disable	Enable
Short cycle protection is done in drive[1]				
28.00	Short cycle protection	Short cycle protection done by the drive.	Enable	Enable
28.01	Interval between stop and start	Start command is ignored until the timer (10s) has elapsed. Only then, can the compressor start.	10s	10s

[1] If short cycle protection enabled in drive, the start will be ignored during minimum stop time.

The diagram below demonstrates how the function works:

Figure 16: Short cycle protection



(a)	Start signal is given by the unit controller
(b)	Compressor started
(c)	Compressor stop requested by the unit controller
(f)	Start signal is given by the unit controller
(g)	Start Command is ignored. Start delay warning (A96)
(h)	Compressor starts after the timer interval between starts (10s) has elapsed.
10sec	Interval between stop and start

Drive alarm

Drive alarms can be a problem with the drive itself or with the compressor. It is necessary to identify the alarm code to determine appropriate trouble shooting actions.

Drive alarms will trip the compressor; therefore, the unit controller must get feedback that the drive is in a fault condition.

The feedback is typically via modbus.

By default, alarms are reset automatically after 30s and the compressor restarts.

If the specified number of automatic resets (10x) is reached within 10 minutes, the drive enters manual reset mode.

Manual reset is via [OFF] key on the LCP or via Modbus. After the manual reset is performed, the drive reset mode returns to automatic reset.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip locked.

Trip lock

Alarms that are trip-locked offer additional protection, meaning that the mains supply must be switched off before the alarm can be reset. After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.

Table 18: Trip lock

Par. nr.	Name	Set value	Default value
14-20	Reset Mode	Automatic reset x10	Automatic reset x10
14-21	Automatic reset time	30s	30s

Stop compressor in case of safeties (LP, HP, DGT)

Table 19: Stop compressor in case of safeties (LP, HP, DGT)

Safeties	Tripping conditions		Re-start conditions	
	Value	Time	Value	Time
HP safety switch	See Pressure setting and max DGT in Operating envelope data	Immediate, no delay. No by-pass	Conditions back to normal Switch closed again	Manual reset
LP safety switch				Manual or Automatic Maximum 5 auto reset during a period of 12 hours, then manual reset.
DGT external				

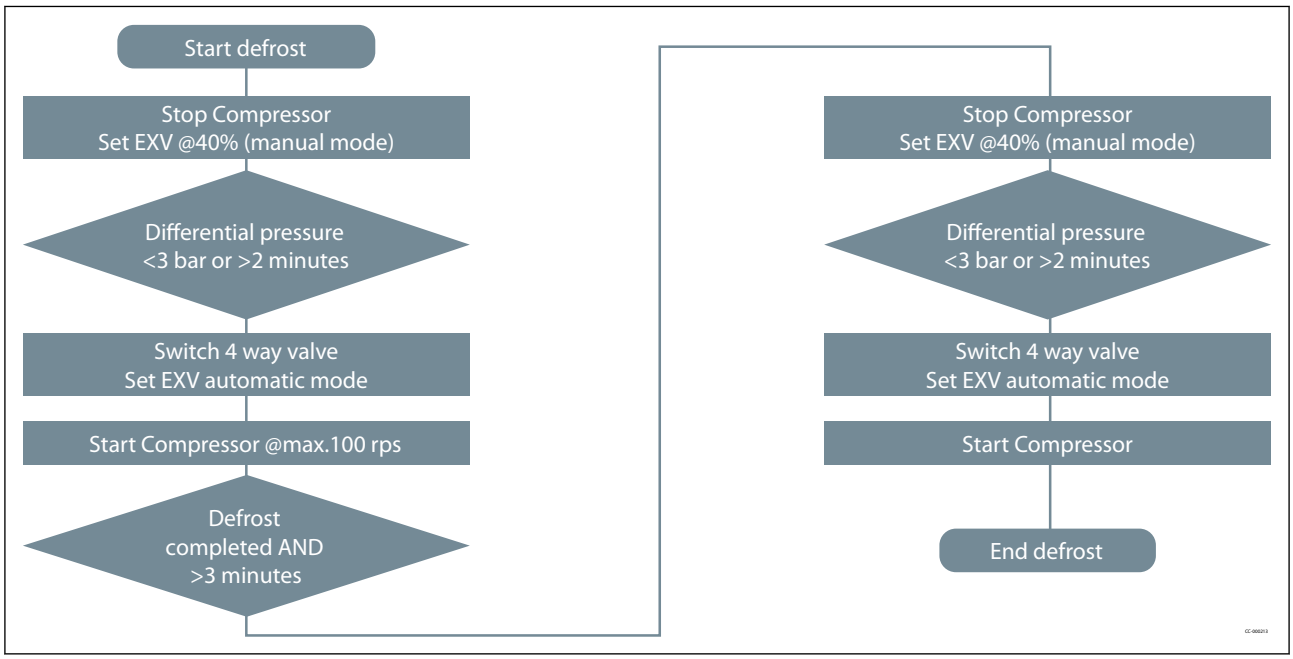
4 Way valve control and defrost logic

The main challenge of a system equipped with a 4-way valve is during the time of the switch period. After that switch, condenser becomes evaporator and vice versa. Pressurized liquid in condenser directly flows to the compressor suction and lead to oil dilution and in extreme case, liquid slugging.

Liquid flood back due to reversing cycle can be reduced by using pressure to transfer liquid refrigerant from one exchanger to the other before the 4-way valve switch. Following flow chart describes the strongly suggested sequence by Danfoss.

Time and pressure difference have to be fine-tuned during system qualification. EXV Opening degree and time have to be set to keep a minimum pressure difference to allow 4-way valve switch.

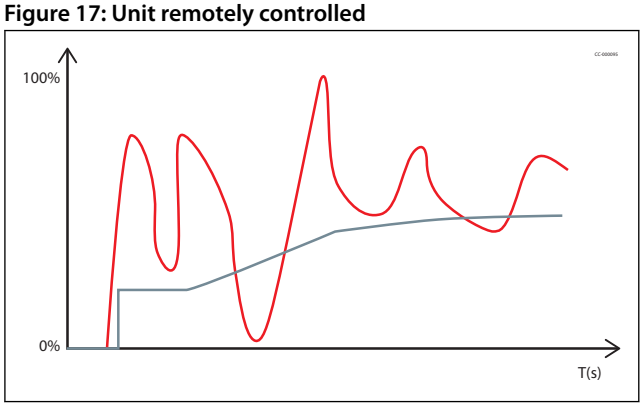
In any case, defrost logics must respect requirements and tests described in Manage Superheat and Operating envelope data sections. Maximum speed 100rps is proposed for defrost cycle.



Unit remotely controlled

If the system demand, and thus compressor speed, can be controlled remotely, for example by a building management system (BMS), it is essential to make sure the demand signal is consistent. Unit controller shall not directly transmit demand from external signal to compressor. Table below show some examples of erratic external demand signal and possible preventions.

Figure 17: Unit remotely controlled



—	External signal demand
—	Compressor speed
T	Time

Table 20: Unit remotely controlled

System demand request	Example of prevention
Demand request changing very fast and often from 0 to 100%	Start in low load and ignore demand signal for the first 5 minutes and then smooth demand signal
Very frequent start and stop request	Ignore stop request for the first 5 min
Very frequent change from cooling to heating and vice versa	Do not allow change from cooling to heating and vice versa in less than 2h

Application

Manage Operating envelope

Requirement

The solid line envelope is valid for a suction superheat within 5K (9°F) at nominal voltage. Higher suction superheat may lead to discharge temperatures above 135°C for VCH115 with R410A.

Moreover, the discharge gas temperature must not exceed 135°C for VCH115.

The Operating envelope data for VCH115 guarantees reliable operations of the compressor for steady-state operation.

High pressure switch

The high-pressure switch must be set at or below "Maximum high pressure switch setting". The high-pressure switch must never be bypassed or delayed and must be placed in a lockout circuit to prevent cycling.

If a discharge valve is used, the HP switch must be connected to the service valve gauge port, which cannot be isolated.

For CDC100 drive, HP switch can be connected to STO (Safe Torque Off) or to an external contactor placed between drive and compressor.

Figure 18: CRAC

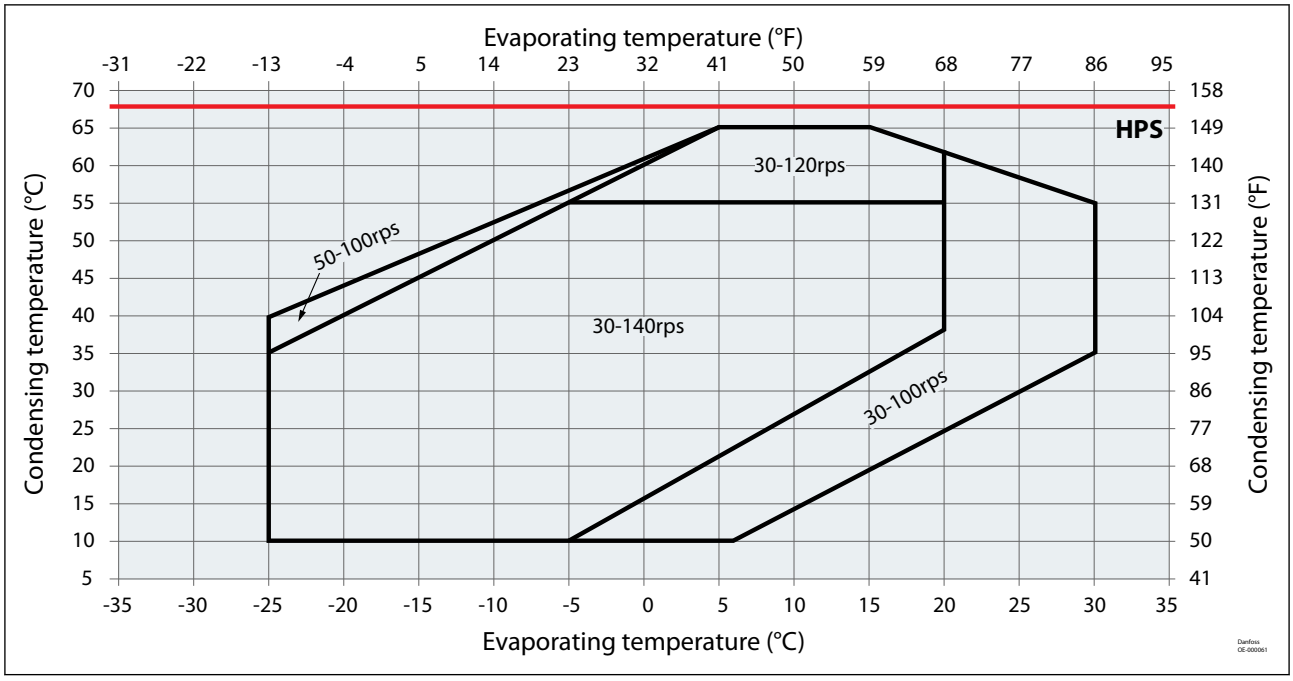
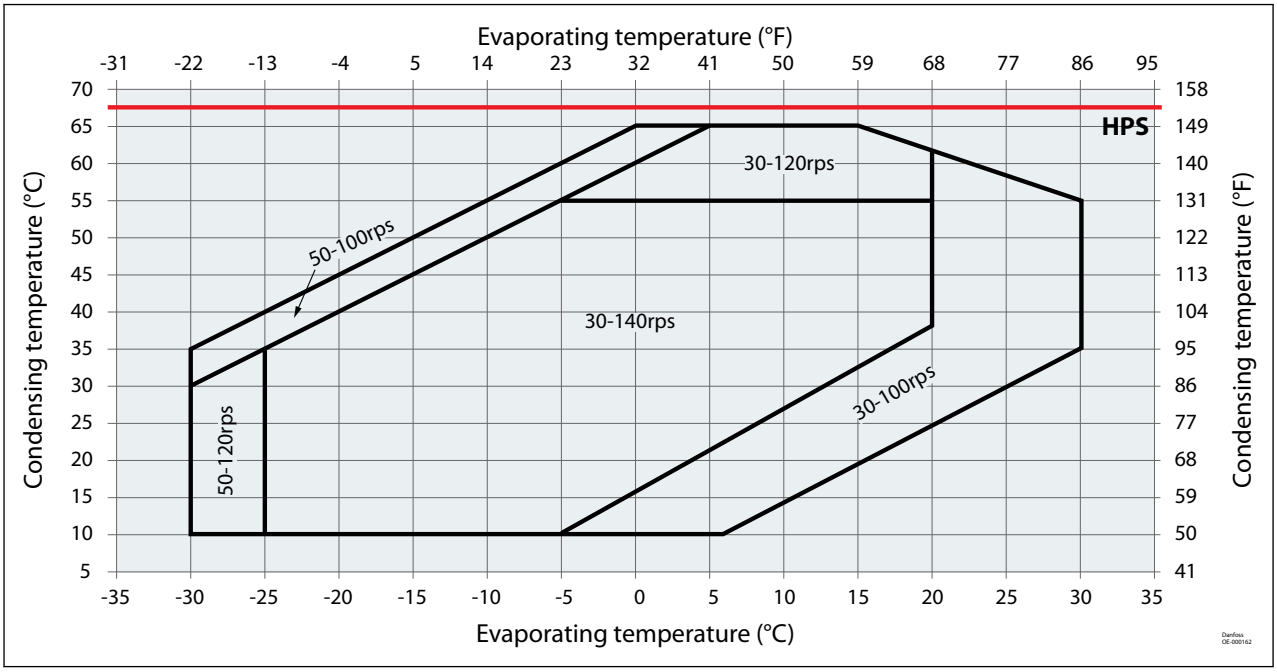


Figure 19: MC



HPS	High pressure safty switch (44 barg)

Low pressure switch

R The low-pressure switch must be set at or above “Minimum Low pressure switch setting”. Operating at low pressures may cause damage to the compressor due to low mass flow through it. The LP switch must be an immediate, no delay feature.

The switch can be integrated directly in the safety chain of the compressor or it can be treated by the unit controller.

For a manual or automatic reset, there is a maximum of 5 auto resets during a period of 12 hours. After this threshold is crossed, a manual reset will be required.

Figure 20: CRAC

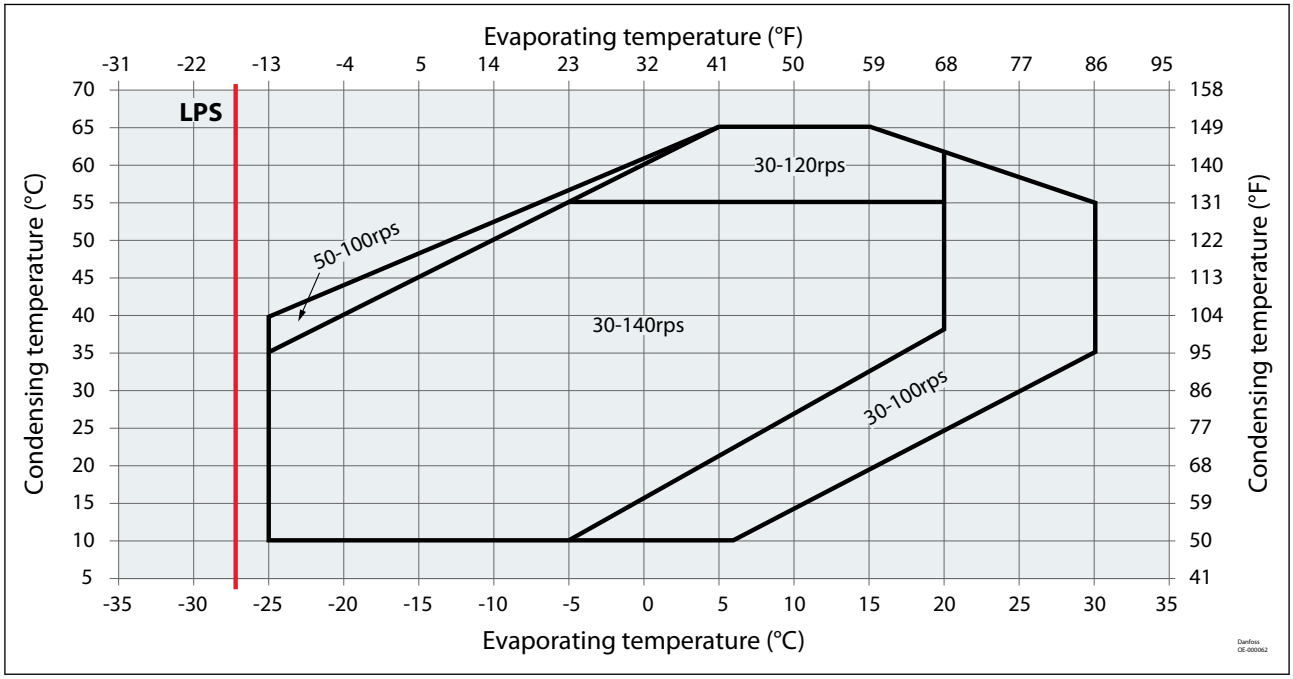
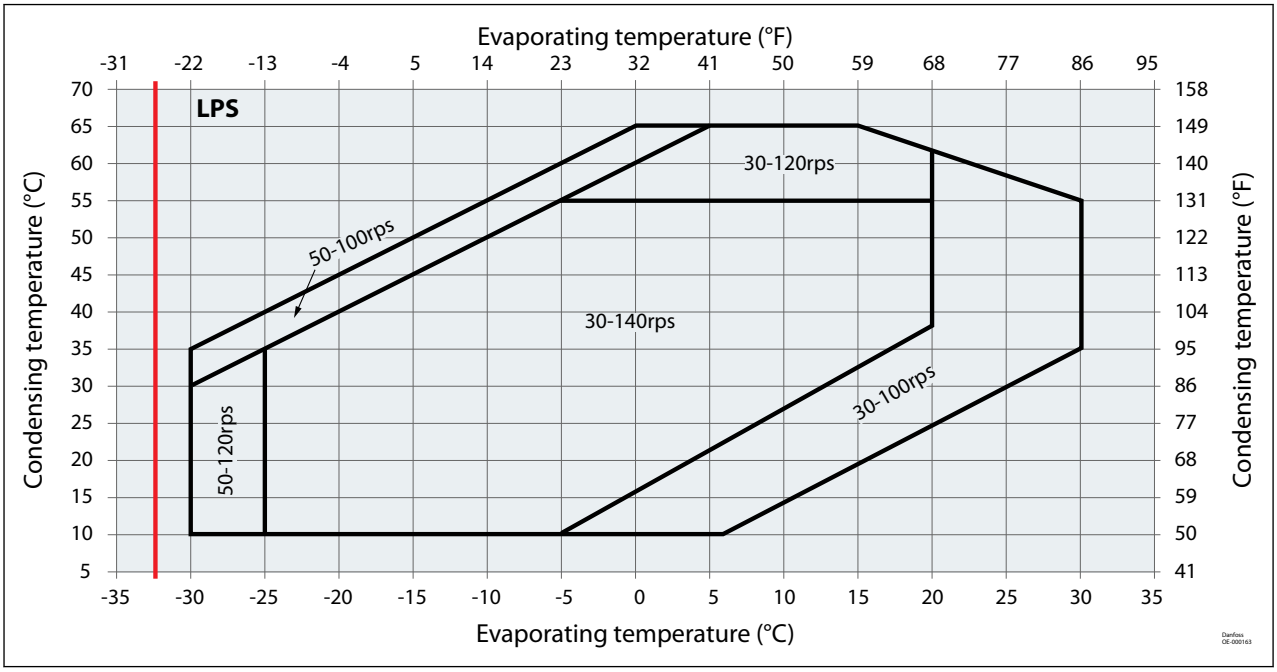


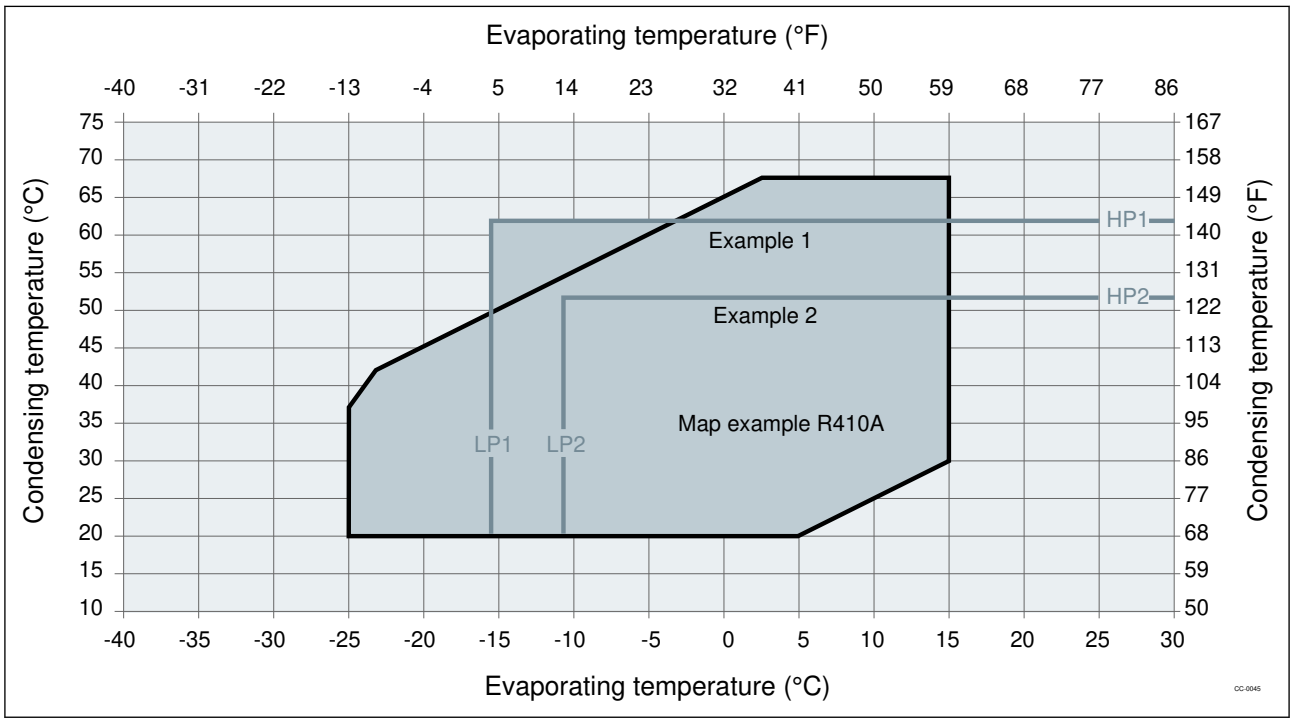
Figure 21: MC



LPS	Low pressure safty switch (CRAC:2 barg; MC:1.43 barg)

Discharge temperature protection

R Discharge gas temperature protection (DGT) is required if the high and low pressure switch settings do not protect the compressor against operations beyond its specific application envelope (example)



Example 1 (R410A, SH = 6K/10.8°F)
LP switch setting: LP1 = 3.3 bar (g) (-15.5°C/4.1°F)
HP switch setting: HP1 = 38 bar (g) (62°C/143.6°F)
Risk of operation beyond the application envelope.
DGT protection required.

Example 2 (R410A, SH = 6K/10.8°F)
LP switch setting: LP2 = 4.6 bar (g) (-10.5°C/13.1°F)
HP switch setting: HP2 = 31 bar (g) (52°C/125.6°F)
No risk of operation beyond the application envelope.
No DGT protection required.

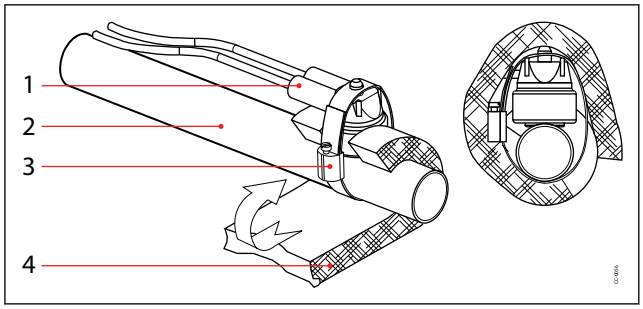
The discharge gas thermostat accessory kit (code7750009) or the discharge temperature sensor is required for installation as shown below. DGT installation must respect the below requirements:

1. The thermostat or the temperature sensor must be attached to the discharge line within 150mm (5.91inch) from the compressor discharge port and must be thermally insulated and tightly fixed on the pipe.
2. The DGT should trip the compressor at a discharge gas temperature set point. Manual or Automatic Reset - maximum of 5 auto resets during a period of 12 hours, then manual reset is required.

The switch can be integrated directedly in safety chain of compressor or treated by unit controller. With variable speed compressors, the thermostat can be replaced by a discharge temperature sensor, then the unit controller can decrease compressor speed to keep the discharge temperature lower than the limit.

For VCH115 with R410A, the discharge gas temperature protection should be set to open at a maximum discharge temperature of 135°C (275°F). the discharge gas thermostat kit(code 7750009) or the discharge temperature sensor could be used.

Figure 22: Discharge temperature protection



1	Thermostat or temperature sensor
2	Discharge line
3	Bracket
4	Insulation

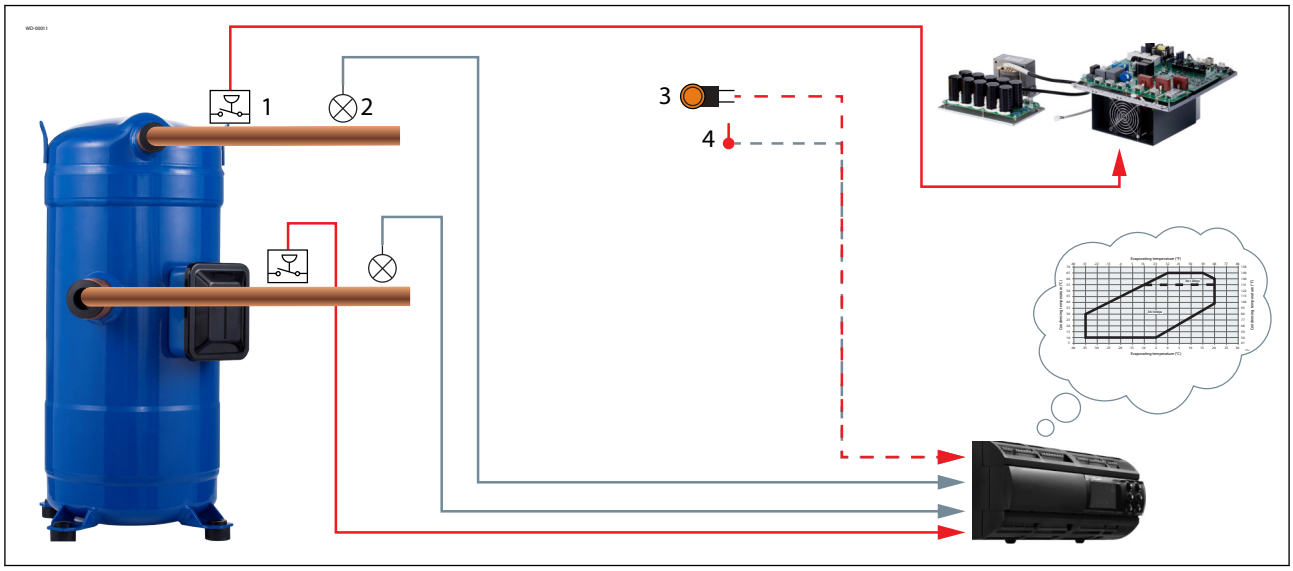
Protection and control of envelope

Low pressure (LP) switch and high pressure (HP) switches are necessary to protect the compressor. Depending on high pressure and low pressure limitations, a discharge gas thermostat (DGT) may also be necessary, see Discharge temperature protection.

For variable speed compressors, it is recommended that the unit controller continuously controls evaporating and condensing temperatures to check that the compressor is running within the defined envelope. This solution offers much better protection than only basic protection (HP, LP, DGT), and offers the possibility to adjust running conditions to avoid tripping (for example reduce compressor speed when reaching high pressure limit).

Operation of VCH115 is not allowed across the envelope at all speeds. Depending on speed range needed and unit controller capability, two types of envelope controls can be considered:

1. Limited speed range to have only one envelope Example 1
2. Full speed range with unit controller maintaining speed according to evaporating and condensing temperature Example 2



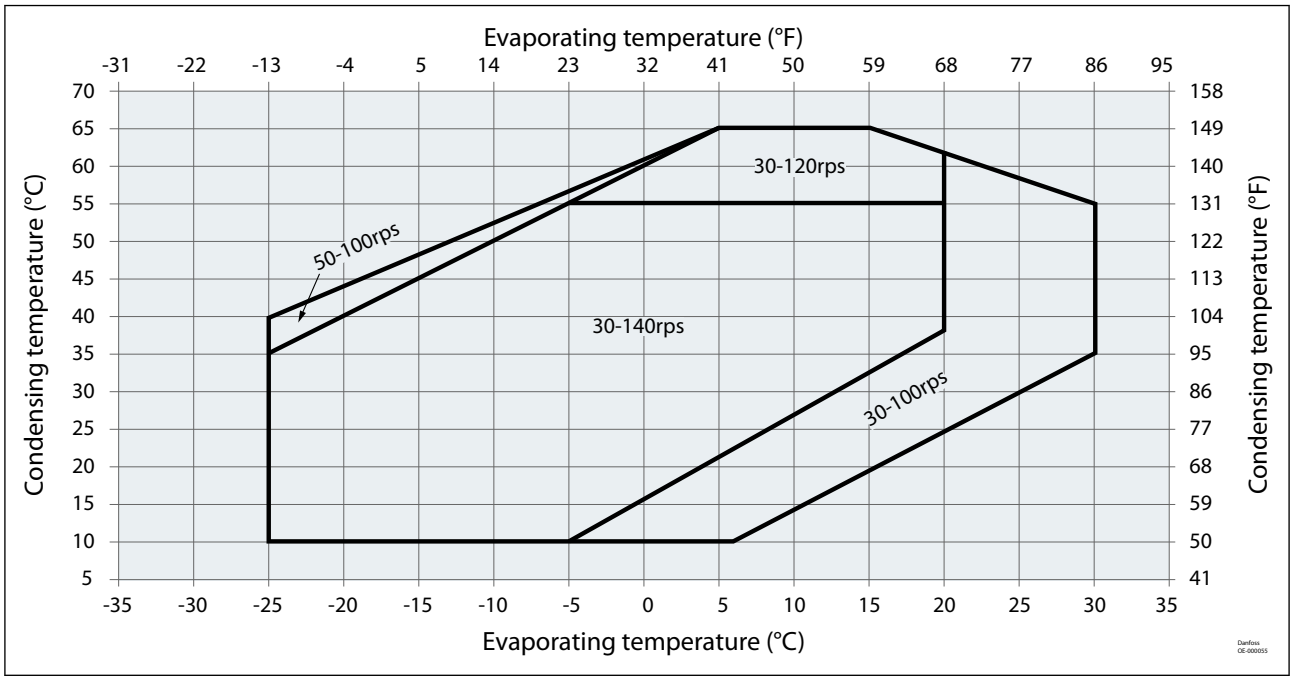
1	Pressure switches
2	Pressure sensor
3	Discharge thermostat
4	Temperature sensor
—	Protection
—	Control

Example 1 with limited speed range from 50rps (3000rpm) to 100rps (6000rpm)

Safeties required High pressure switch, Low pressure switch, Discharge gas thermostat set @135°C (275°F) if necessary see Discharge temperature protection.

Drive setting Adjust the minimum and maximum reference (speed setpoint) limits accordingly:
Par. 3-02 Minimum reference 3000 rpm (50 rps).
Par. 3-03 Maximum reference 6000 rpm (100 rps).

Envelope control The unit controller continuously measures evaporating and condensing temperatures in order to maintain the compressor within the envelope independently of compressor speed.

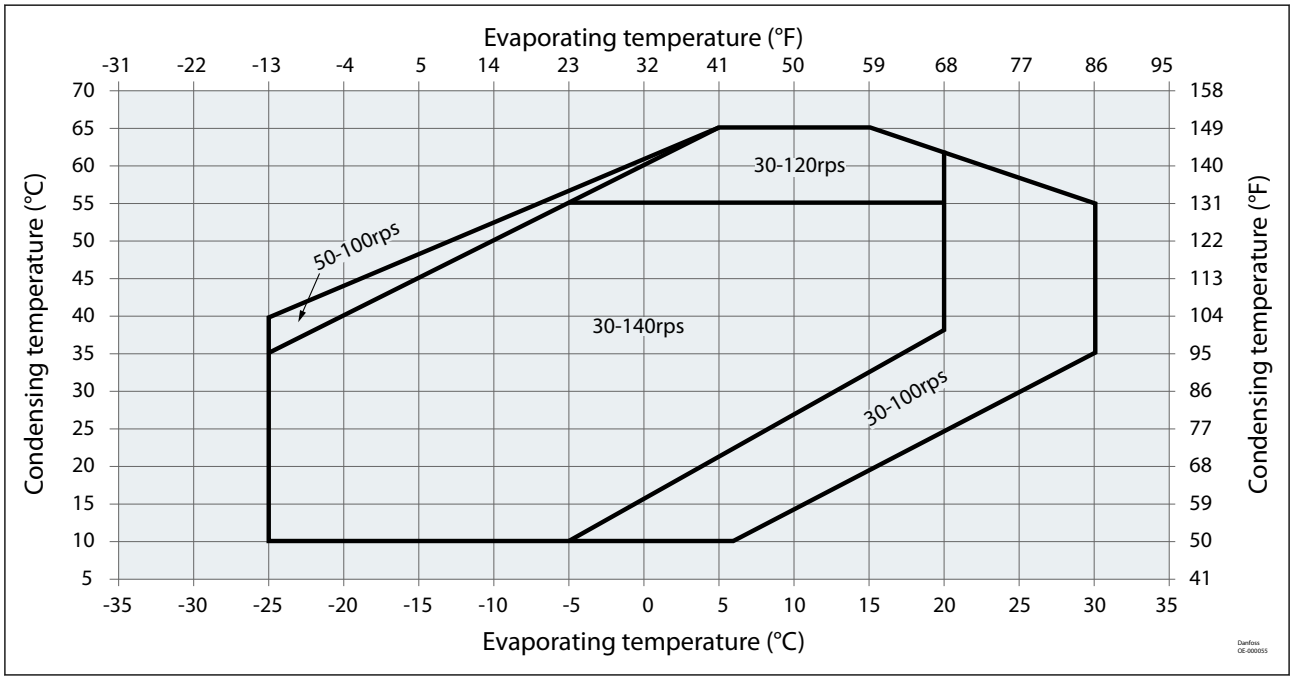


Example 2 with full speed range from 30rps (1800rpm) to 140rps (8400rpm)

Safeties required High-pressure switch, Low pressure switch, Discharge gas thermostat set @135°C (275°F) if necessary see Discharge temperature protection.

Drive setting No parameter change required, keep default value.

Envelope control The unit controller continuously measures evaporating and condensing temperatures, as well as maintains compressor speeds according to specific zone restrictions.



Manage sound and vibration

Sound level

The sound radiating from the compressor is emitted through the air, the sound waves travel in all directions from the compressor.

We can consider two means to reduce compressors sound radiations: Acoustic hoods are quick and easy to install and do not increase the overall size of the compressors.

Acoustic hoods are available from Danfoss as accessories, in "sound and vibration data" section "sound level and acoustic hood".

The use of sound insulation on the inside of the unit panels is an effective way to mitigate sound. You can find sound level and acoustic hood accessories in "sound and vibration data" section "sound level and acoustic hood".

Vibrations

Compressor generates some vibrations that propagate into the surrounding parts and structure. The vibration level of a VCH compressor alone does not exceed 127 µm peak to peak. However, when system structure natural frequencies are close to running frequency, vibrations are amplified due to resonance phenomenon. A high vibration level is damageable for piping reliability and generates high sound levels.

To avoid resonance phenomenon, pipings and frame must have natural frequencies as far as possible from running frequencies. This could be challenging on a variable system as all resonant frequencies between minimum speed to maximum speed will be excited.

It is mandatory to check that piping vibrations are acceptable across speed range. This test can be done by increasing slowly speed and monitoring piping behaviour through, strain gage, acceleration, or displacement measurement. As alternative visual check with strobe light can also emphasis high piping displacement.

If some resonant frequencies generate high piping vibration, problem can be solved by increasing piping stiffness with brackets or changing layout. Dampers can also be installed to mitigate vibration.

If some frequencies continue to produce unacceptable vibration levels, speed by-pass is adjustable in the frequency converter, in order to avoid some frequency ranges. Four by-pass ranges are adjustable, and settings can be made in parameter group 4.6x

Ensure that there is no direct contact between vibrating components and structure.

Gas pulsation

The Danfoss VCH scroll compressor has been designed and tested to ensure that gas pulsation is optimized for the most commonly encountered heat pump pressure ratio.

If an unacceptable level is identified, a discharge muffler with the appropriate resonant volume and mass can be installed.

Oil return management

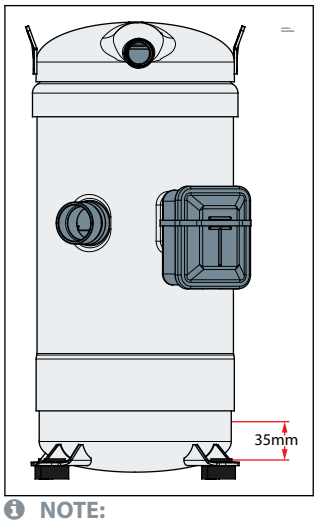
During operation, compressors always discharge amount of oil with refrigerant when start-up. After a while, some oil will return into the compressor but some will take part in refrigerant cycle or gets trapped somewhere in the system. When too much oil gets trapped or takes part in refrigerant cycle and doesn't return into the compressor, compressor may not have enough oil to operate properly.

System with reheat coils, multiple or split evaporator and condenser have a high potential to reduce mass flow and can be susceptible to oil logging. Furthermore, more oil will take part in refrigerant cycle because of large refrigerant charge quantity.

VCH115 has large speed range and large capacity range. Customer unit design has large deviation such as the dimension of condenser, evaporator, suction accumulator, pipes. Oil separator installation is mandatory for VCH115 application in order to reduce oil loss risk.

Customer can define the oil loss evaluation test according to the unit design and application. At the same time, customer should refer to below general proposal of Danfoss variable speed compressor. Qualification of the units should be done in unfavorable conditions with each feature engaged and disengaged to check oil return management and oil loss risk of compressor.

During customer unit test especially for oil management test, an oil level sensor or and oil sight glass at the lowest safety level should be added into the test compressor, the install position refer to the picture. If oil level is above the centerline in oil sight glass or oil level sensor doesn't trip compressor during oil return and oil loss risk qualification test in lab, then it means no oil loss risk in field where oil sight glass or oil level sensor is not installed for the standard compressor.



NOTE:
The measurement is taken by considering the center of the oil sight glass or oil level sensor.

Oil return test

Table 21: Oil return test

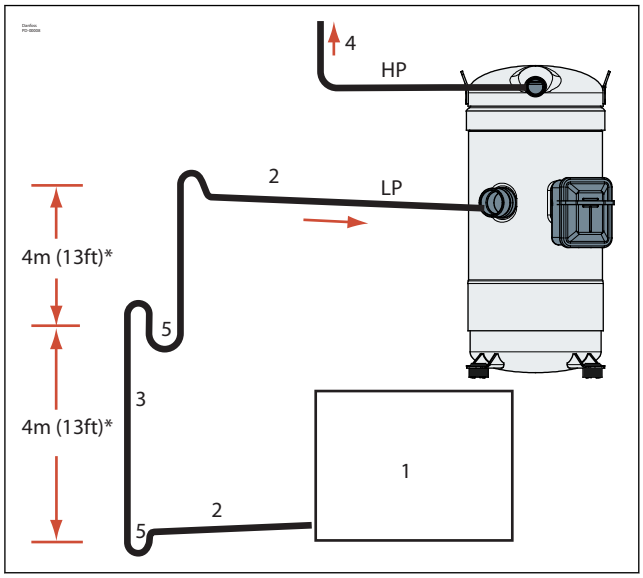
Test conditions	Pass criteria	Comments
Most un-favourable conditions for oil return are as below: 1. Lowest refrigerant velocity and mass flow at low Te and lowest speed for both cold start up test and continuous running test 2. Highest refrigerant velocity and mass flow at high Te and highest speed For reversible unit, repeat test in both heating and cooling mode. For advanced unit (Multiple exchangers roof top re-heat coil, four-pipe chiller…) repeat test in all possible configuration	Oil level must be above centerline or full in oil sight glass. Compressor with oil level sensor, no oil level sensor trip	If oil return test fails: 1. Check if potential oil trap in the system. 2. Adjust oil management parameters to optimize oil returning. 3. Add additional oil or oil separator in the system till oil is visible in the sight glass

Piping recommendations to ensure oil return

Oil return is highly linked to refrigerant velocity in pipes. The most unfavorable conditions for oil return are at lowest refrigerant velocity corresponding to lowest evaporating T° and minimum compressor speed. Another most unfavorable conditions for oil level safety are at high refrigerant velocity and mass flow corresponding to highest evaporating T and maximum compressor speed, which means more oil quantity will take part in refrigerant cycle while less oil is left inside compressor.

General recommendations are described in the figures below: To guaranty reliability, it is essential to fully qualify oil return especially in most unfavourable conditions. Take particular care to units with reheat coil or multiple exchangers.

Systems with reheat coils, multiple or split evaporator and/or condensers can be susceptible to oil logging. A means to empty or pump out circuitry when not engaged should be implemented to prevent oil logging.



1	Evaporator
2	0.5% slope, 4m/s or more (13ft/s or more)
3	8 to 12m/s (26 to 40ft/s)
4	To condenser
5	U-trap, as short as possible
*****	max.

Oil separator

Oil separator is mandatory, it removes oil from the compressor's discharge gas, and return it to the compressor's crankcase. Oil separators are located close to the compressor in the discharge line.

Floating valve oil separators are the easiest to implement in the system. Oil return connection must be done on the suction line after suction pressure and temperature sensors have been used for superheat control.

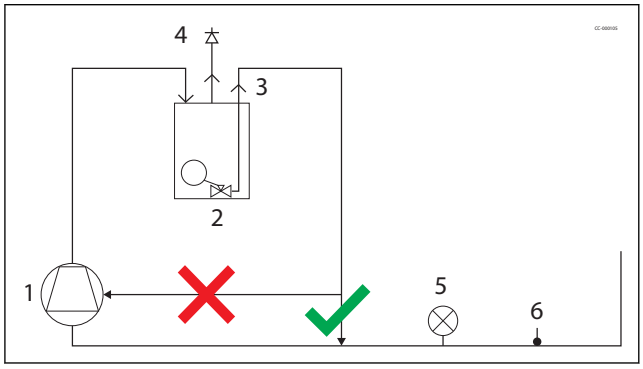
The outlet of the oil separator must be equipped with a non-return valve in order to prevent liquid refrigerant from migrating back from the condenser.

To avoid having the oil separator act as a condenser, do not place it in the airflow or oversize it. If airflow is unavoidable, the oil separator must be insulated.

Some separators require an initial oil charge to float the needle valve float.

For installation and dimensioning, always follow manufacturer recommendations.

Figure 23: Oil separator



1	Compressor
2	Oil separator
3	Oil return
4	Non return valve
5	Pressure sensor
6	Temperature sensor

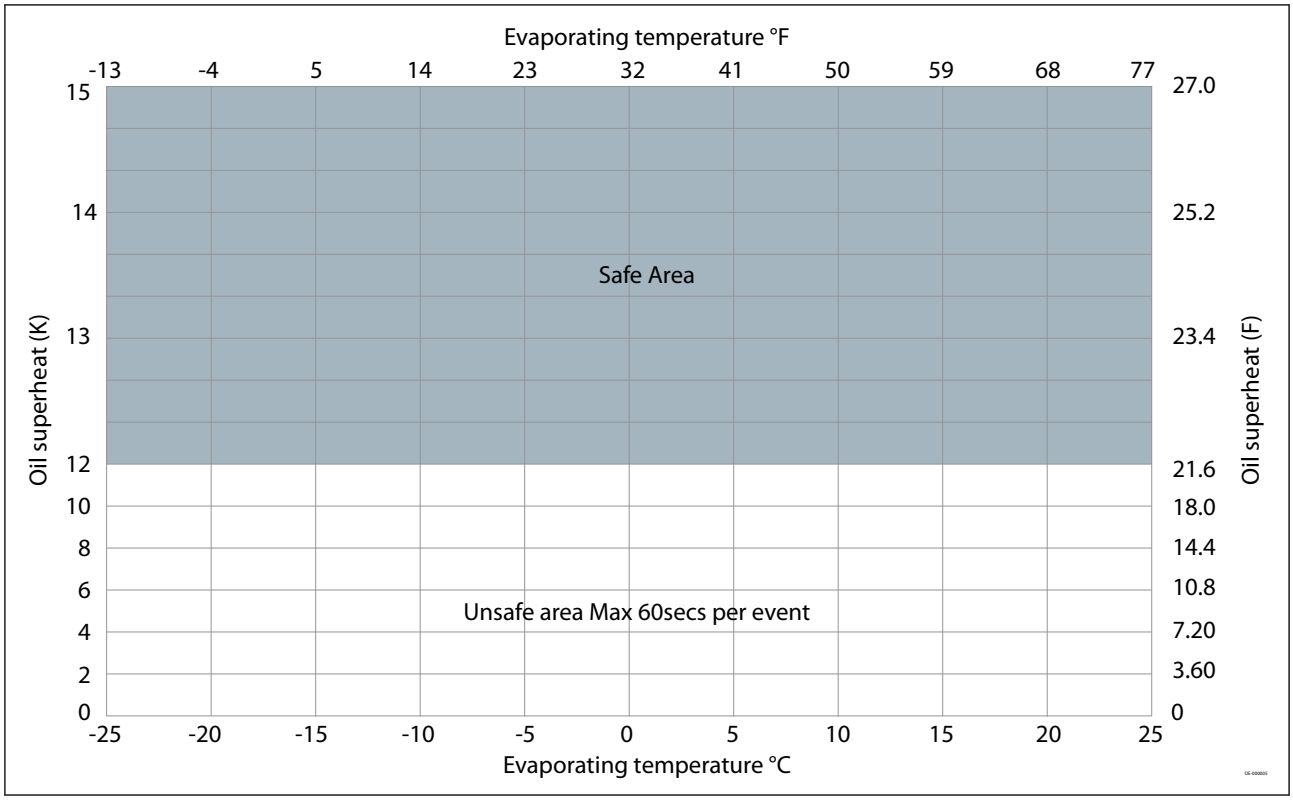
Manage Superheat

During normal operation, refrigerant enters the compressor as a superheated vapor. Liquid flood back occurs when some refrigerant returns to the compressor in a liquid state. Liquid flood back can cause oil dilution and, in extreme situations, lead to liquid slugging that can damage the compressor.

In steady state conditions, suction superheat must be maintained within 5K to 30K (9 to 54°F) and oil superheat must be higher than 12K (21.6°F). In transient conditions, oil superheat below 12K (21.6°F) must not last more than 60s per event. Note: oil superheat criterion is mainly used during qualification to confirm liquid flood back is acceptable. It is not mandatory to monitor it on production unit.

Oil superheat measurement during qualification

Figure 24: VCH115 R410A - Dilution chart (reference at 20°C / 68°F ambient temperature)



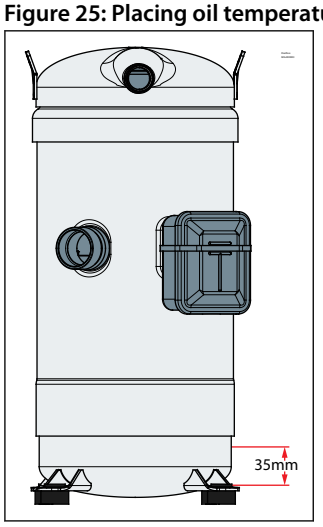
Placing oil temperature sensor

Inserted type oil temperature sensor such as PT100 should be placed the position as below picture.

Surface temperature thermal couple should be pasted on the bottom surface of compressor oil sump on the opposite side of suction tube. Thermal couple must be correctly thermally insulated from the ambient.

The Oil superheat is defined as: (Oil temperature - Evaporating temperature)

Figure 25: Placing oil temperature sensor



NOTE:
The measurement is taken by considering the center of the oil temperature sensor

Test and components required per application

Table 22: Define tests and components required for your application

Application		Tests and components required		
Non-Reversible	Reversible [1]	Suction accumulator	Test	Comments
X		Optional	Pass liquid floodback test	If no test performed, suction accumulator is mandatory
	X	Recommended	Pass liquid floodback test Pass defrost test	

[1] Unit equipped with a 4-way valve.

Liquid floodback and defrost test

Table 23: Liquid floodback and defrost test

Test	Test conditions	Pass criteria	Comments
Liquid flood back test	**1. Steady state** Most unfavourable conditions for superheat control (expansion valve threshold): **Lowest evaporating T°, highest condensing T°, compressor at minimum speed.** For **reversible unit**, repeat test in both heating and cooling mode. For advanced unit (Multiple exchangers roof top reheat coil, four-pipe chiller…) repeat test in all possible configuration	Suction superheat >5K (9°F) and stable Oil superheat above 12K(21.6°F)	If test fails, 1. Check EXV size selection. 2. Check TXV settings and bulb position. 3. Check EXV measurement location and optimize EXV control. 4. Add suction accumulator. 5. Optimize heat exchange design and refrigerant charge quantity. 6. Increase ramp-up and ramp down time to slow down compressor speed change
	2. Transient Test must be carried out with most common transient such: Compressor starts Fan staging Compressor speed ramp up and ramp down from min speed to max speed	Oil superheat must not be more than 60 sec below 12K(21.6°F).	
Defrost cycle	Defrost test must be carried out in the most unfavourable conditions (~ 0°C 32°F ambient conditions)	After defrosting, Oil superheat must not be more than 60 sec below 12K(21.6°F).	Check defrost logic. 4 Way valve control and defrost logic Add suction accumulator

Expansion valve

R Role of expansion device is to open and close to maintain a proper superheat at outlet of evaporator (s)

- Electronic expansion device (EXV) is preferred to thermostatic expansion device (TXV) as it has a better ability to control superheat at low load.
- It is essential that valve closes when compressor stops.
- For TXV, liquid line solenoid valve is strongly recommended, and if not possible, suction accumulator can be used as an alternative.
- Bleed type valve is not accepted.
- For EXV, controller must be programmed to close it when the compressor stops, including in power shut down situation.

Suction accumulator

R The role of suction accumulators is to collect any excess liquid that may come out of the evaporator during the transient period or low load conditions.

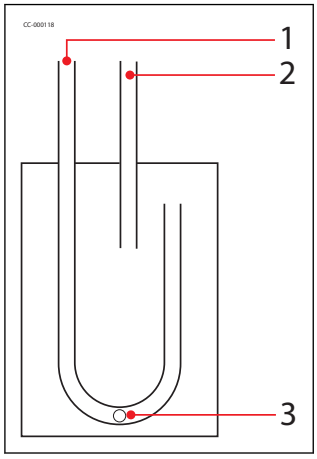
See §Test and components required per application in §Superheat management to know when to use suction accumulator.

Suction accumulator sizing must be made according to its manufacturer recommendation. Liquid capacity must be above 50% of system charge. To not penalize too much energy efficiency, the pressure drop generated by accumulator should be below 2°C evaporating temperature.

To prevent oil from getting trapped in the bottom of the suction accumulator, the suction line inside the accumulator (U shape) has a small orifice to drain the collected oil. Commonly used orifice diameter is about 1.8mm~2.0mm, this is up to the system unit design to get the balance between keeping oil return and avoiding too much refrigerant liquid return.

The superheat measurement must be done before suction accumulator.

Figure 26: Suction accumulator



1	outlet
2	Inlet
3	Orifice for oil return

Manage off cycle migration

General information

R Off -cycle refrigerant migration happens:

- When the compressor is located at the coldest part of the installation, refrigerant vapour condenses in the compressor.
- Directly in liquid-phase by gravity or pressure difference.
- Refrigerant migrates to evaporator during off cycle.

Poor lubrication when a compressor starts can reduce compressor bearing life. The oil can be diluted by liquid refrigerant that migrates to the crankcase in the off-cycle, or liquid refrigerant stored in evaporator slugging the compressor when it first re-starts. In extreme situations, this leads to liquid slugging that can damage the compressor scroll set.

Compressor charge limit

If the charge limit is exceeded, protective measures must be taken to limit the risk of liquid slugging and extreme dilution at start.

Table 24: Compressor charge limit

Compressor model	Refrigerant charge limit	
	Kg	lb
VCH115	13	29

Test and components required per application

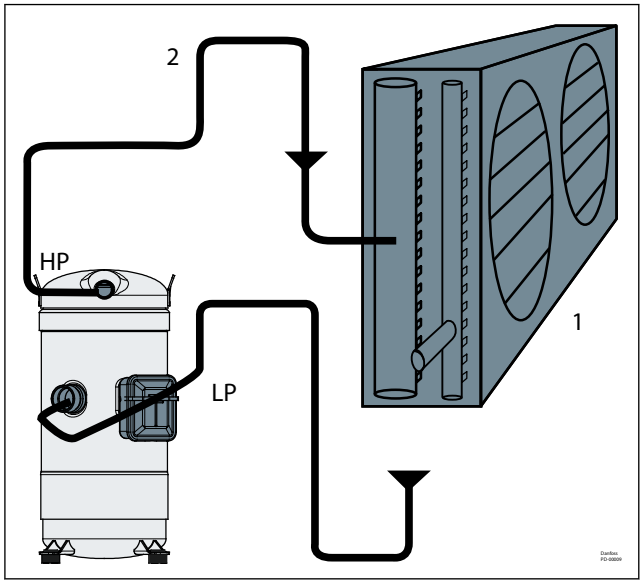
Table 25: Test and components required per application

Application				Components required		
Non-Split [1]	Split	Below charge limit	Above charge limit	Belt sump heater	Non return valve	Comments
X		X		Mandatory	Mandatory for unit with water condenser (W/W or reversible A/C Chiller)	Ensure tightness between condenser & evaporator when system is OFF. • If thermostatic expansion valve (TXV): Liquid line solenoid valve LLSV strongly recommended, if not possible Suction accumulator can be used as an alternative Bleed type valve not accepted. • If electronic expansion valve (EXV): must close when the system stops, including in power shut down situation or power loss
X			X	Mandatory	Mandatory	
	X			Mandatory	Mandatory	

[1] Unit pre charge at OEM factory, no refrigerant piping done on field

R To avoid condensed liquid refrigerant from draining back when the compressor is shut off, the condenser outlet must have an “upper loop” shape.

Figure 27: Avoid condensed liquid refrigerant from draining back



1	Condenser
2	Upper loop

Sump heater

When the unit idles, refrigerant migrates to the coldest point of the system. Sump heater are designed to avoid compressor becoming the coldest point of system and accumulate refrigerant in sump.

See Test and components required per application to know when to use heater.

100W belt sump heater should be mounted on compressor shell to guarantee safe cold start-up even at the worst condition.

Basing on customer unit design and application situation, customer can select lower power belt sump on condition that safe cold start-up can be guaranteed.

Sump heater control logic

The heater is typically controlled by a unit controller and shall be ON whenever all compressors within the circuit are OFF.

For units that may be totally power shut down on a regular basis, such as exhibition hall, it is strongly recommended to the heater to a secured power supply in order to maintain migration protection.

Sump crankcase heater installation is mandatory. When compressor is put on hold, crankcase heater should be powered on.

At commissioning, the surface sump heater must be energized at least 6 hours in advance to remove refrigerant from sump.

To optimize energy efficiency of heater, oil sump temperature can be permanently monitored by the unit controller, and the heater can be turned off when oil superheat (oil temperature – evaporating temperature) is above 12K (21.6°F).

To further protect against flooded starts, a logic can be programmed in the unit controller. After each unit power up, the compressor can start only if the oil super heat is above 12K (21.6°F). More details regarding the oil sump temperature measurement can be found in section "Application- Manage Superheat "

Non return valve

Non-return valve at discharge prevents from liquid or gas migration. Selection of non-return valve is a trade-off between pressure dropping at high speed, and the state of the valve stability while at low speed. Non-return valve is mandatory.

The following table displays present Danfoss non-return valve selection per each specific compressor.

Compressor model	NRV model
VCH115	NRV 19

Assembly line procedure

Reduce moisture in the system

Excessive air and moisture

- can increase condensing pressure and cause high discharge temperatures.
- can create acid giving rise to copper platting.
- can destroy the lubricating properties of the oil.

All these phenomena can reduce service life and cause mechanical and electrical compressor failure.

Requirements

The compressors are delivered with < 100 ppm moisture level. At the time of commissioning, system moisture content may be up to 100 ppm.

During operation, the filter drier must reduce this to a level between 20 and 50 ppm.

Solutions

To achieve this requirement, a properly sized and type of drier is required. Important selection criteria include:

- driers water content capacity,
- system refrigeration capacity,
- system refrigerant charge.

For new installations of the compressors with POE oil, Danfoss recommends using the Danfoss DML (100% molecular sieve) solid core filter drier.

Compressor storage

Store the compressor in a manner that it is not corrosive or flammable atmosphere between -35°C to 70°C (-31°F to 158°F) when charged with nitrogen and between -35°C (-31°F) and 55°C (131 °F) when charged with R410A refrigerant.

Compressor holding charge

Each compressor is shipped with a nominal dry nitrogen holding charge between 0.3 and 0.7 bar (4 psi and 10psi) and is sealed with elastomer plugs.

Respect the following sequence:

- Remove the nitrogen holding charge via the suction Schrader valve to avoid an oil mist blow out.
- Remove the suction plug first and the discharge plug afterwards to avoid discharge check valve gets stuck in open position.

An opened compressor must not be exposed to air for more than 20 minutes to avoid moisture is captured by the POE oil.

Handling

- Use lifting equipment rated and certified for the weight of the compressor or compressor assembly.
- 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 is recommended.
- Never use the lift rings on the compressor to lift the full unit.

Maintain the compressor in an upright position during all handling manoeuvres (maximum of 15° from vertical).

Figure 28: Heavy do not lift manually

Figure 29: handle with Spreader bar

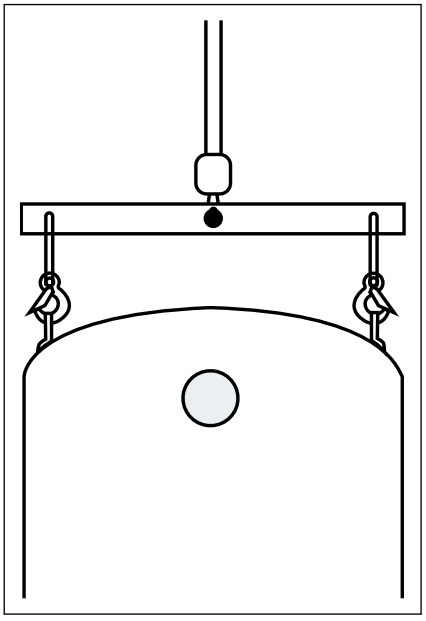
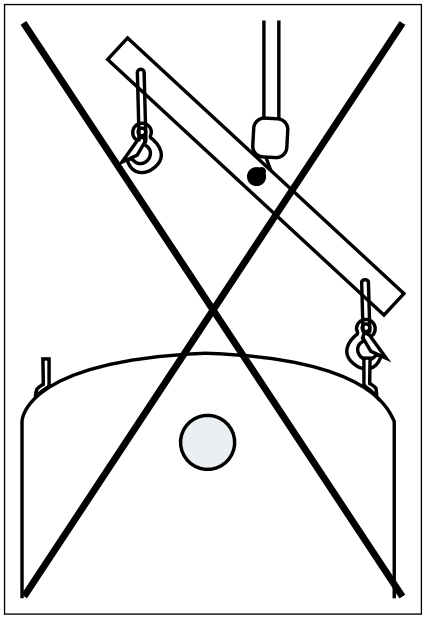


Figure 30: incorrect handling



Piping assembly

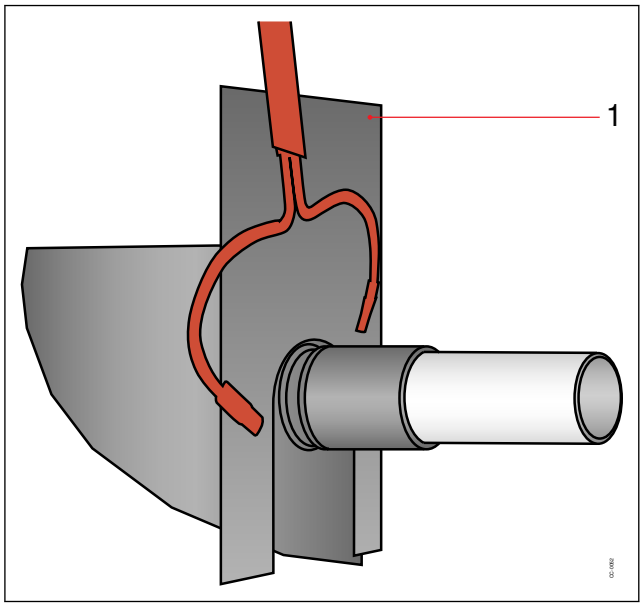
Good practices for piping assembly are pre-requisite to ensure compressor lifetime (system cleanliness, brazing procedure etc.)

Table 26: System cleanliness

Circuit contamination possible cause:	Requirement:
Brazing and welding oxides	During brazing, flow nitrogen through the system.
Filings and particles from the removal of burrs in pipework	Remove any particles and burrs generated by tube cutting and hole drilling.
Moisture and air	Use only clean and dehydrated refrigeration grade copper tubing. Opened compressor must not be exposed to air more than 20 minutes to avoid moisture captured by PVE oil.

Brazing procedure:

- Brazing operations must be performed by qualified personnel.
- Make sure that no electrical wiring is connected to the compressor.
- To prevent compressor shell and electrical box overheating, use a heat shield and/or a heat-absorbent compound.
- Clean up connections with degreasing agent.
- Flow nitrogen through the compressor.
- Use flux in paste or flux coated brazing rod.
- Use brazing rod with a minimum of 5% silver content.
- It is recommended to use double-tipped torch using acetylene to ensure a uniform heating of connection.
- To enhance the resistance to rust, a varnish on the connection is recommended.



1	Heat shield

Before eventual un-brazing of the compressor or any system component, the refrigerant charge must be removed.

System pressure test and leak detection

The compressor has been strength tested and leak proof tested (<3g/year) at the factory. For system tests:

- Always use an inert gas such as Nitrogen or Helium.
- Pressurize the system on HP side first then LP side.
- Do not exceed the following pressures indicated in table below.

Table 27: Maximum compressor test pressures

Maximum compressor test pressures	
Maximum compressor test pressure high side (HP)	53.6 bar(g) / (777 psig) HP-LP<37bar / (537psi)
Maximum compressor test pressure low side (LP)	36.7 bar(g) / (497 psig) LP-HP<5bar / (73psi) Maximum speed 4,8 bar/second (70psi/s)[1]

[1] An external non return valve is present on the discharge line and maximum pressurizing speed must be respected to ensure pressure equalization between LP and HP side over scroll elements.

Vacuum evacuation and moisture removal

Requirements:

- Never use the compressor to evacuate the system.
- Connect a vacuum pump to both the LP and HP sides.
- Evacuate the system to a pressure of 500 µm Hg (0.67 mbar/0.02 in.Hg) absolute.

Recommendations:

- Energized heaters improve moisture removal.
- Alternate vacuum phases and break vacuum with Nitrogen to improve moisture removal.

For more detailed information see “Vacuum pump-down and dehydration procedure” TI-026-0302.

Refrigerant charging

Initial charge:

- For the initial charge, the compressor must not run.
- Charge refrigerant as close as possible to the nominal system charge.
- This initial charging operation must be done in liquid phase between the condenser outlet and the filter drier.

If needed, a complement of charge can be done, in liquid phase while compressor is running by slowly throttling liquid in.

Never bypass safety low pressure switch.

For more detailed information see “Recommended refrigerant system charging practice“ AP000086421422.

Dielectric strength and insulation resistance tests

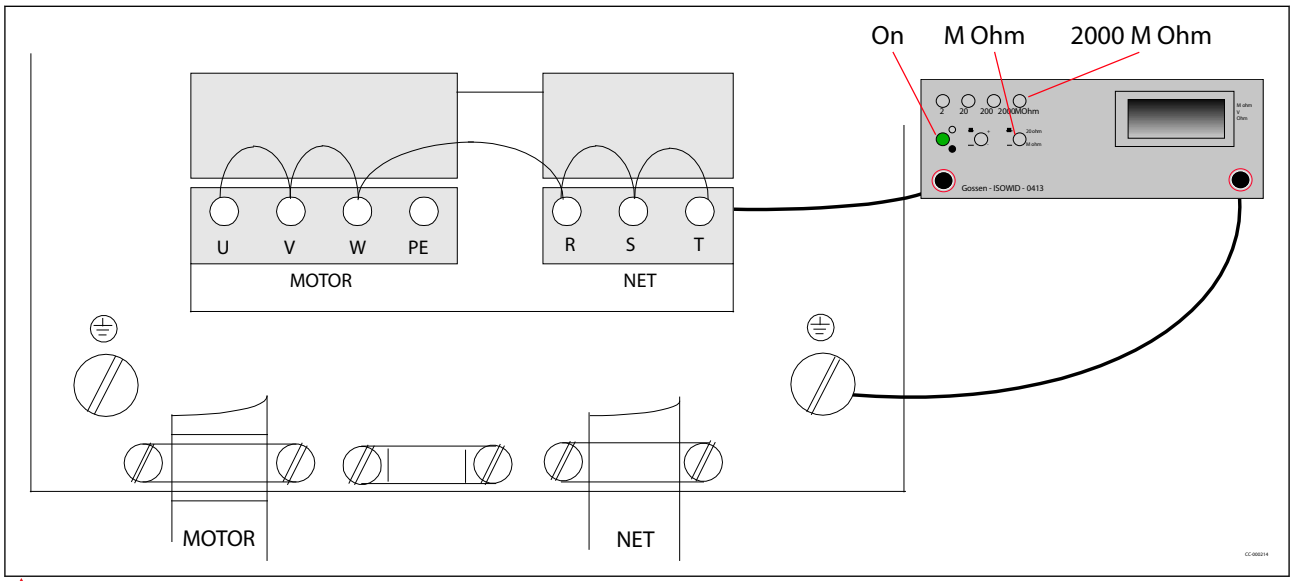
The tests are performed on each compressor and frequency converter in the factory, so it is not necessary and not recommended to do often Hipot test (dielectric withstand test) as it may damage the motor or frequency convertor.

If a Hipot test has to be done anyway, following instructions must be followed.

Motor:
- 1800VDC (for code G) for 1 seconds must be applied; Further reduce test voltage if do more Hipot test.
- The current leakage must be below 5mA.

Drive:
- Compressor not connected.
- R, S, T, U, V, W Terminals must be shortened and connected to high voltage terminal of the testing device, refer to the picture.
- DC voltage 2100V.
- Ramp up time 3 seconds, Full DC voltage must be established 2 seconds.
- The current leakage during the test must be below 10mA.
- Ramp down time to 0V in 25 seconds.

When conducting a high voltage test make sure the system is not under vacuum, this maybe cause electrical motor failure.



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

Commissioning

Preliminary check

R Check electrical power supply:

- Phase order: Reverse rotation is obvious if the compressor does not build up pressure and sound level is abnormal high. VCH compressor will only operate properly in one direction. If electrical connections are done correctly between the drive and the compressor terminals (compressor terminals T1, T2 ,T3 and drive terminals U, V & W matching), the drive will provide correct phase supply to the compressor, and reverse rotation will be not possible: For more details refer to Motor protection.
- Voltage and voltage imbalance within tolerance: For more details refer to section Supply voltage.

Initial start-up

- Cranckcase heaters must be energized at least 6 hours in advance to remove liquid refrigerant.
- Do not provide any power to the drive unless suction and discharge service valves on compressor are open, if installed.
- Energize the drive. The compressor must start, according to defined ramp-up settings. If the compressor does not start, check wiring conformity.
- Check the frequency converter control panel: If any alarm is displayed check the wiring and in particular the polarity of the control cables. If an alarm is shown, refer to the frequency converter application manual. Verify in particular the combination of compressor, frequency converter and refrigerant.
- Check current draw and voltage levels on the mains. The values for the compressor electrical motor can be directly displayed on the frequency converter control panel.

System monitoring

The system must be monitored after initial startup 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.
- Crankcase heaters must be energized at least 6 hours in advance to remove refrigerant.
- Correct oil level in compressor sump indicates proper oil return.
- Low foaming in sight glass and compressor sump temperature above 12K for VCH115 saturation temperature to show that there is no refrigerant migration taking place.
- Current draw of compressor within acceptable values (MOC ratings)
- No abnormal vibrations and noise.

Oil level checking and top-up

In installations with good oil return and line runs up to 15m (49.2 feet), no additional oil is required. If installation lines exceed 15m (49.2 feet), additional oil may be needed. 3% of the total system refrigerant charge (in kg/lb) can be used to roughly define the required oil top-up quantity (in liters) but in any case, the oil charge has to be adjusted based on the oil level in the compressor sight glass.

In the phase of system study, oil sight glass would be added.

When the compressor is running under stabilized conditions, the oil level must be visible in the sight glass.

The presence of foam filling in the sight glass indicates large concentration of refrigerant in the oil and / or presence of liquid returning to the compressor.

The oil level can also be checked a few minutes after the compressor stops, the level must be visible in sight glass.

When the compressor is off, the level in the sight glass can be influenced by the presence of refrigerant in the oil.

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

Dismantle and disposal

Danfoss recommends that compressors and compressor oil should be recycled by a suitable company at its site.

Packaging

Single pack

Table 28: Single pack

Compressor model	Height	Width	Depth	Weight
	(mm)	(mm)	(mm)	(kg)
VCH115EGE/VCH115FGE	718	565	470	77
VCH115EGP/VCH115FGP				
VCH115EGQ	718	565	470	77.5

Industrial pack

Table 29: Industrial pack

Compressor model	Number	Height	Width	Depth	Gross Weight	Static stacking pallets
		(mm)	(mm)	(mm)	(kg)	
VCH115EGE/VCH115FGE	8	1150	950	750	552	2
VCH115EGP/VCH115FGP						
VCH115EGQ	8	1150	950	750	556	2

Frequency converter single pack

Table 30: Frequency converter CDC100 single pack

Drive supply voltage	Drive power	IP20			
		Height (H)	Width (W)	Depth (D)	Weight
	(kW)	(mm)	(mm)	(mm)	(Kg)
T4: Code G	30	588	348	228	14

Ordering

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

Single pack

Table 31: Single pack

Compressor model	Technical Name	Motor code G
		380V/3ph/50Hz
VCH115 CRAC	VCH115EGENA	120G0341
	VCH115EGPNA	120G0475
	VCH115EGQNA	120G0473
VCH115 MC	VCH115FGENA	120G0570
	VCH115FGPNA	120G0572

Industrial pack

Table 32: Industrial pack

Compressor model	Technical Name	Motor code G
		380V/3ph/50Hz
VCH115 CRAC	VCH115EGENA	120G0342
	VCH115EGPNA	120G0476
	VCH115EGQNA	120G0474
VCH115 MC	VCH115FGENA	120G0571
	VCH115FGPNA	120G0573

Voltage code G-380 Volt

Compressor model	Frequency converter			
	Model	power	IP class	Code no. for ordering
VCH115	CDC100 high performance version	30kW	IP00	133F9960
	CDC100 standard version	30kW	IP00	133F9961

LCP: user interface 133G1811 (accessory)

Accessories and Spare parts

Acoustic hoods - Lubricant, acoustic hoods and spare parts

Code no.	Description	Application	Packaging	Pack size
120Z0850	VCH115 acoustic hood-IP22	-	Single pack	1
120Z0930	VCH115 acoustic hood-IP54	-	Single pack	1

E-box Plug

Code no.	Description	Application	Packaging	Pack size
120Z0852	VCH115 E-box plug	-	Multi pack	10

Mounting kits

Code no.	Description	Application	Packaging	Pack size
120Z0066	Mounting kit for 1 scroll compressor including 4 grommets, 4 sleeves, 4 bolts, 4 washers	VCH115	Single pack	1

Terminal boxes, covers & T-block connectors

Code no.	Description	Application	Packaging	Pack size
8173230	T block connector 52 x 57 mm	VZH088-G/H, VZH117-G/H, VCH115-G	Multipack	10
120Z149	Electrical box cover	VZH088-G/H, VZH117-G/H, VCH115-G IP22	Single Pack	1

Lubricant / oils

Type	Code no.	Description	Application	Packaging	Pack size
160SZ	7754023	POE lubricant, 160SZ, 1 litre can	VCH with R410A	Multipack	12

Spare parts for frequency converter

Code no.	Description	Application	Packaging	Pack size
133G1811	LCP display	Frequency converter CDC100	Single pack	1
133G1023	RFI option	Frequency converter CDC100	Single pack	1

Discharge thermostats and sensors

Code no.	Description	Application	Packaging	Pack size
120Z0157	Discharge temperature sensor / converter kit	VCH115	Single pack	1
120Z0158	Discharge temperature sensor	VCH115	Single pack	1
120Z0159	Discharge temperature converter	VCH115	Single pack	1
7750009	Discharge thermostat kit	VCH115	Multipack	10

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