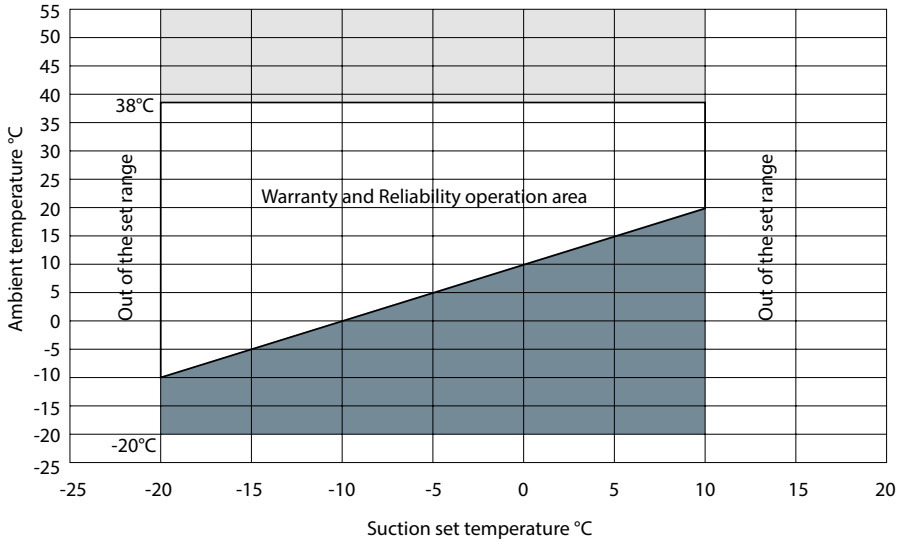
ENGINEERING
TOMORROW

Application guidelines

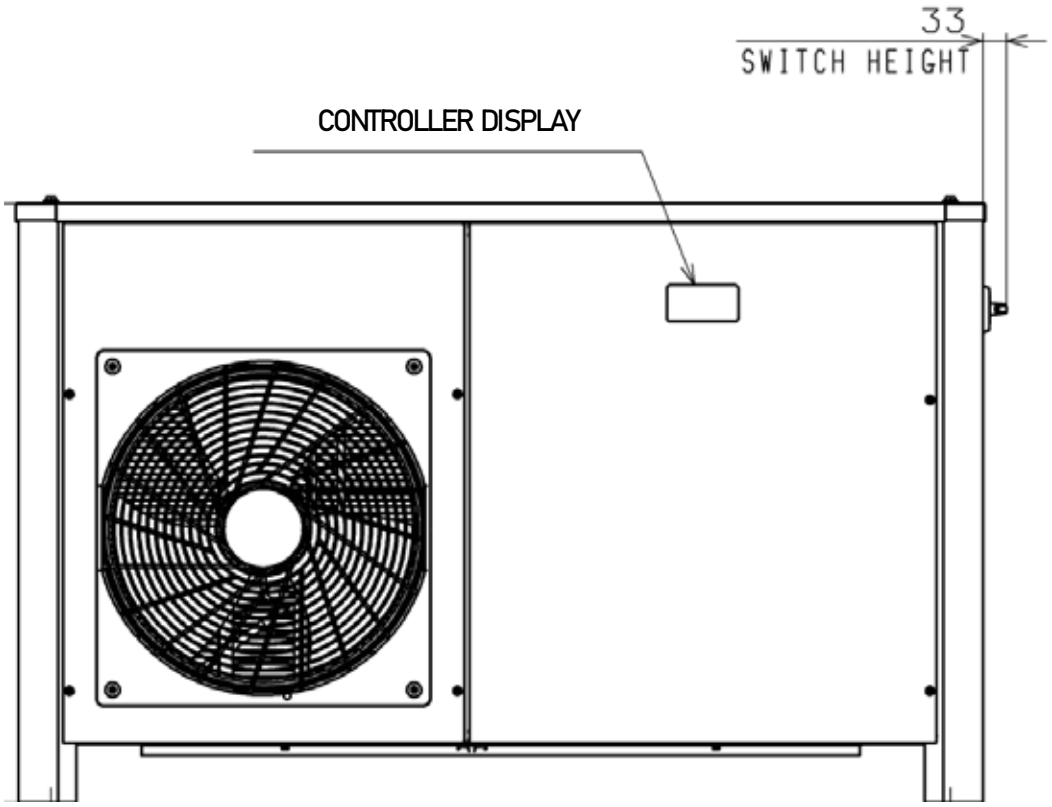
Optyma™
iCO₂ condensing units

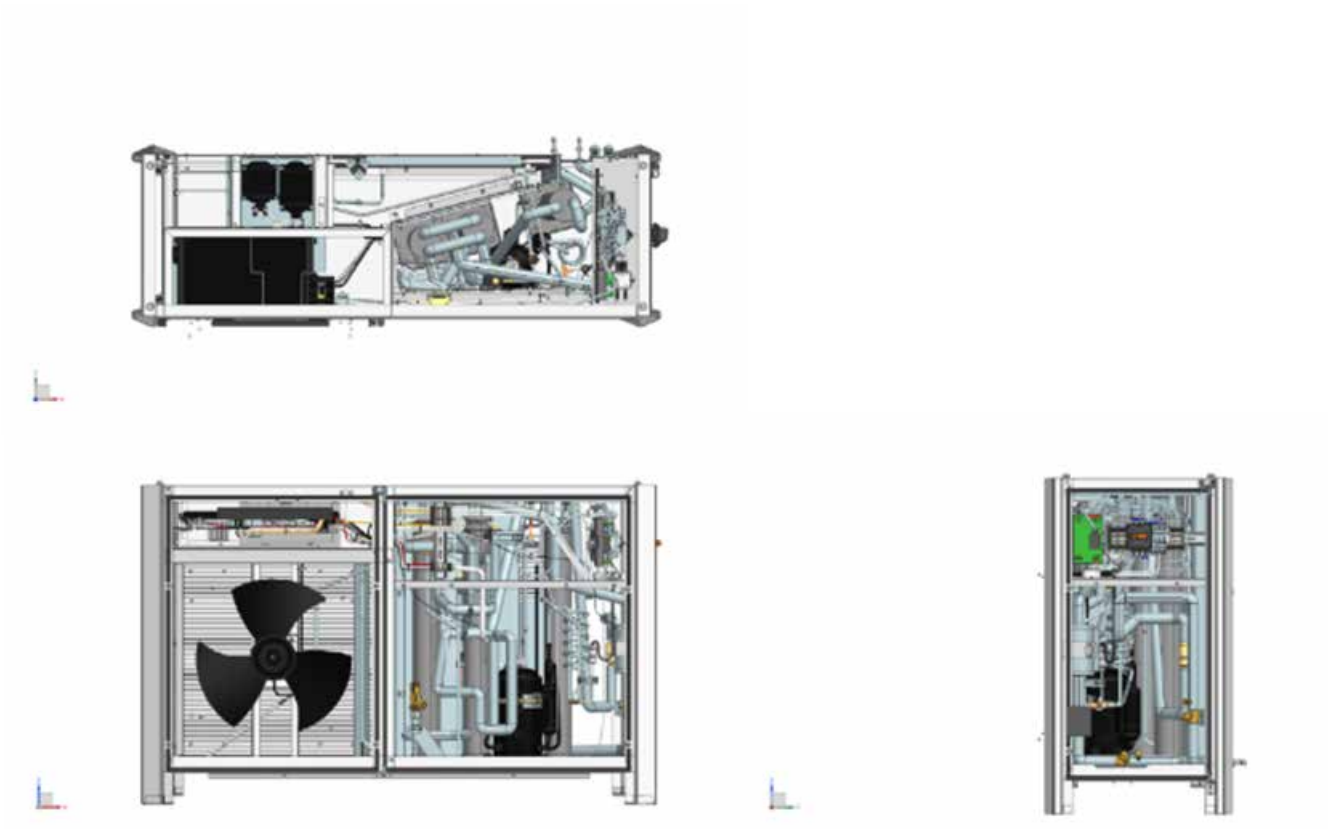
R744 | 50 Hz

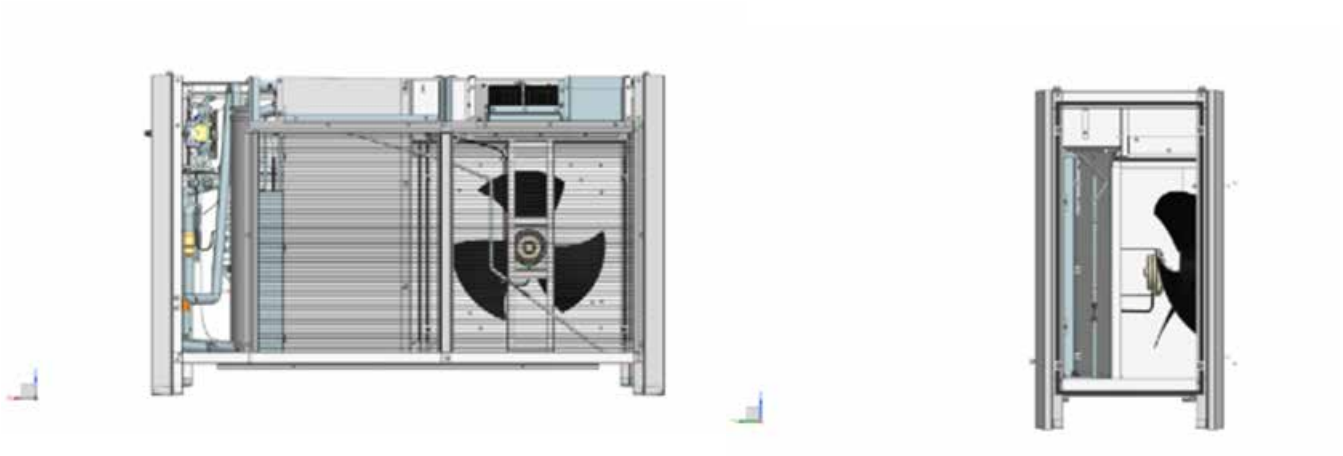
www.danfoss.com

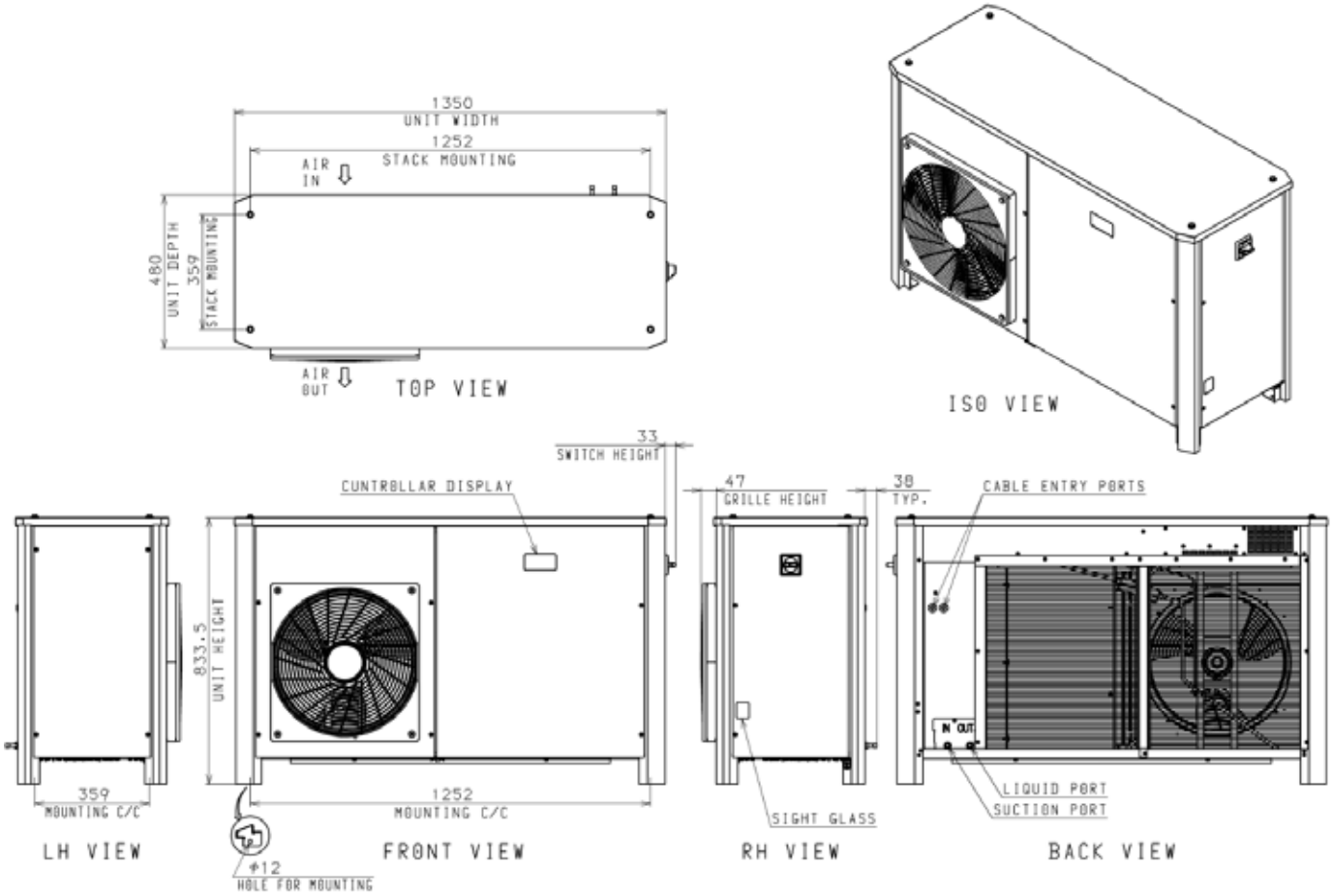
Storage temperature range	-25 °C ~ 50 °C
Envelope map	 **Note** *Dark grey area - Danfoss has no operating data and can not guarantee the performance of the unit.* *Strong wind, for example, will give unstable cooling capacity, evaporating temperature setting will be higher than ambient temperature and can disturb the operation mode.* *Warranty will be null in case of abnormal operations (Out of temperature ranges, bad installation, etc).*
Operation humidity range	MAX 95%RH
Power	Rated voltage: Single phase 230V±10% Rated frequency: 50Hz Neutral connection : Yes **Note** *Compressor of Optyma™ ICO2 is equipped with a IPM (Interior Permanent Magnet) motor and built in Frequency converter in the condensing unit.* *The compressor cannot operate without Danfoss dedicated frequency converter. It will be destroyed immediately if connected directly to public network. The applied frequency from the inverter will be 73,3 Hz for 36,66 rps (2200 rpm) up to 228 Hz for 114 rps (6840 rpm).* *Compressor speed Min Max* *rps 36.66 to 114* *rpm 2200 to 6840* *230V 1N ~50Hz through inverter*
Current	MCC is 15A so for fuse protection we recommand: 16A to 20A rms
IP protection level	54
RCD type	Type A or B
Levelness	Side to side : Less than or equal 2 degrees Ensure a foundation with horizontal surface (less than 2 degrees slope), strong and stable enough to carry the entire unit weight and to eliminate vibration and interference.

2.1 Delivery product appearance

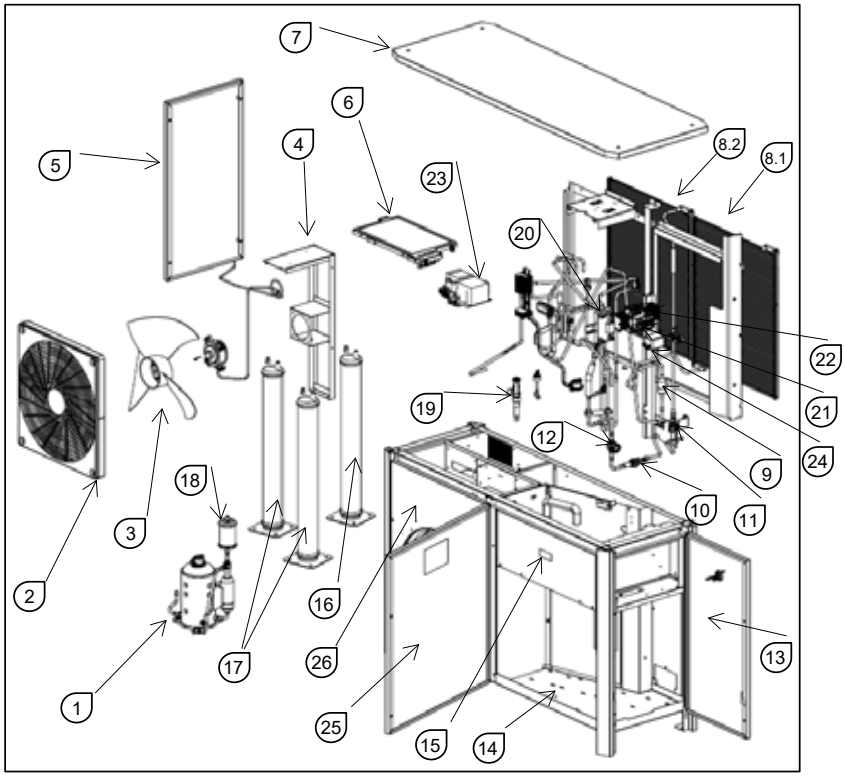






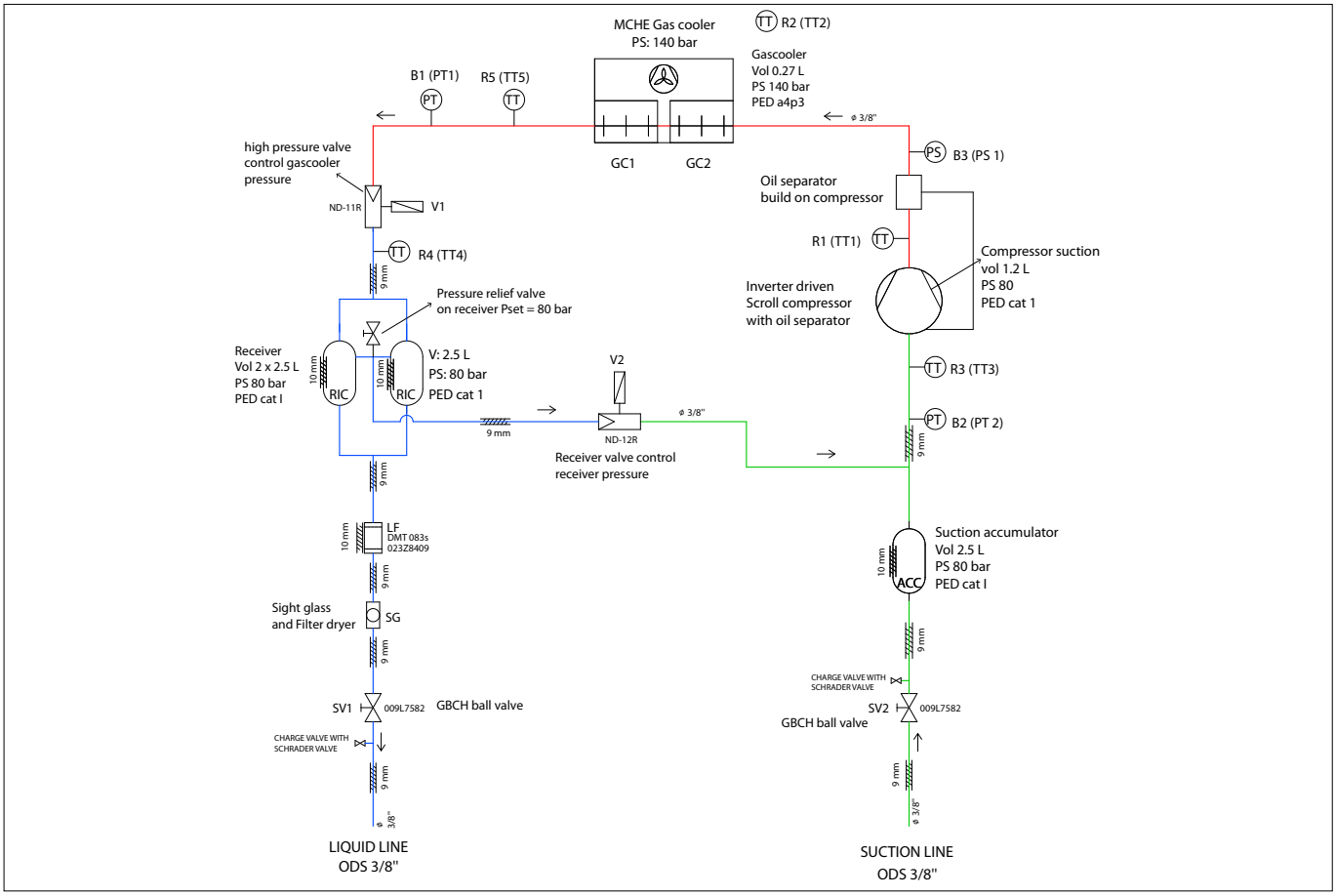


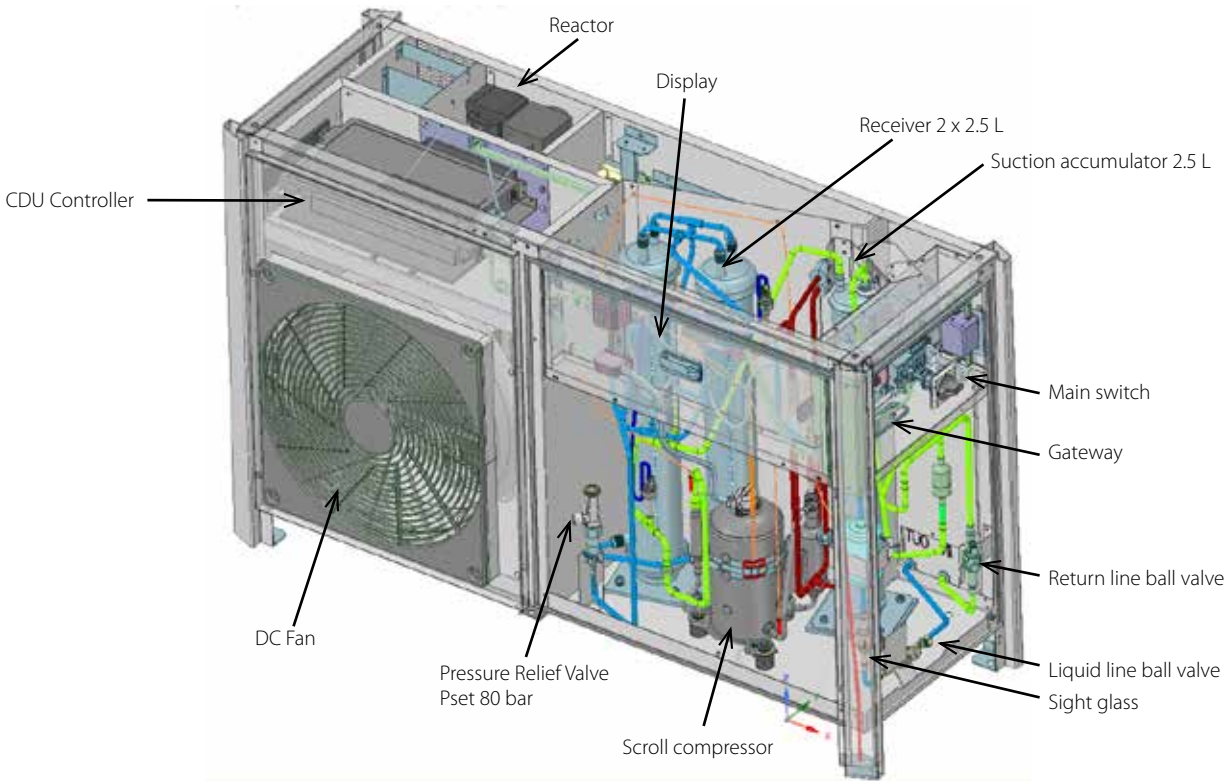
NOTE: (1)-(2)-(3)-(4): fixing hole with Φ 12 mm



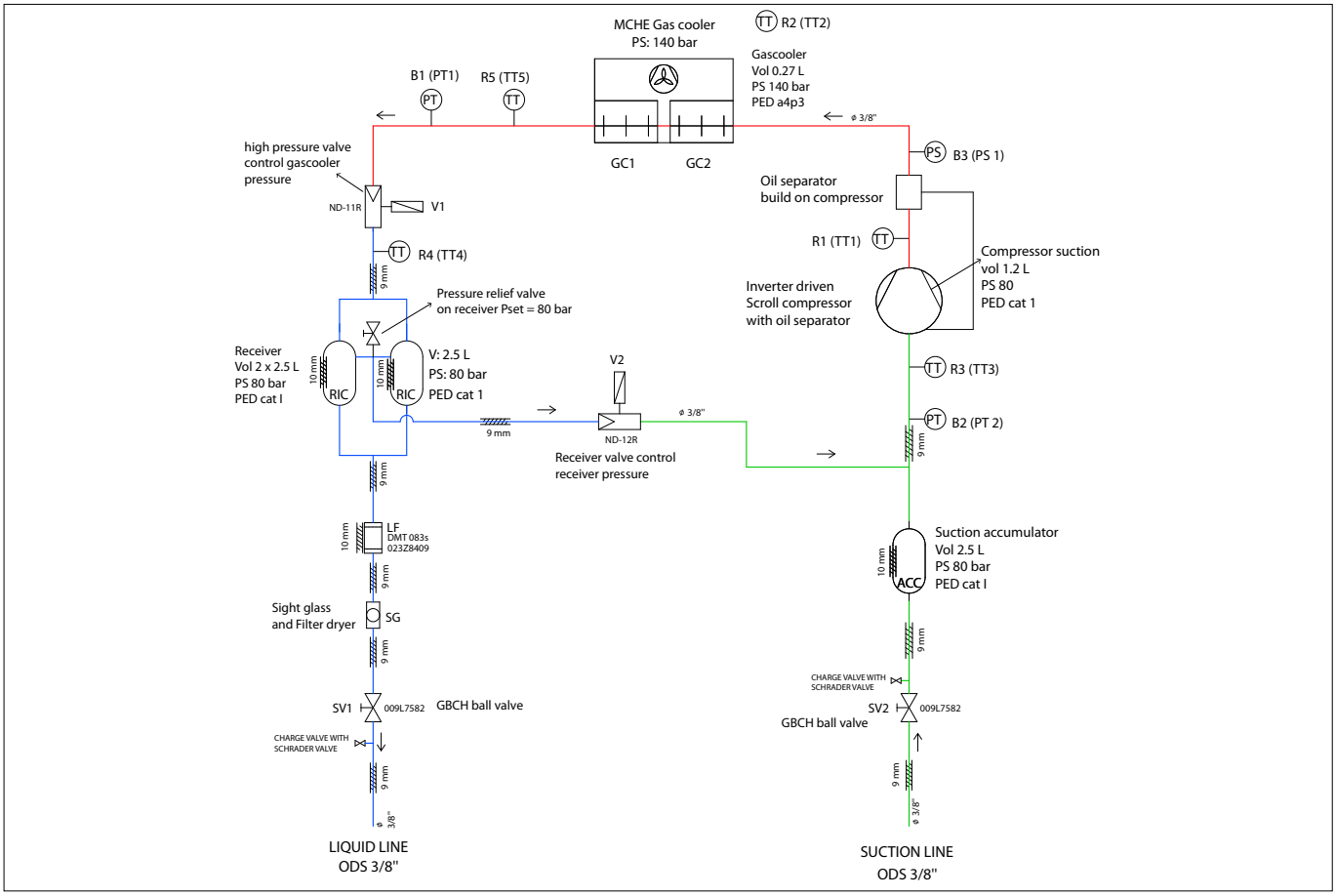
Nr	Component type legend	Component code	SAP Description
1	Compressor	118U4105	SPARE PART, COMPRESSOR 045CC
2	Fan cowl/grill	118U4100	SPARE PART, FAN GRILL D1
3	Fan assembly	118U4129	SPARE PART, FAN ASSEMBLY (D 415)
4	Braket	No spare part	Fan braket
5	Sheet metal left	118U4099	SPARE PART, LEFT SIDE D1
6	Electronic controller	118U4126	SPARE PART, CONTROLLER D1
7	Sheet metal top	118U4101	SPART PART, TOP PANEL D1
8.1	Condenser	118U4112	SPARE PART, FIRST GAS COOLER D1
8.2	Condenser 2	118U4116	SPARE PART, SECOND GAS COOLER D1
10 , 11	Shut-off ball valve, GBC 10s	009L7582	GBCH 10s CO2 90bar Ball Valve M/25 w AP
12	Sight glass	118U4111	SPARE PART, SIGHT GLASS
13	Sheet metal service panel	118U4097	SPARE PART, RIGHT DOOR D1
14	frame	No spare part	Unit frame
15	Display	080G0233	MMILDS Elect.Control Panel I/25
16	Accumulator	118U4104	SPARE PART, ACCUMULATOR
17	Receiver	118U4103	SPARE PART, RECEIVERS 2X2,5L
18	Filter drier	023Z8409	Filter drier DMT 083S I/12
19	Pressure relief valve	118U4106	SPARE PART, RELIEF VALVE 80B (15.6 MM2)
20	Gateway	118U4119	SPARE PART, GATEWAY D1
21	Main Switch Handle	118U3858	HANDLE, ABB-OHB2AJM,MSMN,OXS5X131
22	Main Switch Ms132 16-20 A	118U3854	MPCB, ABB-MS132-20+HK1-12
23	Reactor	118U4124	SPARE PART,REACTOR(BIG) (VFD,DRIVE)
23	Reactor 2	118U4125	SPARE PART,REACTOR (SMALL) (VFD,DRIVE)
24	EMC filter (Controller)	118U4120	SPARE PART, NOSIE FILTER (TYPE:EMI FILTE
25	Sheet metal front	118U5273	SPARE PART, FRONT DOOR D1
26	Sheet metal fan	118U4098	SPARE PART, FAN PANEL D1
	Valve body	118U4107	SPARE PART, EXP VALVE (3/8")
	Suction pressure sensor	118U4108	SPARE PART, PRESSURE SENSOR (0-10 MPA RA
	Discharge pressure sensor	118U4109	SPARE PART, HIGH PR SWITCH (14MPA)
	High-pressure switch	118U4110	SPARE PART, HIGH PR SWITCH(0-19.6MPA RAT
	High pressure valve coil 1	118U4117	SPARE PART, EXP VALVE (3/8")
	Receiver valve coil 2	118U4118	SPARE PART, EXP VALVE (3/8")
	Temperature switch	118U4121	SPARE PART, THERMAL SWITCH KIT
	Temperature switch 2	118U4122	SPARE PART, REACTOR THERMAL KIT
	Temperature sensor	118U4123	SPARE PART, THERMISTOR KIT

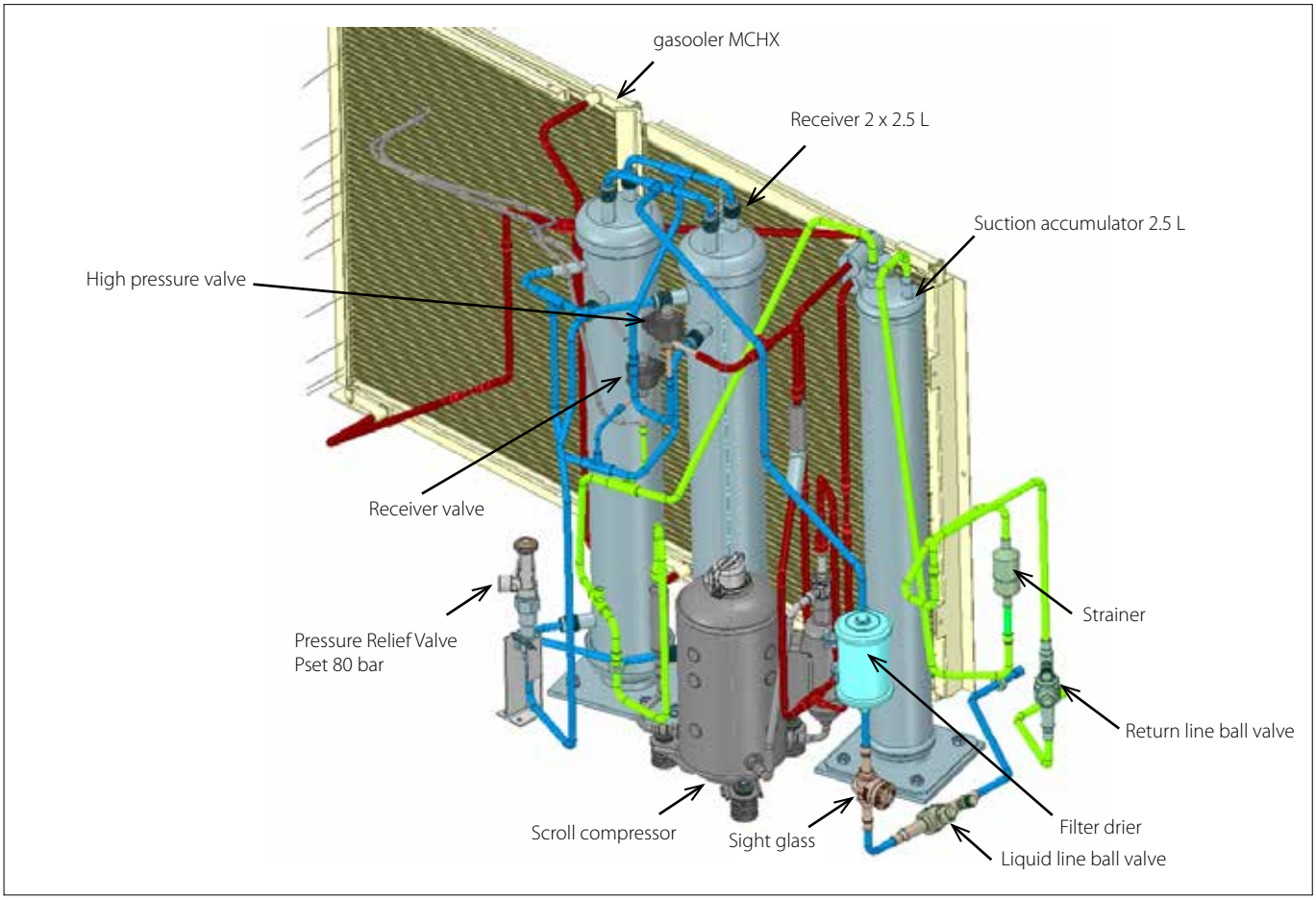
Components



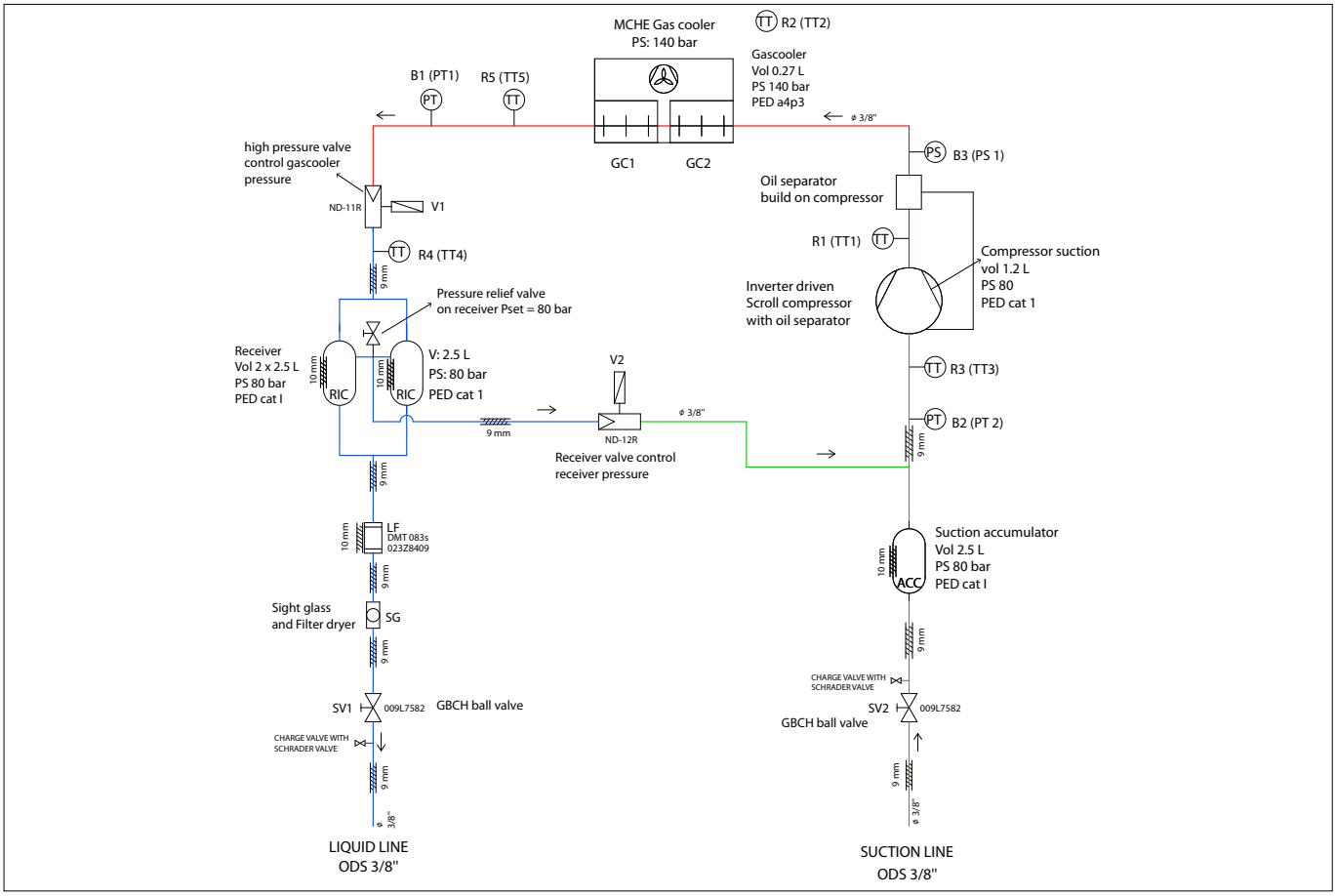


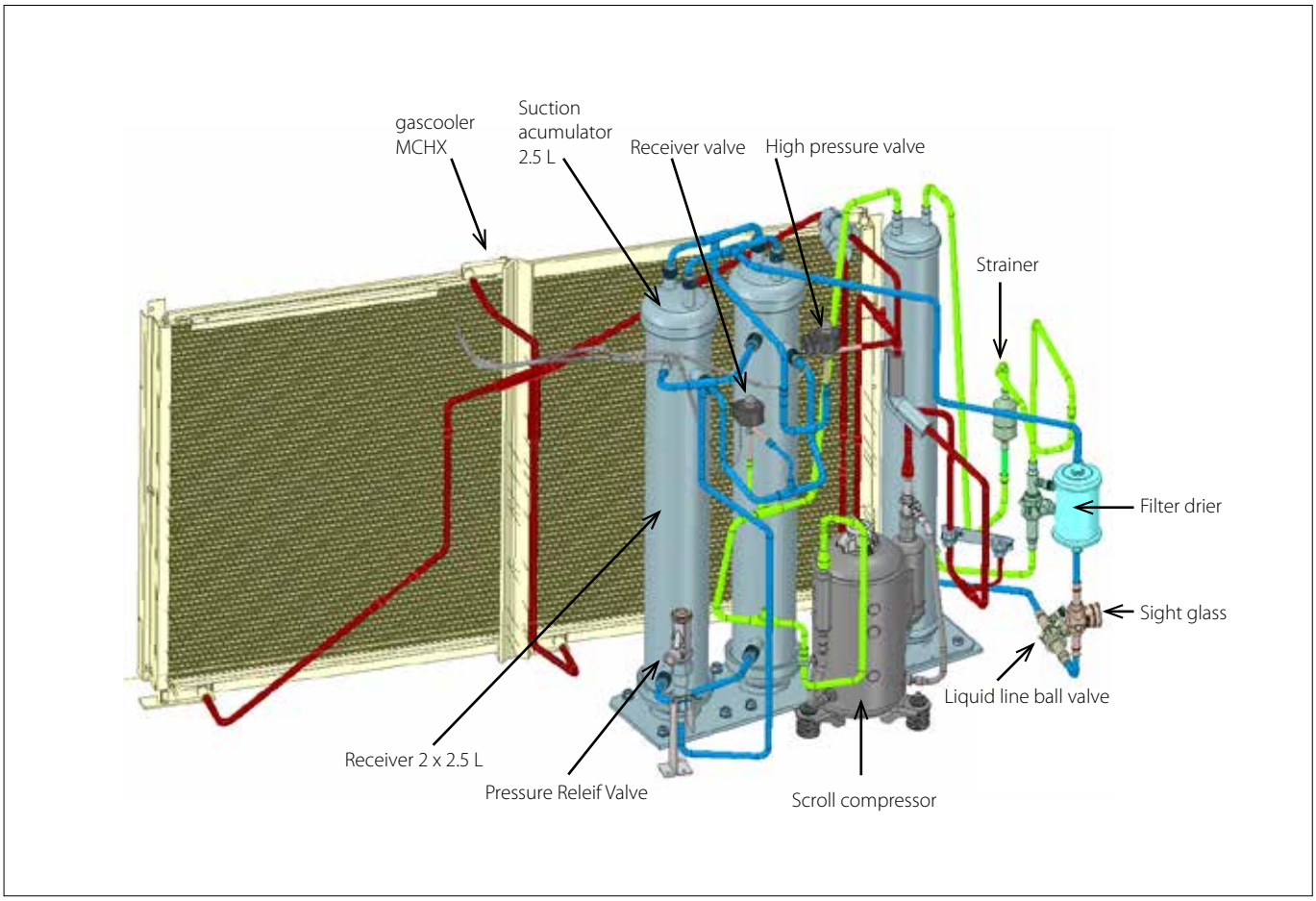
Components


MCHE Gas cooler
PS: 140 bar
R2 (TT2)
Gascooler
Vol 0.27 L
PS 140 bar
PED a4p3
B1 (PT1)
R5 (TT5)
ø 3/8"
GC1
GC2
B3 (PS 1)
high pressure valve
control gascooler
pressure
ND-11R
V1
Oil separator
build on compressor
R1 (TT1)
R4 (TT4)
Compressor suction
vol 1.2 L
PS 80
PED cat 1
Inverter driven
Scroll compressor
with oil separator
Pressure relief valve
on receiver Pset = 80 bar
Receiver
Vol 2 x 2.5 L
PS 80 bar
PED cat I
RIC
RIC
V: 2.5 L
PS: 80 bar
PED cat 1
V2
R3 (TT3)
B2 (PT 2)
9 mm
ND-12R
Receiver valve control
receiver pressure
LF
DMT 083s
023Z8409
Suction accumulator
Vol 2.5 L
PS 80 bar
PED cat I
ACC
Sight glass
and Filter dryer
SG
CHARGE VALVE WITH
SCHRADER VALVE
SV1
009L7582
GBCH ball valve
SV2
009L7582
GBCH ball valve
LIQUID LINE
ODS 3/8"
SUCTION LINE
ODS 3/8"

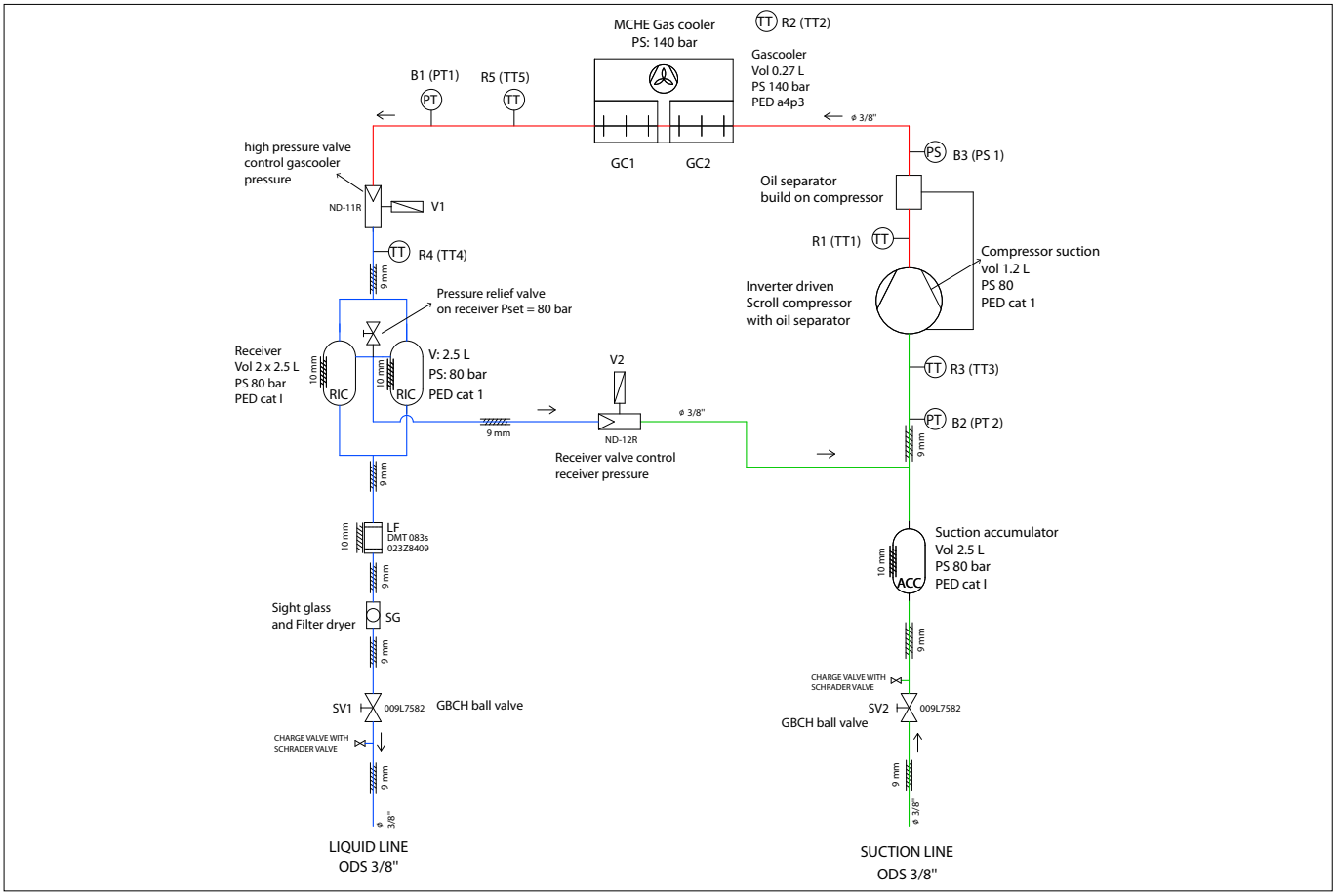

gasooler MCHX
Receiver 2 x 2.5 L
Suction accumulator 2.5 L
High pressure valve
Receiver valve
Pressure Relief Valve
Pset 80 bar
Strainer
Return line ball valve
Scroll compressor
Sight glass
Filter drier
Liquid line ball valve

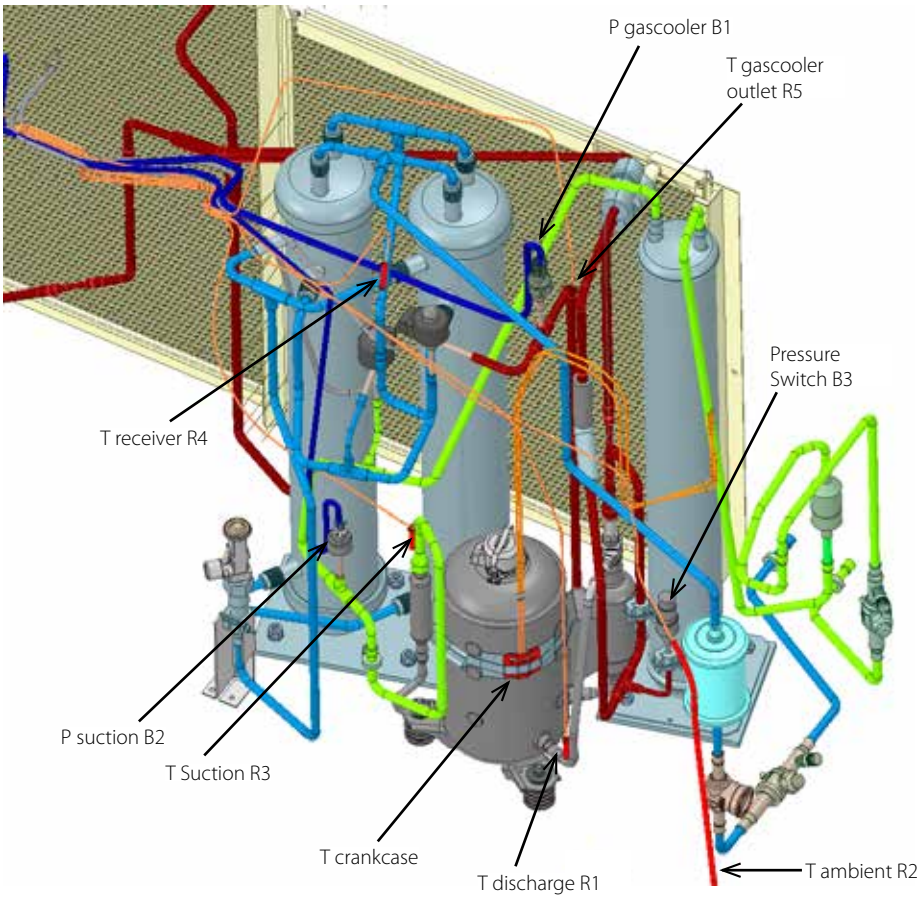
Components





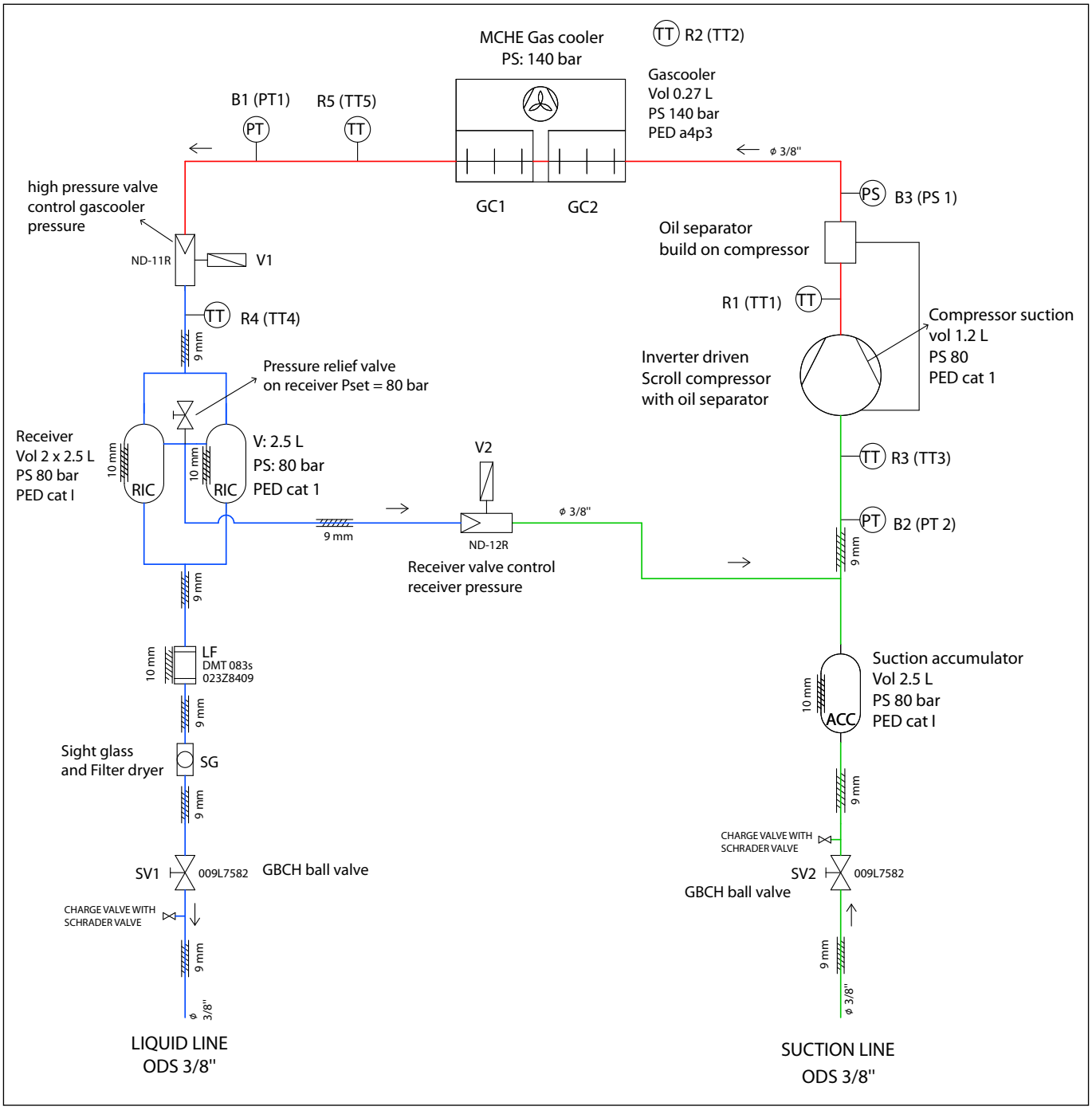
Sensors


MCHE Gas cooler
PS: 140 bar
R2 (TT2)
Gascooler
Vol 0.27 L
PS 140 bar
PED a4p3
B1 (PT1)
R5 (TT5)
GC1
GC2
B3 (PS 1)
high pressure valve
control gascooler
pressure
ND-11R
V1
Oil separator
build on compressor
R1 (TT1)
R4 (TT4)
Compressor suction
vol 1.2 L
PS 80
PED cat 1
Inverter driven
Scroll compressor
with oil separator
Pressure relief valve
on receiver Pset = 80 bar
Receiver
Vol 2 x 2.5 L
PS 80 bar
PED cat I
RIC
RIC
V: 2.5 L
PS: 80 bar
PED cat 1
V2
R3 (TT3)
B2 (PT 2)
ND-12R
Receiver valve control
receiver pressure
LF
DMT 083s
02328409
Suction accumulator
Vol 2.5 L
PS 80 bar
PED cat I
ACC
Sight glass
and Filter dryer
SG
CHARGE VALVE WITH
SCHRADER VALVE
SV1
009L7582
GBCH ball valve
SV2
009L7582
GBCH ball valve
LIQUID LINE
ODS 3/8"
SUCTION LINE
ODS 3/8"


P gascooler B1
T gascooler
outlet R5
Pressure
Switch B3
T receiver R4
P suction B2
T Suction R3
T crankcase
T discharge R1
T ambient R2

Refrigerant name / amount	CO_2 Pure grade 99.995% / According to charge calculation excel sheet
Compressor oil	Danfoss oil tank 118U4144 (1 can=250 ml) / 268g±25g PAG ND8 (Factory default)
Dimension	H 1028 / W 800 / L 1500 mm
Weight	114 kg (with total charge of oil inside CDU 268 g = 158 g compressor charge + 110 g suction accumulator charge)
Reference standard and regulation	All reference needed for issuing of CE declaration of incorporation for the Optyma™ iCO_2
Condition1 (rated condition)	Evaporating Temperature : -10 °C
	Ambient Temperature : 32 °C
	Super Heat : 10 K
Connecting piping specification	in/ou diam 3/8'', max working pressure 80 bars
Cooling capacity	4.58 kW under condition1
Cooling COP / SEPR	1.55 / 3.2 (according to Ecodesign Detective 2009/125/EC, Regulation (EU) 2015/1095) under condition1
Power and sound pressure (standard ISO 3745)	67dB(A) (Sound power level). 35 dB(A) sound pressure at 10 m (free field) under condition 1
Environmental response	Compatible with REACH and RoHS: equipment containing electrical components must not be disposed of together with domestic waste. It must be separately collected with electrical and electronic waste according to local and currently valid legislation. **RoHS Directive 2011/65/EU including amendment 2015/863** Though Condensing units are not in the scope of RoHS 2011/65/EU, declaration Danfoss declares that the listed products and spare parts/accessories are compliant with the requirements of the Directive 2011/65/EU of the European Parliament and of the Council of June 8th, 2011. Assessment done according to standard EN IEC 63000:2018. Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances. **REACH** Danfoss supports the objective of REACH (Registration, Evaluation, Authorization and restriction of Chemicals, 1907/2006/EC) to further improve the European Union's chemicals regulatory system, including the aim to advance public health and safety as well as the protection of the environment.

2.2 PID (Piping & Instrumentation Diagram)



B1 - High pressure sensor
B2 - Low pressure sensor
B3 - High pressure switch
R1 - Discharge temperature sensor
R2 - Ambient temperature sensor
R3 - Suction temperature sensor
R4 - Receiver inlet temperature sensor
R5 - Gas cooler outlet temperature sensor
V1 - Expansion valve (main)

V2 - Expansion valve (gas by-pass)
PRV - Pressure Relief valve
GC1 - Gas cooler 1
GC2 - Gas cooler 2
LF - Liquid filter with dryer
SG - Sight glass with moisture indicator
SV1 - Service valve 1 (liquid line)
SV2 -Service valve 2 (suction line)

Red line - high pressure line
Blue line - Liquid line
Green line - Suction line
Black line - Oil line

2.4 Pressure resistance

Max. working pressure	High pressure side 140 bar Low pressure side 80 bar Medium pressure 80 bar PRV (Pressure Release Valve) setting : 80 bar
Test pressure	According to EN378-2

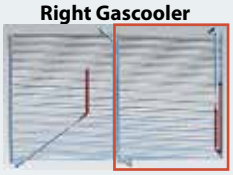
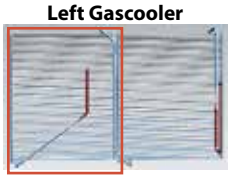
2.5 Strength

Corrosion resistance	Salt spray test 1000 h (According to EN60068-2-52)

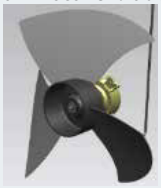
2.6 Electric safety tests (according EN60335-1:2010)

TEST	MAIN FEATURES
Protective Bond Test	25A, 0.1Ω Max time 3 sec.
High Voltage Test	1000V, 1sec. Max current 20mA
Insulation Resistance Test	500V DC Low limit 1MΩ
Leakage Current Test	Max 3.5mA at 1.06 rated voltage

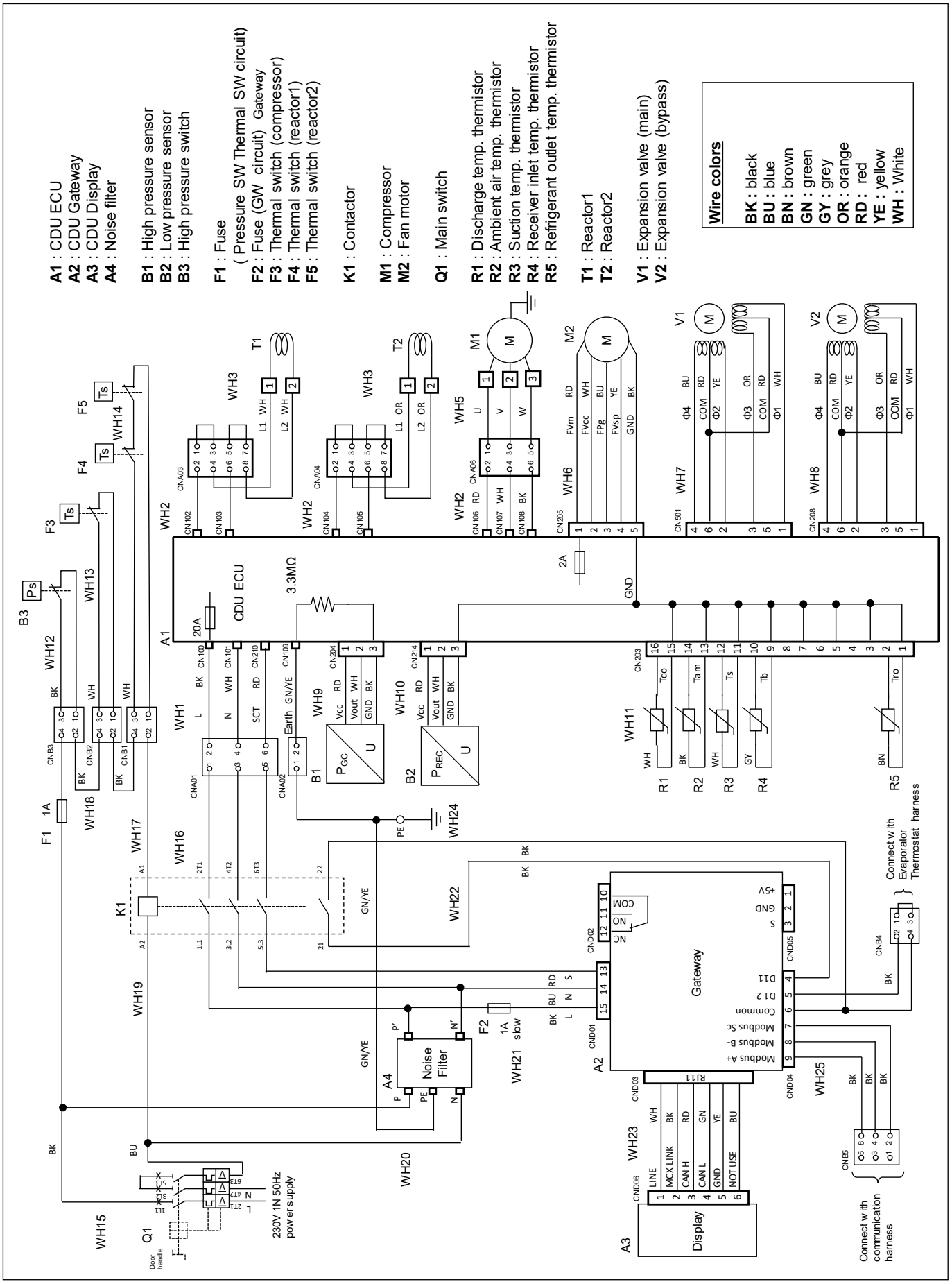
3.1 Parts name and specification

Parts Name	Specification
Kit Compressor (included insulation) 	Spare part code : 118U4105 Rated voltage : DC165V Power voltage : Through Danfoss Optyma™ iCO2 inverter controller (118U4126)
Right Gascooler 	Spare part code : 118U4112 (Right GC) Type : Aluminum Brazed (external view). Microchannel technology (internal view) Dimension : H480 mm X W572mm X D11.5mm
Left Gascooler 	Spare part code : 118U4116 (Left GC) Type : Aluminum Brazed (external view). Microchannel technology (internal view) Dimension : H480 mm X W572mm X D11.5mm
Kit Receiver (included insulation) 	Spare part code : 118U4103 Vessel dimension : Diameter 76mm Height 687mm Volume : 2.5 L each Pipe diameter : 3/8" X 5 pipes
Kit Accumulator (included insulation) 	Spare part code : 118U4104 Vessel dimension : Diameter 76mm Height 687mm Volume : 2.5 L Pipe diameter : 3/8" X 2 pipes
Dryer 	Spare part code : 118U4145 Manufact. designation : DMT 083s Dimension : Diameter 68.0mm Length 144mm Connection : 3/8" X 2 pipes
Moisture indicator 	Spare part code : 118U4111 Dimension : Length 117 mm Indication : From Yellow (wet) to green (dry) Connection : 3/8" X 2 pipes
Charge Valve 	Spare part code : 118U4146 Manufact. designation : GBCH 10s Manufacturer P/N : 009L7582 Connection : 3/8" X 2 pipes

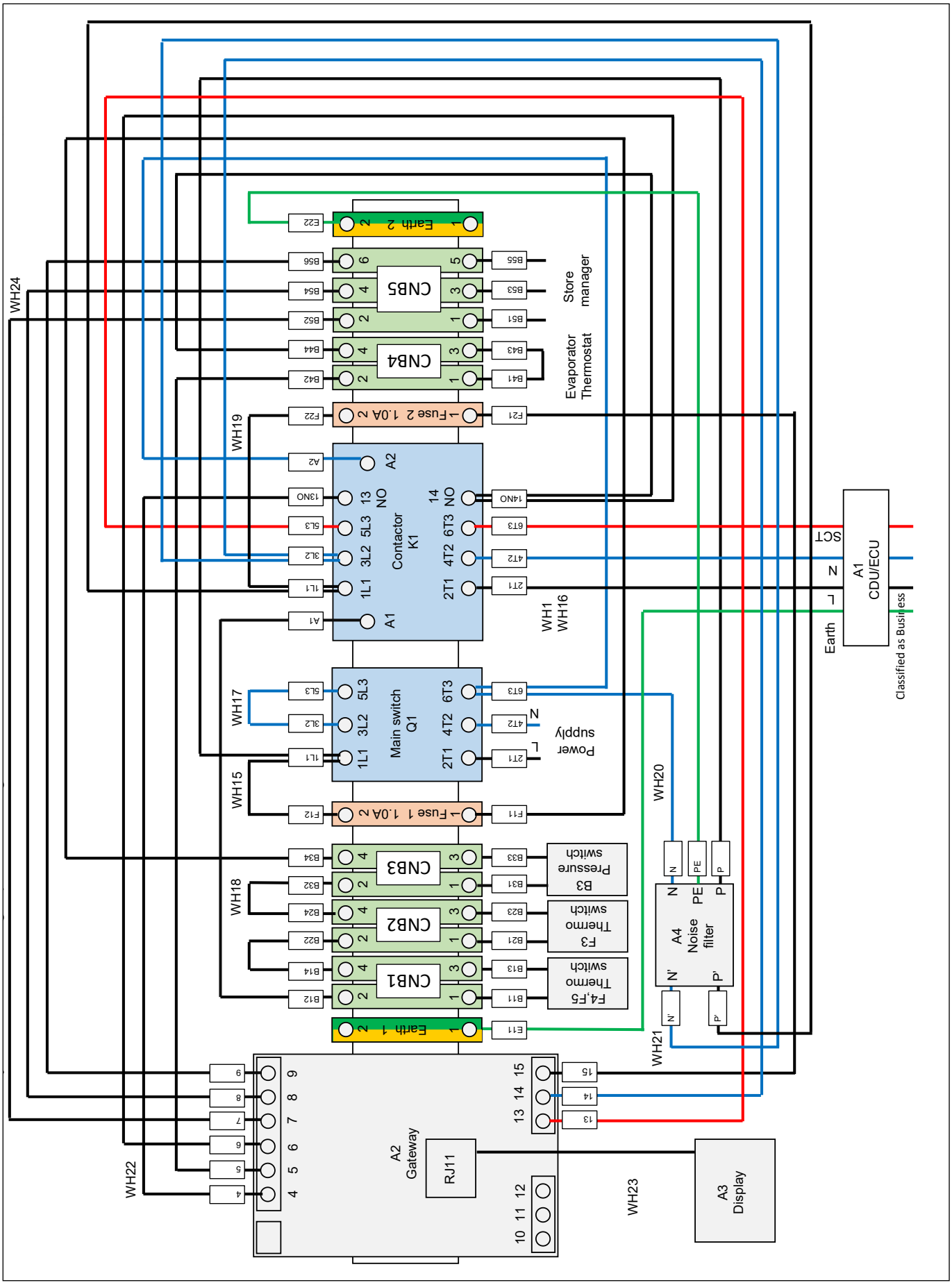
Parts Name	Specification
High pressure valve coil 	Spare part code : 118U4117 Type : ND-11R Rated coil voltage : DC 14 V Rated coil current : 0.3 A (per phase) Rated coil resistance: 46 Ω (at 20°C)
receiver valve valve coil 	Spare part code : 118U4118 Type : ND-12R Rated coil voltage : DC 14 V Rated coil current : 0.3 A (per phase) Coil resistance : 46 Ω (at 20°C)
Spare part valve body for both high pressure valve and receiver valve (3/8") 	Spare part code : 118U4107 Inlet pipe diameter : Φ 6 mm Outlet pipe diameter : Φ 9.5 mm
Discharge temperature thermistor 	Spare part code : 118U4123 Resistance : R_{100} = 184.3 kΩ ± 3% (Gas cooler refrigerant outlet thermistor, Receiver inlet temperature thermistor, Ambient air thermistor, Suction temperature thermistor) Resistance : R_{100} = 3.3 kΩ ± 5% (Discharge temperature thermistor)
Relief valve 	Spare part code : 118U4106 Set pressure : 80 bar Over pressure : +10% Blowdown :-15% Connection : INLET 3/8" OUTLET ¾"
High pressure sensor 	Spare part code : 118U4110 Type : Ratiometric Rated voltage : DC 5 V Measuring range : 0 bar~196 bar Pipe diameter : 6 mm
Low pressure sensor 	Spare part code : 118U4108 Type : Ratiometric Rated voltage : DC 5 V Measuring range : 0 bar~100 bar Pipe diameter : 6 mm
High Pressure switch 	Spare part code : 118U4109 Type : PS80-2X series Actuation pressure :140 + 0 bar -7 bar Current range :~1A

Parts Name	Specification
Thermal switch (Compressor surface) 	Spare part code : 118U4121 Type : JP72 series Actuation temperature :125 ± 5 °C Release temperature : 85 ± 15 °C Current range : 5 mA ~ 1.5 A
Thermal switch (Reactor surface) 	Spare part code : 118U4122 Type : JP72 series Actuation temperature :110 ± 5 °C Release temperature : 70 ± 15 °C Current range : 5 mA ~ 1.5 A
CDU Controller (6) 	Spare part code :118U4126 Rated voltage : 230 V Rated frequency : 50 Hz Input current : Less than or equal 15 Arms
Reactor 1 	Spare part code : 118U4124 Type : VFD (Variable Frequency Drive) Rated current : 16 A (There are two Reactor per condensing unit)
Reactor 2 	Spare part code : 118U4125 Type : VFD (Variable Frequency Drive) Rated current : 16 A (There are two Reactor per condensing unit)
Fan motor & blade 	Spare part code : 118U4129 Type : DC brushless motor with built-in sine wave circuit Specifications : Rated voltage DC 240 V Rated current 0.08 A Control power supply volt : DC 15 V Rated rotation speed : 870 rpm
Main switch 	Spare part code : 118U3854 Official designation : KIT MPCB, ABB-MS132-20+HK1-11 Rated voltage : 690 V Rated current : 20 A
Main switch handle 	Spare part code : 118U3858 Type : MSHDLTB Rated current : 20 A
Contactor 	Spare part code : 118U3847 Official designation: KIT MPCB, ABB-A16-30-01-80+CA5-10 Rated voltage : 690 V Rated current : 16 A Design life : ON/OFF 10.000.000 cycle

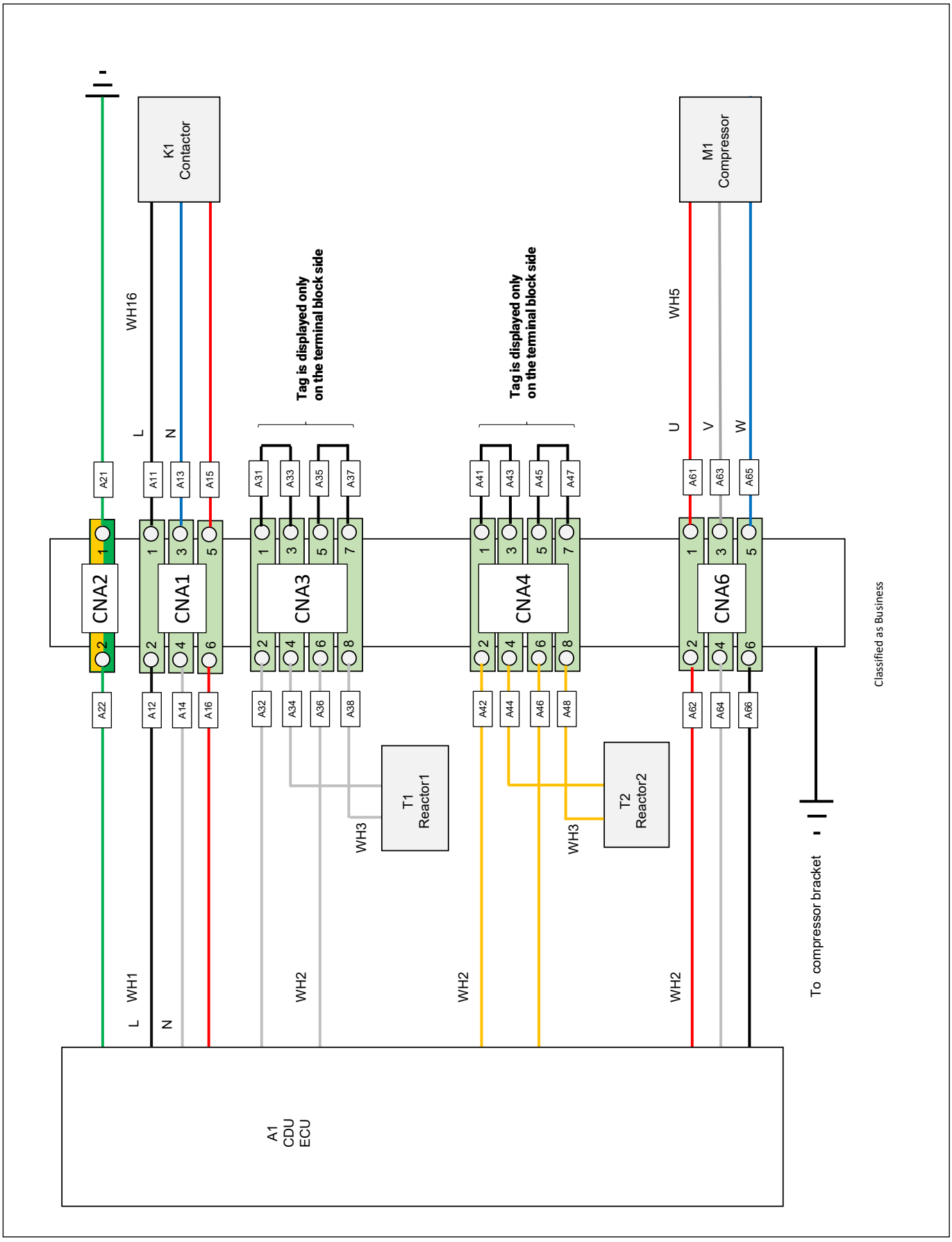
3.2 Electric diagram



Terminal block layout and wiring plan with tags (1/2)

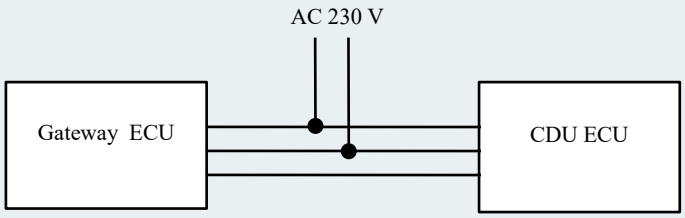


Terminal block layout and wiring plan with tags (2/2)



4.1 Optyma™ iCO₂ Gateway – interface description

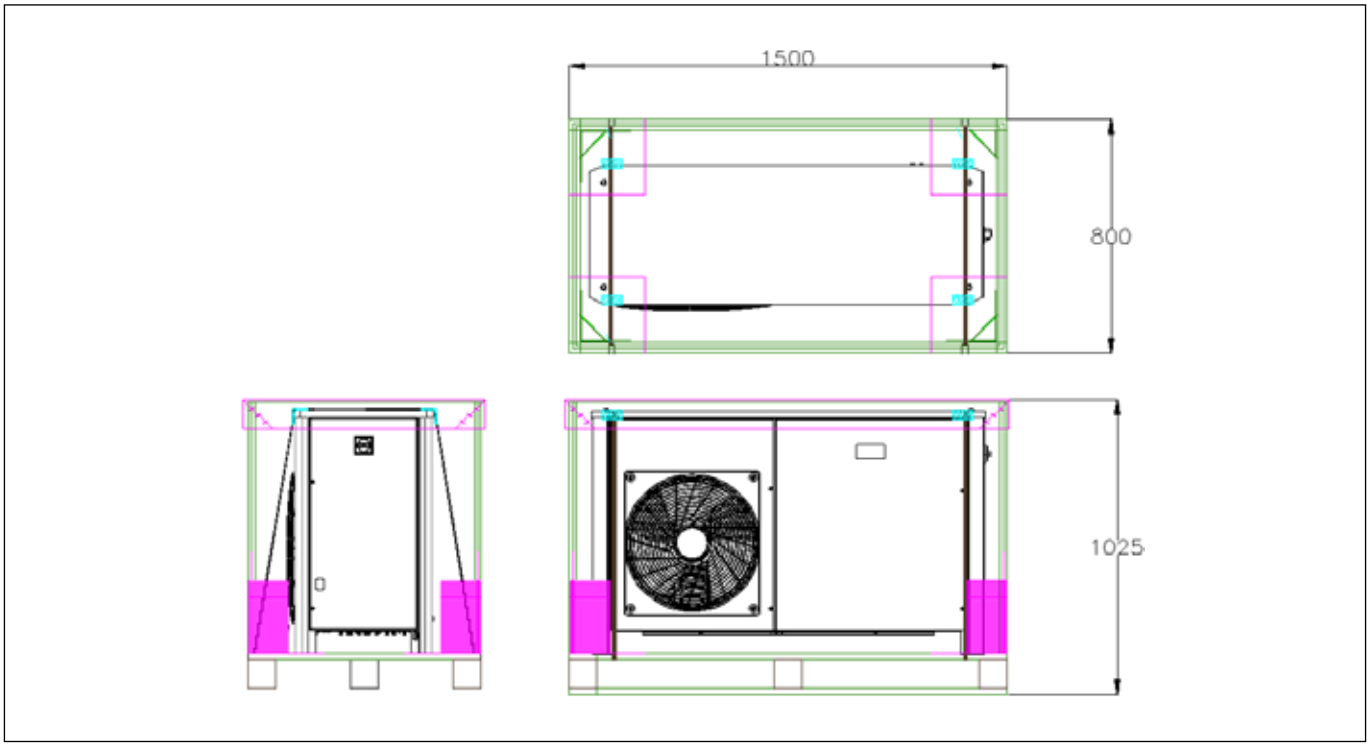
The iCO₂ condensing unit is equipped with a gateway for communication to external controls:

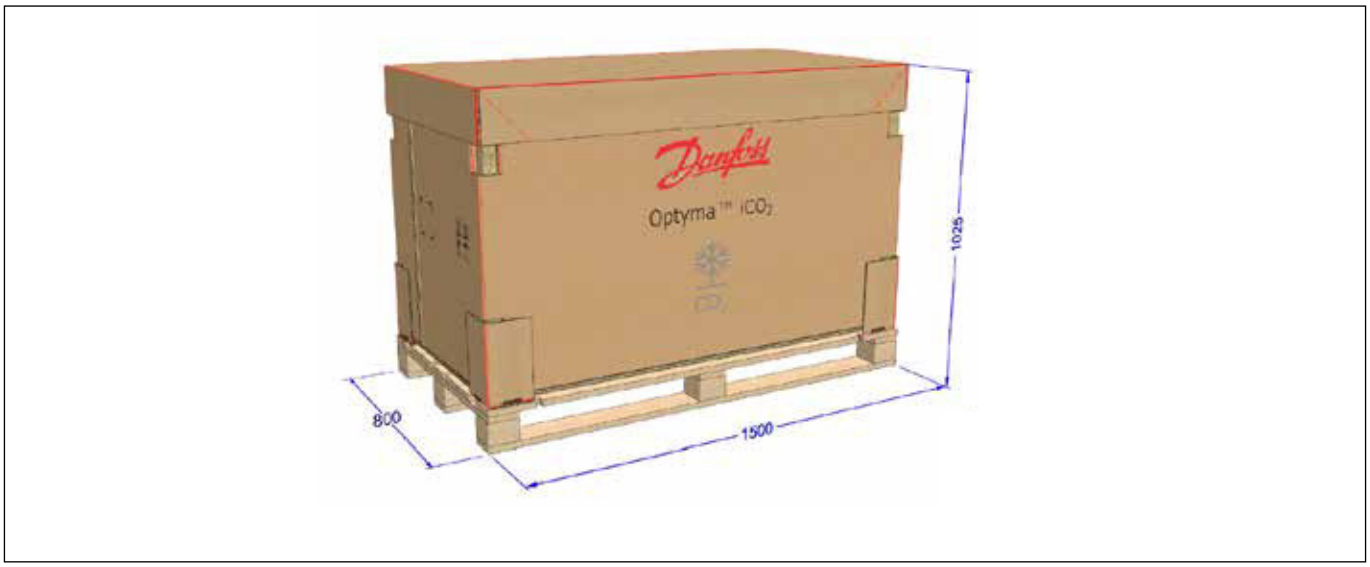
Physical Specification	
Mounting	DIN-rail
Dimensions	75x119x59 mm
Weight	~150 g
Environment	-30°C to +60°C during operation -40°C to +70°C during transport 20 – 90% Rh, not condensed
Power supply	
Input	100-277VAC, 50/60Hz Max. 8VA
Protection	1A slow-blow fuse
Alarm relay SPDT to connect alarm horns or lights, ext. controllers or control circuits.	
Contact function	SPDT (Single-Pole Double-Throw)
Max. voltage	277 VAC, 30 VDC
Max. current	3 A (resistive load)
Connection	3 screw terminals
Digital Inputs to be used for auxiliary signals, such as an external thermostat.	
Nominal voltage	12 V
Connection	3 screw terminals
Analog Input to be used with a ratiometric pressure transmitter.	
Nominal voltage	5 VDC
Max. current	30 mA
Connection	3 screw terminals
230V Universal Asynchronous Receiver Transmitter (UART) to communicate with the condensing unit controller	
	
Cable type:	3-wire cable (VVF φ 2.6 mm).
Cable length:	Max. 30 m
Transmission system	Super imposed AC power supply system
Transmission waveform	Rectangular wave
Logic	Negative Logic (NRZ signal)
Transmission rate	500 bps ± 1.0%
Synchronization method	Start-stop synchronous half-duplex system
Start bit	Logical 0
Data delivery	LSB First
Parity	Even parity
Stop bit	Logical 1
Character Spacing	In principle, no space is left between the stop bit and the next character, but up to 100 ms is permitted by design.

RS485 Modbus to connect to Danfoss ADAP-KOOL® network or programmable controllers. For more details refer to Danfoss design guide no. RC8AC902 "Data communication between ADAP-KOOL® refrigeration controls".	
Baudrate	19 200 / 38 400 Kbps (automatic selection)
Data bits	8
Stop bits	1
Parity	Even
Termination	A 120 ohm resistor should be mounted if the Gateway ECU is the last node on the bus
Biasing	Biasing resistors (pull-up, pull-down) should typically be built-in in master on the bus
Protocol	Modbus RTU
CAN bus to connect the local display MMILDS. See more details in chapter 9.1ff within this document.	
Baudrate	50 Kbps
Termination	Built-in 120 ohm resistor
Protocol	CANopen

5.1 Unpacking

When unit reaches your warehouse, inspect the packing for any visible damage and make sure it is in good condition. In the event you detect any damage, please contact your forwarder immediately: send a registered letter to the shipping company claiming the suffered damage, a copy of which should be sent responsible contact in Danfoss.





5.2 Disposal Instruction

Equipment containing electrical components must not be disposed of together with domestic waste. It must be separately collected with electrical and electronic waste according to local and currently valid legislation.

6.1 Service and safety advice

If the refrigerant system has been opened the system has to be flushed with dry air or nitrogen to remove moisture and a new filter dryer has to be installed. Beware of hot and cold components in the refrigeration system. The components in the refrigeration system are pressurized; as a consequence special attention has to be paid during operation on these components.

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

Safety goggles, gloves, protective clothing, safety boots, hard hats or another safety equipment should be worn when necessary.
Never install a system in the field and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.
Do not touch the compressor until it has cooled down. Ensure that other materials in the area of the compressor do not get in touch with it.

Before Starting Repair Work

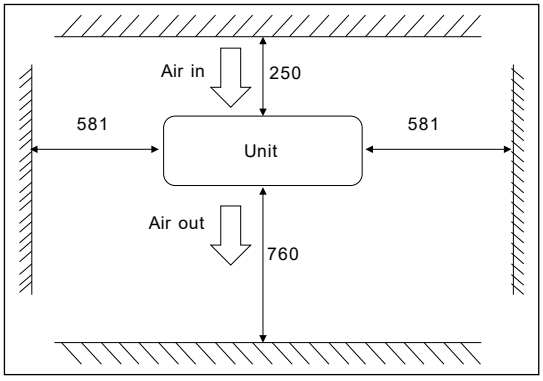
- Disconnect from mains
- Wait as stated before for discharge of the DC-link. (Refer section 4.5.1 Warning when touching unit when OFF)
- Remove compressor cable.

Item	Contents
Transportation and delivery	1. Cargo unloading work should be carried out using appropriate handling equipment (Forklifts, cranes, etc.). Do not let the unit fall.
Notes	Do not install in the following locations. 1. A dusty place 2. Place with flammable gas atmosphere 3. Place where water or oil (contain machine oil) is scattered or where there is a lot of steam 4. Place exposed to direct sunlight for a long time. 5. Areas with large voltage fluctuations 6. Place where there is a machine that generates electromagnetic waves
Installation	1. The base shall be installed so that the angle of inclination of the unit is within 2 degrees. 2. The maximum number of stack of the units shall be two and the top unit shall be fixed. 3. The base must be strong enough to withstand the weight of the unit.
Leak inspection	1. Do not pressurize with oxygen or air for leak inspection. 2. The maximum pressure is 80 bar. 3. If you find a leak, do leakage inspection again after repair.
Evacuation and Refrigerant charge	Please see specific paragraph 6.9.2.
Trial run	1. Check that the refrigerant is filled. (Do not turn on the compressor in vacuum.) 2. Do not insert or remove electrical connectors during operation.

Failure to comply with the instructions will avoid the warranty.

6.2 Location & fixings

Install the equipment in a plane surface where air circulates around the equipment and the equipment operates correctly.



So not install in the following locations:

- A dusty place
- Place with flammable gas atmosphere
- Place where water or oil (contain machine oil) is scattered or where there is a lot of steam
- Place exposed to direct sunlight for a long time.
- Area with high corrosive atmosphere
- Install the unit in areas with a lot of snow, wind, and lightning so that it does not interfere with the operation of the unit. If snow accumulates on its feet, it will cause problems with outside air temperature measurement.
- Areas with large voltage fluctuations
- Place where there is a machine that generates electromagnetic waves
- Place where not blocking or expose an obstacle for walking areas, doors, windows etc.

The base shall be installed so that the angle of inclination of the unit is within 2 degrees.
The maximum number of stack of the units shall be two and the top unit shall be fixed.
The base must be strong enough to withstand the weight of the unit.

6.3 Electrical connection

Electrical connections shall be performed by qualified personnel in accordance with applicable national legal standards and EN -60204 -1.
Before connecting the equipment electrically, confirm that the voltage and frequency rating of the AC power line corresponds to the indication on the identification plate and that the power supply voltage is within the allowable range of +/- 10% of the rated value.
Be sure to connect the ground wire (PE).The unit is to be placed in such that it is not blocking or expose an obstacle for walking areas, doors, windows etc.
Below table lists recommended wiring sizes for the condensing unit power supply cables. These wiring sizes are valid for a cable length up to 30 m.

Model	Cable size, mm^2 (from network to unit main switch)
Optyma iCO_2	2.5mm^2 up to 4.00mm^2 depending on ambient temperature and grouping

Note:
The wire size here is the guideline. In each specific case required cable size should be specified by the installer depending on the system design, ambient temperature, the wire material, current, etc.
In order to ensure a safe and problem free operation of the unit it is recommended to:
- *Ensure that the power supply corresponds to the unit and that the power supply is stable (see nominal values on unit label and power supply limits in paragraph 3.5).*
- *Make the power supply according to present norm and legal requirements. Ensure that the unit is properly connected to ground.*

The unit is equipped with a main switch with overload protection. Overload protection is preset from factory. Value for overload protection can be found in the wiring diagram. Wiring diagram can be found in front door of unit. Unit is equipped with high and low pressure switches, which directly cuts the power supply of the compressor contactor in case of activation.
Unit is equipped with an Gateway + display and Controller.
The controller and Electronic controller are pre- programmed with parameters ready for use with the actual unit.

Thermostat joint. For the connection of the CDU with the thermostat, it need to remove the jumper (bridge connection) on PIN B41 and B43 and connect the thermostat on the same PIN (see image below).

6.4 Power supply protection

You should use only original circuit breaker, min. short circuit breaking capacity needs to be 100 kA. Please refer to spare part set section for selection of components for service replacement.
RCD type: Type A or B.

6.5 Protection and features

- Thermal compressor protection against overload: Actuation temperature: 125±5 °C
- Electronic thermal for each current filter protection against overload.
- HP pressure cartridge setting: cut out 140 bar, cut in 100 bar.
- Pressure release valve: cut out 80 bar
- The root cause of an individual alarm can be shown with the display.

6.6 Electrical protection standard

Complete unit Ingress Protection Code: IP54
The unit is fully wired and factory tested. Electrical connection compromises only power supply.

6.7 EMC compliance

All necessary actions taken to secure EMC compliance of complete condensing unit (reference to declaration of incorporation).

6.8 Warning when touching unit when OFF

Capacitors in condensing unit controller can remain charged even when the condensing unit controller is not powered. To avoid electrical hazards, disconnect AC remains and wait 15 min for the capacitors to fully discharge before performing any service or repair work (see par. 9.4 Alarm indications and Status messages, pg. 40). Failure to wait the specified time after power has been removed before doing service or repair could result in death or serious injury.

6.9 Brazed connections

- Piping must be of refrigeration quality compliant with PED 2014/68/EC and EN 12735 -1.
- Be careful not to let foreign matter or water enter in the unit.
- At the time of piping brazing, carry out the process while blowing with nitrogen to suppress the generation of copper oxide.
- Piping the suction pipe to ensure oil return.
- The height difference between the outdoor unit and the freezer case shall be 5 m or less.
- Installation piping should be covered with insulation to ensure performance.
- Support construction piping at appropriate intervals.
- Maximum distance between Evaporator and the unit straight line is mentioned 20 m.

Note:

During installation of the unit or replacement of CO_2 carrying components it's mandatory to use chlorine free flux material in order to preserve the hydraulic circuit from internal corrosion. Silver flux is admitted but must be chlorine free.

6.10 System design recommendations: Pipe works

All parts of the liquid line must be rated for PS 80 bar.
Liquid line and receiver are protected by a pressure relieve valve connected to the receiver. Pressure limit set at 80 bar.
The design pressure of the evaporator(s) and suction line is preferable to be 80 bar, no less than 60 bar - Ensure if liquid line stub supplied on display case is 80 bar
Suction line must be protected by a pressure relief valve (Contractor responsibility) set at the MWP of the evaporators and suction pipe. All section of system that can be close by isolation valve must be protected by a PRV or a check valve to allow flow in the direction of a PRV. Pressure relieve valve must be place where no risk for people or goods.
The suction piping connected to the compressor must be flexible in 3 dimensions to dampen vibrations.
The pipes should be sized to ensure optimum performance and good oil return. Do not assume that the liquid/ suction connection sizes on the unit are in fact the correct sizes to run your interconnecting refrigeration pipes. The sizing must also take into account the full capacity range through which this particular unit will need to operate.
Pipe runs should be kept as short as possible, using the minimum number of directional changes
Use large radius bends and avoid trapping of oil and refrigerant. This is especially important for the suction line.
All pipes should be adequately supported to prevent sagging which can create oil traps. Piping must be supported and clamped every 1 meter for D3/8".

Tube size	Distance between 2 clamp supports
3/8"	1.0 m

Refrigerant velocity in liquid line should not exceed 1 m/s

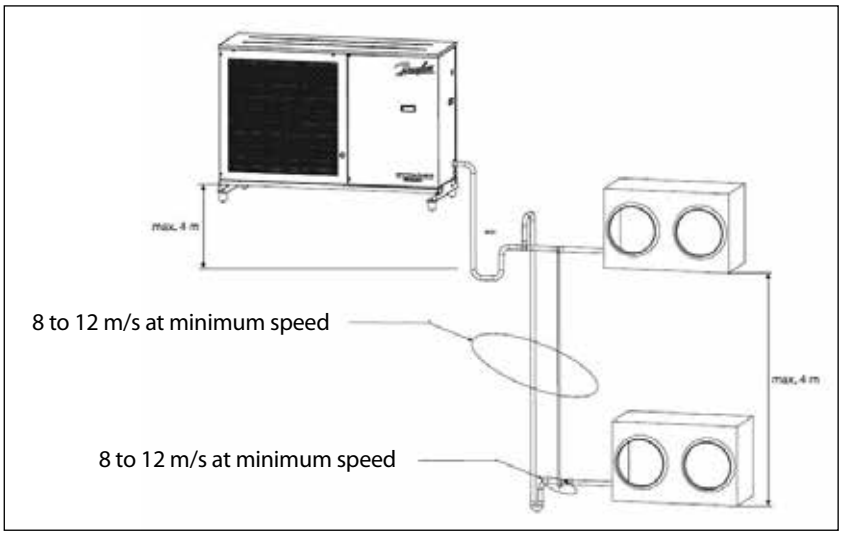
The suction line should :

- secure gentle slope towards the unit (recommended slope minimum 0.5/100)
- have P traps, double risers and reduced pipe diameters where long vertical risers cannot be avoided

The suction gas velocity must be sufficient to ensure a good oil return :

- 8 to 12 m/s in vertical risers
- 4 m/s in horizontal pipes

The use of U trap and double suction risers is often required. These suction risers must always be fitted with a U trap at the bottom and a P trap at the top and never be higher than 4 m unless a second U trap system is fitted.



Maximum safety length of pipes between CU and last evaporator is 20 m.
Diameter of separate suction lines from evaporators to condensing unit manifold should be with appropriate size according evaporator capacity (securing recommended speed for proper oil return). Common manifold tube should be as close as possible to condensing unit.
The installer is responsible for the installation of the unit and complete refrigeration system design according particular conditions of each application as this is not scope of current Guideline

Leak and pressure test

Pressure tests :

- Test liquid line at 1.1 x PS = 88 bars.
- Test suction line at 1.1 x PS according to suction line design pressure (60 or 80 bars).
- When testing at 88 bar, close unit shutoff valve to prevent the receiver PRV to blow-out. Condensing unit does need to be tested at 88 bar. It has already been pressure tested in factory.
- Don't forget to remove suction line PRV and place it back again after pressure test and before leak test.

leak test

- Perform a leak detection test on the complete system at pressure P = 0,25 x PS = 20 bar.
- When a leak is discovered, repair the leak, and repeat the leak detection.

After completion of test, vent nitrogen to atmosphere and open condensing unit service valve.

6.11 How to charge oil

The condensing unit is supplied with PAG oil, the oil separator and accumulator is pre-charged with 268 g (Total charge 268 g = 158 g compressor charge + 110g suction accumulator charge).

Use the provided tool (excel file) "Calculation sheet for refrigerant and oil charge ver 8.1.xlsm" in order to identify the amount of oil that must be added. The file already include 20 m + 20 m of pipes between CDU and evaporator so it's only requested to fill in:

- Number of evaporators
- Max Ambient temperature

Highest the setting of the oil return strategy, lowest the oil amount that must be added. See example below

<input>	
Evaporator unit (≤ 2.0L/unit)	1 unint
Suction set point temperature	-15°C
Highest operating ambient temperature	35°C

<Output>	
Oil retun control set value	Amount of additional Oil
Unnecessary	430g, but the oil return is not good
3000rpm (Default)	190g
4500rpm	No add oil
5600rpm	No add oil

Oil boost speed is default 3000 rpm, you can see in the below chart oil addition for two different ambient temperatures and different evaporator volumes.
(The default oil boost speed us 3000 rpm, this can be increased however it could lead to increased compressor noise and sharp reduction in evaporating temperature as well as increased discharge temperature)

TA	°C	38
Oil boost	rpm	3000

Oil Addition (gr)

Evap Vol	Te [°C]			
Liters	-15	-10	0	5
2	430	430	430	190
4	530	530	530	290
6	630	630	630	390

TA	°C	32
Oil boost	rpm	3000

Oil Addition (gr)

Evap Vol	Te [°C]			
Liters	-15	-10	0	5
2	190	190	190	0
4	290	290	290	100
6	390	390	390	200

If additional oil is required inside Optyma™ iCO_2, please following below procedure:

1. Start Vacuum mode (see par. 6.12 Start Vacuum mode) and complete the vacuum
2. Charge additional oil quantity needed from the suction side through the suction service valve
3. Charge refrigerant

Note:
Oil can 250 ml inside the Optyma™ iCO_2 packaging already supplied by Danfoss.

Note:
Add oil only after vacuum. Do not charge oil from through the liquid service valve; do not charge oil when the compressor runs.

6.12 Evacuation and Refrigerant charge

Vacuum and Refrigerant charging mode

Vacuum shall be applied after completion of leakage inspection.

Do not test electrical strength of the compressor motor insulation while it is under vacuum, to prevent motor damages.

Start Vacuum mode:

- Select Vacuum mode by changing the MMILDS display parameter "r12" to "2". The stepper valves will fully open within the 10 seconds.
- Connect the vacuum pump to suction and liquid service valves (and open the service valve).
- Turn on the vacuum pump, keep this condition for at least 4 hours min.
- Check if gauge is showing 0.67mbar (absolute) after 4 hours since the start of vacuuming.
- In case if pressure was not able to reach to 0.67mbar (absolute) within 4 hours, break the vacuum with Nitrogene gas with 1 bar, restart vacuum procedure, repeat 3 times to eliminate all moisture and impurities.
- In case of use at higher altitude place pressure read does not reach to 0.67mbar (absolute) in the short duration, prolong the vacuum time for 30minutes more.
- Shut stop-valve of vacuum pump hose.
- Turn OFF the vacuum pump.
- Leave them for 30 min. Then check that vacuum gauge read does not show any changes (i.e. keeping 0.67mbar (absolute) for 30 min.
- If pressure increases rapidly, the system is not airtight. Locate and repair leaks. Restart the vacuum procedure, followed by steps 1, 2 etc.
- If pressure increases slowly, the system contains moisture inside. Break a vacuum with nitrogen gas and restart the vacuum procedure
- After confirming the stable 0.67mbar (absolute), go to charge refrigerant.

Suggested actions if vacuum level cannot be reached or pressure gauge readings change:

- Check hose connections for any leakage.
- Check flare connections if tightened.
- Check copper brazing for any leakage.
- Remaining CO_2 gas can still diffuse out of the oil. Retry vacuuming for 10min.
-

Start Charging

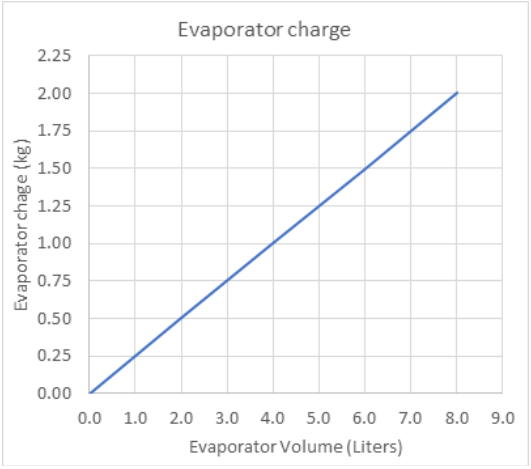
CO_2 gas purity must be refrigerant grade >99,99%

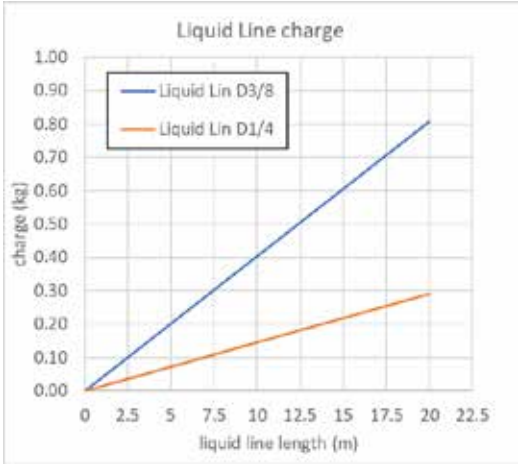
Charging amount should be calculated by excel file (Evaporator volume, pipe diameter and length). Suggested tolerance: ±0,05kg

Charging amount can also be estimated using below equation :

Charge amount = 2.15 kg for the CDU + Evaporator charge + liquid line charge

Evaporator and liquid line charge are given below versus volume and pipe diameter





if only liquid line length D3/8 is use, it is also possible to read charge amount directly in below tab

liquide line length D3/8	Evap Vol (L)							
m	1	2	3	4	5	6	7	8
0	2.40	2.65	2.90	3.15	3.40	3.65	3.90	4.15
5	2.60	2.85	3.10	3.35	3.60	3.85	4.10	4.35
10	2.80	3.05	3.30	3.55	3.80	4.05	4.30	4.55
15	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75
20	3.20	3.45	3.70	3.95	4.20	4.45	4.70	4.95

- use a scale to measure the refrigerant charge you put in system
- Check condensing unit is in vacuum mode. Parameter r12 should be set to value 2. This will force HP and BP valve fully open.
- Always break the vacuum with CO2 refrigerant in gas phase to min. 7 - 10 bar (on both HP/LP side) to avoid any dry ice building.
- Select Stop mode by changing MMILDS display parameter "r12" to "0".
- Charge the rest amount of the calculated of CO2 refrigerant in liquid phase into liquid line.
- Depending on ambient condition, it is possible that you cannot complete the charge with unit OFF and need to start the unit to finish the charge.
- Start the condensing unit by changing MMILDS display parameter "r12" to "1".

Charge limit and max evaporator size
- Condensing unit charge should not exceed 3.65 kg (without counting for liquid line).
- The condensing unit cannot store the charge of evaporator bigger than 6 Liters.
- Max evaporator volume (or sum of all evaporator volume in 1-to-N configuration) in pump down mode is 6 liters.
- In thermostat control mode (no pump down), total sum of all evaporator volume should not exceed 8 Liters.

Check the charge
- Now that parameter r12 is set to 1 = Automatic, unit should start
- if suction pressure too low, you miss charge. If expansion valve is fully open and SH too high you miss charge. Typicall SH value should be 6 - 9 K
- Charge addition should be done on suction line in vapor phase. Do not fill with liquid on suction line. It risks to damage the compressor. Do not fill on liquid line when system is running. Depending on running conditions, pressure of liquid line can reach high values, higher than cylinder pressure.
- Do not overcharge the system. Overfilling the system may risk in pressure increase and release of refrigerant through the receiver relief valve. The liquid line sight glass does not need to be full of liquid.
- Correction for overcharged unit: Release refrigerant via the access port of the suction side. Connect a service pipe equipped with a shutoff valve to the Shrader port. Open the valve very slowly (If there is a possibility of overcharged, release all the refrigerant and start over).
- When you have reach stabilized superheat : Simulate high ambient by covering the gascooler and check system run correctly.

Record type and amount of refrigerant charge as well as operating conditions as a reference for future inspections
Never leave the filling cylinder connected to the circuit. Disconnect and remove refrigerant bottle from the unit, close Schrader valves with their protection caps.

6.13 Check before start

1. Compliance between unit and power supply
2. Check the service valves inlet/outlet both are opened
3. Check that fan can rotate freely
4. Check for possible faults in the installation
5. Check main switch overload protection setting

6.14 General recommendations

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

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

It is recommend to check the unit for leakages minimum once a year.

Furthermore following should be checked:
1. Electrical and refrigerant connections for damages, corrosion etc.
2. The mounting devices (bolts, nuts, etc.) of the unit.
3. Vibrations: if it is on the same level as after installation or any signs of abnormal vibration.
4. Operation conditions.
5. Airflow across the gas cooler.
6. Tightness of electrical connections.

6.15 Gas cooler maintenance

Gas cooler should at least once a year be checked for clogging and be cleaned if deemed necessary. Access to internal side of condenser takes place through fan door. Remember to switch off the unit at main switch before opening the fan door.
In comparison to fin and tube heat exchangers, microchannel coils tend to accumulate more of the dirt on the surface and of the less dirt inside which can make them easier to clean.

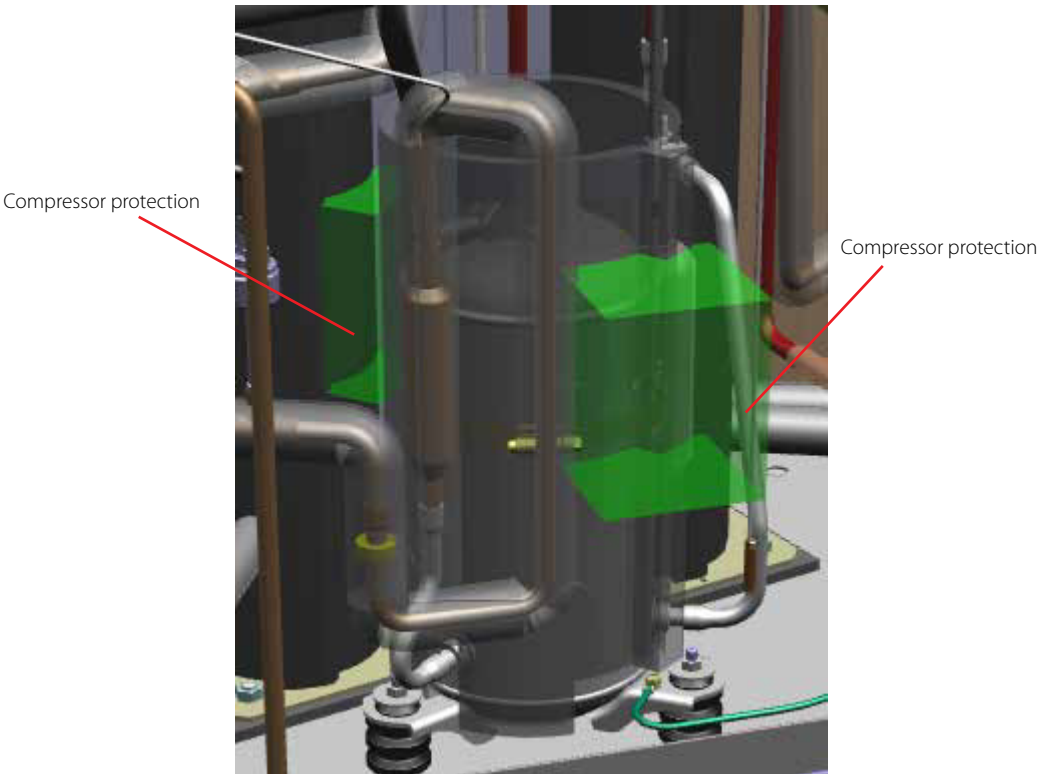
Step 1: Remove surface debris
Remove surface dirt, leaves, fibers, etc. with a vacuum cleaner (preferably with a brush or
other soft attachment rather than a metal tube), compressed air blown from the inside out, and/ or a soft bristle (not wire!) brush. Do not impact or scrape the coil with the vacuum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

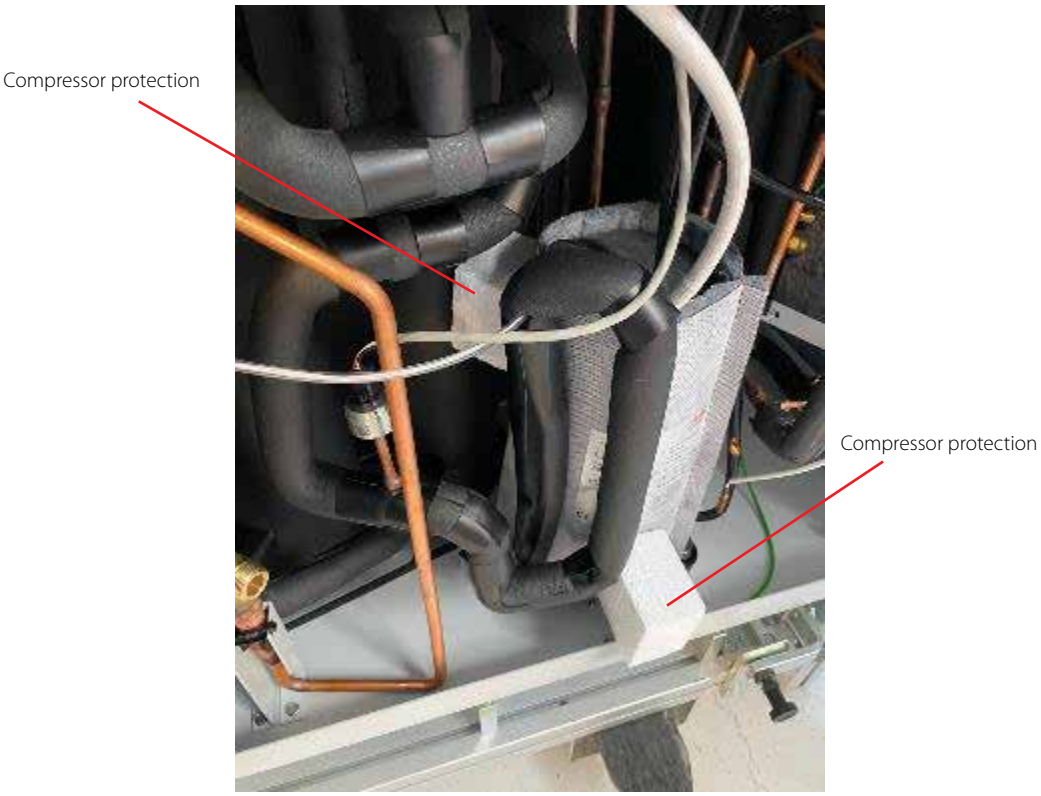
Step 2: Rinse
Do not use any chemicals (including those advertised as coil cleaners) to wash microchannel heat exchangers. They can cause corrosion. Rinse only with water. Hose the MCHE off gently, preferably from the inside out and top to bottom, running the water through every fin passage until it comes out clean.
Microchannels fins are stronger than traditional tube & fin coil fins but still need to be handled with care. Do not bang the hose into the coil.

Step 3: Optional blow dry
Microchannel heat exchangers, because of their fin geometry, tend to retain water more than traditional fin & tube coils. It may be beneficial to blow or vacuum out the rinse water from your unit to speed drying and prevent pooling

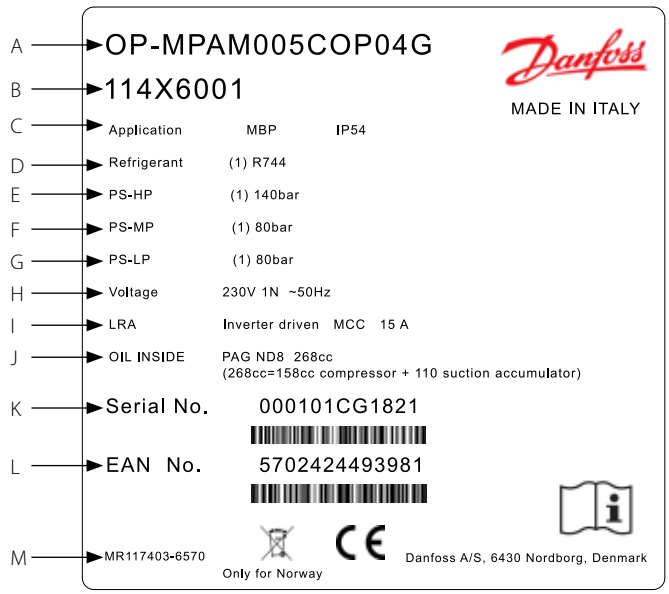
7.1 WARNING

WARNING: remember to remove compressor protection during installation procedures.



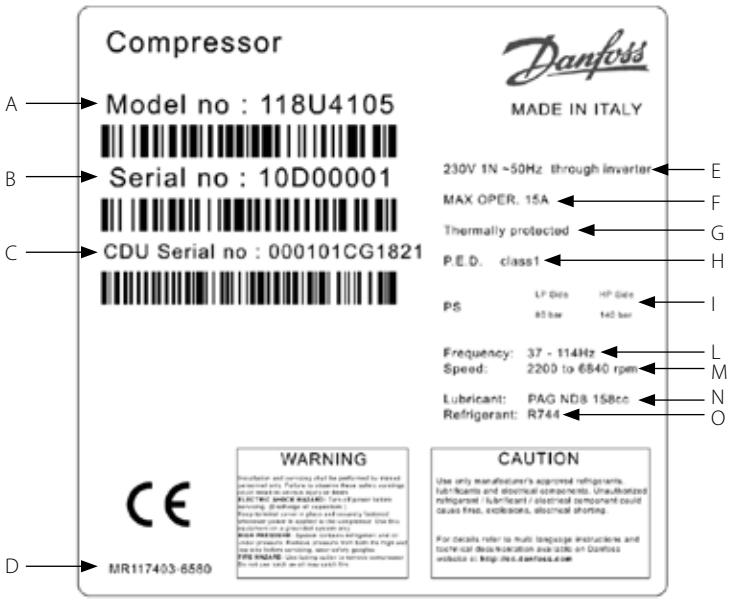


8.1 CDU CO_2 – Optyma™ iCO_2 label



A: Model
B: Code number
C: Application, IP protection level
D: Refrigerant (R744=CO_2)
E: Hight side working pressure
F: Liquide line circuit working pressure
G: Suction line working pressure
H: Supply voltage
I: Locked Rotor Ampere, Maximum Current Consumption
J: Oil type
K: CDU serial number
L: European Article Number
M: Condensing unit Label PN (Factory)

8.2 Compressor label



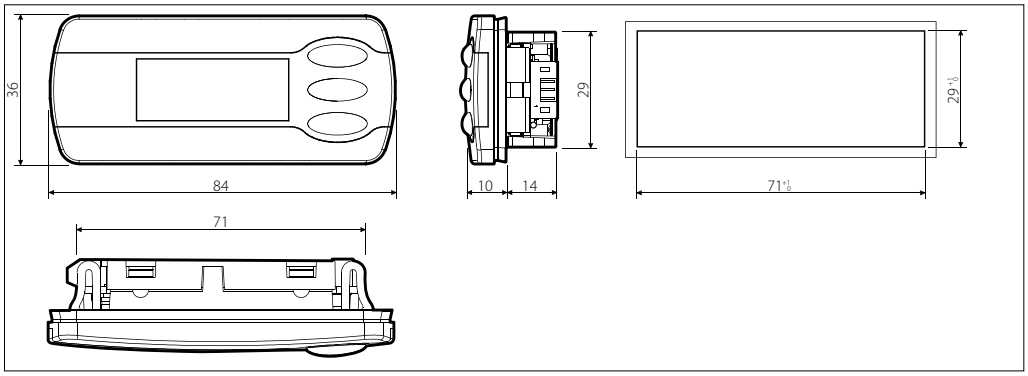
A: Spare part PN
B: Compressor serial number
C: Condensing unit serial number
D: Compressor Label PN (Factory)
E: Supply voltage
F: Maximum Current Consumption
G: Compressor protection type
H: Pressure Equipment Directive and classification
I: Min and Max working pressure
L: Min and Max compressor operation frequency
Electrical frequency is twice 74 ... 228Hz (4-pole motor)
M: Min and Max compressor operation rotation speed
N: Oil type
O: Refrigerant (R744=CO_2)

CAUTION: Variable speed compressor electric supply via Danfoss approved frequency converter only.

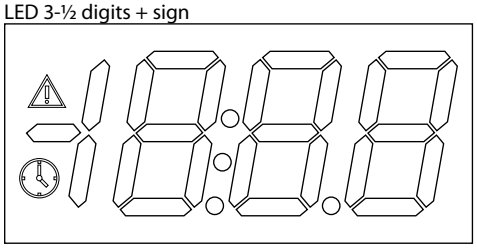
9.1 MMIDLS product description

- Preset controller
- LED display 3-½ digit
- Easy connection through CANbus to Danfoss Optyma iCO₂ gateway
- Pre-programmed
- Give a master connection to the drive
- Indicate and record errors and alarms

Dimensions



User interface

TYPE	FEATURES	DESCRIPTION
LED display	Display	LED 3-½ digits + sign 
	Digits	Green colour
	Allarm/warning icons	Red colour
	Dimensions	45 x 17 mm
Keyboard	Number of keys	3
	Keys function	Set by the application software

Common MMILDS display operation

- Press the upper button for more than 3 seconds to get access to parameter menu. The first parameter "r05" is shown on the display.
- Press short upper or lower button to go to the next or previous parameter.
- Press the middle button briefly to show the value of the selected parameter.
- Press the upper or lower button to change the value of the selected parameter.
- The parameter value will be stored with a short press on the middle button.
- The parameter menu closes, and display returns to the main screen after 10 seconds without any activity on the buttons. It shows again the saturated suction temperature in °C.

9.2 Survey of functions

Function	Parameter	Parameter by operation via data communication
Normal display		
The display shows the saturated temperature value of the suction pressure Ts.	---	Ts

Regulation		
Unit Set here if the display should show SI-units or US-units 0: SI (°C and bar) 1: US (°F and Psig).	r05	r05 Temp.unit °C=0 / °F=1 (Only °C on AKM, whatever the setting)
Start / stop of refrigeration With this setting the condensing unit can be started, stopped, vacuumized or a manual override of the outputs be allowed. For manual control the value is set to -1, then outputs like fan motor speed F07 can be force controlled by the respective parameter F20. Start / stop of refrigeration can also be accomplished with the external switch function connected to a digital input. The digital input must be shorted, if the external switch function is deselected. Stopped refrigeration will give a "Standby alarm".	r12	r12 Main switch -1: Manualmode 0: Stop 1: Start 2: Vaccuum
Day / Night status Status of Day / Night (on or OFF), 1 = on = Night operation.	u13	u13 NightCond
Reference Ts Setpoint Saturated suction pressure Ts setpoint (°C/°F).	r23	r23 Ts Ref
Reference Ts Reading Readout of Saturated suction pressure Ts (°C/°F).	r24	- - - Reference
Reference Ts Offset Value added to the Reference r23 in the night.	r43	r43 Night Offset

Compressor		
Compressor min. speed Here set the minimum allowable speed for compressor.	c46	c46 Min Speed
Compressor max. speed Upper limit for compressor speed during day operation.	c 48	c48 Max Spd Day
Compressor max. Speed night Upper limit for compressor speed during night operation.	c 69	c69 Max Spd Night
Minimum suction pressure Enter the lowest permitted suction pressure here, where the compressor should stop, if the pressure drops below this minimum value.	c 75	c75 Ps OFF
Restart suction pressure Enter the permitted suction pressure here, where the compressor should restart, if the pressure rises after a stop and exceed this limit.	c 76	c76 Ps ON
Oil return management Judgement speed If the compressor exceeds this limit, a time counter will be increased. It will be decreased if the compressor speed falls down below this limit.	P77	P77 Spd Thrshld
Oil return management Judgement time Limit value above described time counter. If the counter exceeds this limit, the compressor speed will be raised to the boost speed.	P78	P78 Jdgmnt Oil R
Oil return management Boost speed This compressor speed ensures that the oil returns to the compressor.	P79	P79 Spd Oil Ret
Oil return management Boost time The compressor operates for this period of time with above boost speed.	P80	P80 Time Oil Ret

Fan		
Fan speed The actual fan speed is read out here as a % of the nominal speed.	F07	F07 Fan Speed%
Maximum fan speed day The fan's top speed during day time can be limited here. The value can be entered by setting the nominal speed from 100% to the desired percentage.	F19	F19 Max Spd Day
Manual fan speed control An override of the fan speed control can be done here. This function is only relevant when the main switch is in service mode (r12=-1). 0=Stop; 1=Low; 2=Medium; 3=High.	F20	F20 Manual Fan%
Max Fan speed night The fan's top speed during night time can be limited here. The value can be entered by setting the nominal speed from 100% to the desired percentage.	F22	F22 Max Spd Nght

9.3 Others MMIDLS product description

Function	Parameter	Parameter by operation via data communication
Real time clock (RTC)		
Switch to day operation Enter the start time where the control reference, fan and compressor speed shall switch back to normal control.	t17	t17 Day start h
Switch to night operation Enter the start time where the control reference shall be raised and where the fan and compressor speed limited.	t18	t18 Night start h
Realtime Clock hour setting.	t07	t07 Clk Hours
Realtime Clock minutes setting.	t08	t08 Clk Minutes
Miscellanous		
Controller address If the controller is built into a data communication network, it must have an unique address and the master of the system must know this address.	o03	o03 Unit Addr
Software version of the Condensing Unit controller	o08	o08 SW version
Factory reset This parameter should reset the gateway and the Condensing Unit Controller when set.to 1. It should also stop the Condensing Unit.	o67	o67 Make Factory
Injection ON Condensing Unit status for Evaporator control to allow the evaporator controller to inject. Injection ON is a Modbus master function.	u99	- - - Injection ON
Statistic		
Operating time for condensing unit The condensing unit's operating time can be read here. The read-out value must be multipilied with 1000 to get the correct hour value. It can be adjusted if required.	P48	P 48 Unit Runtime
Operating time for compressor The compressor's operating time can be read here. The read-out value must be multipilied with 1000 to get the correct hour value. It can be adjusted if required.	P49	P 49 Comp Runtime
Number of HP alarms The number of high pressure alarms can be read here. It can be adjsted if required.	P51	P 51 HP Alarm Cnt
Number of LP alarms The number of low pressure alarms can be read here. It can be adjsted if required.	P52	P 52 LP Alarm Cnt
Number of high discharge alarms The number of high discharge temp. alarms can be read here, can be adjsted if required.	P53	P 53 DisAlarm Cnt
Service		
Measured High pressure	u01	u01 Pc bar
Status of gateway Digital Input 1 (DI1 = evaporator controller alarm; 0=no alarm)	u10	u10 DI1 Status
Calculated Superheat	u21	u21 Superheat K
Status of gateway Digital Input 2 (DI2 = request from cold room thermostat; 0=no reqest)	u37	u37 DI2 Status
Readout of Compressor speed in %	u52	u 52 CompCap%
Status of gateway Alarm Relay	U62	U62 Alarm Relay
Measured Gascooler outlet temperature	U05	U05 Sgc Temp
Measured Receiver inlet temperature	U07	U07 Srec2 temp
Measured Receiver pressure (gateway option) - CURRENTLY NOT AVAILABLE	U08	U08 Prec pressure
Converted Receiver pressure (gateway option) - CURRENTLY NOT AVAILABLE	U09	U09 Trec temp
Converted High pressure	U22	U22 Tc
Measured Suction pressure	U23	U23 Po
Converted Suction pressure	U24	U24 To
Ambient temperature	U25	U25 T Ambient
Discharge temperature	U26	U26 T Discharge
Suction temperature	U27	U27 T Suction
High pressure valve opening degree OD	U91	U91 Vhp %
Receiver pressure valve opening degree OD	U92	U92 Vrec %

9.4 Alarm indications and Status messages

Alarm indications	
Function	**Code**
Gascooler outlet Temperature sensor error	E20
Ambient Temperature sensor error	E31
Discharge Temperature sensor error	E32
Suction Temperature sensor error	E33
Suction Pressure sensor error	E39
Receiver inlet Temperature sensor error	E40
Receiver Pressure sensor error (option)	E41
Low Pressure Alarm - pressure limit 14 bar (-28.5°C)	A2
High Pressure Alarm - pressure limit 148 bar	A17
Gascooler low fan speed Alarm - fan speed <= 100 rpm for 60 seconds	A34
Main Switch Off Alarm (r12=0 or DI2=0)	A45
Receiver Temperature Alarm	A85
Discharge Temperature Alarm - Temperature above 138 deg.C for more than 5 seconds	A96
High pressure switch - safety Alarm - pressure limit 140bar	A97
Condensing Unit controller alarm, code for fault analysis	H23
	H24
	H25
	H26
	H28
	H29

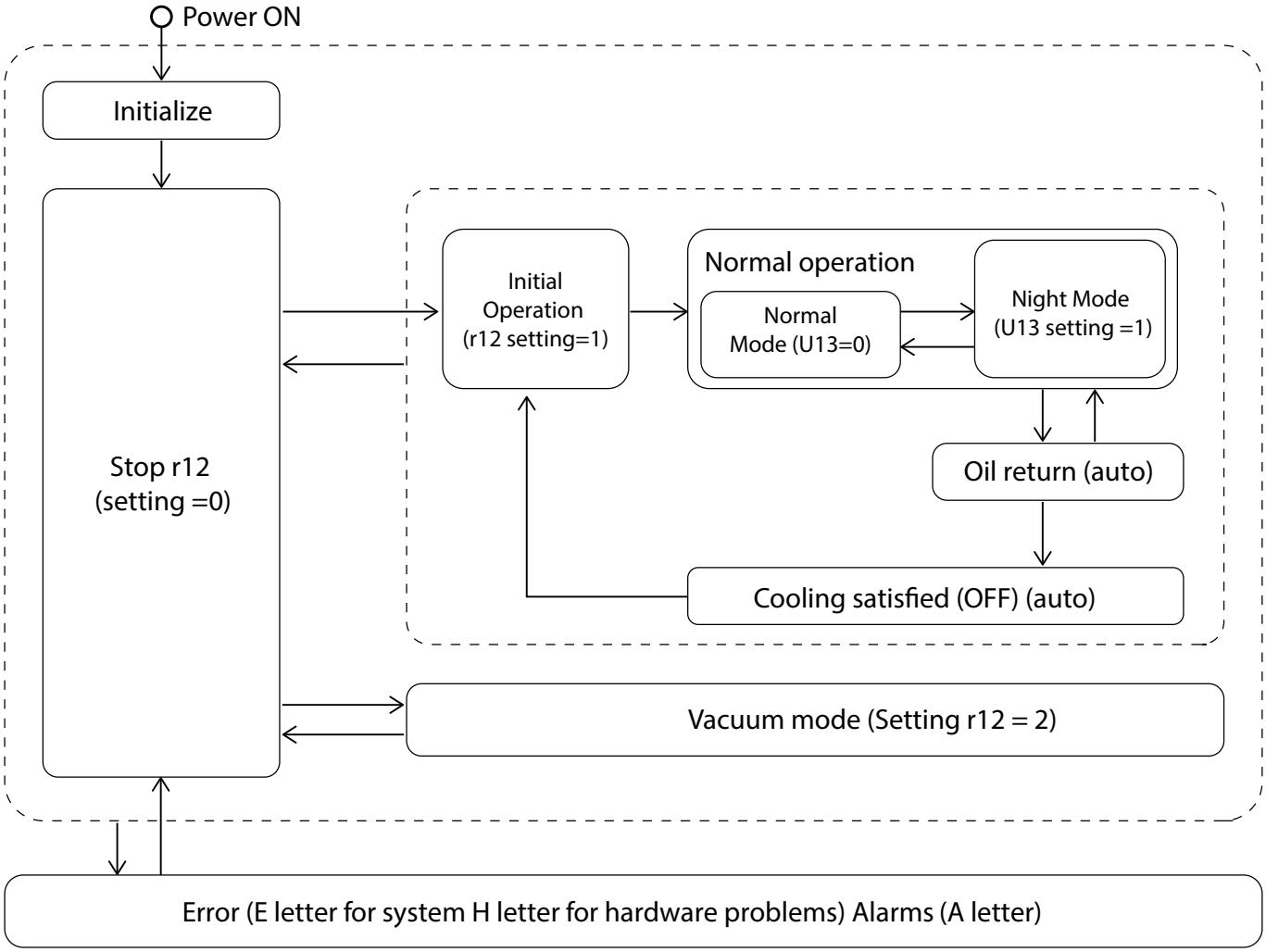
Status messages	
Function	**Code**
Communication initialisation between Gateway and Condensing Unit Controller	F0
Normal Control	S0
Stopped by Main switch: Internal (r12) or external (DI2)	S10
Manual Mode (r12=-1)	S25
Safe Stop (Pressure and Temperature safety switches on DI1)	S34
Restart state 101 (High pressure)	Sr1
Restart state 102 (Fan motor)	Sr2
Restart state 103 (Discharge temp)	Sr3
Restart state 104 (Receiver pressure)	Sr4

9.5 Parameters of MMIDLS

Parameter			Minimum value	Maximum value	Factory setting	Actual
Function		Code				
Regulation						
Selection of SI and US units: 0=SI (°C-barg) and 1=US (°F-psig)		r05	0	1	0	
Control Main switch: -1=Manual; 0=Stop; 1=Automatic; 2=Vaccuum mode		r12	-1	2	0	
Day / Night mode: 0=Day (normal); 1=Night	*	u13	0	1	0	
Reference Setpoint: Saturated suction pressure Ts setpoint (°C/°F)		r23	-20.0 °C	10.0 °C	-10.0 °C	
Readout of Saturated suction pressure Ts (°C/°F)	*	r24	-40.0 °C	50.0 °C	-10.0 °C	
Reference Offset: Value added to the Reference r23 in the night		r43	0 °C	10 °C	2 °C	
Compressor						
Min comp. capacity		c46	32%	58%	32%	
Max comp. capacity during day operation		c 48	59%	100%	100%	
Max comp. capacity during night operation		c 69	59%	100%	80%	
Low Pressure OFF		c 75	-25.0 °C	30.0 °C	-15.0 °C	
Low Pressure ON		c 76	-20.0 °C	30.0 °C	-5.0 °C	
Compressor speed threshold for oil return control		P77	33%	58%	35%	
Judgment time for oil return control		P78	5 min	720 min	20 min	
Compressor speed during oil return control		P79	35%	100%	44%	
Operation time for oil return control		P80	10 s	600 s	60 s	
Fan						
Readout of Fan speed in %	*	F07	0%	100%	-	
Max. Fan speed during day		F19	38%	100%	100%	
Fan speed setting in manual mode (r12=-1): 0=Stop; 1=Low; 2=Medium; 3=High		F20	0	3	0	
Max Fan speed during night		F22	38%	100%	80%	
Real time clock (RTC)						
Day time start for Day / Night function		t17	0 h	23 h	0 h	
Night time start for Day / Night function		t18	0 h	23 h	0 h	
RTC setting (hours)		t07	0 h	24 h	0 h	
RTC setting (minutes)		t08	0 min	59 min	0 min	
Miscellanous						
Controller address on Modbus Network		o03	0	240	0	
Software version of the Condensing Unit controller	*	o08	0	9999	-	
Factory reset of Gateway and Condensing Unit controller		o67	0	1	0	
Condensing Unit status for Evaporator control (Injection ON = Master function).	*	u99	1	1	-	
Statistic						
Condensing Unit runtime in 1000 hours		P48	0	999	0	
Compressor runtime in 1000 hours		P49	0	999	0	
Number of HP alarms registered		P51	0	1999	0	
Number of LP alarms registered		P52	0	1999	0	
Number of High discharge alarm registered		P53	0	1999	0	
Service						
Measured High pressure	*	u01	-1,0 bar	250 bar	-	
Status of gateway Digital Input 1 (DI1 = evaporator alarm)	*	u10	0 (OFF)	1 (ON)	-	
Calculated Superheat	*	u21	-10,0 K	50,0 K	-	
Status of gateway Digital Input 2 (DI2 = request from cold room thermostat)	*	u37	0 (OFF)	1 (ON)	-	
Readout of Compressor speed in %	*	u52	0	100	-	
Status of gateway Alarm Relay	*	U62	0 (OFF)	1 (ON)	-	
Measured Gascooler outlet temperature	*	U05	-30.0 °C	150.0 °C	-	
Measured Receiver inlet temperature	*	U07	-100.0 °C	200.0 °C	-	
Measured Receiver pressure (gateway option) - Currently not available	*	U08	-1,0bar	99,0 bar	-	
Converted Receiver pressure (gateway option) - Currently not available	*	U09	-50.0 °C	50.0 °C	-	
Converted High pressure	*	U22	-50.0 °C	100.0 °C	-	
Measured Suction pressure	*	U23	-1,0bar	99,0 bar	-	
Converted Suction pressure	*	U24	-50.0 °C	100.0 °C	-	
Ambient temperature	*	U25	-10.0 °C	100.0 °C	-	
Discharge temperature	*	U26	-10.0 °C	250.0 °C	-	
Suction temperature	*	U27	-10.0 °C	100.0 °C	-	
High pressure valve opening degree OD	*	U91	0%	100%	-	
Receiver pressure valve opening degree OD	*	U92	0%	100%	-	

** Read only*

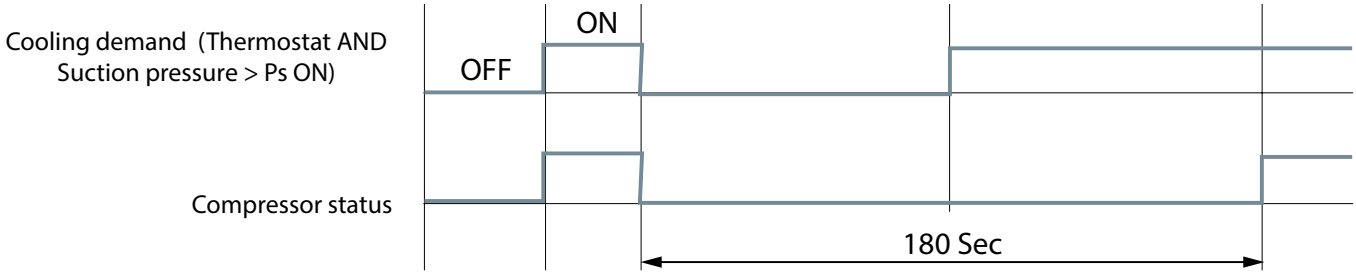
10.1 State transition diagram



If the communication between controller condensing unit and Gateway controller of the unit is lost, the condensing unit will continue to operate with the set value before the losing communication.
If communication is lost in STOP status, the Condensing unit cannot be operated unless communication is restored.

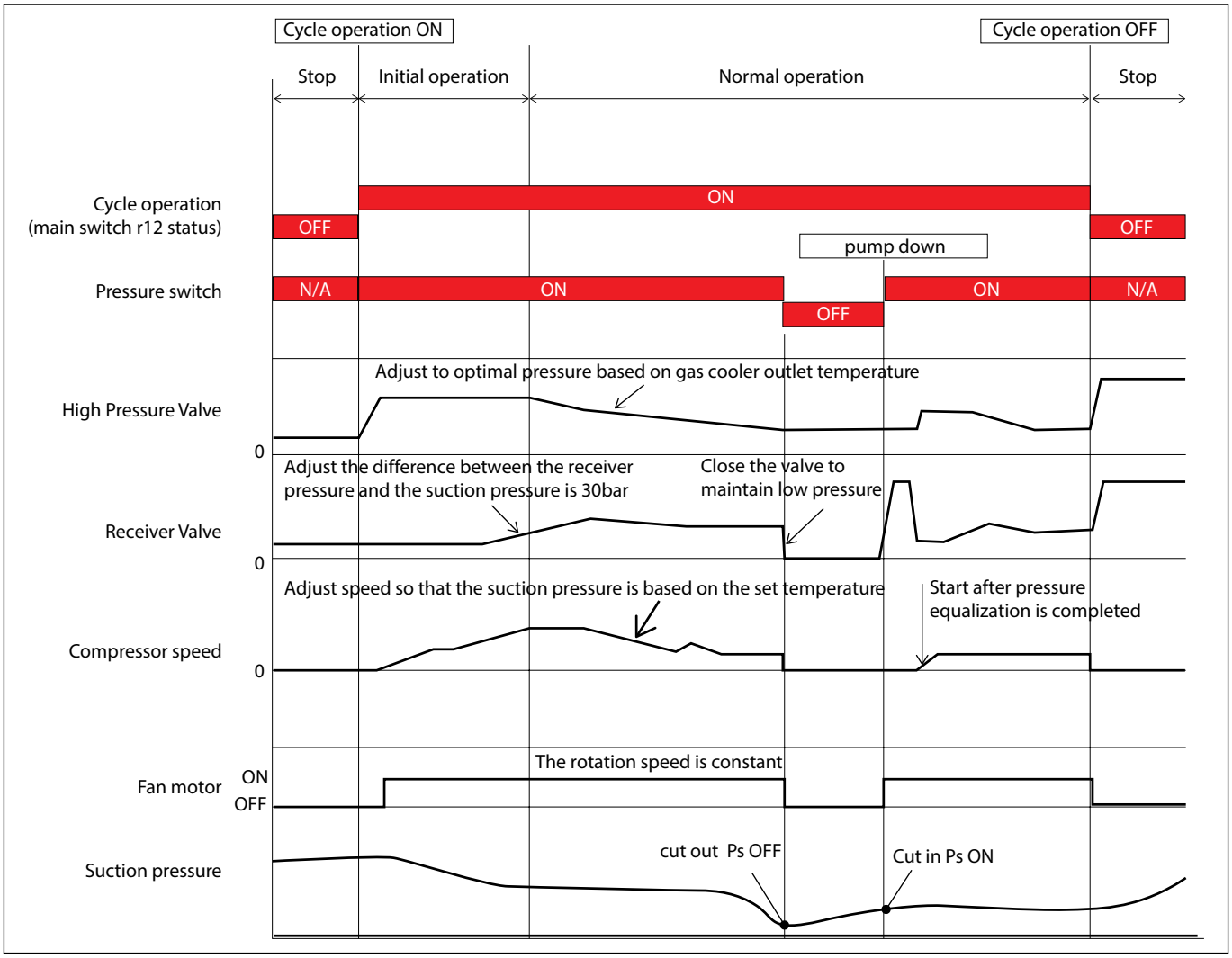
10.2 Constraint of cycle operation

For 180 seconds after having stopped cycle operation, the state of operation is held as OFF.



10.3 Control of the cycle operation

When the cycle operation is started, the condensing unit runs such as below.



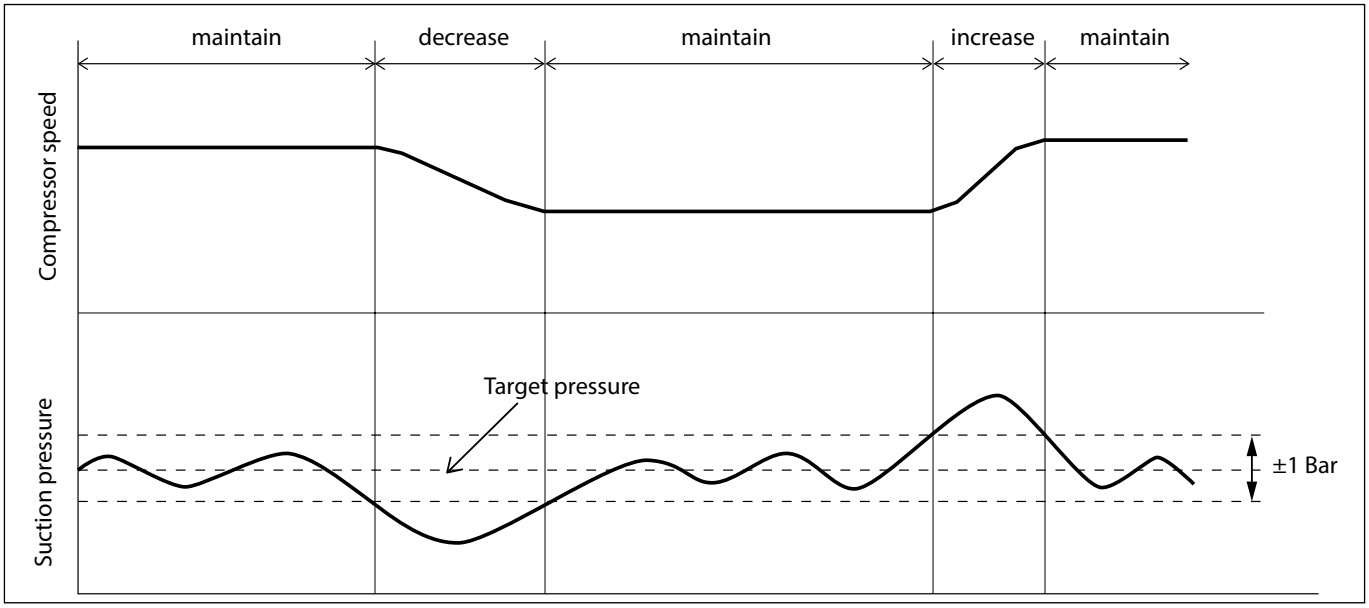
10.4 Normal operation

Compressor operation

Compressor changes speed (refrigeration capacity) based on suction pressure.

If the actual suction pressure is lower than the target set pressure, decrease the compressor speed, and if the actual suction pressure is higher than the target, increase the compressor speed.

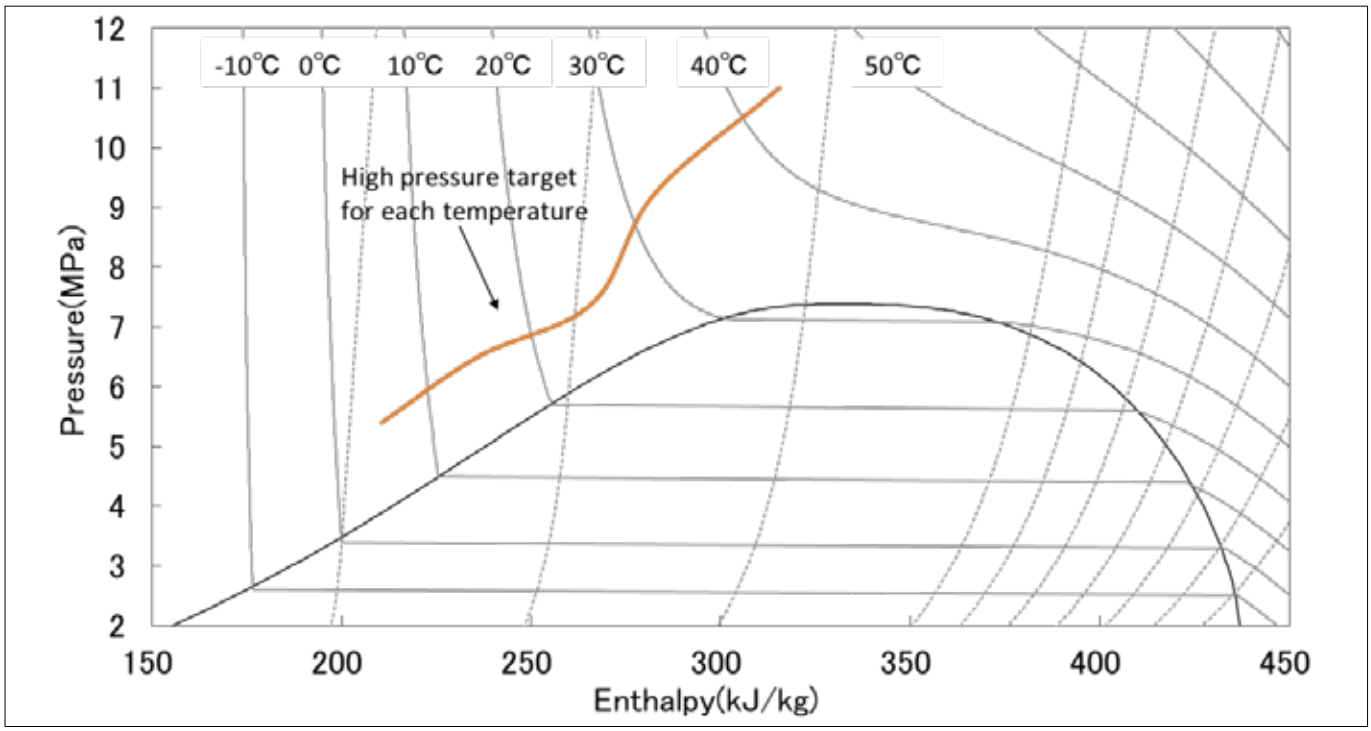
If the actual suction pressure is within ± 1 bar of the target low pressure, the compressor speed is maintained.



High pressure valve operation

High pressure valve controls high pressure based on the gas cooler outlet temperature.

High pressure target for each temperature is below.



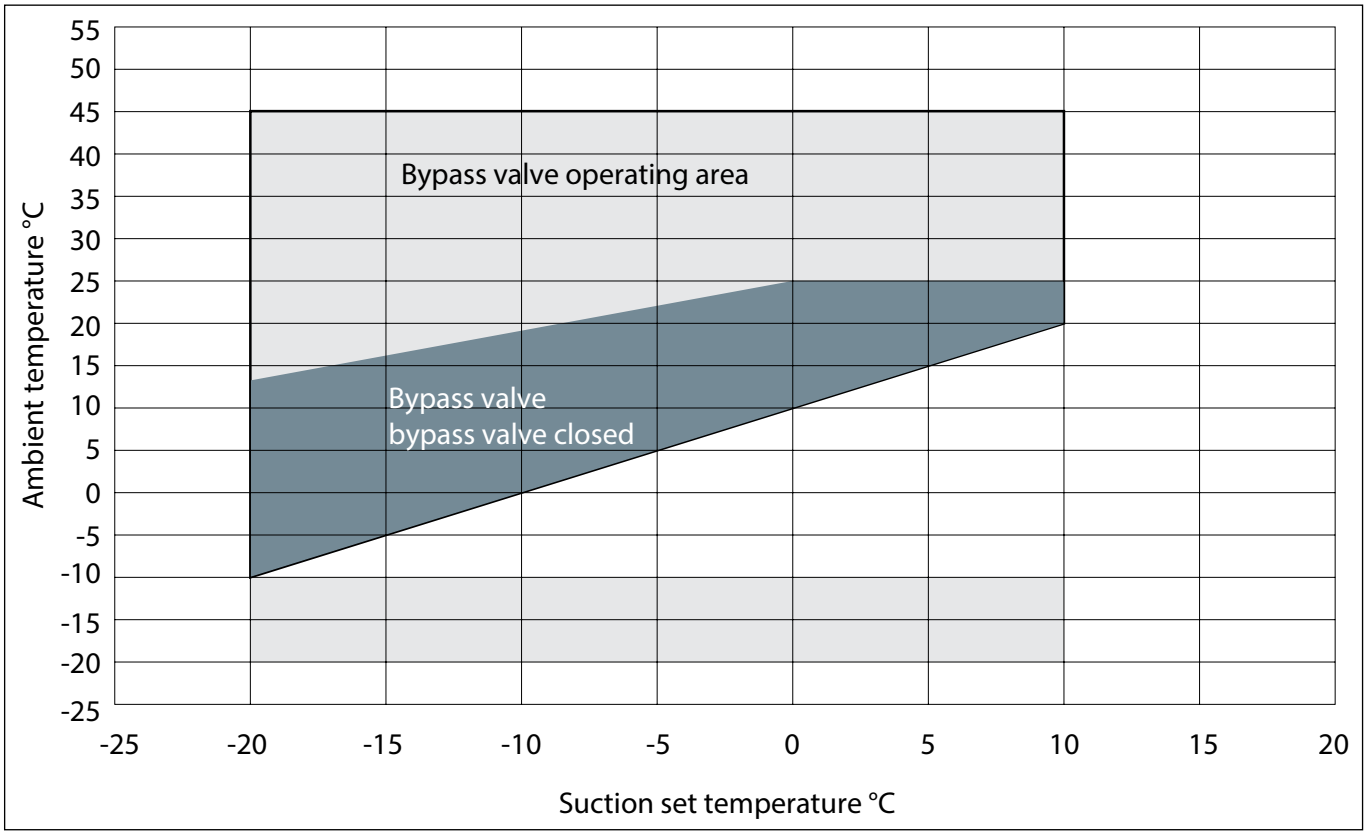
Notes

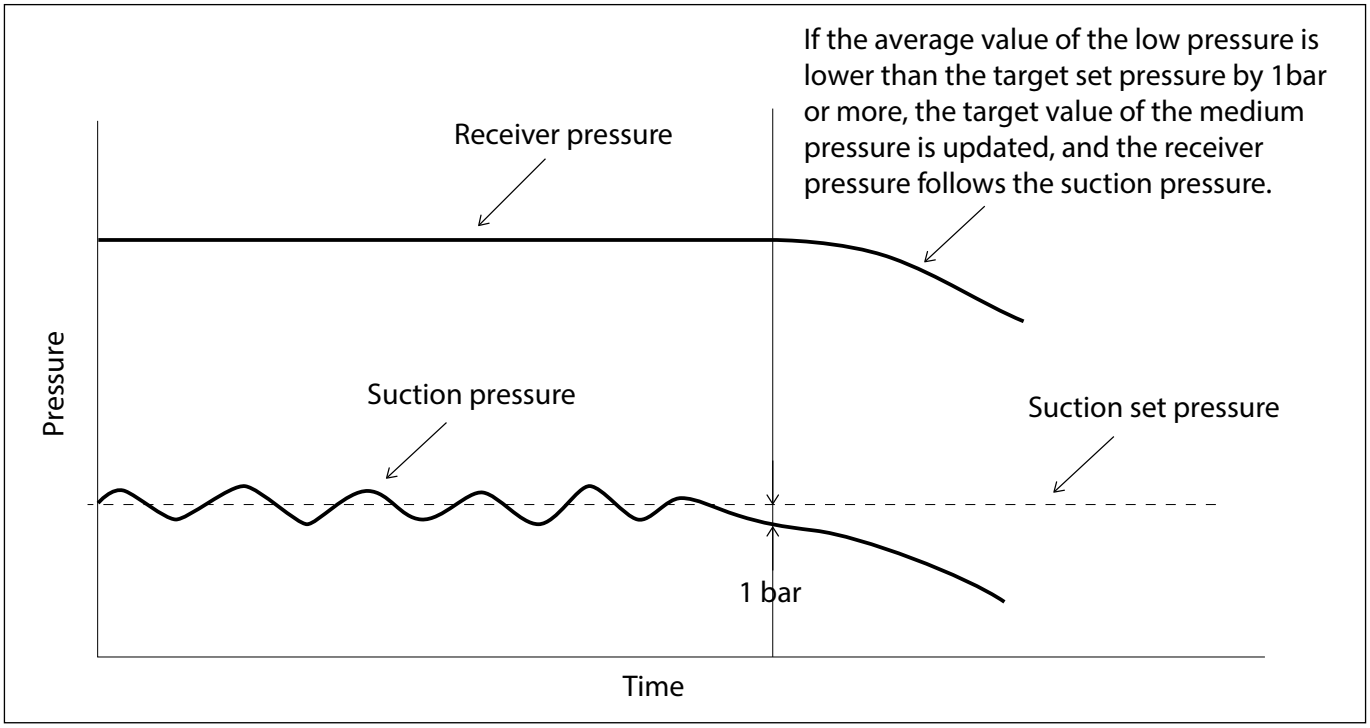
The gas cooler pressure is optimized to maintain the best COP - For each gas cooler outlet temperature we have an optimal pressure to maximize the COP

To stay within the compressor operating envelope the gas cooler pressure is maintained above 30 bar above suction pressure.

Bypass valve operation

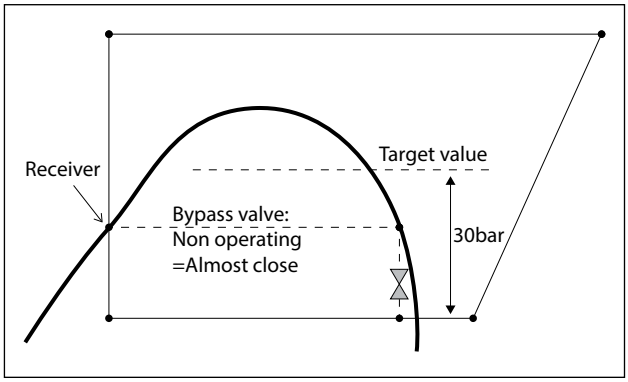
The controller operating the the receiver pressure valve valve tries to maintain a pressure difference between receiver pressure and suction pressure of 30 bar



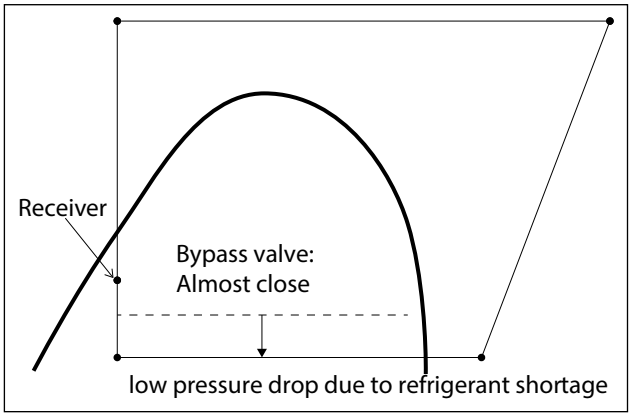


The condensing unit controller continues to operate even if the receiver pressure is lower than the target value.
The following are possible cases where the receiver pressure is lower than the target value.

Case 1: When the ambient temperature is low and the bypass valve is closed. In this case, the receiver pressure is on the saturated liquid line, so there is no need to worry about decreasing cooling capacity and exceeding the design pressure.

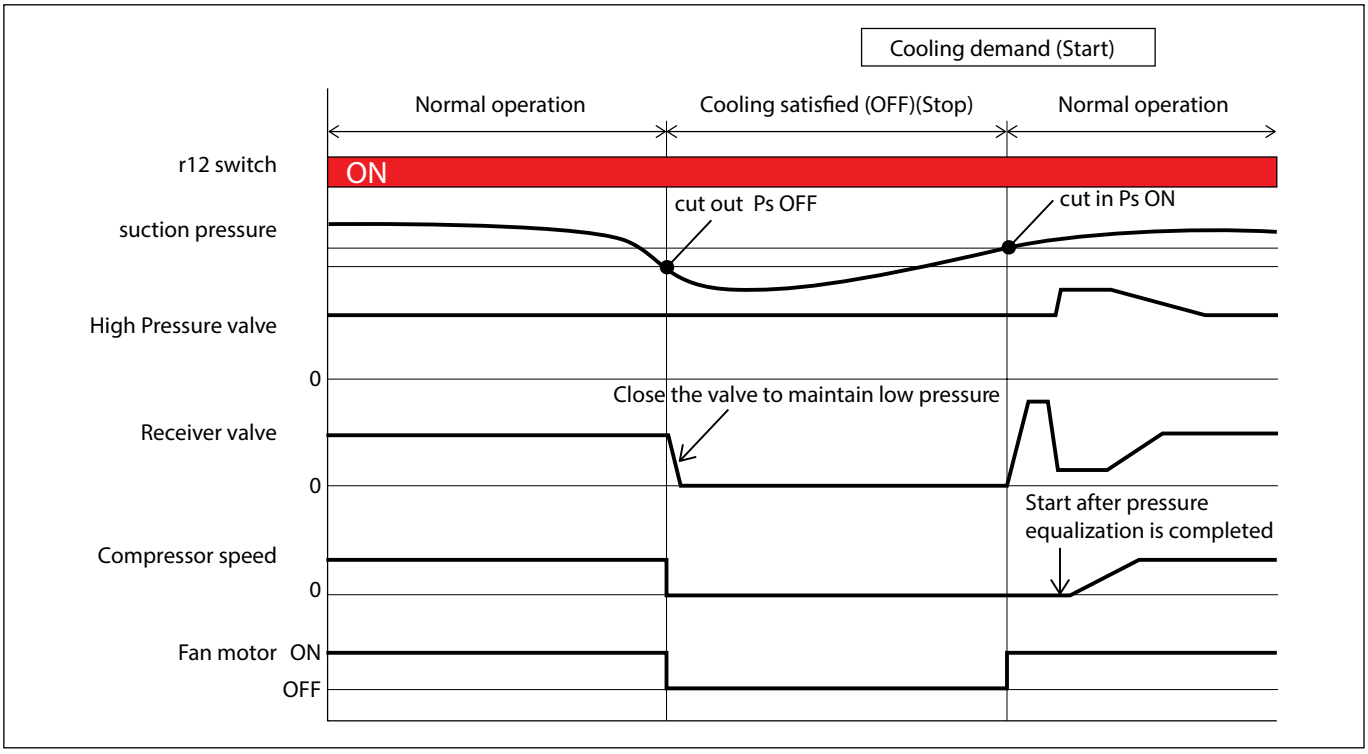


Case 2: When the refrigerant is shortage. In this case, cooling capacity decreases due to low pressure drop due to refrigerant shortage, but operation continues. And there is no danger in safety because the receiver pressure is lower than the target value.



10.5 Compressor OFF/ON

The unit stop when the suction pressure falls below the set value based on Ps OFF (Parameter C75) and the unit starts when the set pressure exceeds the set value based on the Ps ON (Parameter C76).

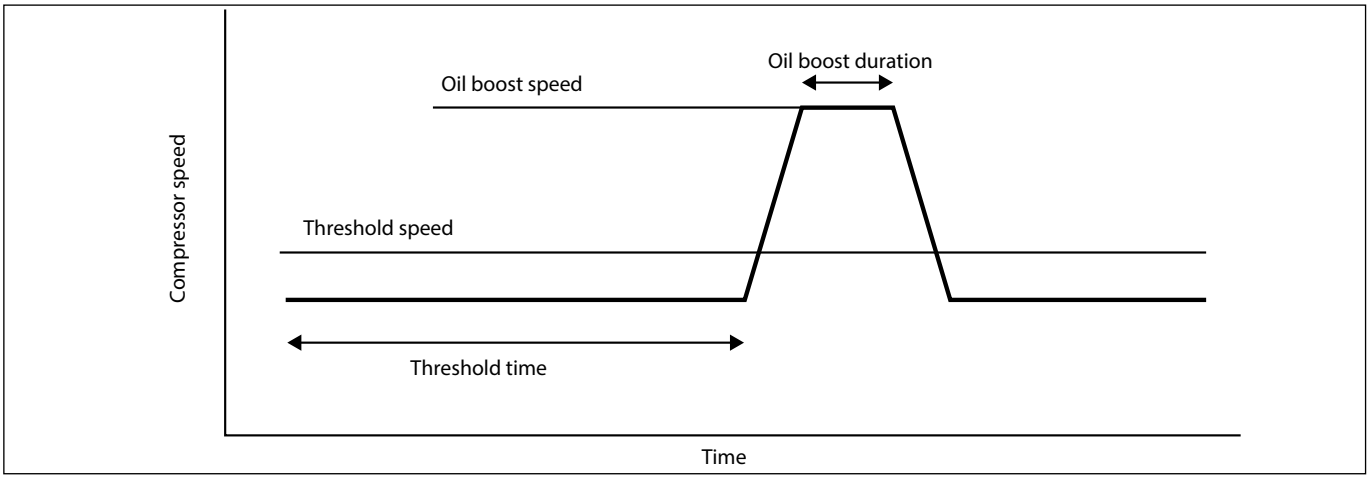


Electronic controllermodify each setting temp so that it is in the order of "Ts set temp > Ps OFF set temp" . "Ps ON set temp > Ps OFF set temp".
If Ps OFF > Ts, then Ps OFF is corrected to Ps OFF = Ts - 5 K
If Ps ON < Ps OFF, then Ps ON is corrected to Ps ON = Ts +5K

User request PsOFF = 0°C with Tset = -10°C and PsON = -12°C. Condensing unit fixes PsOFF =Ts - 5 K = -15°C

10.6 Oil return

If the operation under the specified rotation speed (35%) is continued for more than a certain time (20 minutes), the compressor rotation speed will be increased (44%) for 60 seconds. (standard/factory setting)
The number of rotations and time can be specified from Gateway

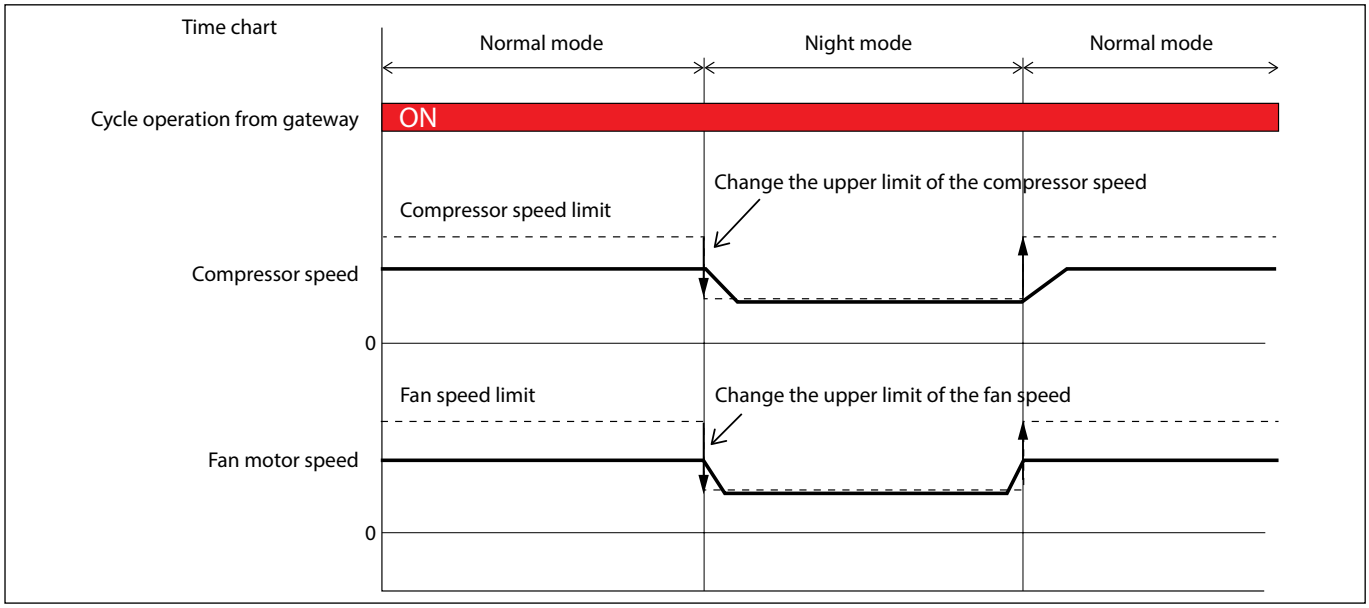


Note

1. If the compressor is stopped (OFF) during oil return operation, the oil return operation will be continued at the next start-up.
2. Compressor speed doesn't increase during emergency pressure or discharge temperature control. Oil return strategy as a lower priority than pressure and discharge temperature control.

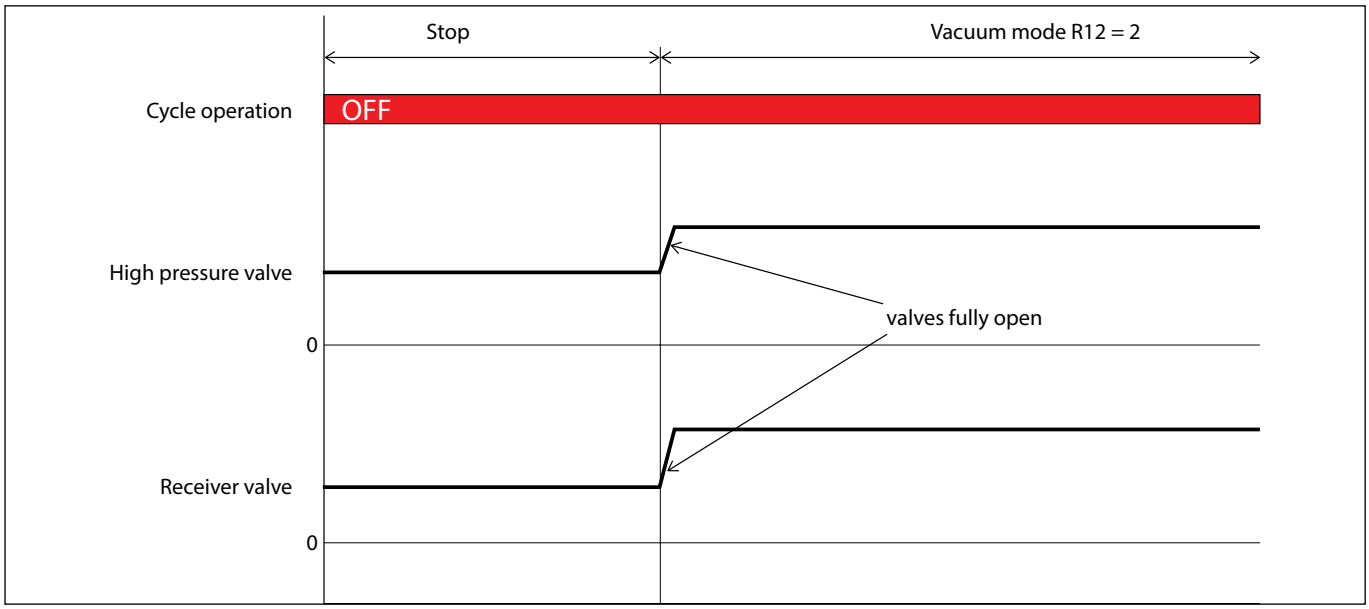
10.7 Normal mode / Night mode (Mass production specifications)

Switch between Normal mode and Night mode based on Gateway request.
Fan and comp speed in each mode can be specified from Gateway.



10.8 Vacuum mode

Vacuum mode is executed based on the Gateway's instruction.
During vacuum mode, the valves become fully open.



10.9 Fan speed management:

For high ambient running conditions, if the temperature difference between gas cooler outlet and ambient temperature is greater than 10K then fan speed is increased by a step of 50 rpm until the temperature difference is at or below 10K
When the ambient temperature is below the evaporator setting, fan speed is adjusted to keep the gas cooler outlet pressure 30 bar above suction pressure.

10.10 Pressure management in case of abnormal pressure rising

Control to avoid the medium receiver over pressure

Case1 : The medium pressure rises during stand still (OFF)

If receiver pressure rise above 76 bar during standstill then compressor restart to lower the receiver pressure.

Note:

1. During standstill the high pressure valve is open and therefore receiver pressure can be read by the gas cooler pressure transmitter
2. There is a minimum of 180 second time delay between stop and a restart (See 10.2). During that time receiver valve is open and receiver pressure is equalized with the compressor suction.

Case2 : The medium pressure rises during normal operation

When the receiver intlet temperature exceeds around 30°C, the compressor will be decelerated. If the temperature still rises, condensing unit will stop.

Case3 : The medium pressure rises higher than the design pressure

The refrigerant is released by PRV when the medium pressure is higher than 80 Bar.

Control to avoid the gas cooler over pressure

Case1 : The high pressure rises during normal operating

Compressor slow down when the gas cooler outlet pressure is higher than 118 Bar.

Case2 : The high pressure rises higher than the design pressure

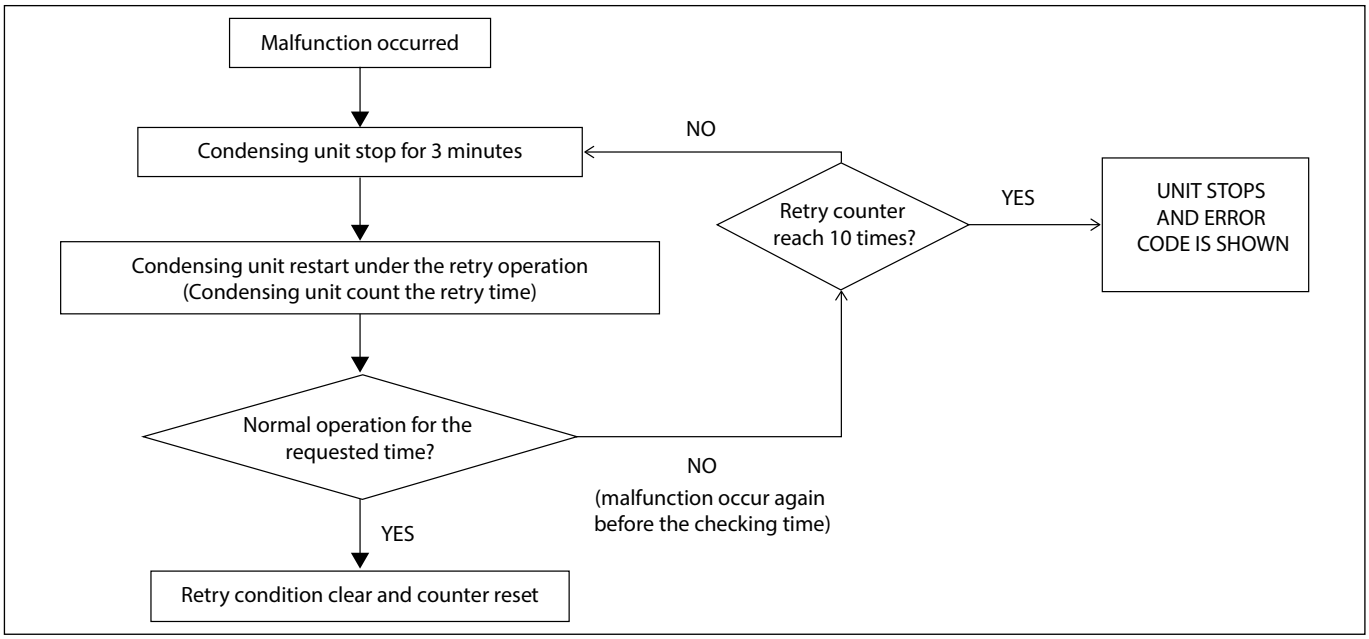
Compressor is stopped by pressure switch when the compressor outlet pressure is higher than 140 Bar.

10.11 Error code

The table below show the number of retry times before, showing the error code and stopping the unit. The table show also the time of normal operation that reset the counter of retry numbers. (Temporary stop Interval between retry is 3 minutes)

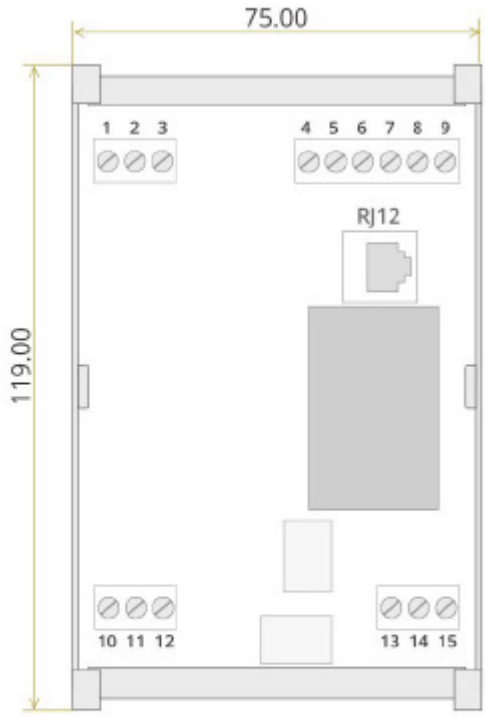
Error code	Number of retry times	Checking Time
A17	10 times	30 min
A34	10 times	72 s
A96	10 times	30 min
H23	10 times	5 min
H24	10 times	5 min
H25	10 times	5 min
H26	10 times	5 min
H28	10 times	5 min
H29	10 times	5 min
A85	10 times	30 min

Retry operation



11.1 Layout and characteristics

Layout



Terminals

1. Pressure Transmitter - +5VDC
2. Pressure Transmitter - GND
3. Pressure Transmitter - Signal
4. Digital Inputs - DI1
5. Digital Inputs - DI2
6. Digital Inputs - Common
7. Modbus RTU - Screen
8. Modbus RTU - B-
9. Modbus RTU - A+
10. Alarm Relay - Common
11. Alarm Relay - Normally Open
12. Alarm Relay - Normally Closed
13. 230V UART - Signal
14. Power Supply - Neutral
15. Power Supply - Live

RJ12. Connector for MMILDS Display

Connection with system manager or external controller

Signal with the Unit controller

6. Not used
5. GND
4. CAN L
3. CAN H
2. Not used
1. VCC

Characteristics

Physical property

Connection method

The connection method is a power superimposition method.

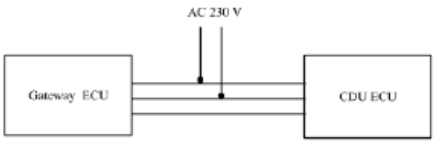


Fig.1 Outline of the connection method

Cable Specifications

Cable type: 3-wire cable (VVF φ 2.6 mm).
Cable length: Up to 30 m

Communication circuit

In the GW ECU, the communication circuit shown in FIG. 2 is mounted, and the communication with the GW ECU is enabled by mounting an equivalent communication circuit in the CDU ECU.

Physical Specifications

Mounting:	DIN-rail
Dimensions:	75x119x59 mm
Weight:	~150 g
Environment:	-30°C to +60°C during operation -40°C to +70°C during transport 20 – 90% Rh, not condensed

Power Supply

Input	100-277VAC, 50/60Hz Max. 8VA
Recommended protection	1A slow-blow fuse

Alarm Relay

Introduction

The Gateway ECU is equipped with a relay that is designed to be used as an alarm relay, allowing the end user to connect this to a supervisor system, a single light or similar.

Specifications

Contact function	SPDT (Single pole Double Throw)
Max. voltage	277 VAC, 30 VDC
Max. current	3 A (resistive load)
Connection	3 screw terminals

Digital Inputs

Introduction

The Gateway ECU is equipped with two digital inputs that are designed to be used for auxillary signals, such as an external thermostat.

Specifications

Nominal voltage	12 V
Connection	3 screw terminals

Analog Inputs

Introduction

The Gateway ECU is equipped with an anolog input as well as a 5V power supply that is designed to be used with a ratiometric pressure transmitter.

Specifications

Nominal voltage	5 VDC
Max. current	30 mA
Connection	3 screw terminals

Real-time clock

Introduction

The Gateway ECU is equipped with a real-time clock (RTC) with a capacitor for backup power. The RTC is designed to be used for day/ night switchover, ect.

Specifications

Power reserve	4 hours

RS-485

Introduction

This section f the specification describes the RS-485 interface that is used for communication between the Gateway ECU and a system Manager manufactured by Danfoss.

Characteristics

The nodes on the RS-485 network are connected according to the RS-485 standard. It is a two/ three wire linear bus terminated at each end with 120Ω resistors.

Baudrate	19 200 / 38 400 Kbps (automatic selection)
Data bits	8
Stop bits	1
Parity	Even
Termination	A 120Ω resistors should be mounted if the Gateway ECU is the last node on the bus
Biasing	Biasing resistors (pull-up, pull-down) should typically be built-in in master on the bus
Protocol	Modbus RTU

Error code	Content	Detection contents	Detection timing	Self-return	Cycle operating status	Remarks
A2	Low pressure alarm (B2)	Low pressure sensor (B2) are less than 14 Bar.	Stand by	Need reset manually	Stop	Reset error codes after charging
A17	Abnormal high-pressure alarm (B1)	High pressure sensor (B1) detects more than 140 Bar, Srl is continued ten times	Compressor running	Need reset manually	Stop*2	10 –times of retrials starting procedure
E20	Gas cooler outlet thermistor error (R5)	Disconnection (less than or equal -30°C) Short (more over or equal 150 °C)	Power supply ON	Need reset manually	Continue*1	Operation continues using alternative setting values. Or Optyma™ iCO_2 to suspend its operation.
E33	Suction temperature sensor (R3) error	Disconnection(less than or equal -40°C) Short(more over or equal 100 °C)	Power supply ON	Need reset manually	Continue*1	Optyma™ iCO_2 to suspend its operation.
E40	Receiver thermistor (R4) error	Disconnection (less than or equal -40°C) Short (more over or equal 100 °C)	Power supply ON	Need reset manually	Stop	Optyma™ iCO_2 to suspend its operation
E31	Ambient air thermistor (R2) error	Disconnection(less than or equal -40 °C) Short(more over or equal 100°C)	Power supply ON	Need reset manually	Stop	Optyma™ iCO_2 to suspend its operation
E32	Discharge thermistor (R1) error	Disconnection(less than or equal -40 °C) Short(more over or equal 250°C)	Power supply ON	Need reset manually	Stop	Optyma™ iCO_2 to suspend its operation
A34	Gas cooler fan motor (M2) error	Rotor pulse signals is detected continuously less than or equal 100rpm for 60 seconds	Compressor running	Need reset manually	Stop*2	10 –times of retrials
E39	Low pressure sensor (B2) error (suction)	Disconnection (less than or equal 0.0 Bar) Short(more over or equal 112 Bar)	Power supply ON (without vacuum mode)	Need reset manually	Stop	Optyma™ iCO_2 to suspend its operation
A96	Discharge temperature (R1) alarm	Discharge temp. thermistor detects more than or equal 138°C for 5 seconds.	Compressor running	Need reset manually	Stop*2	10 –times of retrials
H23, H24 H25, H26 H28, H29	Optyma™ iCO_2 Electronic controller error	It depends on the signal output from an inverter.	Compressor running	Need reset manually	Stop*2	10 –times of retrials
E41	Pressure sensors (B1/B2) error or refrigerant shortage	Disconnection (more over or equal 219.5 Bar) Short (less than or equal 0.0 Bar)	Power supply ON (without vacuum mode)	Need reset manually	Stop	Optyma™ iCO_2 to suspend its operation
A85	abnormality medium pressure	Receiver thermistor (R4) detects more than 78 Bar in pressure conversion value	Compressor running	Need reset manually	Stop*2	10 –times of retrials
A97	High pressure sensor safety switch (B3) alarm	Mechanical high pressure safety switch (B3) disconnect contactor & compressor	Compressor running	Need reset manually	Stop	
A45	Main Switch OFF	Main switch par. r12 OFF	Stand by	Need reset manually	Stop	

**1 When the following sensors fail, the Optyma™ iCO_2 continues to operate using another sensor.*

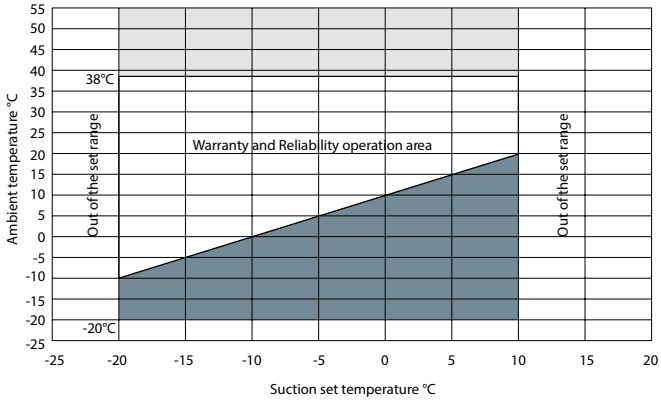
- *GC outlet thermistor → Ambient air thermistor : Except operating out of the envelope map*
- *Suction thermistor → Low pressure sensor (Convert to temperature)*

Optyma™ iCO_2 stops when two or more errors are occurred at the same time.

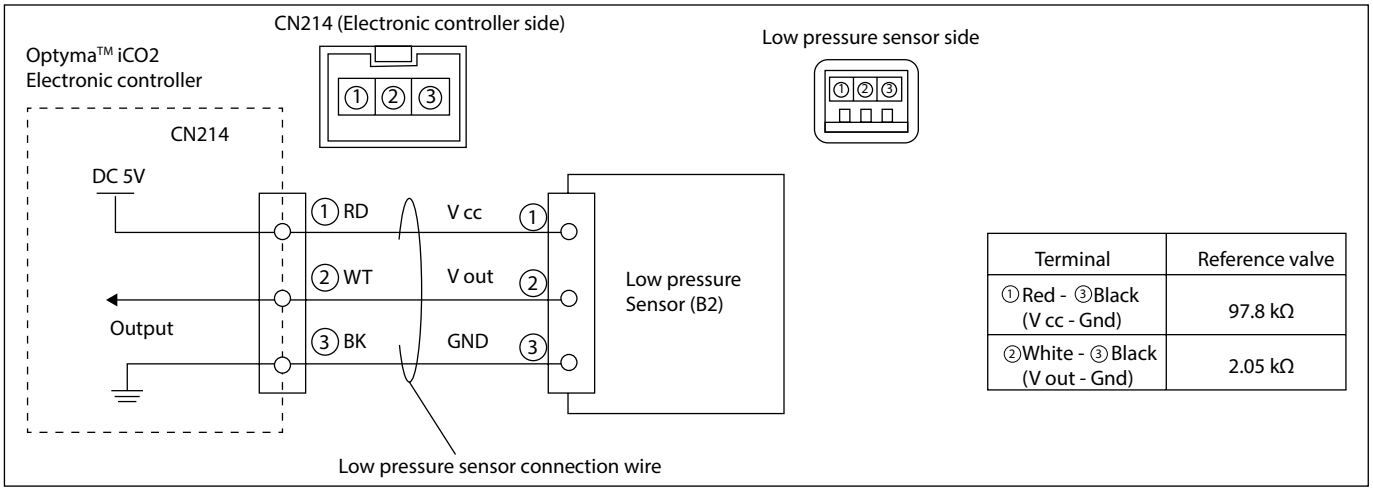
**2 Optyma™ iCO_2 to suspend its operation when error continues after 10 –times of retrials; after this, sending error code.*

***ATTENTION**: Do not reach your hands into the Optyma™ iCO_2 unit because there is a possibility of electric shock.*

***Note (1):** Electronic controller is Electronic controller + driver*
***Note (2):** For the abbreviations R1, R2, R3, etc., please see appendix material*



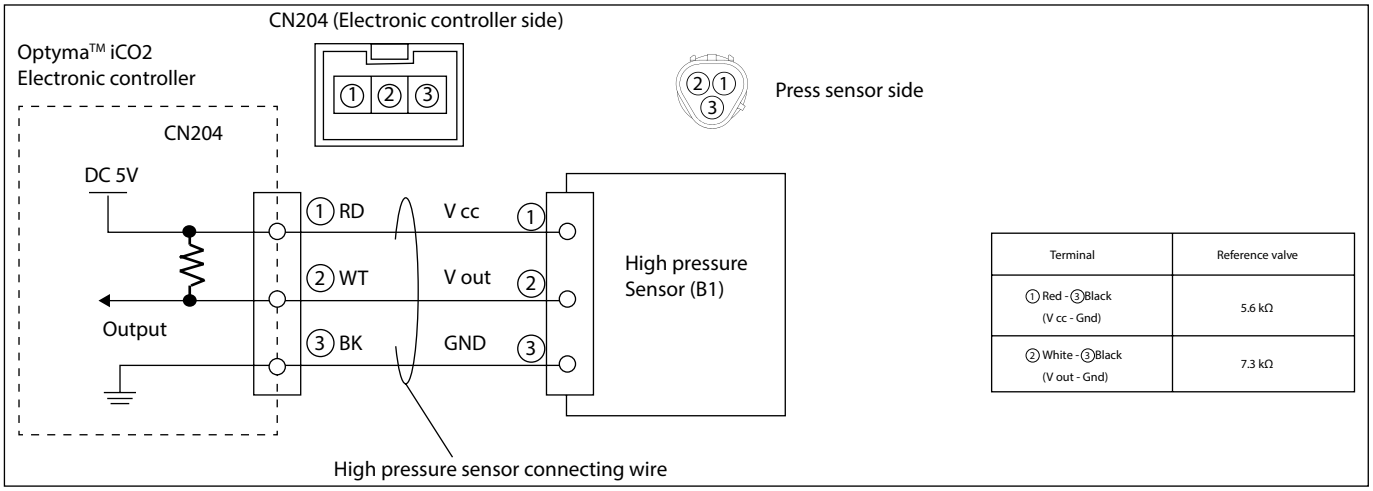
Error code A2 - Low pressure alarm (sensor B2)



Terminal	Reference valve
①Red - ③Black (V cc - Gnd)	97.8 kΩ
②White - ③Black (V out - Gnd)	2.05 kΩ

1. Detection condition	Diagnosis flow	Cause (action taken)
Low pressure are less than 14 Bar for 10 s.	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector/service valves closed by visual check 2. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
	Correct quantity of gas? YES	Check if there is any leak and correct the refrigerant charge. (Reset error codes after charging)
	NO → Leak test system ? YES	Repair leak
	NO → Cancel the error codes and re-start Optyma™ iCO2 unit. For reset all the alarms, switch off CDU unit, wait five minutes and switch on the unit.	
2. Detection timing	Same Error code shows up again? YES	
When a cycle operation signal from GW change OFF to ON	NO → Turn off mains power (230V AC) to the system (before open maintenance door), then check followings after 5 min. •Corrosion of Optyma™ iCO2 Electronic controller	
	Corrosion found? YES	Replace failure parts
	NO → Disconnect connectors from Optyma™ iCO2 Electronic controller and a low pressure sensor, and check if there is a wire snapping or/and a short circuit.	
	Wire snapping or short circuit found? YES	Low pressure sensor connecting wire (replace connecting wire)
	NO → Measure inter-terminal (①-③, ②-③) resistances for the pressure sensor	
3. Estimated causes	Wire snapping or short circuit to a part of terminals? YES	Pressure sensor failure (Replace pressure sensor)
1. Refrigerant not charged or leak 2. Low pressure sensor	NO → Replace Optyma™ iCO2 Electronic controller, then reset error codes. Restart Optyma™ iCO2 unit by turning on and of the unit)	
	Operates normally ? YES	Optyma™ iCO_2 Electronic controller failure (Repair complete)
	NO	Refrigerant leak, blockage(Identify leak portion, and replace parts)
	If the problem cannot be solved by checking only Optyma™ iCO_2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO_2, so please check that as well.	Watch the consequence

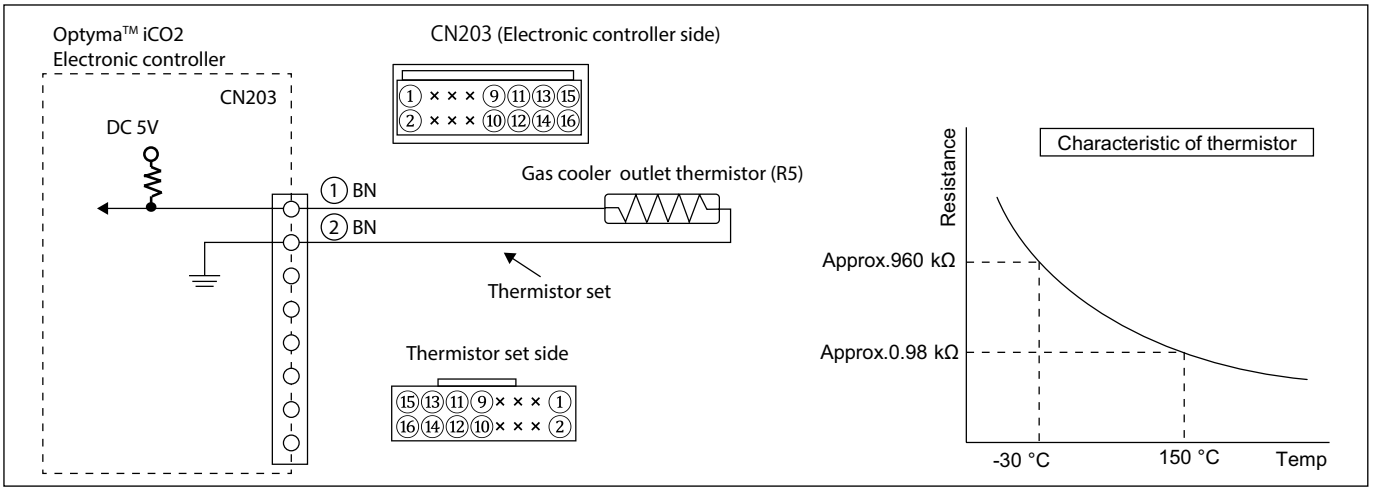
Error code A17 - Abnormal high-pressure alarm (sensor B1)



Terminal	Reference valve
① Red - ③Black (V cc - Gnd)	5.6 kΩ
② White - ③Black (V out - Gnd)	7.3 kΩ

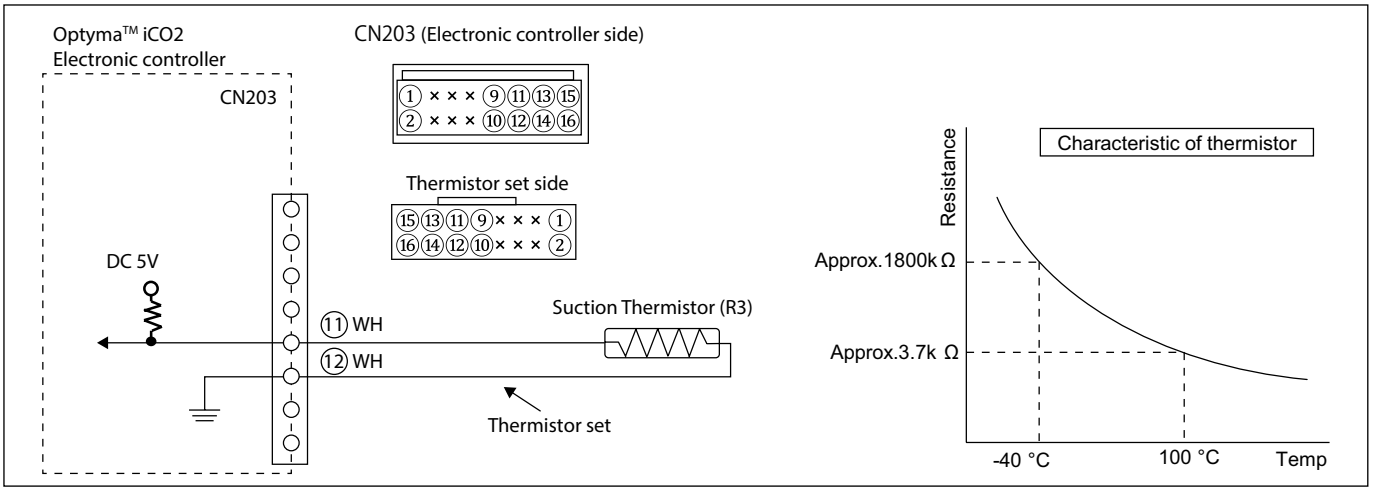
1. Detection condition	Diagnosis flow	Cause (action taken)
High pressure sensor (B1) transmitter more than 140 Bar (0.5 s) 2. Detection timing Compressor running 3. Estimated causes 1. High pressure sensor 2. Fan motor 3. Optyma™ iCO_2 Electronic controller 4. Expansion valve 5. CO_2 cycle 6. Gas cooler 4. Action when error occurred Optyma™ iCO_2 to suspend its operation if abnormal continues after 10 times of retrial **Note** Retrial control logic: Re-start operation after 3 min. of operation stop.	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector/service valves closed / gas cooler blockage (air side) by visual check 2. To check whether if there is pipes distortion, blockage/ filter blockage 3.Conduct diagnosis per following flow chart only when there is no abnormal found by visual check. Measure resistances for a pressure sensor (B1) Broken Wire or short circuit? — YES NO Switch o☒ CDU unit, wait five minutes and switch on the unit, then confirm following points: • Corrosion of Optyma™ iCO2 Electronic controller Corrosion? (CN204 section) — YES NO Cancel the error codes and re-start Optyma™ iCO2 unit. **For reset all the alarms, switch off CDU unit, wait five minutes and switch on the unit.** "Clang-clang" noise? (stepper valve) — NO YES Operates normally? — YES NO Replace Optyma™ iCO2 Electronic controller, then re-start Optyma™ iCO2 Operates normally ? — YES NO If the problem cannot be solved by checking only Optyma™ iCO_2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO_2, so please check that as well.	High pressure sensor (B1) or wire failure (Replace failure parts) Replace abnormal parts To Check and fix Expansion valve or Bypass valve Watch the consequence Optyma™ iCO_2 Electronic controller failure (Repair complete) Optyma™ iCO_2 failure (blockage)

Error code E20 - Gascooler outlet thermistor error (R5)



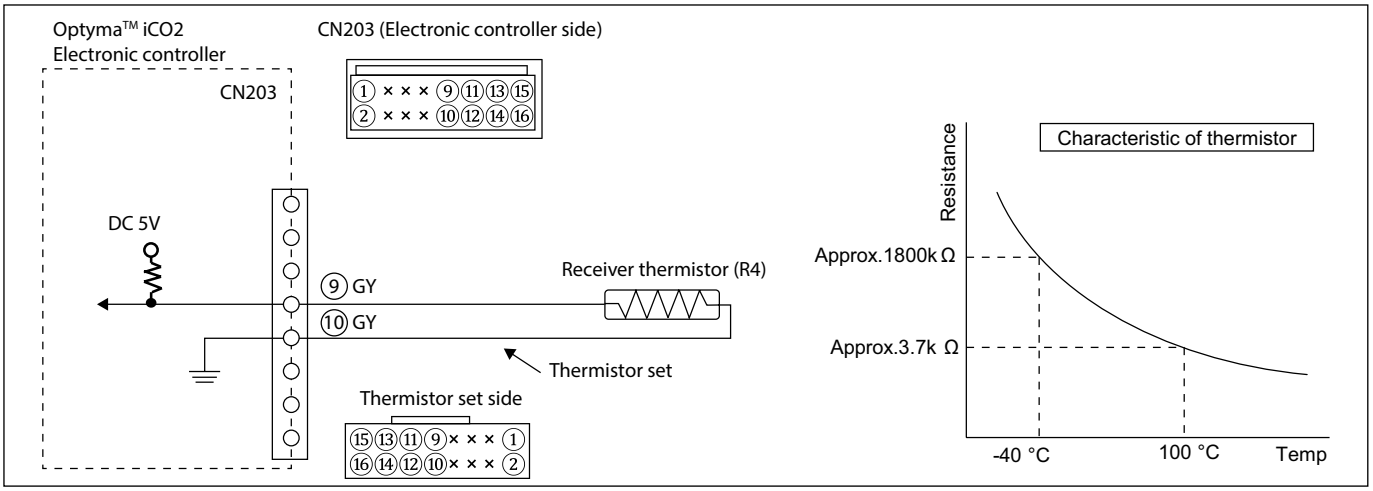
1. Detection condition	Diagnosis flow	Cause (action taken)
1. Wire snapping (- 30 °C or lower to last for 10 s) 2. Short circuit (150 °C or higher to last for 10 s)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector by visual check 2. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
2. Detection timing	ATTENTION: Turn o☒ mains power (230V AC) to the system	
Power supply ON	Disconnect CN203, Measure resistance of the Gas cooler outlet thermistor by measuring resister between terminal ① and ②	
3. Estimated causes	Approx. 960 kΩ or higher? YES	Gas cooler Outlet thermistor broken (Replace the thermistor)
1. Thermistor 2. Connector connection failure. wire snapping, etc. 3. Optyma™ iCO₂ Electronic controller	NO Approx. 0.98 kΩ or lower? YES	Gas cooler Outlet thermistor Short circuit (Replace thermistor)
4. Action when error occurred	NO Re-connect the connector and reconfirm thermistor temp by the maintenance mode.	
Operation continues using alternative setting values. Or Optyma™ iCO₂ to suspend its operation.	Normal value, between 960 kΩ÷0.98 kΩ ? Abnormal	Optyma™ iCO₂ Electronic controller failure (Replace Optyma™ iCO₂ Electronic controller)
	Normal	Repair complete (Watch the consequence)
	Note Resistance value checking process: (Hold a thermistor by hand) 1. Read resistance value 2. Compare temp between values on the resistance-temp table and measured value. (Criteria: If there is a gap for 10 % or more, it is judged NG. Replace the thermistor)	

Error code E33 - Suction temperature sensor (R3) error



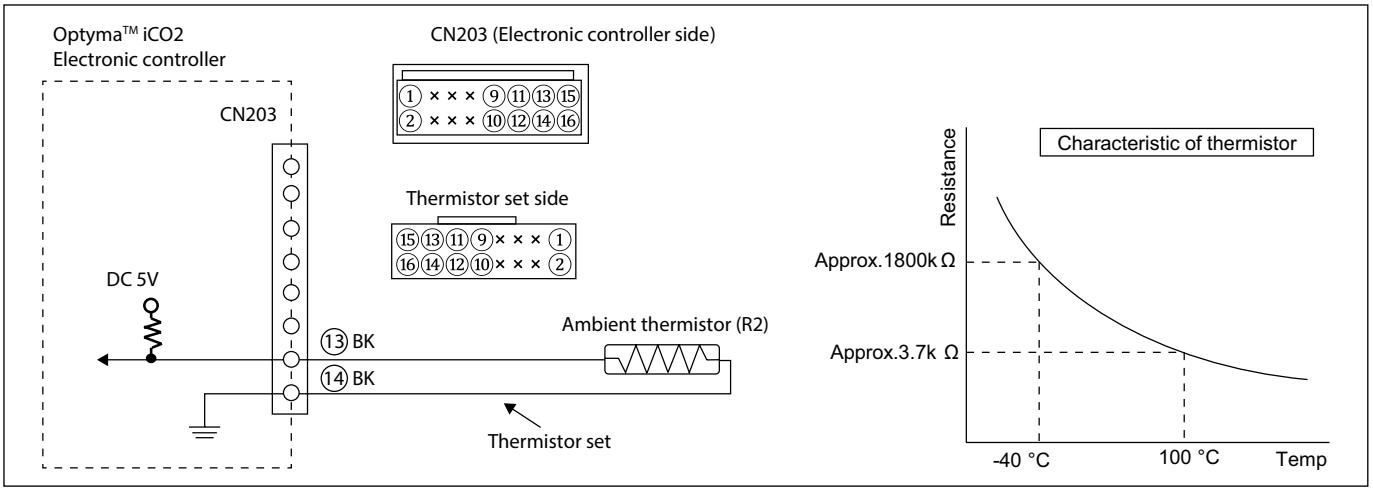
1. Detection condition	Diagnosis flow	Cause (action taken)
1. Wire snapping (- 30 °C or lower to last for 10 s) 2. Short circuit (150 °C or higher to last for 10 s)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector by visual check 2. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
2. Detection timing	ATTENTION: Turn off mains power (230V AC) to the system	
Power supply ON	Disconnect CN203. measure the resistance of the suction thermistor by measuring terminals between ⑪-⑫	
3. Estimated causes	Approx. 1800 kΩ or higher? YES	Suction Thermistor broken (Replace the thermistor)
1. Thermistor 2. Connector connection failure. wire snapping, etc. 3. Optyma™ iCO_2 Electronic controller	NO Approx. 3.7 kΩ or lower? YES	Suction Thermistor Short circuit (Replace thermistor)
4. Action when error occurred	NO Re-connect connectors, and reconfirm thermistor temp by maintenance mode	
Operation continues using alternative setting values. Or Optyma™ iCO_2 to suspend its operation.	Normal value, between 1800 kΩ÷3.7 kΩ ? Abnormal	Optyma™ iCO_2 Electronic failure (Replace Optyma™ iCO_2 Electronic controller)
	Normal	Repair complete (Watch the consequence)
	Note Resistance value checking process: (Hold a thermistor by hand) 1. Read resistance value 2. Compare temp between values on the resistance-temp table and measured value. (Criteria: If there is a gap for 10 % or more, it is judged NG. Replace the thermistor)	

Error code E40 - Receiver thermistor error (R4)



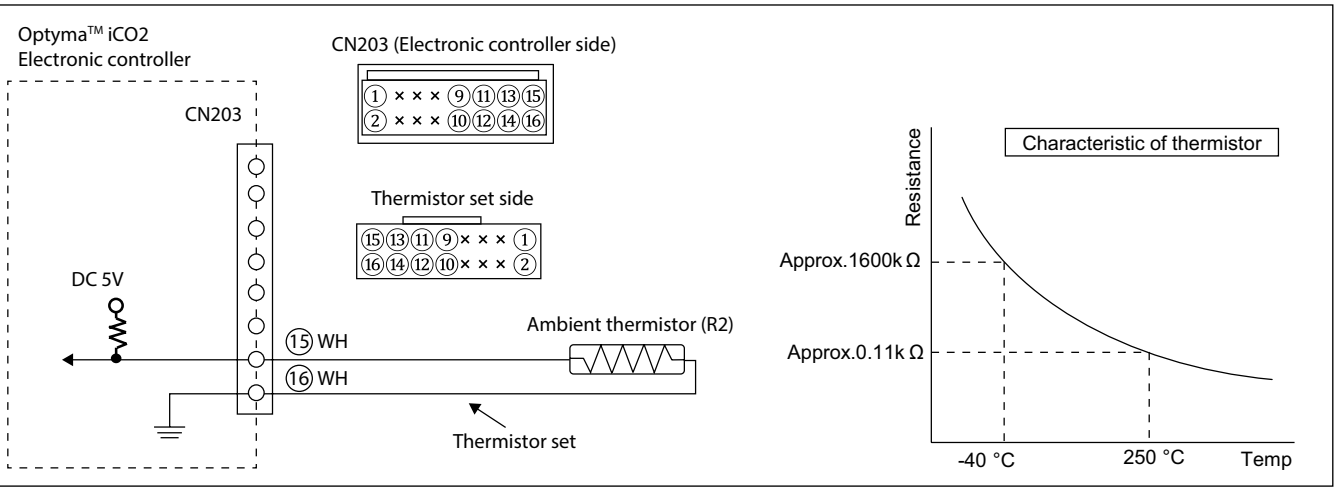
1. Detection condition	Diagnosis flow	Cause (action taken)
1. Wire snapping (- 40 °C or lower to last for 10 s) 2. Short circuit (100 °C or higher to last for 10 s)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector by visual check 2. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
2. Detection timing Power supply ON	ATTENTION: Turn off mains power (230V AC) to the system Disconnect CN203, measure the resistance of the receiver thermistor by measuring terminals between ⑨-⑩ Approx. 1800 kΩ or higher? YES → Receiver thermistor broken (Replace the thermistor) NO Approx. 3.7 kΩ or lower? YES → Receiver thermistor Short circuit (Replace thermistor) NO Re-connect connectors, and reconfirm thermistor temp by maintenance mode Normal value, between 1800 kΩ÷3.7 kΩ ? Abnormal → Optyma™ iCO₂ Electronic failure (Replace Optyma™ iCO₂ Electronic controller) Normal → Repair complete (Watch the consequence)	
3. Estimated causes 1. Thermistor 2. Connector connecting error, Snapping of the wire 3. Optyma™ iCO₂ Electronic controller	**Note** Resistance value checking process: (Hold a thermistor by hand) 1. Read resistance value 2. Compare temp between values on the resistance-temp table and measured value. (Criteria: If there is a gap for 10 % or more, it is judged NG. Replace the thermistor)	
4. Action when error occurred Optyma™ iCO₂ to suspend its operation.		

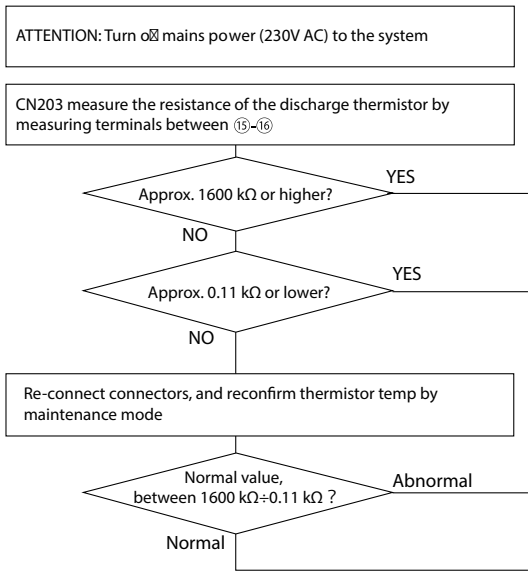
Error code E31 - Ambient air thermistor error (R2)



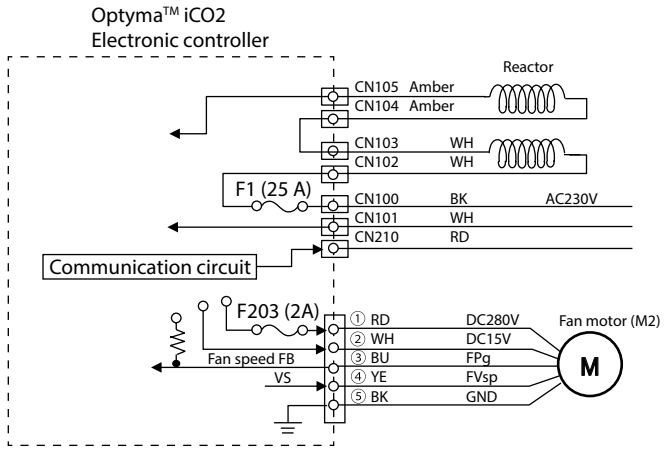
1. Detection condition	Diagnosis flow	Cause (action taken)
1. Wire snapping (- 40 °C or lower to last for 10 s) 2. Short circuit (100 °C or higher to last for 10 s)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector by visual check 2. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
2. Detection timing	ATTENTION: Turn off mains power (230V AC) to the system	
Power supply ON	Disconnect CN203, measure the resistance of ambient air thermistor by measuring terminals between ⑬-⑭	
3. Estimated causes	Approx. 1800 kΩ or higher? YES	Ambient air thermistor broken (Replace the thermistor)
1. Thermistor 2. Connector connecting error, Snapping of the wire 3. Optyma™ iCO_2 Electronic controller	NO Approx. 3.7 kΩ or lower? YES	Ambient air thermistor Short circuit (Replace thermistor)
4. Action when error occurred	NO Re-connect connectors, and reconfirm thermistor temp by maintenance mode	
Optyma™ iCO_2 to suspend its operation.	Normal value, between 1800 kΩ÷3.7 kΩ ? Abnormal	Optyma™ iCO_2 Electronic failure (Replace Optyma™ iCO_2 Electronic controller)
	Normal	Repair complete (Watch the consequence)
	Note Resistance value checking process: (Hold a thermistor by hand) 1. Read resistance value 2. Compare temp between values on the resistance-temp table and measured value. (Criteria: If there is a gap for 10 % or more, it is judged NG. Replace the thermistor)	

Error code E32 - Discharge thermistor (R1) error



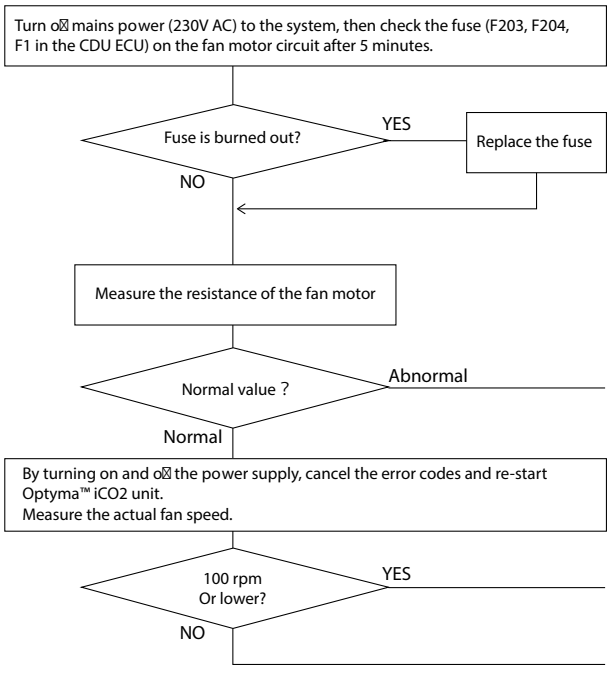
1. Detection condition	Diagnosis flow	Cause (action taken)
1. Wire snapping (- 40 °C or lower to last for 10 s) 2. Short circuit (200 °C or higher to last for 10 s)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector by visual check 2. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.  	Discharge thermistor broken (Replace the thermistor) Discharge temp thermistor Short circuit (Replace thermistor) Optyma™ iCO_2 Electronic failure (Replace Optyma™ iCO_2 Electronic controller) Repair complete (Watch the consequence)
2. Detection timing Power supply ON		
3. Estimated causes 1. Thermistor 2. Connector connecting error, Snapping of the wire 3. Optyma™ iCO_2 Electronic controller		
4. Action when error occurred Optyma™ iCO_2 to suspend its operation.	**Note** Resistance value checking process: (Hold a thermistor by hand) 1. Read resistance value 2. Compare temp between values on the resistance-temp table and measured value. (Criteria: If there is a gap for 10 % or more, it is judged NG. Replace the thermistor)	

Error code A34 - Fan motor error (M2)

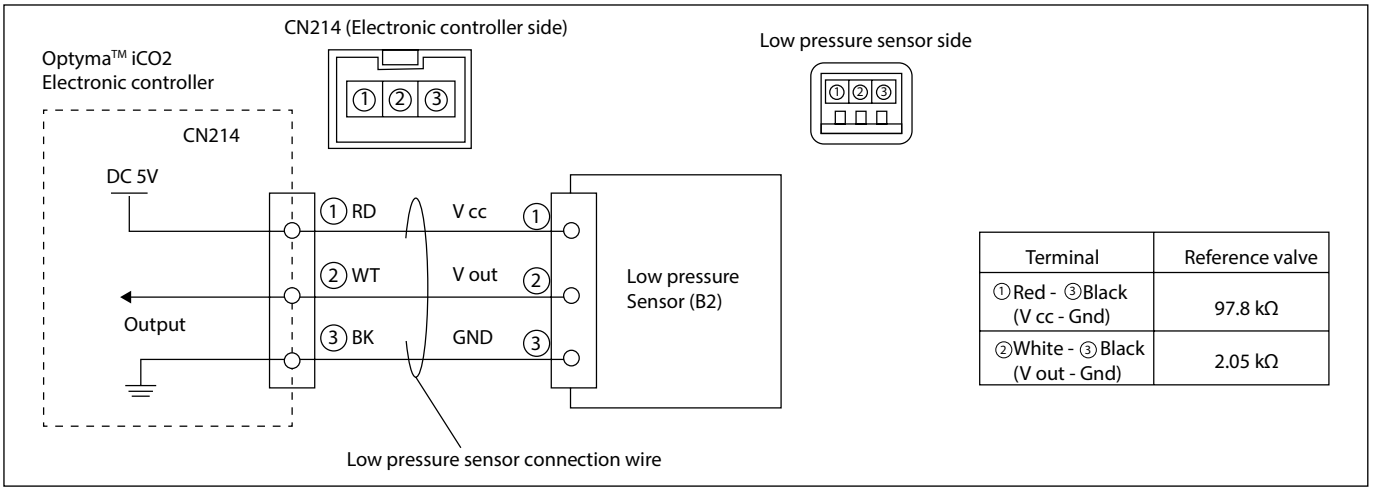


Terminals	Reference valve
Red – White	∞
Red – Black	∞
White – Black	1.25 kΩ
Blue – Black	∞
Yellow - Black	210 kΩ

1. Detection condition	Diagnosis flow	Cause (action taken)
Rotor pulse signals is detected continuously less than or equal 100 rpm for 60 seconds	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector by visual check 2. To check if there is any foreign matter getting caught in the fan blade 3. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
2. Detection timing		
Fan motor is ON		
3. Estimated causes		
Fans do not turn due to vegetation, freezing, snow, etc. 1. Fan motor 2. Optyma™ iCO_2 Electronic controller 3. Connector connection failure. wire snapping, etc.		Fan motor failure (Replace fan motor) * If after replace fan motor, this one does not work, It is suggested to replace also the Electronic controller.
4. Action when error occurred		
Optyma™ iCO_2 to suspend its operation when error continues after 10 –times of retrials. <Retrial control> Return back to normal operation after Optyma™ iCO_2 to be suspended for 3 min.		Fan motor failure (Replace fan motor) Repair complete (Watch the consequence)



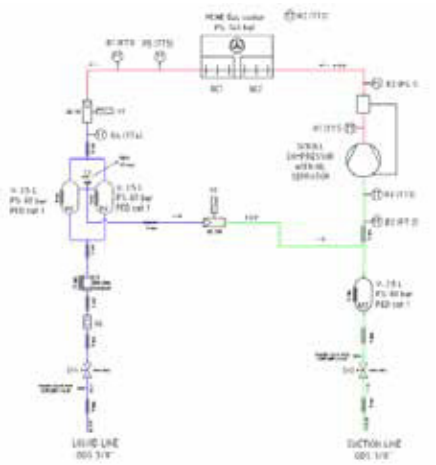
Error code E39 - Low pressure sensor (B2) error (suction)



Terminal	Reference valve
①Red - ③Black (V cc - Gnd)	97.8 kΩ
②White - ③Black (V out - Gnd)	2.05 kΩ

1. Detection condition	Diagnosis flow	Cause (action taken)
1. Wire snapping (approx. 4.5 V to last for 10 s) 2. Short circuit (approx. 0.5 V to last for 10 s)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector by visual check 2. To check whether if there is pipes distortion, blockage/ filter blockage 3. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
2. Detection timing Power supply ON	By turning on and off the power supply, cancel error codes and re-start Optyma™ iCO2 unit. Same Error code shows up again? YES / NO Turn off mains power (230V AC) to the system (before open maintenance door), then check followings after 5 min. ・Corrosion of Optyma™ iCO2 Electronic controller Corrosion found? YES / NO	Replace failure parts
3. Estimated causes Product related factors : 1. wiring, connector connecting 2. Optyma™ iCO_2 Electronic controller 3. Low pressure sensor 4. Press. Sensor wiring 5. CO_2 cycle 6. Ref. gas leakage 7. Service valve	Disconnect connectors from Optyma™ iCO2 Electronic controller and pressure sensor, and check if there is a wire snapping or/and a short circuit. Wire snapping or short circuit found? YES / NO	Pressure sensor connecting wire (replace connecting wire)
	Measure inter-terminal (①-③, ②-③) resistances for the pressure sensor Wire snapping or short circuit to a part of terminals? YES / NO	Pressure sensor failure (Replace pressure sensor)
	Replace Optyma™ iCO2 Electronic controller,then reset error codes. Restart Optyma™ iCO2 unit. Operates normally ? YES / NO	Optyma™ iCO_2 Electronic controller failure (Repair complete)
4. Action when error occurred Optyma™ iCO_2 to suspend its operation.	If the problem cannot be solved by checking only Optyma™ iCO_2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO_2, so please check that as well.	Refrigerant leak, blockage (Identify leak portion, and replace parts) Watch the consequence

Error code A96 - Discharge temperature error (R1)



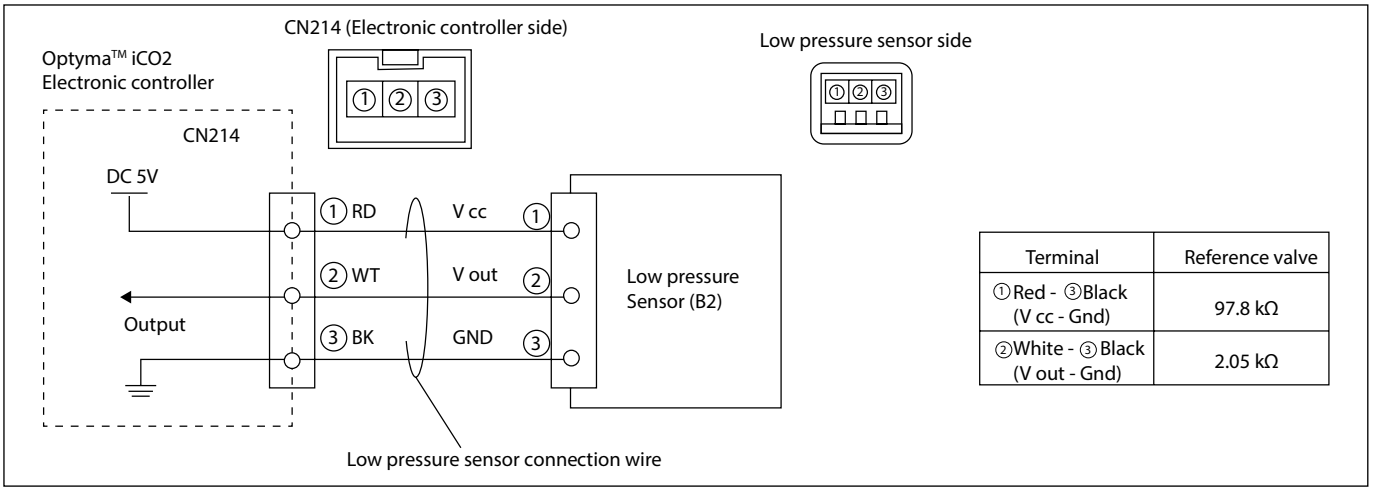
LEGEND:

B1 - High pressure sensor
B2 - Low pressure sensor
B3 - High pressure switch
R1 - Discharge temperature sensor
R2 - Ambient temperature sensor
R3 - Suction temperature sensor
R4 - Receiver inlet temperature sensor
R5 - Gas cooler outlet temperature sensor
V1 - Expansion valve (main)
V2 - Expansion valve (gas by-pass)
PRV - Pressure Relief valve
GC1 - Gas cooler 1
GC2 - Gas cooler 2
LF - Liquid filter with dryer
SG - Sight glass with moisture indicator
SV1 - Service valve 1 (liquid line)
SV2 - Service valve 2 (suction line)

Red line - high pressure line
Blue line - Liquid line
Green line - Suction line
Black line - Oil line

1. Detection condition	Diagnosis flow	Cause (action taken)
Ref. Compressor outlet temp. : Tco to be 138 °C or higher for 5 s or more. 2. Detection timing When comp is ON 3. Estimated causes 1. Thermistor is not properly connected. 2. Gas-cooler (air flow failure) 3. Optyma™ iCO2 Electronic controller 4. Expansion valve 5. Bypass valve 6. CO2 cycle 4. Action when error occurred Optyma™ iCO2 to suspend its operation if abnormal continues after 10 times of retrial **Note** Retrial control logic: Re-start operation after 3 min. of operation stop.	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector/service valves closed / gas cooler blockage (air side) by visual check 2. To check whether if there is pipes distortion, blockage/ filter blockage 3. To check Whether the oil was properly filled at the time of installation 4. If other error code to be shown, follow the diagnosis procedure for that error code. 5. If no any other errors aren't shown, follow process flow shown below: Turn off mains power (230V AC) to the system, and turn ON after 5 min. Confirm the noise of "clang-clang" (Zero-reset noise for stepper valve EXV) to come out from Optyma™ iCO2 unit. "Clang-clang" noise (ex. EXV)? — NO → To Check and fix Expansion valve or Bypass valve YES By turning on and off the power supply, cancel the error code, Power OFF the Optyma™ iCO2 power line, then power ON again after 1 min. Check the operation condition in maintenance mode. Only A96 is shown? — No (other error code is shown) → Conduct diagnosis based on that error codes (ex. A17, A34) YES Suspend Optyma™ iCO2 operation, measure resistance value of the discharge thermistor parts (see diagnosis flow for error code E32). 1.0 kΩ or lower? — YES → Discharge thermistor failure (replace thermistor set) NO Check connection if there is a failure for gas cooler outlet / Discharge thermistor connection failure of thermistors? — YES → Thermistor connection failure (Connect it properly) NO Able to operate Normally? — YES → Watch the consequence Especially check if super-heat is above 30 °C and Optyma™ iCO2 is stopped by pressure switch NO → CO2 cycle or Gascooler failure (blockage) If the problem cannot be solved by checking only Optyma™ iCO2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO2, so please check that as well.	

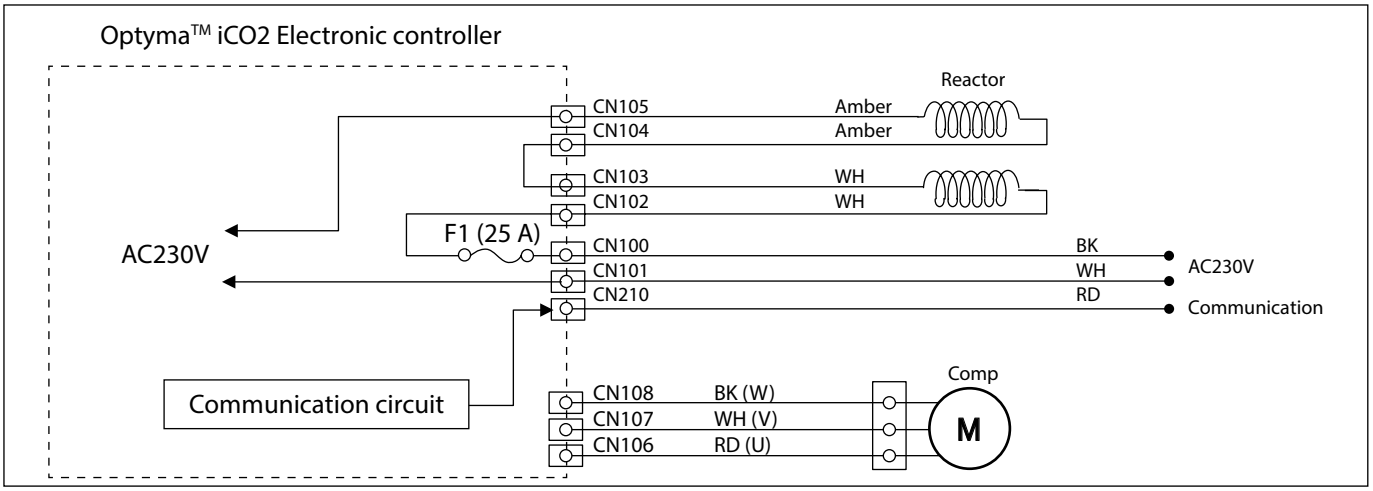
Error code E39 - Low pressure sensor (B2) error (suction)



Terminal	Reference valve
①Red - ③Black (V cc - Gnd)	97.8 kΩ
②White - ③Black (V out - Gnd)	2.05 kΩ

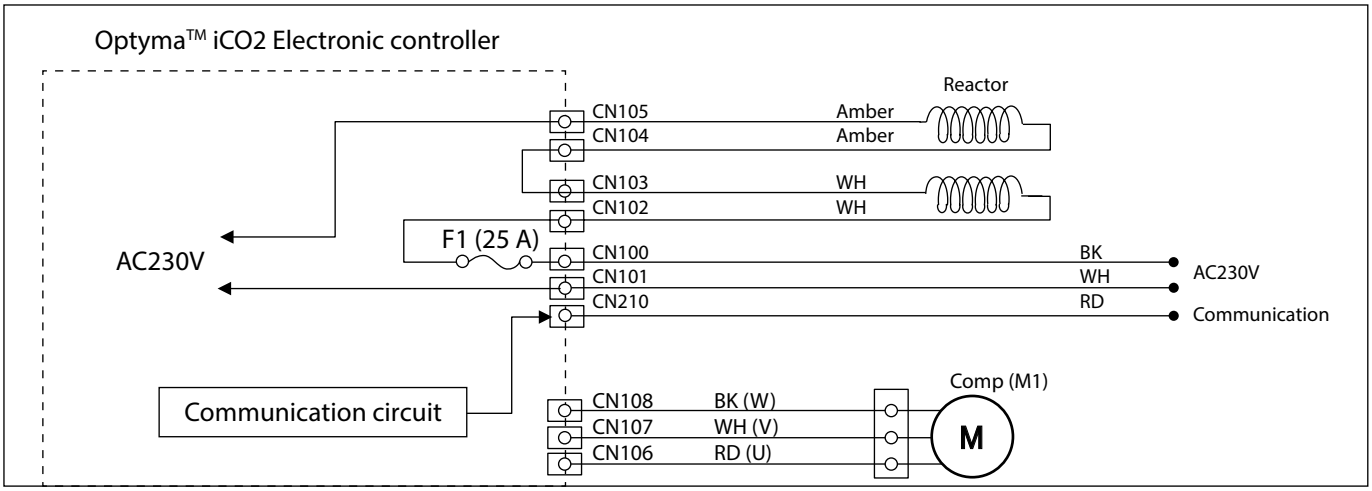
1. Detection condition	Diagnosis flow	Cause (action taken)
1. Wire snapping (approx. 4.5 V to last for 10 s) 2. Short circuit (approx. 0.5 V to last for 10 s)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector by visual check 2. To check whether if there is pipes distortion, blockage/ filter blockage 3. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
2. Detection timing Power supply ON	By turning on and off the power supply, cancel error codes and re-start Optyma™ iCO2 unit. Same Error code shows up again? YES / NO Turn off mains power (230V AC) to the system (before open maintenance door), then check followings after 5 min. ・Corrosion of Optyma™ iCO2 Electronic controller Corrosion found? YES / NO	Replace failure parts
3. Estimated causes Product related factors : 1. wiring, connector connecting 2. Optyma™ iCO2 Electronic controller 3. Low pressure sensor 4. Press. Sensor wiring 5. CO2 cycle 6. Ref. gas leakage 7. Service valve	Disconnect connectors from Optyma™ iCO2 Electronic controller and pressure sensor, and check if there is a wire snapping or/and a short circuit. Wire snapping or short circuit found? YES / NO Measure inter-terminal (①-③, ②-③) resistances for the pressure sensor Wire snapping or short circuit to a part of terminals? YES / NO	Pressure sensor connecting wire (replace connecting wire) Pressure sensor failure (Replace pressure sensor)
4. Action when error occurred Optyma™ iCO2 to suspend its operation.	Replace Optyma™ iCO2 Electronic controller,then reset error codes. Restart Optyma™ iCO2 unit. Operates normally ? YES / NO If the problem cannot be solved by checking only Optyma™ iCO_2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO_2, so please check that as well.	Optyma™ iCO_2 Electronic controller failure (Repair complete) Refrigerant leak, blockage (Identify leak portion, and replace parts) Watch the consequence

Error code H23 to H26 - Optyma™ iCO2 Electronic controller error



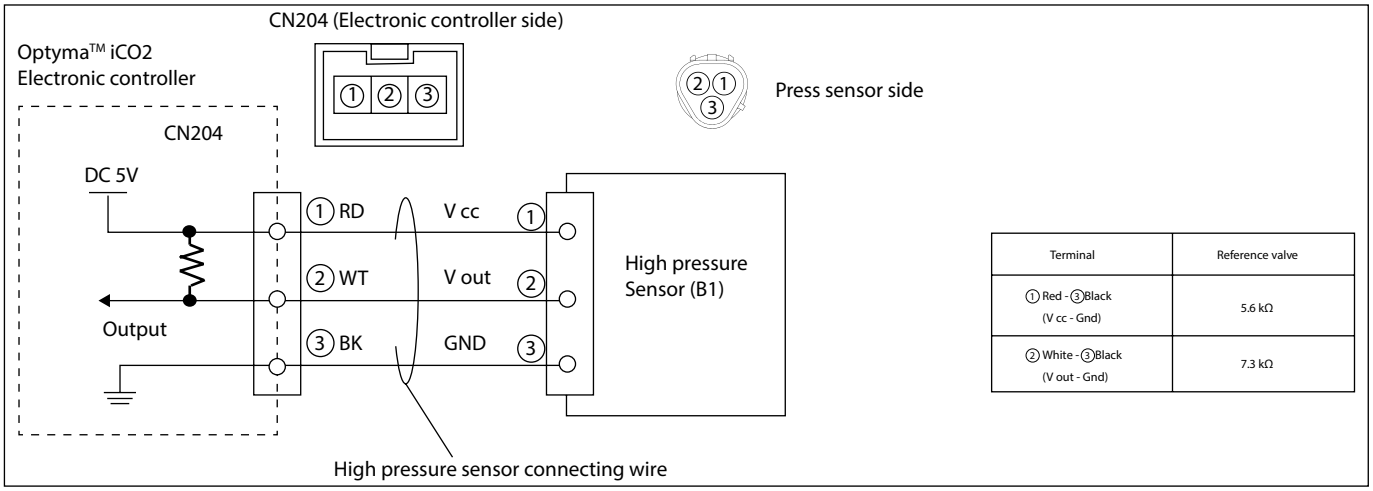
1. Detection condition	Diagnosis flow	Cause (action taken)
Optyma™ iCO2 Electronic controller to receive compressor control failure.	Conduct following checks before starting diagnosis: Whether there is/are Disconnection of connectors, pinch of connector wire at swaging part by visual check. **Note** This error code won't be shown due to refrigeration cycle abnormal. Turn off mains power (230V AC) to the system, and turn ON after 5 min. then check following: • Corrosion of Optyma™ iCO2 Electronic controller Corrosion? YES → Replace failure parts NO Verify poor contact or/and wire snapping for the connectors for both Optyma™ iCO2 Electronic controller side and comp side. Abnormal? YES → Properly re-connect failure part, or replace parts NO → Optyma™ iCO2 Electronic controller failure (Replace Optyma™ iCO2 Electronic controller)	
2. Detection timing When comp is ON		
3. Estimated causes 1. Wiring, connector connection 2. Optyma™ iCO2 Electronic controller		
4. Action when error occurred Optyma™ iCO2 to suspend its operation when error continues after 10 –times of retrials. <Retrial control> Return back to normal operation after Optyma™ iCO2 to be suspended for 3 min.		

Error code H28 and H29 - Optyma™ iCO2 Electronic controller error



1. Detection condition	Diagnosis flow	Cause (action taken)
Optyma™ iCO2 Electronic controller to receive compressor control abnormal (H28, H29)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector/service valves closed / gas cooler blockage (air side) by visual check 2. To check whether if there is pipes distortion, blockage/ filter blockage 3. To check Whether the oil was properly filled at the time of installation 4. If other error code to be shown, follow the diagnosis procedure for that error code. 5. If no any other errors aren't shown, follow process flow shown below:	
2. Detection timing	Turn off mains power (230V AC) to the system, and turn ON after 5 min. Confirm the noise of "clang-clang" (Zero-reset noise for stepper valve EXV) to come out from Optyma™ iCO2 unit.	
When Comp is ON (H28, H29)	"Clang-clang" noise (ex. EXV)? NO / YES	To Check and fix Expansion valve or Bypass valve
	Turn off mains power (230V AC) to the system, then confirm following points after 5 minutes • Corrosion of Optyma™ iCO2 Electronic controller	
3. Estimated causes	Corrosion? YES / NO	Replace abnormal parts
Product related factors : 1. Power fluctuates seriously (Fluctuates more than 5 V momentary)	Verify poor contact or/and wire snapping for the connectors for both Optyma™ iCO2 Electronic controller side and comp side.	
	Abnormal? YES / NO	(Re-connect failure portion, or replace failure parts)
Product related factors : 1. wiring, connector connection 2. Optyma™ iCO2 Electronic controller 3. Comp	Confirm connection of gas cooler outlet thermistor, Compressor outlet Thermistor	
	connection failure of thermistors? YES / NO	Thermistor connection failure (Properly re-connect the parts)
4. Action when error occurred	Replace Optyma™ iCO2 Electronic controller, then re-start Optyma™ iCO2	
Optyma™ iCO2 to suspend its operation when error continues after 10 –times of retrials. <Retrial control> Return back to normal operation after Optyma™ iCO2 to be suspended for 3 min.	Able to operate Normally? YES / NO	Optyma™ iCO2 Electronic controller failure (Repair complete) Comp or CO2 cycle failure (Replace Optyma™ iCO2 unit)
	If the problem cannot be solved by checking only Optyma™ iCO2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO2, so please check that as well.	

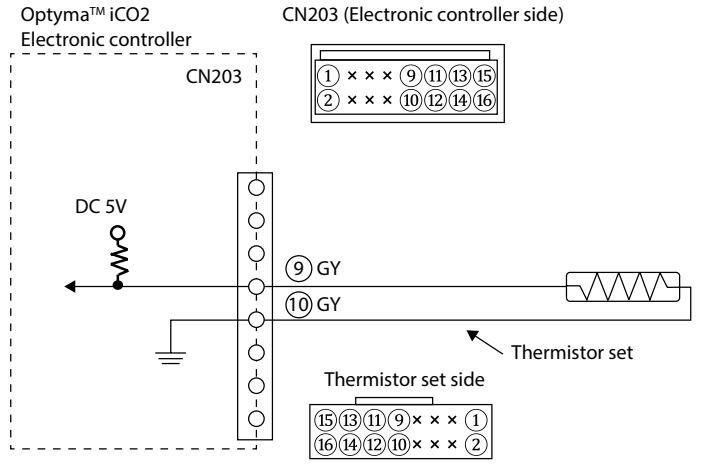
Error code A41 - Discharge pressure sensor (B1) error



Terminal	Reference valve
① Red - ③Black (V cc - Gnd)	5.6 kΩ
② White - ③Black (V out - Gnd)	7.3 kΩ

1. Detection condition	Diagnosis flow	Cause (action taken)
1. Wire snapping (approx. 5 V to last for 10 s) 2. Short circuit (approx. 0.5 V to last for 10 s)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector/service valves closed / gas cooler blockage (air side) by visual check 2. To check whether if there is pipes distortion, blockage/ filter blockage 3. To check Whether the oil was properly filled at the time of installation 4. If other error code to be shown, follow the diagnosis procedure for that error code. 5. If no any other errors aren't shown, follow process flow shown below:	
2. Detection timing Power supply ON	Referring to a log data, Pressure sensor failure to be established if E41and A17 are to be shown at the same time. Cancel error codes and re-start Optyma™ iCO2 unit. For reset **all the alarms, switch off CDU unit, wait five minutes and switch on the unit.** Same Error code shows up again? YES / NO Turn off mains power (230V AC) to the system (before open maintenance door), then check followings after 5 min. ・Corrosion of Optyma™ iCO2 Electronic controller Corrosion found? YES / NO	Replace failure parts
3. Estimated causes Product related factors: 1. wiring, connector connecting 2. Optyma™ iCO2 Electronic controller 3. High pressure sensor 4. Press. Sensor wiring 5. Refrigeration cycle 6. Ref. gas leakage 7. Gas cooler	Disconnect connectors from Optyma™ iCO2 Electronic controller and pressure sensor, and check if there is a wire snapping or/and a short circuit. Wire snapping or short circuit found? YES / NO Measure inter-terminal (①-③, ②-③) resistances for the pressure sensor Wire snapping or short circuit to a part of terminals? YES / NO	Pressure sensor connecting wire (replace connecting wire) Pressure sensor failure (Replace pressure sensor)
4. Action when error occurred Optyma™ iCO2 to suspend its operation	Replace Optyma™ iCO2 Electronic controller,then reset error codes. Restart Optyma™ iCO2 unit. Operates normally ? YES / NO If the problem cannot be solved by checking only Optyma™ iCO2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO2, so please check that as well.	Optyma™ iCO2 Electronic controller failure (Repair complete) Refrigerant leak, blockage (Identify leak portion, and replace parts) Watch the consequence

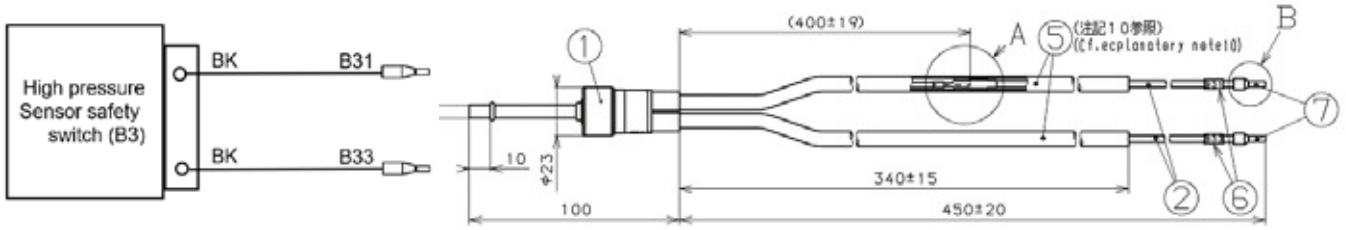
Error code A85 - Medium temperature/pressure alarm



Ambient temperature	Reference value
-20 °C	535 kΩ
-10 °C	310 kΩ
0 °C	185 kΩ
10 °C	113 kΩ
20 °C	71 kΩ
30 °C	46 kΩ
40 °C	30 kΩ
50 °C	20 kΩ

1. Detection condition	Diagnosis flow	Cause (action taken)
Receiver thermistor value is 33 °C or higher for 5 s or more.	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector/service valves closed / gas cooler blockage (air side) by visual check 2. To check whether if there is pipes distortion, blockage/ filter blockage 3. To check whether if there is anything around the Optyma™ iCO2 that raises the intake air temperature of the Optyma™ iCO2 (heating element, wall surrounding the Optyma™ iCO2, etc.) 4. If other error code to be shown, follow the diagnosis procedure for that error code. 5. If no any other errors aren't shown, follow process flow shown below:	
2. Detection timing When Comp is ON	Turn off mains power (230V AC) to the system, and turn ON after 5 min. Confirm the noise of "clang-clang"(Zero-reset noise for stepper valve) to come out from Optyma™ iCO2 unit.	
	"Clang-clang" noise (ex. EXV)? NO	To Check and fix Expansion valve or Bypass valve
	YES	
	Cancel the error code, Power OFF the Optyma™ iCO2 power line, then power ON again after 1 min. Check the operation condition in maintenance mode.	
3. Estimated causes Product related factors: 1. wiring, connector connecting 2. Optyma™ iCO2 Electronic controller 3. Refrigeration cycle 4. Expansion valve 5. Bypass valve 6. Fan	Only Sr3 is shown? No (other error code is shown)	Conduct diagnosis based on that error codes (ex. A17, E31, A96 or Sr3, A34 or Sr2)
	YES	
	Suspend Optyma™ iCO2 operation, measure resistance value of the receiver thermistor parts(see diagnosis flow for E32).	
	Abnormal? YES	Receiver Thermistor failure (Replace thermistor set)
	NO	
	Check connection if there is a failure for: Receiver thermistor	
4. Action when error occurred Optyma™ iCO2 to suspend its operation when error continues after 10 –times of retrials. <Retrial control> Return back to normal operation after Optyma™ iCO2 to be suspended for 3 min.	connection failure of thermistors? YES	Thermistor connection failure (Connect it properly)
	NO	
	Replace Optyma™ iCO2 Electronic controller, then re-start Optyma™ iCO2	
	Able to operate Normally? YES	Watch the consequence
	NO	
	If the problem cannot be solved by checking only Optyma™ iCO2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO2, so please check that as well.	CO2 cycle or Gas cooler failure (Replace parts)

Error code A97 - High pressure sensor safety switch (B3) alarm



1. Detection condition	Diagnosis flow	Cause (action taken)
High pressure sensor safety switch (B3) alarm. CDU cannot run (fan and compressor switched off)	1. To check whether if there is disconnection/abnormal swaging / moisture ingression/wire jamming of the connector/service valves closed / gas cooler blockage (air side) by visual check 2. To check whether if there is pipes distortion, blockage/ filter blockage 3. Conduct diagnosis per following flow chart only when there is no abnormal found by visual check.	
2. Detection timing		
Start signal from GW and cooling cap demand are present but CDU is not running		
3. Estimated causes		
1. Pressure in the circuit higher than 140 bar 2. Pressure switch broken 3. Protection circuit broken 4. Optyma™ iCO2 Electronic controller		
4. Action when error occurred		
Optyma™ iCO2 to suspend its operation if abnormal continues after 10 times of retrial **Note** Retrial control logic: Re-start operation after 3 min. of operation stop.	If the problem cannot be solved by checking only Optyma™ iCO2, there is a possibility of leakage or blockage in the Evaporator or the piping between a Evaporator and Optyma™ iCO2, so please check that as well.	

Measure continuity of the high pressure sensor safety switch (B3), between ist terminal B31 and B33

Continuity — NO → High pressure sensor safety switch (B3) or wire failure (Replace failure parts)

YES

Check that continuity is present between pin B34 and B12

Continuity? — NO → Check wire connection or replace thermal switch

YES

Check corrosion of the Optyma iCO2 controller

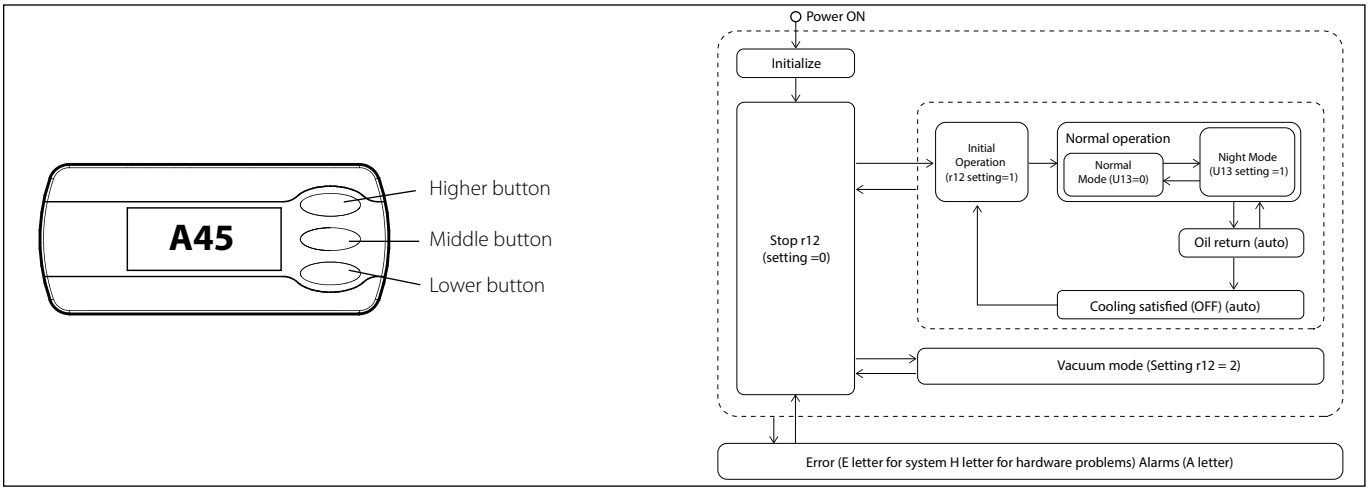
Corrosion — YES → Replace controller

NO

Check Gateway — YES → Watch the consequence

NO → Optyma™ iCO2 failure (blockage) Gateway failure

Error code A45 - Main Switch OFF

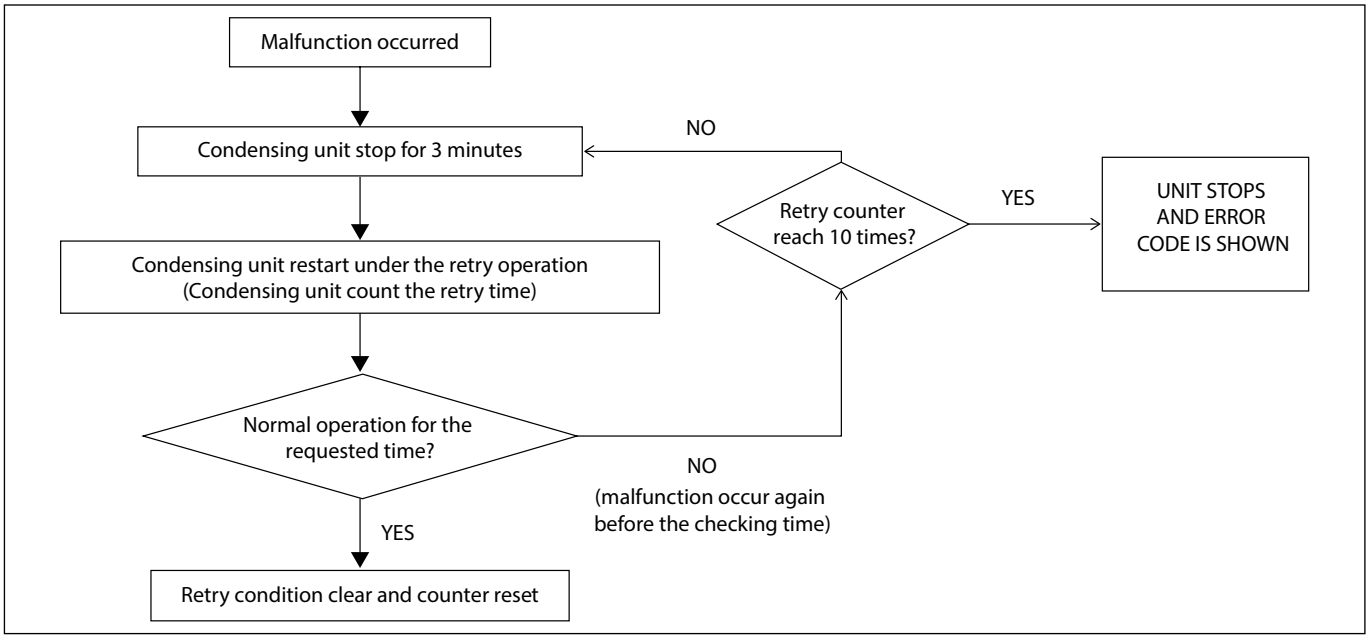


1. Detection condition	Diagnosis flow	Cause (action taken)
Display show alarm A45	1. Controller main switch off mean that the internal controller is on Stop Mode meaning R12 parameter =0 Go to Menu on the MMILDS Display (pushing higher buttom for 5 second) Navigate to R12 paremeter Push midle button to Select R12 parameter Change the setting to 1 for operation or to start cooling Compressor start NO YES	
2. Detection timing		
Start from powering the unit or after maintenance or Charging procedure		Check Error or Alarm code on the MMILDS display
3. Estimated causes		
1. Initialization 2. Vacuum mode 3. From wrong parameter/mode setting		
4. Action when error occurred		
Wrong setting of the parameter		

LEGEND:
B1 - High pressure sensor
B2 - Low pressure sensor
B3 - High pressure switch
R1 - Discharge temperature sensor
R2 - Ambient temperature sensor
R3 - Suction temperature sensor
R4 - Receiver inlet temperature sensor
R5 - Gas cooler outlet temperature sensor
V1 - Expansion valve (main)
V2 - Expansion valve (gas by-pass)
PRV - Pressure Relief valve
GC1 - Gas cooler 1
GC2 - Gas cooler 2
LF - Liquid filter with dryer
SG - Sight glass with moisture indicator
SV1 - Service valve 1 (liquid line)
SV2 - Service valve 2 (suction line)

Error code: 10 – times of retrials

Retry operation



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