# Installation & Operation Instruction

DC-3

SMART REFRIGERATION

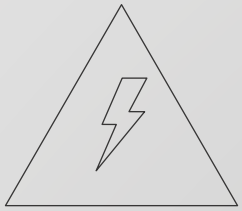
# DC-3 Smart Refrigeration System

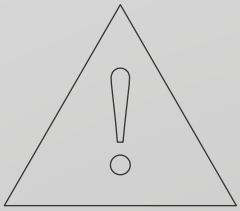
Index



This document should be kept with the installed DC3 condensing unit.

# 1. Safety warnings for end users, installation and maintenance personnel





**DANGER – High Voltage –** this refrigeration system contains electrical parts, isolate the power supply before working on this unit. All field wiring must be carried out by a licensed electrical contractor and all wiring must be in accordance with the equipment specification, local and national codes.

**DANGER – High Voltage –** the inverter and compressor is always powered, even when compressor is not running. Ensure power is isolated for more than 5 minutes before removing cables.

**DANGER – Moving Machinery –** this refrigeration system has moving parts which may start and stop without warning.

**CAUTION – Auto Start –** this refrigeration system and its moving parts can start automatically without warning.

**CAUTION – High Pressure –** this refrigeration system contains high pressure refrigerant and oil.

**CAUTION – High and Low Temperature Surfaces –** during normal operation and during fault conditions some components will reach high and/or low temperatures.

**CAUTION – Sharp Edges –** this refrigeration system contains parts with sharp edges, appropriate personal safety equipment must be worn.

**Only fully qualified licensed personnel should install service, carry out maintenance or decommission this refrigeration system.**

# 2. End user information

## Design usage

This refrigeration system is designed for commercial refrigeration duty within the limits of the published application data, ambient temperature range, refrigerant types and electrical specification. This system is not intended for environments that are corrosive or flammable including marine environments.

If subjected to corrosive environments this unit should receive additional corrosion protection/s.

## Maintenance intervals

It is good practice to have regular preventative maintenance performed to ensure this refrigeration system continues to perform efficiently.

Only fully qualified licensed personnel should carry out maintenance to this refrigeration system.

**3 to 6 monthly – dependent on location and duty**

- Air cooled condenser and evaporator check, clean as required
- Operational checks including but not limited to electrical connections, voltages, amperages, pressures, temperatures including compressor superheat, discharge temperature, unit sub-cooling, refrigerant leak check, moisture indicator check and compressor oil level.

Use of genuine spare parts from Actrol is recommended.

## Decommissioning

This refrigeration system contains refrigerant and oil that is harmful to the environment; these must be recovered and returned to an approved recycling or destruction facility.

Only fully qualified and licensed personnel should carry out decommissioning of this unit.

It is illegal to vent some types of refrigerant to the atmosphere.

# 3. Installation instructions

## Safety first

- All refrigeration and electrical work must be carried out by fully qualified and licensed personnel.
- Personal safety protection equipment must be worn when working with this refrigeration system.
- Refer to the safety warnings in “Section 1” of this instruction.

## Initial inspection and damage notification

This equipment must be inspected for damage ‘before’ installation and any damage found reported to the equipment supplier so appropriate action can be taken.

### Lifting and handling of unit

Ensure all components are balanced when lifting as the weight is not central.

## Design conditions and refrigerant type

Confirm the application is to operate within the published design limits before installing this unit. Ensure the refrigerant type matches the published data, ‘flammable refrigerants or ammonia must not be used’.

## Oil Type

PVE (Polyvinyl-ether) oil is used to lubricate this compressor. Only use PVE oil of the correct viscosity as listed in the compressor data when adding or replacing oil.

## Positioning and Mounting of Outdoor Unit

### Clearance dimensions

- Avoid short cycling the condenser air by ensuring no obstruction of the discharged air.
- A minimum of half one fan diameter clearance must be allowed between the condenser coil and a wall on the inlet air side for correct air flow.
- Safe access for service and maintenance must be provided including clear access to all serviceable components within the unit.
- A minimum of 800mm clearance should be provided adjacent all removable panels.

### Noise considerations

- Consideration should be given to ensure noise from this unit will not be of concern to surrounding sound sensitive environments. Information on noise control is available from Actrol.

### Mounting and fixing

- This condensing unit must be installed level on the horizontal plane.
- The condensing unit is to be fixed to a solid base using anti vibration mounts or rubber pads.

# 3. Installation instructions

## System pipe sizing, design, and pressure testing

### Holding pressure
The condensing unit and evaporator have a holding charge of dry nitrogen which must be released in a safe manner.

### Pipe sizing
The pipe sizing chart in this instruction must be followed to ensure optimum system performance and oil return to the compressor. The refrigerant mass flow will vary considerably in the normal operation of the system.

### Oil return
Pipe design must allow for adequate oil return to this condensing unit, the use of “P” traps and double risers may be required; all horizontal sections of the suction line must fall towards the condensing unit.

### Soldered and MaxiPro pipe fittings
Nitrogen must be used when soldering the field pipe work to stop the formation of copper oxides.

MaxiPro fittings may be used without dry nitrogen as no heat is used.

### Pipe insulation
The suction line must be adequately insulated to minimize heat absorption into the return vapour. The National Construction Code of Australia lists the minimum insulation R Values for refrigerant pipes. Actrol recommend a minimum of 19mm wall thickness.

### Pressure testing
The entire system must be pressure tested and any leaks repaired prior to system evacuation.

### Maximum design pressure and test pressure
This refrigeration system is designed for a maximum design pressure (PS) of 31 bar gauge.

Test pressure of the suction side must not exceed 20.5 bar gauge as indicated on the compressor name plate.

The pressure relief device fitted is set at 31 bar gauge (1 x PS) in accordance with AS/NZS-5149.2.

### Safety pressure switch settings
The pressures of the encapsulated HP and LP safety switches are factory set within the limits shown in the compressor application envelope. These settings cannot be changed.

The HP safety switch is factory set to open at 31 bar gauge and close at 24 bar gauge.

The LP safety switch is factory set to open at 0.5 bar gauge and close at 1.5 bar gauge.

### Evacuation
A vacuum of less than 500 microns must be achieved and held before breaking the vacuum with the correct mass of liquid refrigerant into the liquid line. The liquid line filter drier will remove further moisture during system operation.

# 3. Installation instructions

### Refrigerant charging R404A or R448A

The vacuum must be broken by charging the correct mass of liquid refrigerant into the liquid line using accurate scales. This will ensure the correct operation of the system in varying load and ambient conditions. The compressor must not be started until refrigerant has been charged into the system.

### Refrigerant Charge (kg)

| DC3 Model | Line Size (inch) | Line Length (m) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Liquid | Suction | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| APDC8.5M2-1 | 1/2 | 7/8 | 8.5 | 9 | 9.5 | 10 | 10.5 | 11.5 | 12 | 12 |
| APDC21.4M3-1 | 5/8 | 1 1/8 | 9.2 | 10.1 | 10.9 | 11.8 | 12.6 | 14.3 | 14.3 | 15.1 |

Fine tuning the refrigerant charge can be achieved by adding small quantities of liquid into the suction Schrader valve while the compressor is running.

Under no circumstances should excessive liquid refrigerant enter the compressor.

**The compressor must never operate in a vacuum as internal parts will overheat and arcing between the electrical terminals will occur within the compressor. This will be fatal for the compressor.**

# 3. Installation instructions

### Electrical connection

- A licensed electrical contractor must carry out all electrical work.
- All electrical work must meet local and national requirements.
- Care must be taken to ensure no damage is done to internal unit components when mounting the electrical isolator or making penetrations for cables.
- An electrical diagram is attached to the inside of the service panel.
- The electrical connections must be made as shown in the electrical diagram.
- Data and low voltage sensor cabling must be separated from power cables.
- A serial cable is connected between the outdoor unit and DC3 room control and between the DC3 room control and the evaporator unit and second evaporator unit if fitted.
- The HP/LP control safety circuit and contactor must not be bypassed.

# 4. Control system overview

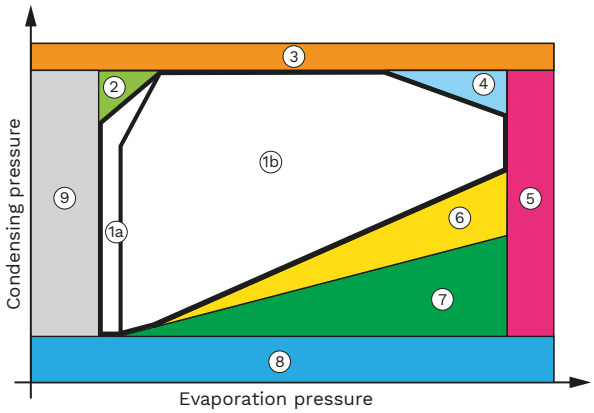
All the DC3 components communicate using serial data cables and make constant adjustments to maintain a smooth room temperature and minimise energy input. A correctly selected and commissioned system will operate the compressor most of the time. The control logic focuses on reducing the room temperature to set point before focusing on energy savings. Once within the set point + differential temperature zone the control system floats the evaporating and condensing pressures and adjusts the compressor speed and superheat to keep the compressor within its design operating envelope. In high ambient situations the DC3 system will maintain the compressor discharge temperature by injecting liquid into the suction line and in extreme conditions by slowing the compressor speed.

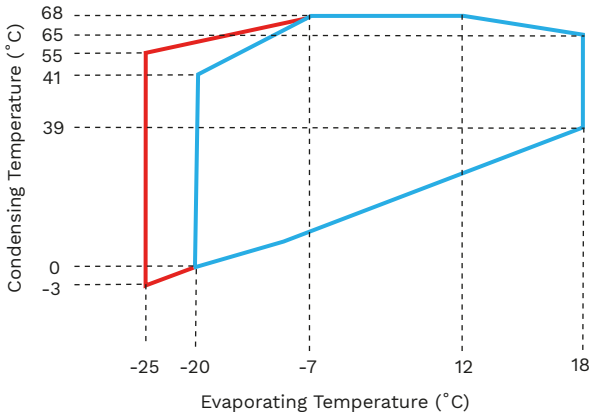
**Main features:**

- Smooth line room temperature control to increase product shelf life
- Maximised coefficient of performance (COP) to minimise operating cost
- Modulation of cooling capacity by BLDC compressor inverter
- Management of EC condenser fans
- Floating suction pressure set point
- Floating condenser pressure set point
- Advanced algorithm for calibrated oil injection to the compressor
- Compressor speed boost for oil return to the compressor
- Oil recovery washing to increase evaporator efficiency
- Advanced algorithm for calibrated liquid injection to the compressor
- Suction and discharge superheat control
- Serial communication between outdoor condensing unit, room control, and up to two indoor evaporators.
- Redundancy and alarms if communication is lost.
- RS485 Modbus serial connection for BMS / Remote monitoring

# 4. Control system overview

## Compressor envelope zones and temperature limits – R404A and R448A




### The following compressor envelope zones are defined;

1. Inside the envelope, note a and b have different maximum discharge temperature limits
2. High compression ratio
3. High condensing pressure
4. High current
5. High evaporation pressure
6. Low compression ratio
7. Low pressure differential
8. Low condensing pressure
9. Low evaporation pressure

### Compressor operation

The unit will start the compressor the best way possible, adapting operating speed to ensure the desired conditions and excellent lubrication are reached very quickly.

The compressor will ramp up to 50rps for the minimum on time of 60 seconds, during this time the out of envelope alarm is disabled but speed control remains active if approaching or exceeding zone 2 = high compression ratio, 3 = high condensing pressure, or 4 = current limit.

If 15 seconds after compressor start up, the pressure differential is less than 0.2 bar gauge higher than the value measured at start up, the compressor will stop and generate a 'No compressor start-up' alarm. The compressor will try to start 5 times with a delay of 30 seconds between each start attempt. After the fifth attempt the alarm is not automatically reset.

### Pressure differential during start up

The BLDC compressor cannot start if the suction to discharge differential pressure is greater than 9 bar. As soon as the differential falls below this limit the compressor can start.

### Pressure equalisation

DC3 uses the EVD Ice to equalise the pressure before starting the compressor.

### Minimum pressure differential for lubrication

The condensing pressure can float very low in winter conditions and can approach the evaporating pressure, if the minimum pressure differential threshold is met for a pre-set time an alarm will stop the compressor. This alarm is reset automatically. The alarm is not active during defrosting.

DC3 controls superheat on the compressor discharge line at the same time as superheat on the suction line.

If compressor suction superheat is less than 0K and discharge superheat is less than 10K, a countdown starts to set off the corresponding alarm – DSH Low Liquid Flowback. (DSH = discharge super heat).

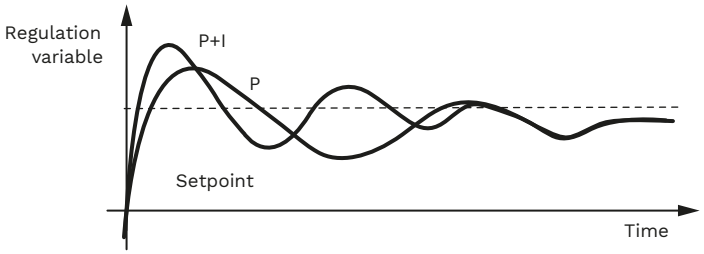
### Compressor minimum run and off times

Time management includes a minimum on time = 60 seconds, minimum off time = 180 seconds, and minimum time between two consecutive starts = 370 seconds.

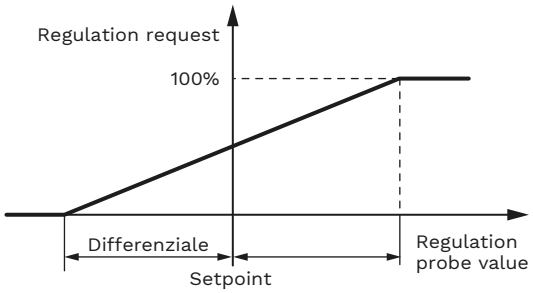
# 4. Control system overview

## Compressor control

The compressor speed is controlled using proportional + integral control, the integral time is summed to the effect of proportional control, giving a null control error in steady operation. This type of control is illustrated in the following diagrams. Proportional + integral offers faster control of parameters.




Proportional Control




Proportional + Integral Control

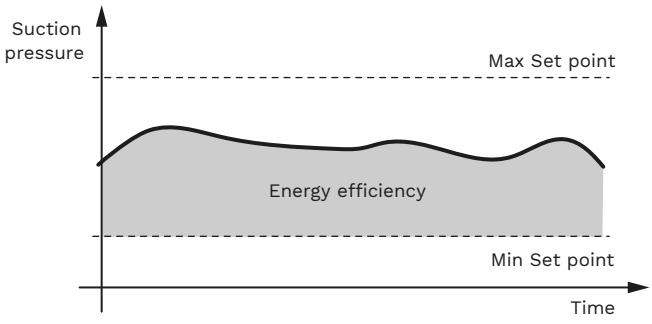
## Floating set point and smooth line functions

Floating suction set point control is available due to the serial communication with the evaporator. Serial communication allows information to be exchanged in real time between the outdoor condensing unit, DC3 room control and the indoor evaporator unit. The smooth line function is set up to reduce on and off cycles of the compressor to allow superior room temperature control.

The condensing unit suction pressure can float between the lower and upper suction float setpoints. The DC3 default values are 2.5 bar gauge and 5.0 bar gauge. These values can be adjusted to suit specific site requirements. If using R448A these values should be altered to 2.0 bar gauge and 4.5 bar gauge.

If serial communication is lost a default suction set point value of 3.5 bar gauge is set until communication returns . If using R448A this should be changed to 3.0 bar gauge.

DC3 uses an advanced algorithm to adapt the condensing unit suction pressure set point based on the proportional request from the indoor evaporator saving energy while accurately controlling the room temperature.



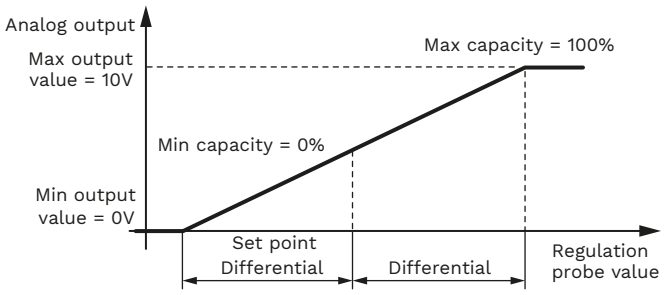

Proportional + integral control is used to reach the suction floating set point.

# 4. Control system overview

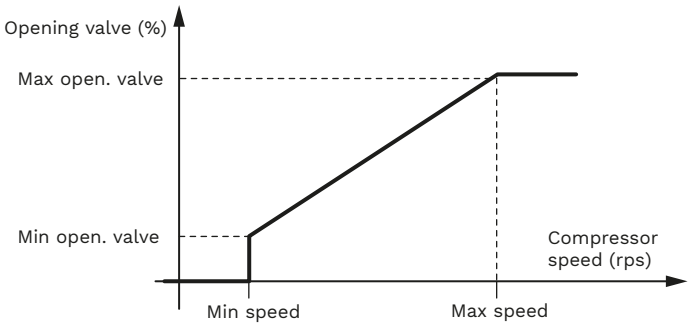
### Pump down
The DC3 is not set to pump down when the compressor cycles off. If pump down is required, the parameter is available using the commissioning tool plugged into the condensing unit. Enter the program parameters then to compressor then to advanced and scroll to the Pump Down option and switch it on. The compressor speed is then reduced to the minimum rps then the evaporator EEV is closed. The compressor will stop when the pre-set pump down threshold is reached. The pump down threshold must be set within the operating envelope of the compressor. The default pump down threshold is 2.2 bar gauge. This value is suitable for R448A.

### Sump heater
The compressor is kept warm during off cycles to minimise the risk of liquid migration to the compressor. The DC3 Power+ inverter control trickles a small amount of current through the compressor windings to act as a sump heater. The default value is 2% of the compressor rated current which equates to about 70 Watts and 95 Watts respectively.

### Condenser fans
The EC (electronically commutated) condenser fans are modulated from 10% to 100% fan speed by the DC3 control. The control outputs a voltage between 0V and 10V to achieve the set condensing pressure. The fans will operate independently of the compressor. The default set point is 11 bar gauge which equates to 23.7C saturated condensing temperature. The default differential is 1 bar gauge. For R448A this should be set to 9.8 bar gauge.




### Oil Management
Oil return is a critical factor when using BLDC compressors. DC3 manages oil return to the compressor using a Carel EEV (electronic expansion valve). The valve opening is calibrated based on the BLDC compressor operating conditions and is adjusted proportionally according to its speed. The oil separator manufactured by SCI has no moving parts. The control algorithm is represented in the below graph and is factory set to suit the compressor model. The default values must not be altered.



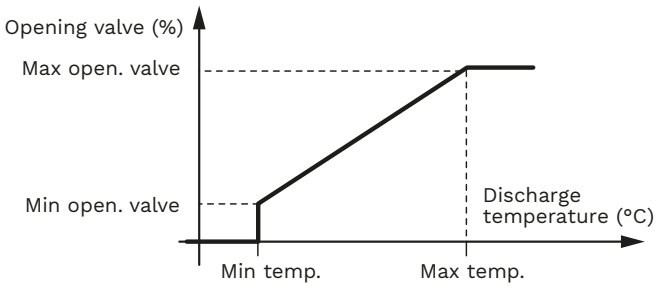
# 4. Control system overview

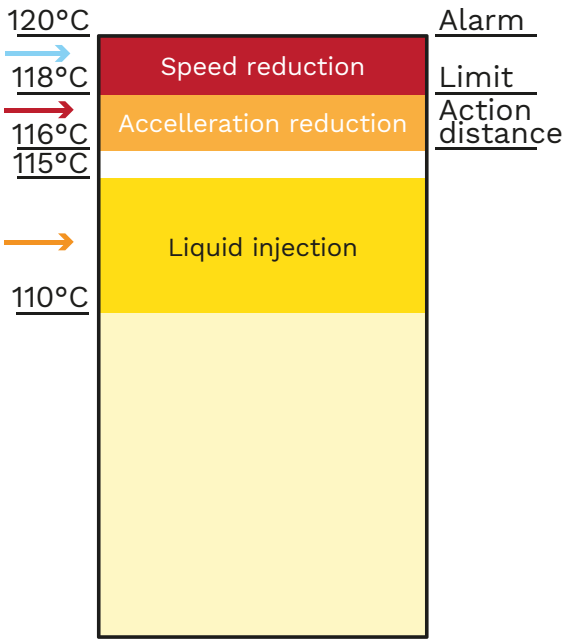
### Oil speed boost
This function boosts the return of oil by operating the compressor at a fixed speed for a set time to recover the oil spread along the refrigerant circuit. This override function is activated if the following default conditions are true. Compressor speed less than 35 rps for 30 minutes. The counter is reset if the compressor speed increases above 35 rps. Speed boost is forced at 40 rps for 3 minutes.

### Oil recovery washing
This function washes the oil from inside the evaporator to increase heat exchange efficiency. The evaporator EEV superheat is forced to 0K for a default time of 120 seconds once every 24 hours. During an evaporator wash cycle the following conditions are set, smooth line = off, evaporator superheat = 0K, low superheat threshold = -10K, room setpoint = -50C.

### High discharge temperature management
The BLDC compressor envelope is also limited by high discharge temperature. Near the limit value the compressor acceleration speed will reduce and if still approaching the limit the speed will be reduced. The default values must not be altered.

### Liquid Injection
The liquid injection function is used to protect the compressor by reducing the discharge temperature. An algorithm injects liquid refrigerant into the suction line using an EEV (electronic expansion valve). The liquid injection line includes a solenoid valve to ensure complete closure if a power failure occurs. The liquid injection algorithm is represented in the below graph. The default values must not be altered.



## Evaporator defrost management

The indoor evaporator/s operates below 0C during normal operation, so any moisture removed from the refrigerated space will accumulate on the evaporator coil in the form of ice. Defrost management is required to remove this ice from the coil as the ice acts as an insulator, reduces the air flow and overall operational efficiency. DC3 uses an off cycle defrost. During a defrost the compressor will cycle off. The evaporator fans will continue to operate throughout the defrost. The air flow through the evaporator will melt the accumulated ice to clear the coil while returning this energy into the cold room.

DC3 uses two different functions to initiate a defrost, demand and time.

A demand defrost is activated when the defrost temperature sensor (located on a return bend of the indoor evaporator unit/sv) falls below a set temperature threshold for a cumulative time since the last defrost. The default values are, temperature threshold = -5C, period = 60 minutes. These values can be altered to suit site specific conditions.

A time defrost is activated after a maximum interval between consecutive defrosts. The default value is 8 hours which equates to 3 defrosts per 24 hours. This value can be altered to suit specific site conditions. In high humidity cold rooms more defrosts are often required.

DC3 will terminate a defrost by either temperature or time to ensure minimum defrost times.

Temperature termination, if the defrost temperature sensor reaches a set temperature during a defrost the defrost will be terminated. The default value is +5C.

Time termination, the defrost will be terminated if the maximum defrost time is reached. The default value is 45 minutes.

## Dual Evaporators (if fitted)

Two evaporators can be used in a single cold room where additional air flow is required. The evaporators are connected to the DC-3 outdoor condensing unit pipe work by branching off the main liquid and suction lines.

The defrost temperature sensors of both evaporators need to be used to ensure either evaporator can demand a defrost and both evaporators are completely defrosted before a temperature termination.

Wiring of the return air regulation temperature sensor of the second (auxiliary) evaporator is optional, if the second sensor is not used the cold room temperature control will be from the sensor in evaporator 1. If both sensors are used the cold room control temperature can be averaged across the two sensors with an even or uneven bias to either sensor. This bias can be set using parameter /A4 using the Carel service tool via the DC-3 room control probes screen.

The second evaporator EEV can be closed using a digital input, this is useful if the second evaporator is close to a door. A separate door switch can be used to close the EEV to reduce ice build up when the door is opened.

The fan of the second evaporator can be controlled using a digital input, this is useful if the second evaporator is close to a door. A separate door switch can be used to stop the fan to minimise warm air infiltration when the door is opened.

# 5. Commissioning and start up

### Visual pre-start checks and power up

A visual check must be carried out to ensure the unit has been installed with the correct companion equipment and in the correct location.

All pipe work and electrical work must be complete and safe.

All electrical connections must be checked for tightness as connections can loosen during transport.

The system must have been liquid charged with the correct mass of refrigerant into the liquid Schrader valve.

Switch on supply power to the outdoor unit and DC3 room control, the system will not start.

Check the supply and control voltage is correct and all components are powered.

Check the outdoor condensing unit user interface display is powered and no alarms exist.

If any communication alarms exist check the connections of both serial cables.

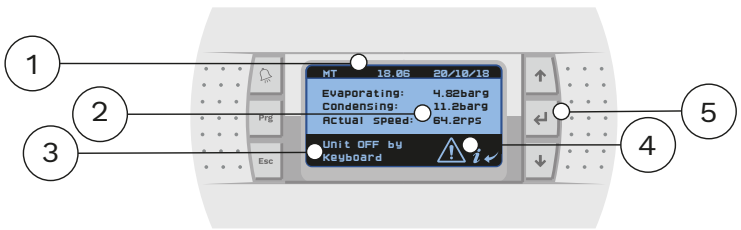
### Outdoor condensing unit interface display panel and Carel service tool with RJ11 connection cable

The Carel service tool is required to commission the DC3 smart refrigeration system.

The service tool can be plugged into the DC3 outdoor condensing unit and the DC3 room control via the RJ11 plug and connection cable. The service tool is simply a larger version of the interface display panel inside the outdoor condensing unit. The service tool displays all the parameters and alarms in plain English including those of the DC3 room control making commissioning, service and maintenance easy.

### Buttons

- Top left = Alarm button, mute alarm buzzer and access active alarms and alarm log.
- Middle left button = Program button, access program functions. The default password = **0000**.
- Lower left button = Escape or Back button, step backwards.
- Upper right button = Up arrow, scroll up or increase a value.
- Middle right button = Enter or Return button, approve a value or action.
- Lower right button = Down arrow, scroll down or decrease a value.




### Condensing unit display

1. Time and date
2. Main values
3. Unit status (unit off) and compressor and fan status (unit on)
4. Active alarm signal and manual operation
5. Further information available by pressing ENTER button

# 5. Commissioning and start up

### DC3 room control start up wizard

Plug a Carel service tool into the DC3 room control via the RJ11 plug on the bottom of the front panel.

The Carel service tool display will show the start-up wizard.

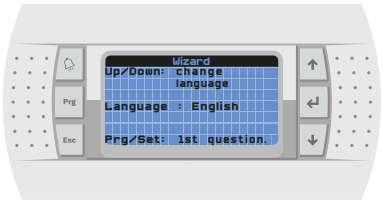
Answer the questions on the start-up wizard to set up the main cold room parameters.

Fine tuning is possible later by accessing the configuration menu.

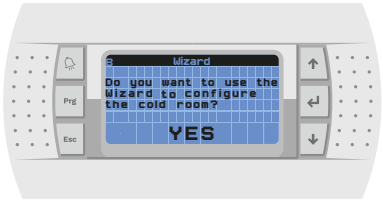
The default password = **1234.**

---

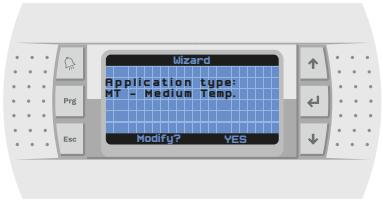
## Start Up Wizard Questions



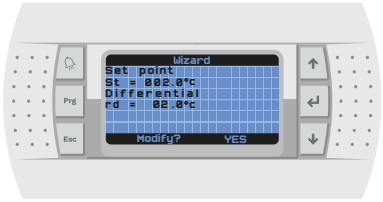

**1.** Enter to accept English Arrow down to change language



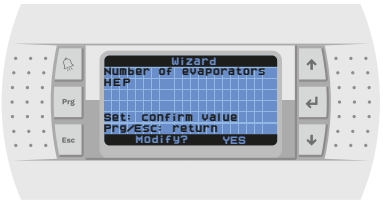

**2.** Enter twice to start the wizard



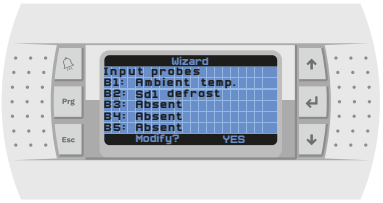

**3.** Enter to accept Medium Temperature



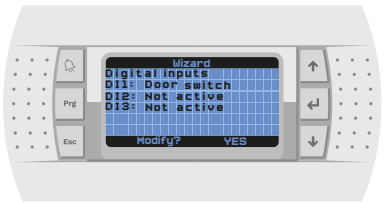

**4.** Enter to accept these settings Arrow down to adjust the set point or differential




**5.** Enter to accept these settings Arrow down to adjust the number of evaporators.




**6.** Enter to accept the probe configuration. Arrow down to add any additional probes or sensors. If two evaporators are fitted both return air probes can be used, add B4 if evaporator 2 return air probe is used.

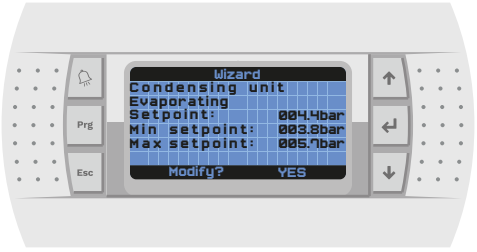



**7.** Enter if a door switch is fitted Arrow down to remove if door switch is not fitted. Add any other digital inputs

# 5. Commissioning and start up


**8.** Enter to accept default defrost parameters Arrow down to change


**9.** Enter to accept light switch default



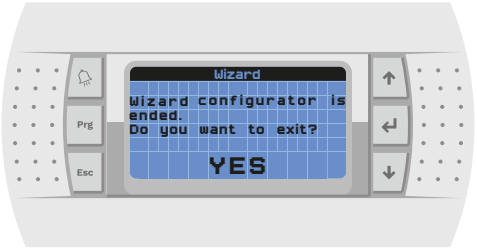

**10.** Enter to accept default values

Setpoint = the back up pressure if communication fails

Min setpoint = minimum suction float limit

Max setpoint = maximum suction float limit

Change these values if R448A is used.




**11.** Arrow to YES and Enter to exit the wizard

### R448A – Additional steps if R448A is used

Plug the Carel service tool into the condensing unit or use the condensing unit display to select R448A refrigerant. Press the program button and enter the password 0000, scroll to 'Compressors' and then scroll to 'Advanced' and press enter button. Select refrigerant type 'R448A' and press escape once to return to the 'Advanced' menu. Scroll to 'Cag02' and press enter, change compressor type to 'AGB33F-R448A' for the two-fan model or 'AGB78-R448A' for the three-fan model. (number of condenser fans). Press escape button multiple times to return to home screen.

### System start up

Unplug the service tool from the RJ11 connection and take it to the outdoor condensing unit.

Unplug the condensing unit display panel and plug the service tool in its place using the RJ11 connector.

Press program button and enter password **0000** to access configuration parameters 'Main Menu' 1/0 screen.

Press enter to 'Unit Status' screen, arrow down to On/Off, press enter to access On/Off and switch unit on.

Repeatedly press the Escape / Back button to return to the default screen.

It is possible to check the status of the inputs and outputs (I/O) of the entire system through the I/O menu on the DC3 service tool.

System I/O (input and output) status's can also be observed from the included outdoor unit display panel.

Other system parameters can be checked using the Carel service tool when plugged into the DC3 room control.

# 5. Commissioning and start up

## Dual evaporators (if fitted)

If two evaporators are fitted the second (auxiliary) evaporator serial address must be manually set using the buttons on the EVD Ice inside the auxiliary evaporator. Access programming mode by pressing Up and Down Arrows together for 5 seconds. Press down arrow to reach parameter ‘n1. Press PRG/ Set to display the value. Press Up/Down to modify the value to ‘98’. Press PRG/Set to confirm and return to parameter code.

The defrost temperature sensors of both evaporators need to be used to ensure either evaporator can demand a defrost and that both evaporators are completely defrosted before a temperature termination.

Wiring of the return air regulation temperature sensor of the second evaporator is optional, if the sensor is not used the cold room temperature control will be from the sensor in evaporator 1. If the sensor in the second (auxiliary) evaporator is used the cold room temperature control can be averaged across the two sensors with an even or uneven bias to either sensor. This bias can be set using parameter /A4 using the Carel service tool via the DC-3 room control probes screen.

The second evaporator EEV can be closed using a digital input, this is called ‘half load operation’ and is useful if the second evaporator is close to a door. This can be enabled using the service tool via the DC-3 room control from the Alarm menu, set A11 = 9. A separate door switch can be used to close the EEV to reduce ice building up when the door is opened.

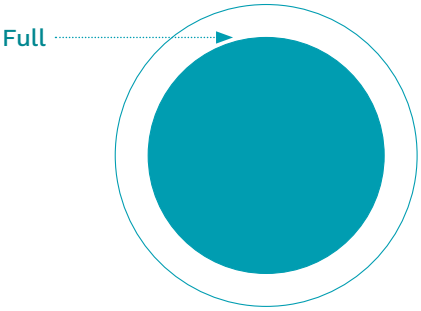
The fan of the second evaporator can be controlled using a digital input, this is useful if the second evaporator is close to a door. A separate door switch can be used to stop the fan to reduce ice building up or warm air being introduced when the door is opened. This can be enabled using the service tool via the DC-3 room control from the Configuration menu, set H5 = 12. This requires separate power wiring of the second evaporator fan via the Auxiliary 2 contacts of the DC-3 room control.

## System operational checks

**Operation checks include but are not limited to the following:**

- Voltages of all phases
- Amperages of compressor and fans
- Suction and discharge pressures
- Compressor suction superheat
- Evaporator one (and two if fitted) suction superheat
- Liquid sub-cooling
- Liquid line moisture indicator colour and sight glass clearness
- Compressor discharge temperature
- Compressor oil sight glass level (Full)
- Confirm that oil is returning to the compressor
- Check defrost sensor/s reading is lower than the return air regulation sensor
- Refrigerant charge
- Vibration and noise
- Suction pressure lower and upper float limits are being maintained
- Condenser fans are modulating based on the condensing pressure set point
- Observe an on/off cycle and ensure no liquid slugging at compressor start-up
- Cycle times (no more than 8 compressor starts per hour)

**Correct compressor oil level**



# 5. Commissioning and start up

### Suction filter cartridge removal

After 24 to 48 hours operation the suction filter cartridge should be removed from the suction filter shell.

The filter cartridge is included in the demountable shell to filter out any debris from the new system pipe work.

1. Close the liquid line PCLV located near the liquid line filter drier and allow the system to pump down to the pump down threshold of 2.2 bar gauge at which point the compressor will switch off.
2. Isolate the outdoor unit power supply.
3. Isolate the suction filter by closing the compressor suction, discharge and oil ball valves.
4. Recover the remaining refrigerant from the suction line into a clean pump down cylinder, this will be a fraction of the total charge as most of the charge will have been pumped down into the liquid receiver and condenser.
5. Remove the filter cartridge and reassemble the empty demountable shell.
6. Leak test and evacuate this section of line and filter shell.
7. Open the compressor suction, discharge and oil ball valves fully.
8. Restart compressor and reintroduce the refrigerant from the pump down cylinder into the suction line.
9. Check unit operation.

# 6. Maintenance and decommissioning guidelines

## Troubleshooting and maintenance tips

The DC3 smart refrigeration system will record alarms in the alarm log.

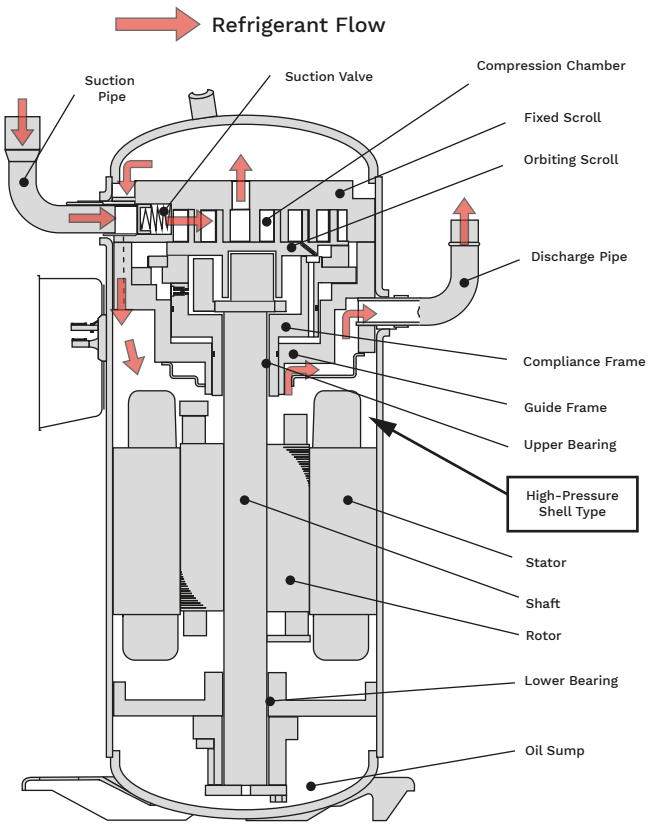
The alarm log is accessible using the alarm button of the outdoor condensing unit user interface display. All alarms in the alarm log are time and date stamped and record the unit vital values at the time of the alarm.

Non-critical alarms are auto reset to ensure ongoing refrigeration.

The electrical wiring diagram is adhered to the electrical panel for easy access.

The suggested field wiring diagram is adhered to the electrical panel for easy access.

**Compressor Construction and Refrigerant Flow**




The system piping and sensor schematic diagram is adhered to the compressor access panel for easy access.

Before carrying out maintenance or altering any settings inspect these diagrams.

HP/LP safety controls – Separate encapsulated high and low-pressure safety switches power a contactor which supplies the Power+ inverter. If a high-pressure or low-pressure safety event occurs the contactor will open removing the three phase AC supply to the Power+ inverter. This will automatically reset when pressure returns to within normal values.

If the serial communication is lost between any of the major components an alarm will activate.

If the serial communication to the outdoor unit is lost the outdoor unit will use the suction set point pressure as the target pressure. The default value is 3.5 bar gauge.

If the indoor evaporator unit/s communication is lost the system will generate an alarm and will operate for 24 hours only as there is a risk of liquid flood back. The EVD Ice will continue to operate without serial communication.

The Carel service tool makes fault finding much easier so it is good practice to plug the service tool into the DC room control when trouble shooting faults. The DC3 room control will display faults as fault codes on its fixed display panel, the service tool will show these faults in plain English.

DC3 has a Modbus point available on the outdoor condensing unit, this can be used to supervise the system remotely using Tera or Boss systems. These systems will log unit data values for analyses, monitor HACCP requirements and allow remote access to reset alarms and change some parameters.

Check the Actrol web site for further trouble shooting tips and manuals.

## Handover to end user

When the commissioning is complete the contractor should provide a full explanation of system usage to the end user.

Section 6 of this instruction should be completed, and this instruction left with the end user, so the unit base data is known.

# 6. Maintenance and decommissioning guidelines

## Maintenance guidelines

Just like a car it is good practice to have regular preventative maintenance performed to ensure this DC3 smart refrigeration system continues to perform reliably and efficiently.

- 3 monthly – Outdoor condenser and indoor evaporator coil checks, clean as required.
- 3 to 6 monthly – Operational check including but not limited to electrical connections, voltages, amperages, pressures, temperatures including compressor superheat, unit sub-cooling and discharge temperature, refrigerant leak check, moisture indicator check and correct compressor oil level.

Use of genuine spare parts from Actrol is recommended.

## De-commissioning guidelines

- This DC3 smart refrigeration system contains refrigerant and oil that is harmful to the environment; these must be recovered and returned to an approved recycling or destruction facility.
- Only fully qualified licensed personnel should carry out decommissioning of this unit.
- It is illegal to vent some types of refrigerant to the atmosphere.
- Disconnection of electricity supply wiring must be carried out by fully qualified and licensed personnel.
- This unit should be disposed of in a responsible manner.

**CAUTION – This unit contains high pressure refrigerant and oil.**

## Glossary of terms

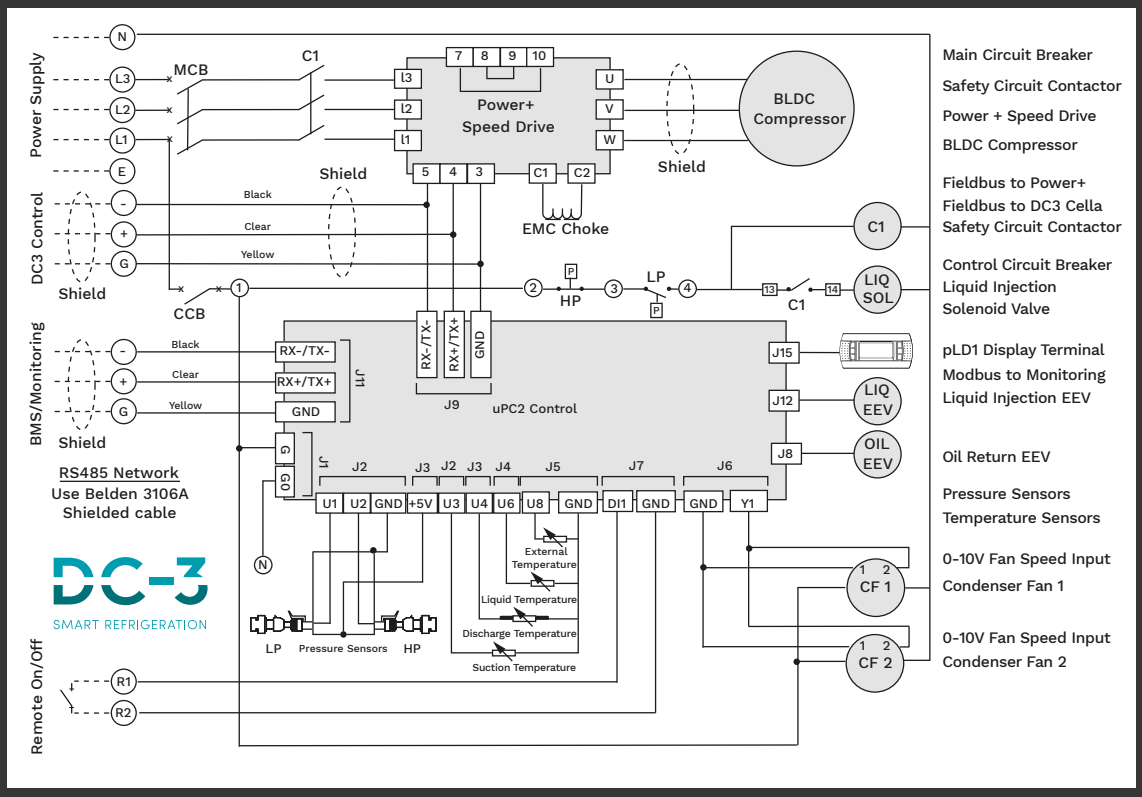
- Outdoor condensing unit – outdoor unit comprising compressor, condenser with associated components to recirculate refrigerant via external components and back through the condensing unit.
- Indoor evaporator unit – heat exchanger with fans and electronic expansion valve and controller mounted inside the refrigerated space.
- DC3 room control – electronic room control and display with system on / off switch.
- BLDC compressor – brushless direct current compressor.
- EC condenser fans – Electronically commutated condenser fans.
- HFC refrigerant – hydro-fluoro-carbon fluid circulated around a refrigeration system used to transfer heat energy by changing phase from vapour to liquid and back to vapour.
- PVE oil – Polyvinyl ether oil contained inside the system to lubricate the compressor.
- External temperature – the air temperature surrounding the outdoor condensing unit.
- Modbus communications – RS485 serial network for communications between all components.
- Power+ Inverter – AC to DC inverter to modulate compressor speed.

## Ongoing product improvement

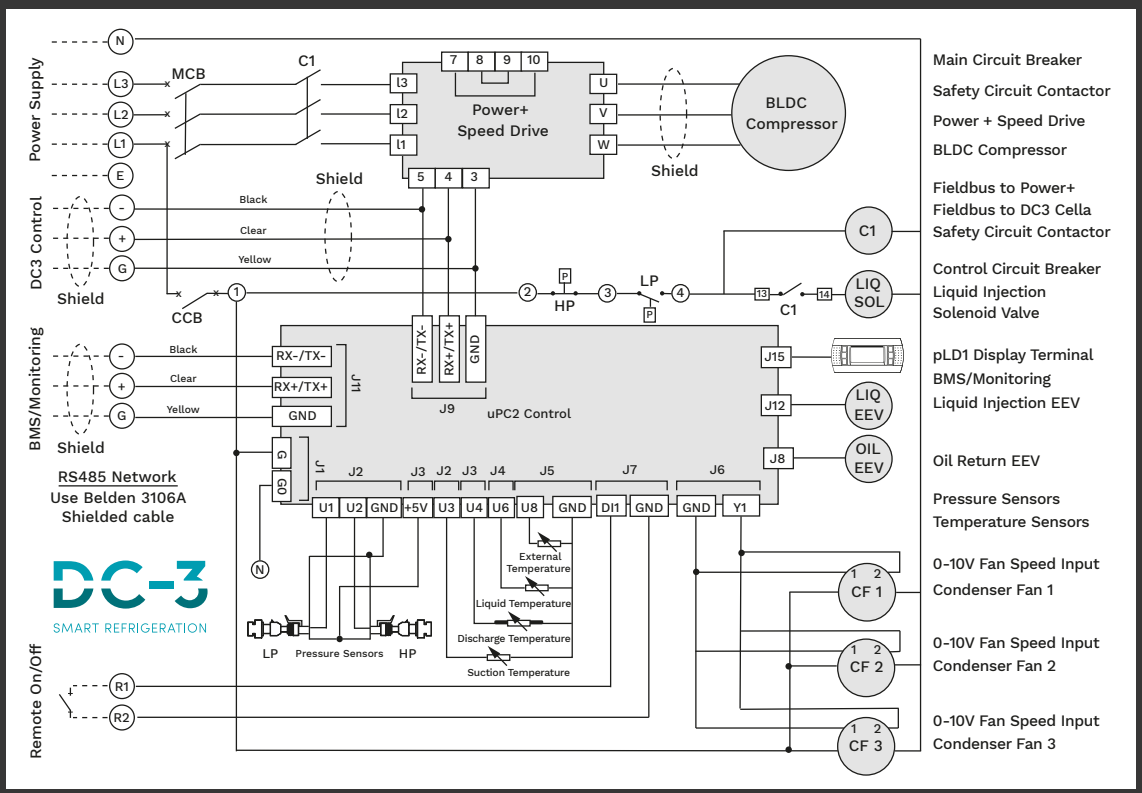
Due to ongoing product improvement Actrol reserves the right to change equipment specification without notice.

# 7. Electrical wiring and unit piping schematic diagrams

## Wiring diagram for model APDC8.5M2-1

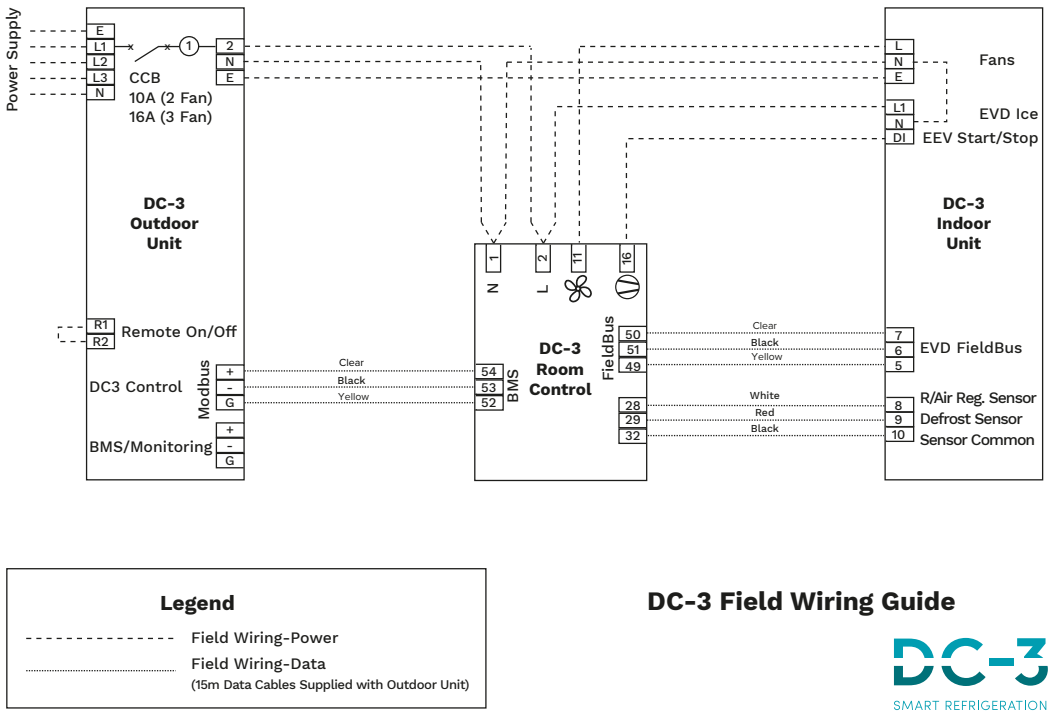



## Wiring diagram for model APDC21.4M3-1

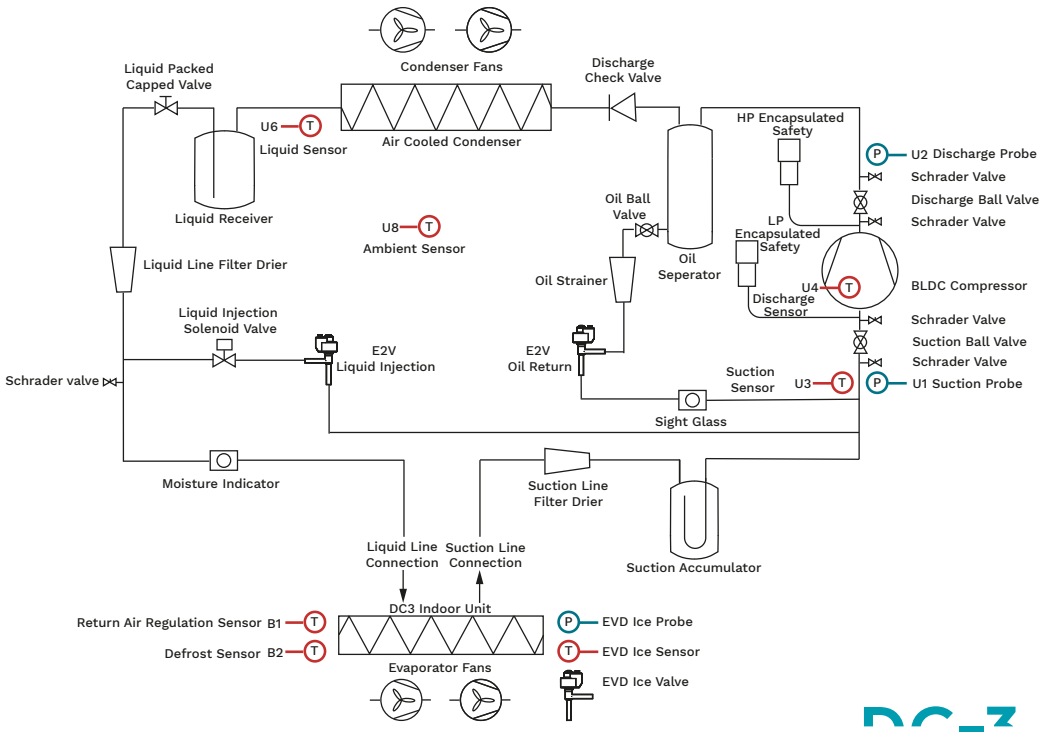


# 7. Electrical wiring and unit piping schematic diagrams

## System field wiring schematic diagram

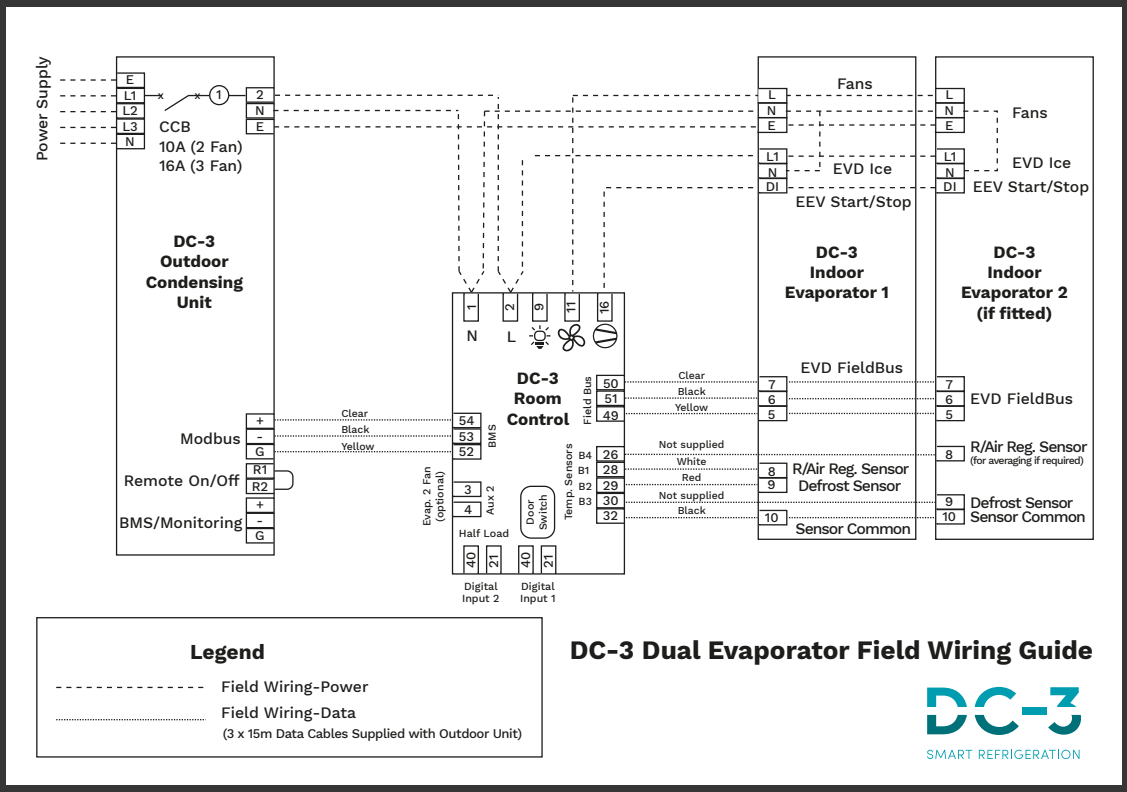



## System pipe and sensor schematic diagram for model APDC8.5M2-1

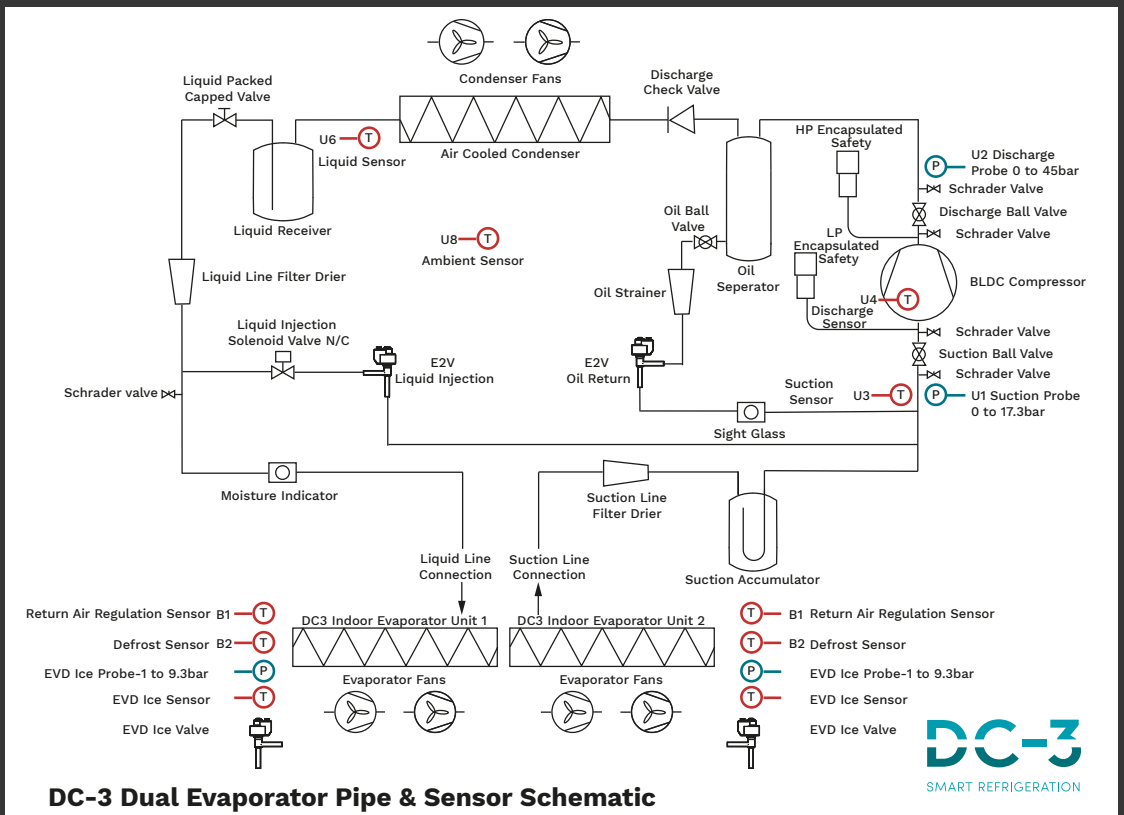


# 7. Electrical wiring and unit piping schematic diagrams

## System field wiring schematic diagrams for single and dual evaporator system




## System pipe and sensor schematic diagram for single evaporator system



# 8. Commissioning and operation details

**CUSTOMER/SITE:** **DATE:**

**SERVICE TECHNICIAN:** **JOB#**

Application Unit ID Code

(Products Stored in Coolroom. Pull Down or Holding Temperature) (i.e. Coolroom # 2.1)

Ambient Temperature (‘C) Application Temperature (‘C)

## Equipment Details

Compressor / Unit Model # Refrigerant

Evaporator (Make & Model)

Condenser / Condensing Unit (Make & Model)

Pipe Run & Sizes (Equivalent Length)

## SYSTEM OPERATIONAL OBSERVATIONS (MOST OBSERVATIONS AVAILABLE FROM OUTDOOR UNIT DISPLAY)

Refrigerant Type Charge Quantity

Charge Condition

(Products Stored in Coolroom. Pull Down or Holding Temperature)

Suction Pressure (Gauge)

Suction Vapour Temperature (‘C) (B )

Suction Pressure (Gauge)

Suction Vapour Temperature (‘C) (E )

Discharge Pressure (Gauge)

Discharge Line Temperature (‘C) (F )

Liquid Pressure (Gauge)

Liquid Line Temperature (‘C) (J )

Equivalent Saturated Suction Temp. (‘C)

**Calculated Evaporator Superheat (K)**

Equivalent Saturated Suction Temp. (‘C)

**Calculated Superheat at Compressor (K)**

Equivalent Saturated Suction Temp. (‘C)

**Calculated Discharge Superheat (K)**

Equivalent Saturated Liquid Temp. (‘C)

**Calculated Liquid Subcooling (K)**

Measured Suction Pressure After Defrost

Compressor Oil Level

(Should be Full Compressor Oil Sight Glass)

Oil Condition

(Clean, Clear, Honey, Brown, Black, Carried Out Acid Test)

Sump Heater Current Draw During Off Cycle (Measured Current Draw)

### CONDENSER

AIR ON TO COIL (TEMP 'C )

AIR OFF TO COIL (TEMP 'C )

### EVAPORATOR

AIR ON TO COIL (TEMP 'C )

AIR OFF TO COIL (TEMP 'C )

### CONDENSER

L.P. Cut In L.P. Cut Out

H.P. Cut In H.P. Cut Out

### DC3 ROOM CONTROL

Set Point

Differential

# of Defrosts/24hrs Defrost Period

Termination Temp.

| Supply Requirement | Volts | Hz | Phase | |
|---|---|---|---|---|
| Measured Volts | L1 | L2 | L3 | (Maximum 2% Imbalance) |
| Measured Current | L1 | L2 | L3 | (Maximum 10% Imbalance) |

(Maximum 8 Starts per Hour)

**Notes**

**Full Name**

**Signature**

# Notes

# Notes

ACTROL™ | DC-3 SMART REFRIGERATION

DC3 Installation and Operation Instruction V2 –
DC3 Outdoor unit, Indoor unit, and Controller – Issued October 2019