Air Cooled Inverter Chiller
Content

- Product Lineup & Features
- Components
- Schematic diagram
- Inverter technology
- Control Algorithm
- Chiller Panel Controller
- Self diagnosis & Troubleshooting
- Installation
Product Lineup & Features
Product Lineup

5ACV30 CR

5ACV55/75 CR

5ACV100/135/210 CR

5ACV30 CR
## Capacity

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cooling</td>
</tr>
<tr>
<td>5ACV030CR</td>
<td>7.94</td>
</tr>
<tr>
<td>5ACV055CR</td>
<td>14.65</td>
</tr>
<tr>
<td>5ACV075CR</td>
<td>20.52</td>
</tr>
<tr>
<td>5ACV100CR</td>
<td>27.80</td>
</tr>
<tr>
<td>5ACV135CR</td>
<td>38.54</td>
</tr>
<tr>
<td>5ACV210CR</td>
<td>58.62</td>
</tr>
</tbody>
</table>
Features

New Technology BPHE- True Dual Circuits

- Conventional Back to Back Circuits BPHE

- 5ACV True Dual Circuits BPHE
Features

**Inverter Compressor**

- **Precise & Stable Temperature Control**
- **Fast Cooling**

**Conventional System**

**Inverter System**

- **LESS START & STOP**
  Frequency regulated compressor resulting in lesser in the sense of start and stop of compressor, which is greatly reduce the energy consumption.

- **FAST COOLING / HEATING**
  Unlike the other conventional systems, inverter compressor has the ability to produce faster cooling / heating capacity at the frequency higher than the dominant capacity frequency.

- **SMART LOADING / UNLOADING**
  With the integration of built in system algorithm; inverter compressor could control the system loading and unloading sophisticatedly.

- **BETTER COMPRESSOR RELIABILITY**
  Reliability of inverter compressor is always better since there is lesser ON/OFF of the system especially during the low load condition.

- **LOW STARTING SURGE**
  Inverter compressor require lower starting torque and thus, resulting in lower starting current.
Inverter is based on ESEER due to part loading (25%-50%-75%-100%).
Features

Elimination of Water Tank

Inverter system provide constant Water Temperature band, or much lesser water temperature fluctuation. With this, water tank of mini chiller system can be eliminated.

Modular Installation

A network up to 50 chillers in a system is possible. Control on the operation of chillers will be done through the microprocessor controller. The external water piping connection can be made either from the left or right side of the unit.

Safety Protection

• High & Low Pressure Switches
• Anti Freeze Protection Sensor
• Discharge Temperature Sensor
• Over Pressure Relief Valve
• Water Pressure Differential Switch
• Anti Freeze Heater on BPHE
• Compressor, Water Pump Overload Protector
Components
Components

- Variable speed fan motors (100%, 70% & 50%)
- Heat exchangers with gold fin as standard
- True dual circuits BPHE (Brazed plate heat exchanger)
- Fan guards
- Coil guards
- Control box assembly
- Expansion tank (8L)
- Water pump
Components

High pressure switch (NC) 600 psi – open, 480 psi – close.
Low pressure switch (NC) 18 psi – open, 28 psi – close.
Differential pressure switch
Over pressure relief valve
Anti freeze heater on BPHE
Pump OLP (overload protector)
Compressor OLP (overload protector)

EXV (Electronics expansion valve)
Chiller panel controller
4 Way valve
Fixed speed scroll compressor (R410A)
Variable speed scroll compressor (R410A)

Variable drive system compartment
Fixed drive system compartment
Components

Control box assembly

- Uni-directional bridge diode
- 3 phase rectifier bridge diode
- PTC starter (Positive temperature coefficient)
- Fan capacitors
- IPM board (Intelligent power module)
- Power board
- Capacitor board
- Main board
- EMI filter
- Magnetic contactors
- PFC capacitor (Power factor correction)
Schematic diagram
Inverter chiller schematic diagram

- Cond In Temp 1 (Condenser)
- Cond Out Temp 1 (Def Comp 1)
- Condenser Coil 1
- Condenser Coil 2
- HP1
- HP2
- 4WV
- LP1
- LP2
- Inv Comp
- Disch Comp 1
- Disch Comp 2
- Suct Temp (Suction)
- BPHE Out Temp (BPHE Out)
- BPHE In Temp (BPHE In)
- EWT (Water In)
- LWT (Water Out)
- Pump
- Check valve
- Cooling Cap Tube
- Heating Cap Tube
- EXV
- Filter Drier
- Liq Rvr
- O/A Temp (Outdoor Air)
- Summary Pages- Screen 3
- Display Menu- Defrost Sensor
- Display Menu- Inverter Chiller
- Display Menu- Discharge Sensor

Air Cooled Inverter Chiller
Inverter technology
Inverter technology

What Inverter can do for us?

- Less Start & Stop
- Fast Cooling/ Heating
- Smart Loading/ Unloading
- Better Compressor Reliability
Inverter technology

Brief Introduction on Inverter Technology

Inverter basic structure

Inverter control technology convert AC supply to DC and convert it back to AC. The frequency & voltage of each phase can be controlled and applied on asynchronous motor for variable load control.
• To minimize emission effect (EMC) and raise immunity level (EMS), a LC filter is used.
• PTC resistor acts to cushion start up current to capacitor.
• Diode bridge inverts AC to DC.
• PTC capacitor acts to restraint PF losses caused by fluctuation of DC voltage.
• Inversion circuits consists of 6 IGBT. (Insulated Gate Bipolar Transistor)
• By controlling the linkages, different frequency and 3 phase AC voltage can be generated.
• IPM (Intelligent Power Module) encased the inversion circuitry, error detection & protection features.
By computing the on-off frequency and timing of IGBT, a series of output voltage pulse widths can be integrated to form a sine wave for application on VVVF. (Variable Voltage Variable Frequency)
• Every inverter chiller has its typical characteristic and VVVF (variable voltage variable frequency) curve.

• To control Asynchronous motor, it is desirable to maintain magnetic flux for torque requirement.

• Excessive of magnetic flux will cause excitation and diminish the flux.

• To maintain optimum flux, the voltage varies with frequency.
Control Algorithm
Control Algorithm

Variable Drive Compressor Control

Cooling mode

Start up condition:

• Pump runs normally for 2 minutes *

• $2^\circ\text{C} \leq T_{\text{water return}} - T_{\text{set}} \leq 4^\circ\text{C}$

• No irreversible errors in variable drive and the systems

• Satisfy a delay of 3 minutes before restart#

Note: If fixed drive system starts first, the variable drive system should trail after 30 sec.

* Depends on Parameter P2 (flow switch alarm delay at pump start. Min 0s, max 199s, default 120s)

# Depends on Parameter C2 (compressor min stop time. Min 0s, max 1990s, default 180s)

For example:
Return water temp. = 14 to 16 °C
Set temp = 12°C
$\Delta T$ = 2 to 4°C
**Control Algorithm**

**Cooling mode**

Cooling mode selected → water pump starts → Outdoor fan starts → variable drive compressor starts

- **Rated Freq.**
  - 5ACV100CR=75Hz
  - 5ACV135CR=95Hz

- **Variable drive comp**
- **Outdoor fan**

- **Increase to rated frequency with the rate of 1Hz/s**
- **Inverter compressor will start from 5Hz to 55Hz and maintain this frequency for 1 min.**

- **Outdoor fan will start 5 sec before compressor start**
Control Algorithm

Cooling mode

Shut down condition:

• Cooling mode terminates, OR

• Variable drive system error occurs, OR

• \( T_{\text{water return}} - T_{\text{set}} \leq -2^\circ\text{C} \)

For example:
Return water temp. = 10°C
Set temp = 12°C
\( \Delta T \) = -2°C
Control Algorithm

Heating mode

Start up condition:

- Pump runs normally for 2 minutes *
- \[2\, ^\circ\, C \leq T_{\text{set}} - T_{\text{water return}} \leq 4\, ^\circ\, C\]
- No irreversible errors in variable drive and the systems
- Satisfy a delay of 3 minutes before restart #

For example:
- Set temp = 40°C
- Return water temp. = 36 to 38°C
- \[\Delta T = 2\, \text{to}\, 4\, ^\circ\, C\]

Note: If fixed drive system starts first, the variable drive system should trail after 30 sec.

* Depends on Parameter P2 (flow switch alarm delay at pump start. Min 0s, max 199s, default 120s)
# Depends on Parameter C2 (compressor min stop time. Min 0s, max 1990s, default 180s)
## Heating mode

Heating mode selected → water pump starts → Variable drive 4WV engages → Outdoor fan starts → compressor starts

- Increase to rated frequency with the rate of 1Hz/s
- Inverter compressor will start from 5Hz to 45Hz and maintain this frequency for 1 min.
- Variable drive 4WV will start 10 sec before compressor start
- Outdoor fan will start 5 sec before compressor start

| 5ACV100CR | 65Hz |
| 5ACV135CR | 90Hz |
Control Algorithm

Heating mode

Shut down condition:

- Heating mode terminates, OR
- Variable drive system error occurs, OR
- $T_{set} - T_{water\ return} \leq -2^\circ C$

For example:
Set temp = 40°C
Water return temp = 42°C
$\Delta T = -2^\circ C$
Control Algorithm

Fixed Drive Compressor Control

Cooling mode

Start up condition:

• Pump runs normally for 2 minutes *

• \( T_{\text{water return}} - T_{\text{set}} > 4°C \)
  
  Fixed drive starts first followed by variable drive

• No irreversible errors in fixed drive and the systems

• Satisfy a delay of 3 minutes before restart #

For example:

- Water return temp = 16°C
- Set temp = 12°C
- \( \Delta T \) = 4°C

Note: If variable drive system starts first, the fixed drive system will only start after the frequency of variable drive drops to 50Hz.

* Depends on Parameter P2 (flow switch alarm delay at pump start. Min 0s, max 199s, default 120s )
* Depends on Parameter C2 (compressor min stop time. Min 0s, max 1990s, default 180s)
Control Algorithm

Cooling mode

Cooling mode selected → water pump starts → Outdoor fan starts → compressor starts

- Fixed drive compressor starts
- Outdoor fan will start 5 sec before compressor start
- Outdoor fan will stop after compressor has stopped for 1 min
Control Algorithm

Cooling mode

Shut down condition:

- Cooling mode terminates, OR
- Fixed drive system error occurs, OR
- $T_{\text{set}} - T_{\text{water return}} > 2^\circ\text{C}$ and variable frequency drops pass 20Hz

For example:

- Set temp = 12°C
- Water return temp = 10°C
- $\Delta T = 2^\circ\text{C}$
Control Algorithm

Heating mode

Start up condition:

- Pump runs normally for 2 minutes *

- $T_{\text{set}} - T_{\text{water return}} > 4^\circ\text{C}$

- No irreversible errors in fixed drive and the systems

- Satisfy a delay of 3 minutes before restart #

Note: If variable drive system starts first, the fixed drive system will start after the variable drive frequency drops to 50Hz.

For example:
Set temp = 40°C
Water return temp = 36°C
$\Delta T$ = 4°C

* Depends on Parameter P2 (flow switch alarm delay at pump start. Min 0s, max 199s, default 120s)
# Depends on Parameter C2 (compressor min stop time. Min 0s, max 1990s, default 180s)
Control Algorithm

Heating mode

Heating mode selected → water pump starts → Fixed drive 4WV engages → Outdoor fan starts → compressor starts.

- Outdoor fan will start 5 sec before compressor start.
- Fixed drive 4WV will start 10 sec before compressor start.
- Outdoor fan and 4WV will stop after compressor has stopped for 1 min.
Control Algorithm

Heating mode

Shut down condition:

- Heating mode terminates, OR

- Fixed drive system error occurs, OR

- $T_{\text{water return}} - T_{\text{set}} > 2^\circ\text{C}$

For example:
- Water return temp = 42°C
- Set temp = 40°C
- $\Delta T$ = 2°C
Control Algorithm

Pump Control

Pump start up

When starting the system, pump will run for 2 minutes * before proceeding to next step.

* Depends on Parameter P2 (flow switch alarm delay at pump start. Min = 0s, Max = 199s, default = 120s)

Pump shut down

After both compressors shut down for 1 minute, pump shuts down.
Control Algorithm

Pump Control

System error

When errors occur in the system and require system to shut down, the pump will shut down 1 minute after the system shuts down. If compressor is not running, the pump shuts down immediately.

Note: When changing operating mode or when temperature reaches setting, pump continues to run.
**Control Algorithm**

**Auxiliary heater control (Info only)**

**Start up conditions**
- System in heating mode AND
- System no error alarm AND
- After heating starts for 1 hour and
  \[ T_{\text{set}} - T_{\text{water return}} > 5^\circ C \]

The second time start up is not time-dependent.

**Switch off conditions**
- System terminates heating mode OR
- Wired handset withdraws auxiliary heating command, OR
- System errors trigger alarm and require shut down, OR
- When \( T_{\text{set}} - T_{\text{water return}} < 2^\circ C \)

For example:
- Set temp = 40°C
- Water return temp = 34°C
- \( \Delta T = 6^\circ C \)

\[ \Delta T < 2^\circ C \]
Control Algorithm

EXV control (Electronic expansion valve)

- When system operates for the first time, EXV will operate to preset openings.

- After system operates for 10 minutes, the EXV will preset to superheat regulation for variable drive system.
Control Algorithm

4 way reversible valve control

- Select heating mode: 4 WV engage 5 sec
- Heating starts
- Stop heating mode: compressor stops 4 WV disengage 60 sec

When selecting heating mode, 4 way valve will engage 5 seconds before heating start up.
When heating stops, 4 way valve will disengage 60 seconds after compressor stops.

Compressor crankcase heater control

- Fixed drive compressor crankcase heater is driven by the fixed drive contactor (NC).
- Variable drive compressor crankcase heater is driven by main board relay.
- Crankcase heater will be ON whenever compressors are not in operation.
Outdoor fan control

Control basic

• Fixed drive and variable drive outdoor fan are independently controlled.

• During start up, fan operates at fixed speed. During operation, fans operate at variable speed.

• There are 3 fan speeds in High, Medium and Low fan speed.

• The High fan speed is 680 RPM and 3800CFM for each fan motor.

• The ratio of fan speed is 100%, 70% and 50% respectively.
Control Algorithm

Outdoor fan control

Fan control for Cooling
- Within 20 minutes of normal operation, when Te (Outdoor ambient temp.) ≥ 28°C, fan operates at highest speed.
- Within 20 minutes of normal operation, when Te (Outdoor ambient temp.) <28°C, fan operates at medium fan.
- After normal operation for 20 minutes, when 40°C < (T_a3, T_b2) < 48°C, the fan operates to variable speed (PI regulation). The lower the temperature the lower the speed.

\[ T_{a3} = \text{condenser outlet temp. (Variable drive system)} \]
\[ T_{b2} = \text{condenser outlet temp. (Fixed drive system)} \]
\[ \text{PI} = \text{program intelligent} \]
Outdoor fan control

Fan control for Heating

- When $Te$ (Outdoor ambient temp.) < 10°C, fan operates at highest speed.
- When $10°C \leq Te$ (Outdoor ambient temp.) ≤ 12°C, fan operates at medium fan.
- When $Te$ (Outdoor ambient temp.) > 12°C, fan operates at variable speed to PI regulation. The higher the temperature the lower the speed.
Control Algorithm

Outdoor fan control

Fan operation during defrosting

Fan stops 1 minute after the compressor stops.
Anti freeze heater control

Anti freeze on/off control during system standby

- Runs when system in standby mode
- If $T_e$ (outdoor ambient temperature) $\leq 5^\circ C$ and $T_{water\ return} \leq 5^\circ C$, water pump runs 5 minutes every hour and antifreeze heater will run on and off together with the water pump.
- If $T_{water\ return} > 6^\circ C$ water pump and antifreeze heater will stop.
- If $T_e \leq 2^\circ C$ and $T_{water\ return} \leq 2^\circ C$, system enters heating mode and returns to standby when $T_{water\ return} > 30^\circ C$
Anti freeze heater control

Anti freeze during cooling

- When $T_{\text{water leaving}} \leq 5^\circ C$, antifreeze heater will operate until $T_{\text{water leaving}} > 7^\circ C$.

- When $T_{\text{water leaving}} \leq 3^\circ C$, alarm will set off until $T_{\text{water leaving}} > 5^\circ C$.

Factory setting for antifreeze heater = 5°C  
alarm set point = 3°C

Water leaving temperature
Defrosting control

Automatic defrosting

Shall satisfying the below automatic defrosting condition for 3 minutes:
- Compressor operates continuously for at least the duration of the defrosting interval.
- When $T_{a3}$ or $T_{b2} \leq 0^\circ C$ * OR
- When $T_{\text{water return}} > 18^\circ C$

* Depends on Parameter D1 (Start defrost temperature. Min -20°C, max 14°C, default 0°C )

Note: Factory defrost interval depends on Parameter D4 (Defrost interval time). Intelligent defrost interval varies. Under Parameter defrost mode, Intelligent defrost is set as default under DISABLE mode. Factory standard defrost will be activated when the parameter is set to ENABLE.

Manual defrosting

Manual defrosting can be carried out when $T_{a3}$ or $T_{b2} < 7^\circ C$
Defrosting control

Defrosting process

Variable drive defrosting process

- When defrosting conditions are met for variable drive, variable drive compressor stops → outdoor fan stops → 4WV disengages → variable drive starts defrost at 90Hz.
- When variable drive defrosting terminates, variable drive compressor stops → 4WV engages → outdoor fan starts → variable drive compressor starts → Resume heating operation.
Defrosting control

Defrosting process

Fixed drive defrosting process
- When defrosting conditions are met for fixed drive, fixed drive compressor stops (15 sec) → outdoor fan stops (2 sec) → 4WV disengages (10 sec) → fixed drive compressor starts defrost
- When fixed drive defrosting terminates, fixed drive compressor stops → outdoor fan starts at high speed for 30 sec → 4 WV engages → Fixed drive compressor starts → Resume heating operation.
Control Algorithm

Defrosting control

Defrosting process

• As the outdoor fan ducts are independent, defrosting is independent, system restricts defrosting of fixed drive and variable drive at the same time.

• When either variable or fixed drive high pressure protection is triggered, compressor will stop.

• During defrosting, low pressure operation will not trigger protection.
Control Algorithm

Defrosting control

Defrosting termination conditions

When either of the below condition is met, defrosting terminates:

- \( T_{a3} \) or \( T_{b2} > 14^\circ C \) *, OR
- Defrosting time exceed 10 minutes #, OR
- \( T_{\text{water return}} < 10^\circ C \)

\( T_{a3} \) = condenser outlet temp. (Variable drive system)
\( T_{b2} \) = condenser outlet temp. (Fixed drive system)

* Depends on Parameter D2 (End defrost temperature. Min=0°C, max=40°C, default =14°C)
# Depends on Parameter D3 (Maximum duration of defrost cycle. Min=1min, max=40min, default=10min)
Defrosting control

Defrosting cycle self-adaptive adjustment

The next defrosting cycle depends on that of the previous.

1. Defrosting time < 2 minutes, next cycle 120 minutes
2. Defrosting time 2 to 4 minutes, next cycle 80 minutes
3. Defrosting time 4 to 6 minutes, next cycle 60 minutes
4. Defrosting time 6 to 8 minutes, next cycle 40 minutes
5. Defrosting time > 8 minutes, next cycle 30 minutes
Control Algorithm

Control system protection

Compressor over-current protection

Variable drive compressor

- When variable drive compressor current reaches the maximum limit, over-current protection triggers and the compressor frequency will reduce.
- When the compressor current drops below the limit, frequency variation resumes.
- When compressor current increase rapidly and reaches the maximum limit, the system will be determined as compressor overload and stop the compressor.

<table>
<thead>
<tr>
<th>Comp amp (A)</th>
<th>Variable compressor stops</th>
<th>Frequency step down</th>
<th>Maintain frequency</th>
<th>Normal Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
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<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Control Algorithm**

**Control system protection**

**High discharge temperature protection**

**Variable drive system**
- When variable drive discharge temperature reaches 110°C, system stops.
- When variable drive discharge temp. between 100°C and 110°C, frequency drops.
- When variable drive discharge temperature is less than 97°C and more than 100°C, frequency increased restricted.
- When discharge temperature falls below 94°C, normal operation resumes.

![Diagram of control algorithm](image)

- Compressor discharge temperature
- System shuts down
- Frequency step down
- Maintain frequency
- Normal operation

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**Air Cooled Inverter Chiller**

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**Technical Training**
Control Algorithm

Control system protection

High discharge temperature protection

Fixed drive system

- When fixed drive discharge temperature reaches 110°C, system stops.
- When discharge temperature falls below 94°C for 3 minutes, system resumes.

\[ T_d = \text{Compressor discharge temperature} \]

\[ T_d = 110°C \]

\[ T_d = 94°C \]

Comp start

Comp Cut

3 min
Control Algorithm

Control system protection

Outdoor coil high temperature protection

Variable drive system
- During cooling, when $T_{coil1} > 60 \, ^\circ C$, frequency drops.
- During cooling, when $T_{coil1} < 55 \, ^\circ C$, system resumes.

Fixed drive system
- During cooling, when $T_{coil2} > 64\, ^\circ C$, compressor stops.
- During cooling, when $T_{coil2} < 51\, ^\circ C$, system resumes.
Control Algorithm

Control system protection

Low pressure switch protection

- Alarm delayed at compressor startup: 30 sec depends on Parameter P3*.
- No protection during defrosting.
- If variable drive or fixed drive low pressure switch is activated for 5 seconds, alarm will be triggered.

* Parameter P3 (Low pressure alarm delay at compressor start up. Min=0s, max=199s, default=30s)

Note: If low pressure alarm occur more than 3 times within 30 minutes, system shuts down to irreversible error.
Control Algorithm

Control system protection

High pressure switch protection

• If fixed drive high pressure switch is activated for 30 sec, alarm will be triggered.
• If variable drive high pressure switch is activated, frequency of variable drive compressor will decrease at 1Hz/s. If it is re-activated for 30 sec, alarm will be triggered.

Note: If high pressure alarm occur more than 3 times within 30 minutes, system shuts down to irreversible error.
Control Algorithm

Control system protection

3 phase AC phase sequence protection
If 3 phase AC phase sequence is incorrectly connected, system will not start and controller will indicate error. System will resume after rectification.

3 phase AC phase missing protection
If phase missing happens, system will not operate. Controller will indicate error. System will resume after rectification.
Chiller Panel Controller
Chiller Panel Controller

Short cut key

- Switching Cool Mode
- Switching Heat Mode
- On/Off Shortcut Key
- Show Alarm Key

Navigation key

- LCD Display
- On/Off Indicator
- Navigation Key (Up & Down)
- Execute Instruction Key
- Cancel Instruction Key

Short cut key can only be used in the summary page!
Chiller Panel Controller

- CMOS Reset Jumper (JH2)
- Reset some of the settings to the DEFAULT value
- Chiller Terminal Unit Connection (CN8)
- +12Vdc, GND; A, B
- Backup Battery
- Memorize of Date, Time & Timer Schedule
Chiller Panel Controller

Setting menu

Setting parameter for Inverter

Inverter parameter setting page on the chiller panel controller

- SETTINGS MENU
  - Set Parameter
  - Change Password
  - Panel Option
  - Set Panel ID

1. General
2. Regulator
3. Compressor
4. Condenser Defrost
5. Cool Mode Antifreeze
6. Inverter
7. Alarm & Contact

<table>
<thead>
<tr>
<th>V1 Cp Freq</th>
<th>0Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>V2 EXV</td>
<td>0</td>
</tr>
<tr>
<td>V3 Cp Manual</td>
<td>Disable</td>
</tr>
<tr>
<td>V4 EXV Manual</td>
<td>Disable</td>
</tr>
<tr>
<td>V5 Def Mode</td>
<td>Disable</td>
</tr>
</tbody>
</table>
### Chiller Panel Controller

There are 5 setting parameters for Inverter (V1 to V5)

<table>
<thead>
<tr>
<th>INVERTER</th>
<th>Unit</th>
<th>Default</th>
<th>Min</th>
<th>Max</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1 Compressor frequency</td>
<td>Hz</td>
<td>Auto</td>
<td>0</td>
<td>120</td>
<td>1</td>
</tr>
<tr>
<td>V2 EXV Opening</td>
<td>Flag</td>
<td>Auto</td>
<td>0</td>
<td>480</td>
<td>1</td>
</tr>
<tr>
<td>V3 Compressor manual setting</td>
<td>Flag</td>
<td>0 (disable) 0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>V4 EXV Manual setting</td>
<td>Flag</td>
<td>0 (disable) 0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>V5 Defrost Mode</td>
<td>Flag</td>
<td>0 (disable) 0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

V1 : Compressor frequency

It allows to set the inverter compressor frequency (max frequency varies according to models)

V2 : EXV (Electronic expansion valve)

It allows to set the EXV opening (0-480 pulsation)

V3 : Cp Manual

This parameter enable automatic or manual setting for the compressor frequency.

(Enable : manual setting is possible, Disable : frequency auto-run)
## Chiller Panel Controller

<table>
<thead>
<tr>
<th></th>
<th>INVERTER</th>
<th>Unit</th>
<th>Default</th>
<th>Min</th>
<th>Max</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>Compressor frequency</td>
<td>Hz</td>
<td>Auto</td>
<td>0</td>
<td>120</td>
<td>1</td>
</tr>
<tr>
<td>V2</td>
<td>EXV Opening</td>
<td>Flag</td>
<td>Auto</td>
<td>0</td>
<td>480</td>
<td>1</td>
</tr>
<tr>
<td>V3</td>
<td>Compressor manual setting</td>
<td>Flag</td>
<td>0 (disable)</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>V4</td>
<td>EXV Manual setting</td>
<td>Flag</td>
<td>0 (disable)</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>V5</td>
<td>Defrost Mode</td>
<td>Flag</td>
<td>0 (disable)</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

V4 : EXV Manual  
This parameter enable automatic or manual setting for the EXV opening.  
( Enable : manual setting is possible, Disable : EXV opening auto-run )

V5 : Def Mode  
This parameter enable automatic intelligent or standard defrosting.  
( Enable : manual setting is possible in Parameter D1-D6, Disable : Intelligent defrosting [auto-run] )
Chiller Panel Controller

Display menu

Display menu for Inverter

Inverter display menu page on the chiller panel controller

**Screen 1**

<table>
<thead>
<tr>
<th>Inverter Chiller</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp Freq</td>
<td>: 75Hz</td>
</tr>
<tr>
<td>EXV</td>
<td>: 320</td>
</tr>
<tr>
<td>Comp Amp</td>
<td>: 9.7A</td>
</tr>
<tr>
<td>DC Bus</td>
<td>: 555V</td>
</tr>
</tbody>
</table>

**Screen 2**

<table>
<thead>
<tr>
<th>Inverter Chiller</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction</td>
<td>: 15.5 ° C</td>
</tr>
<tr>
<td>BPHE In</td>
<td>: 45.9 ° C</td>
</tr>
<tr>
<td>BPHE Out</td>
<td>: 18.3 ° C</td>
</tr>
<tr>
<td>Condenser</td>
<td>: 28.4 ° C</td>
</tr>
</tbody>
</table>

DISPLAY MENU
Defrost Sensor
Discharge Sensor
Comp. Run Time
Inverter Chiller
Chiller Panel Controller

Display menu

Display menu for Inverter

Compressor Frequency
It shows the operating inverter compressor frequency. (Hz)

EXV
It shows the operating EXV opening (pulse).

Comp Amp
It shows the operating inverter compressor running current. (A)

DC Bus
It shows the operating DC voltage in the inverter system. (V)

Inverter Chiller

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp Freq</td>
<td>75Hz</td>
</tr>
<tr>
<td>EXV</td>
<td>320</td>
</tr>
<tr>
<td>Comp Amp</td>
<td>9.7A</td>
</tr>
<tr>
<td>DC Bus</td>
<td>555V</td>
</tr>
</tbody>
</table>
Chiller Panel Controller

Display menu

Display menu for Inverter

Suction
It shows the inverter compressor suction temperature. (°C)

BPHE In
It shows the refrigerant inlet temperature at the BPHE during cooling mode. During heating mode, the value represents the refrigerant outlet temperature at the BPHE. (°C)

BPHE Out
It shows the refrigerant outlet temperature at the BPHE during cooling mode. During heating mode, the value represents the refrigerant inlet temperature at the BPHE. (°C)

Condenser
It shows the inverter condenser coil inlet temperature. (°C)

<table>
<thead>
<tr>
<th></th>
<th>Inverter Chiller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction</td>
<td>15.5 ° C</td>
</tr>
<tr>
<td>BPHE In</td>
<td>45.9 ° C</td>
</tr>
<tr>
<td>BPHE Out</td>
<td>18.3 ° C</td>
</tr>
<tr>
<td>Condenser</td>
<td>28.4 ° C</td>
</tr>
</tbody>
</table>
Self Diagnosis & Troubleshooting
## Self Diagnosis & Troubleshooting

### Error Code

<table>
<thead>
<tr>
<th>Error display</th>
<th>Error description</th>
<th>Reset (default)</th>
<th>Control measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase Missing</td>
<td>Phase missing</td>
<td>Manual</td>
<td>Pump</td>
</tr>
<tr>
<td>Phase Seq Error</td>
<td>Wrong phase sequencing</td>
<td>Manual</td>
<td>System 1 (Variable Drive)</td>
</tr>
<tr>
<td>Memory Error</td>
<td>EEPROM read/write error</td>
<td>Auto</td>
<td>System 2 (Fixed drive)</td>
</tr>
<tr>
<td>Entering Water Sensor Open/Short</td>
<td>BPHE water in sensor error</td>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>Leaving Water Sensor Open/Short</td>
<td>BPHE water out sensor error</td>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>Outdoor Air sensor Open/Short</td>
<td>Ambient temp sensor error</td>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>Water Flow Error</td>
<td>Cv contact opened</td>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>Cool Mode Antifreeze</td>
<td>Leaving water temp. too low</td>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>OV/UN Voltage</td>
<td>Comp. High Voltage (&gt;490V)</td>
<td>&lt;460V, Auto</td>
<td></td>
</tr>
<tr>
<td>OV/UN Voltage</td>
<td>Comp. Low Voltage (&lt;310V)</td>
<td>&gt;340V, Auto</td>
<td></td>
</tr>
<tr>
<td>Pump Overload</td>
<td>Pump OLP opened</td>
<td>Auto</td>
<td>Pump</td>
</tr>
<tr>
<td>IPM Error</td>
<td>IPM over-current or overheat</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Comp 1 Overload</td>
<td>Comp 1 overload</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Comp 1 Discharge Overheat</td>
<td>Comp 1 discharge Overheat</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>High pressure 1</td>
<td>System 1 high pressure</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Low pressure 1</td>
<td>System 1 low pressure</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Comp 1 Defrost sensor Open/Short</td>
<td>Coil out system 1 sensor error</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Comp 1 Suct sensor Open/Short</td>
<td>Suction comp system 1 sensor error</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Comp 1 Discharge sensor Open/Short</td>
<td>Discharge comp system 1 sensor error</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Coil 1 Inlet Temp Open/Short</td>
<td>Coil in system 1 sensor error</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>V-Hx Inlet Temp sensor Open/Short</td>
<td>BPHE refrigerant in sensor error</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>V-Hx Outlet Temp sensor Open/Short</td>
<td>BPHE refrigerant out sensor error</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Comp 2 Overload</td>
<td>Comp 2 overload</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>High pressure 2</td>
<td>System 2 high pressure</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Low pressure 2</td>
<td>System 2 low pressure</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Comp 2 Defrost sensor Open/Short</td>
<td>Coil out system 2 sensor error</td>
<td>Auto</td>
<td>Off</td>
</tr>
<tr>
<td>Comp 2 Discharge sensor Open/Short</td>
<td>Discharge comp system 2 sensor error</td>
<td>Auto</td>
<td>Off</td>
</tr>
</tbody>
</table>

### Control measure

- **Comp**: System 1
- **Fan**: System 1
- **Comp**: System 2
- **Fan**: System 2

**System 1**: (Variable Drive)

**System 2**: (Fixed drive)

**Error Code**: Reset (default)
1. No response after power-on

- **No response**
  - **Is LED main board lit?**
    - Yes: Check Input conditions
    - No: **Is R,S,T Input voltage normal?**
      - Yes: Check Input power supply
      - No: **Is Power board DC-IN voltage normal?**
        - Yes: Replace power board components
        - No: Check DC rectifier circuit
  - **Is J P-power/ DC-OUT output normal?**
    - Yes: Main board faulty, To replace.
    - No: **Is connection between main board and IPM normal?**
      - Yes: Main board or IPM short circuit, To replace.
      - No: Replace power board components

DC-IN (+590VDC)
JP-power (+12VDC & +5VDC)
DC-OUT (+15VDC)
Power board
2. LED on main board normal, but no output.

1. LED lit, No output

   - Is output condition ok?
     - Yes
     - No → Rectify

   - Is load ok?
     - Yes
     - No → Rectify

   - Is main board's fuse ok?
     - Yes
     - No → Rectify

2. Replace main board
Self Diagnosis & Troubleshooting

3. Other functions normal but compressor not functioning

- Others OK, Comp not functioning
  - Is fuse in DC loop ok?
    - Yes: Check operating conditions
    - No:
      - Is IPM ok?
        - Yes
          - Is compressor ok?
            - Yes: Change fuse
            - No: Replace
        - No: Replace
      - Replace
4. Flow switch protection

Water flow error

Short JK4

Is water flow error persists?

No
Flow switch faulty or pump stopped.

Yes
Main board faulty, replace main board

JK4 on main board
Self Diagnosis & Troubleshooting

5. Over voltage protection

OV/ UN Voltage

Is Power supply > 490VAC?

Yes → Rectify

No

Is Power supply < 460VAC?

Yes → Power board error, rectify.

No
6. Under voltage protection

- **OV/ UN Voltage**
  - Is Power supply < 310VAC?  
    - Yes: Rectify  
    - No: Is Power supply > 340VAC?  
      - Yes: Power board error, rectify.  
      - No: No
7. Pump overload protection

- Pump overload
  - Is voltage of 97, 98 on heat relay VDC = 0 V
    - No
    - Yes
      - Remove JK8, 97 & 98, is it still conducting?
        - No
          - Main board faulty
        - Yes
          - Pump overload

JK8 on main board
8. Phase missing

- Is Voltage between R,S,T 415VAC ±20%?
  - Yes → 3 Phase supply
  - No → Check incoming supply

- Is J-RST on main board 415VAC ±20%?
  - Yes → Main board faulty
  - No → Disconnect power, remove J-RST, is voltage of socket 415VAC ±20%?
    - Yes → To Check/replace EMI filter
    - No
9. IPM protection

**IPM Error**

- Is IPM ok?  
  - Yes → Replace
  - No → Is heat sink temperature >100°C?  
    - Yes → Rectify
    - No → Is IPM temperature >100°C?  
      - Yes → Reapply heat compound
      - No → Main board faulty or wrong signal

- Is current at rated frequency ok?  
  - Yes → Check compressor
  - No → Is IPM Error persists?  
    - Yes → Normal
    - No → Change IPM
10. Variable compressor over-current protection

- Comp 1 overload
  - Restart. Set freq. with handset. Check current, is it ok?
    - Yes → Comp and current checked, circuit ok.
    - No → Main board or compressor faulty
      - Replace
11. Variable drive high pressure protection

- High Pressure 1
- Is high pressure switch ok? (Yes/No)
  - Yes: Check AC system for overload
  - No: Replace

- Rectify
12. Variable drive low pressure protection

- **Low Pressure 1**
  - Is low pressure switch ok?
    - No → Replace
    - Yes → Check AC system for low pressure
      - Rectify
13. Variable compressor high discharge temperature protection

**Comp 1 Discharge Overheat**

- **> 110 °C ?**
  - Yes: Compressor stops
  - No: Temp sensor ok? (<100°C?)

- **Temp sensor ok? (<100°C?)**
  - No: Replace
  - Yes: Check AC system

- **Check AC system**
  - Rectify
14. Fixed compressor over-current protection

- **Comp 2 Overload**
  - Check on compressor winding resistance, is it to spec?
    - No → Rectify
    - Yes →
      - Check on Compressor insulation, is it ok?
        - No → Rectify
        - Yes →
          - Is supply voltage ok?
            - No → Rectify
            - Yes →
              - Check current reading on handset against actual reading, is it very big different?
                - No → Normal
                - Yes →
                  - Current sensing circuit error. Replace main board

Installation
Installation

- Unit Handling
- Unit Placement
- Maintenance Access
- Water Connection
- Power Supply & Electrical Connection
- Piping Cleaning
- Preliminary Checking before Start-up
Unit Handling

5ACV 55 CR

5ACV 75 CR

5ACV 100/135/210 CR
# Unit Placement

- Air Cooled Chiller are cooled by air, space restriction will reduce the airflow, decrease the cooling capacity, increase the power input and, in some cases, prevent the unit from operating because of an excess of condensation pressure.

- 5ACV equipped with propeller fan, which doesn’t need ductwork on fan outlet.

- Direct effect of the wind on the discharge surface of the fan should be avoided.

- Enough clearance around the unit for maintenance works.
Minimum clearances

5ACV30/55/75CR

5ACV100/135CR
Maintenance Access

Figure 13

5ACV30/ 55/ 75CR

5ACV 30 CR 5ACV 55 CR 5ACV 75 CR
Maintenance Access

5ACV100/ 135/ 210 CR
Water Piping & Fitting

Install piping with minimum bends and changes in elevation to minimize pressure drop. Consider the following:

- Vibration eliminators to reduce vibration and noise transmission to the building.
- Shut off valves to isolate the unit from the piping system during unit servicing.
- Manual or automatic air vent valves at the highest points of the chilled water piping.
- A means of maintaining adequate system water pressure (expansion tank or regulating valve)
- Temperature and pressure indicators located at the unit to air in unit servicing.
Water connection could be damaged by an excessive stress when screwing them. Use a second spanner to compensate the stress of tightening.

- Safety differential pressure switch is used to ensure adequate water flow to evaporator before starting up the unit.
- Balancing valve to regulate the amount of water flow rate through the unit.

It is mandatory to install a strainer at the inlet of the unit.
**Power Supply & Electrical Connection**

### Electrical Data

<table>
<thead>
<tr>
<th>Model</th>
<th>5ACV30CR</th>
<th>5ACV55CR</th>
<th>5ACV75CR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power Supply</strong></td>
<td>V-ph-Hz</td>
<td>230 / 1 /50</td>
<td>415 / 3 /50</td>
</tr>
<tr>
<td><strong>Voltage range</strong></td>
<td>V</td>
<td>220 / 240</td>
<td>380 / 415</td>
</tr>
<tr>
<td><strong>Nominal Power Input (Cooling/Heating)</strong></td>
<td>kW</td>
<td>5.3 / 4.5</td>
<td>7.6 / 6.1</td>
</tr>
<tr>
<td><strong>Nominal Current Input (Cooling/Heating)</strong></td>
<td>A</td>
<td>26.6 / 21.5</td>
<td>16.1 / 14.0</td>
</tr>
<tr>
<td><strong>Compressor Full Load Current (FLA)</strong></td>
<td>A</td>
<td>25.9</td>
<td>18.6</td>
</tr>
<tr>
<td><strong>Rotor Locked Current (Comp 1/2)</strong></td>
<td>A</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Pump Power Input (max speed)</strong></td>
<td>W</td>
<td>200</td>
<td>700</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>5ACV100CR</th>
<th>5ACV135CR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power supply</strong></td>
<td>V-ph-Hz</td>
<td>400 / 3 /50</td>
</tr>
<tr>
<td><strong>Voltage range</strong></td>
<td>V</td>
<td>380-415</td>
</tr>
<tr>
<td><strong>Nominal Power Input (Cooling/Heating)</strong></td>
<td>W</td>
<td>12 / 11.4</td>
</tr>
<tr>
<td><strong>Nominal Current Input (Cooling/Heating)</strong></td>
<td>A</td>
<td>24.4 / 23.9</td>
</tr>
<tr>
<td><strong>Compressor Maximum Continous Current</strong></td>
<td>A</td>
<td>System 1*</td>
</tr>
<tr>
<td><strong>Compressor Full Load Current (FLA)</strong></td>
<td>A</td>
<td>21.0</td>
</tr>
<tr>
<td><strong>Compressor Locked Rotor Current (LRA)</strong></td>
<td>A</td>
<td>16.4</td>
</tr>
<tr>
<td><strong>Pump Power Input (Cooling/Heating)</strong></td>
<td>W</td>
<td>1013 / 1026</td>
</tr>
</tbody>
</table>

*Readings taken at rated compressor frequency. The Power Input and Current differ depending on the combination of outdoor temperature and entering water temperature. For further details, please refer to Technical Manual.*
**Recommended Fuses & Cable Size**

<table>
<thead>
<tr>
<th>Model</th>
<th>5ACV30CR</th>
<th>5ACV55CR</th>
<th>5ACV75CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Range **</td>
<td>230 / 1 / 50</td>
<td>415 / 3 / 50</td>
<td>415 / 3 / 50</td>
</tr>
<tr>
<td>Recommended Fuse *</td>
<td>A</td>
<td>36</td>
<td>25</td>
</tr>
<tr>
<td>Power Supply Cable Size *</td>
<td>mm²</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Number of Conductor</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Interconnection Cable Size *</td>
<td>mm²</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>5ACV 100 CR</th>
<th>5ACV 135 CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Range **</td>
<td>380 – 415V / 3Ph / 50Hz + N + @</td>
<td></td>
</tr>
<tr>
<td>Recommended Fuse *</td>
<td>A</td>
<td>40</td>
</tr>
<tr>
<td>Power Supply Cable Size *</td>
<td>mm²</td>
<td>10</td>
</tr>
<tr>
<td>Number of Conductor</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Interconnection Cable Size *</td>
<td>mm²</td>
<td>1.5</td>
</tr>
</tbody>
</table>

**IMPORTANT**: *The figures shown in the table are for information purpose only. They should be checked and selected to comply with the local/national codes of regulations. This is also subject to the type of installation and conductors used.*

**The appropriate voltage range should be checked with label data on the unit.**
Before carrying out any operations on the electrical system, make sure that the unit is de-energized.

It is important that the appliance is grounded.

Before connecting the power supply lines, check that the available voltage value does not exceed the range specified in the electrical data being provided in Installation Manual.

It’s recommended to check the correct sequence of the 3 supply phases R-S-T before the unit start up.
Preliminary Checking before Start-up

- Check the section of power supply and grounding cable.
- Check that any voltage and phase variation in the power supply does not exceed the prefixed thresholds.
- Check that components of the external water circuit (user equipment, filters, power supply tank and reservoir, if any) have been installed properly, and according to the manufacturer’s instructions.
- Check that the filling of the hydraulic circuits, and make sure that the fluid circulation is correct, without any trace of leaks and air bubbles.
- Check that the direction of rotation of the pumps is correct.
- Adjust the liquid distribution network in such a way that the flow rate is within the specified range.
- Check that the water quality is up to the specification.
Piping Cleaning

- Run the clean water through the water inlet and operate the pump to drain out the dirty water. Clean the strainer after running the pump for 30 minutes.

- Fill up the water circuit after connecting the pipes and equipment. Check water leakage at all connections and joints. Do not start the unit when the system is leaking.

- To optimize the capacity of the system, ensure that the system is free of air bubbles. The air trapped in the system would make the system unbalanced.
Thank You