Haier

Single-Zone Technical Overview









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SPECIFICATIONS

Single-Zone Outdoor

	System	12LC	12LC 18LC		18LCSL	12LCSC	18LCSC
Model Name	Outdoor	1U12LC2VHA	1U18LC2VHA	1U12LC2VHA	1U18LC2VHA	1U12LC2VHA	1U18LC2VHA
	Indoor	AW12LC2VHA/ AW12LC2VHB	AW18LC2VHA/ AW18LC2VHB	AD12SL2VHA/ AD12SL2VHB	AD18SL2VHA/ AD18SL2VHB	AB12SC2VHA	AB18SC2VHA
Operating	Cooling °F(°C)	0~115(-18~46)	0~115(-18~46)	0~115(-18~46)	0~115(-18~46)	0~115(-18~46)	0~115(-18~46)
Range	Heating °F(°C)	5~75(-15~24)	5~75(-15~24)	5~75(-15~24)	5~75(-15~24)	5~75(-15~24)	5~75(-15~24)
Power Supply	Voltage, Cycle, Phase V/Hz/-	208-230/60/1	208-230/60/1	208-230/60/1	208-230/60/1	208-230/60/1	208-230/60/1
	Compressor Type		DC Inverte	r Driven Rotary	-		
	Maximum Fuse Size A	15	25	15	25	15	25
	Minimum Circuit Amp A	15	15	15	15	15	15
Outdoor Unit	Dimension: Height in (mm)	21 1/4 (540)	21 1/4 (540) 27 (688) 21 1/4 (540) 27 (688)		21 1/4 (540)	27 (688)	
	Dimension: Width in (mm)	30 3/4 (780)	31 7/8 (810)	30 3/4 (780)	31 7/8 (810)	30 3/4 (780)	31 7/8 (810)
	Dimension: Depth in (mm)	9 5/8 (245)	11 5/16 (288)	9 5/8 (245)	11 5/16 (288)	9 5/8 (245)	11 5/16 (288)
	Weight (Ship/ Net)- Ibs (kg)	75.4/68.8 (34.2/31.2)	100.3/94.8 (45.5/43)	75.4/68.8 (34.2/31.2)	100.3/94.8 (45.5/43)	75.4/68.8 (34.2/31.2)	100.3/94.8 (45.5/43)
	Dimension: Height in (mm)	11(280)	12 3/4 (322)	7 5/16 (185)	7 5/16 (185)	10 1/4 (260)	10 1/4 (260)
	Dimension: Width in (mm)	33 5/8 (855)	39 1/4 (997)	33 7/16 (850)	46 1/16 (1170)	22 7/16(570)	22 7/16(570)
	Dimension: Depth in (mm)	: n) 8 1/16 (204) 9 1/4 (235) 16 9/16 (420) 16 9/16 (420)		22 7/16(570)	22 7/16(570)		
	Max. External Static Pressure in.W.G(Pa)	NA	NA	0.16 (40)	0.16 (Pa)	NA	NA
	Drainpipe Size O.D. in	NA	NA	1 1/4	1 1/4	1 1/4	1 1/4
	Internal Conden- sate Pump	NA	NA	Standard	Standard	Standard	Standard
	Max. Drain-Lift height in(mm)	NA	NA	27 9/16 (700)	27 9/16 (700)	27 9/16 (700)	27 9/16 (700)
	Grill Model	NA	NA	P1B-890(O)/(I)	P1B-1210(O)/(I)	PB-700IB	PB-700IB
	Weight (Ship/ Net)- Ibs (kg)	26.9/22.05 (12.2/10)	35.3/28.7 (16/13)	47.2/36.8 (21.4/16.7)	62.4/51.4 (28.3/23.3)	61.3/47 (27.8/21.3)	61.3/47.0 (27.8/21.3)
	Connections	Flare	Flare	Flare	Flare	Flare	Flare
	Liquid O.D. in	1/4	1/4	1/4	1/4	1/4	1/4
	Suction O.D. in	3/8	1/2	3/8	1/2	3/8	1/2
Refrigerate Line	Factory Charge Oz	42.32	45.86	42.32	45.86	42.32	45.86
	Maximum Line Length Ft / m	50/15	83/25	50/15	83/25	50/15	83/25
	Maximum Height Ft / m	33/10	50/15	33/10	50/15	33/10	50/15

SAFETY OVERVIEW

Read These Safety Precautions

Be sure to read the safety precautions before conducting work. The items are classified into "Warning" and "Caution." The "Warning items are especially important since they can lead to death or serious injury if not followed closely. The "Caution" items can also lead to serious accidents under some conditions if they are not followed. Therefore, be sure to observe all safety precautions listed here.

- Δ This symbol means be careful when doing this procedure or touching this equipment.
- o This symbol indicates a prohibited action.
- This symbol means that an action must be taken; the action will be listed next to the symbol.

After the repair work is complete, be sure to conduct a test operation to ensure that the equipment operates properly; explain the safety precautions for operating the equipment to the customer.

Warning

Disconnect the power cable from electrical socket before disassembling equipment for repair. Working on equipment that is connected to a power supply can cause an electrical shock.		Be sure to install the product correctly by using the standard installation frame provided. Incorrect use of the installation frame and improper installation can cause equipment to fall, resulting in injury.	For integral units only
If the refrigerant gas discharges during the repair work DO NOT touch the discharging refrigerant gas. The refrigerant gas can cause frostbite.	\bigcirc	Do not repair the electrical components with wet hands. Working on equipment with wet hands can cause electrical shock.	\bigcirc
Before disconnecting the suction or discharge pipe of the compressor at the welded section, recover the refrigerant gas in a well-ventilated area. If		Do not clean the equipment by splashing water. Washing the unit with water can cause an electrical shock.	\bigcirc
refrigerant gas remains inside the compressor, the refrigerant gas or the refrigerating machine oil will discharge when the pipe is disconnected and may		Make sure that the unit is grounded when reparing the equipment in a wet or humid place to avoid electrical shocks.	9
If the refrigerant gas leaks during the repair work, ventilate the area. The refrigerant gas can generate	0	Be sure to turn off the power switch when cleaning the equipment; the internal fan rotates at a high speed and may cause injury.	
The step-up capacitor supplies high-voltage	Δ	Do not tilt the unit when removing it. Water inside the unit can spill, wetting the floor.	
electricity to the electrical components of the outdoor unit. Be sure to discharge the capacitor completely before conducting repair work. A charged capacitor can cause electrical shock.	4	Be sure to check that the refrigeration cycle section has cooled down sufficiently before conducting repair work. Working on the unit when the refrigerating cycle is hot can cause burns.	
Be sure to use parts listed in the service parts of the applicable model and appropriate tools to	\bigcirc	Use the welder in a well-ventilated place. Using the welder in an enclosed room can cause oxygen deficiency.	0
conduct repair work. Never attempt to modify the equipment. The use of inappropriate parts or tools can cause electrical shock, excessive heat generation, or fire.		Be sure to use a dedicated power circuit for the equipment; follow appropriate technical standards for the electrical equipment, the internal wiring regulations and the instruction manual for	
When relocating the equipment make sure that the new installation site has sufficient strenght to withstand the weight of the equipment. If the new		installation when conducting electrical work. Insufficient power circuit capacity and improper electrical work can cause an electrical shock or fire.	
and if the installation work is not conducted securely, the equipment can fall and cause injury.	\oslash		
	1		

SAFETY OVERVIEW

Read These Safety Precautions

Be sure to use the specified cable to connect		
between the indoor and outdoor units. Make the connections securely and route the cable properly so that there is no force pulling the cable at the connection terminals.	Replace power cables and lead wires if they are scratched or deteriorated. Damaged cable and wires can cause electrical shock, excessive heat generation, or fire.	
When connecting the cable between the indoor and outdoor units make sure that the terminal cover does not lift off or dismount because of the cable. If the cover is not mounted properly, the terminal connection section can cause an electrical shock, excessive heat generation, or fire.	Check to see if the parts are mounted correctly, that the wires are connected correctly, and that connections at soldered or crimped terminals are secure. Improper installation and connections can cause excessive heat generation, electrical shock,	
Do not damage or modify the power cable. Damaged or modified power cables can cause electrical shock or fire. Placing heavy items on the power cable and heating or pulling the power cable can damage the cable.	and fire. If the installation platform or frame has deteriorated or corroded, replace it. Corroded platform or frames can cause the unit to fall, resulting in injury. Check to make own that the equipment is grounded	
Do not mix air or gas other than the specified refrigerant (R=4 10A/R22) in the refrigerant system. If air enters the refrigerant system, an excessively high pressure results, causing equipment damage and injury.	Repair it if it is not properly grounded. Improper grounding can cause an electrical shock. Be sure to measure the installation resistance of the repair. Be sure that the resistance is 1 M ohm	
If the refrigerant gas leaks, be sure to locate the leak and repair it before charging the refrigerant. If the leak cannot be located and the repair work cannot be stopped, be sure to perform pump-down and close the service valve to prevent the refrigerant	Be sure to check the drainage of the indoor unit after the repair. Faulty drainage can cause the water to spill, wetting the furniture and the floor.	
gas from leaking into the room. The refrigerant gas itself is harmless, but it can generate toxic gases when it contacts flames, such as fan and other heaters or stoves and ranges.	Important Safety Related Installation Information Indoor Clearances: If noncompliant may lead to temperat	ture
When replacing the remote control battery, be sure to safely dispose of the battery to prevent children from swallowing it.	control complaints. Wire Sizing: If noncompliant may lead to communication e and inverter irregular operation.	errors
Do not install the equipment in a place where there is a possibility of combustable gas leaks. If combustible gas leaks and remains near the unit, it may cause a fire.	Splices in Field Wiring: Splices between the wires that con between the outdoor and indoor unit should be avoided. Communication errors may occur if noncompliant.	nnect
Be sure to install the packing and seal on the installation frame correctly. If the packing and seal are not properly installed, water can spill out, wetting furniture and the floor.	For- integral units only Sealing Penetrations: If penetrations at back of unit are n sealed, unconditioned air may be drawn into the back of th indoor wall mount unit. Temperature control and capacity complaints may occur.	not ne /

Functions and Controls

Auto Mode

When the running mode is turned to auto after starting the system, the system will first determine the running mode according to the current room temperature and then will run according to the determined mode: Tr means room temperature; Ts means temperature setting; Tp means temperature of indoor coil pipe

Tr≥73°F Choose Cooling Mode Tr<73°F Choose Heating Mode

After turning to the auto mode, the running mode will be switched between cooling mode, fan mode, and heating mode according to the change of the indoor ambient temperature. There is a 15 minute delay between mode changes.

Cooling operation mode

Temperature control range: 60°F---86°F Temperature difference: ±2°F

* Control features: When Tr (input airflow)>Ts (set temperature) °F, the indoor fan will operate at the set speed, the mode signal will be sent to the outdoor system, and the compressor will start. When Tr (input airflow)< Ts (set temperature)°F, the indoor fan will operate at the set speed, and the mode signal will be sent to the outdoor system, and the compressor will stop. The system will keep the original status if Tr= Ts.

Airflow speed control: (temperature difference $\pm 2^{\circ}$ F) Automatic:

> When $Tr \le Ts + 4^{\circ}F$ high speed. When $Ts+2^{\circ}F \le Tr < Ts+5^{\circ}F$, medium speed When $Tr < Ts+2^{\circ}F$, low speed When the sensor is off, low speed

When the airflow speed has no delay from the high to low switching, the speed should be delayed for 3 minutes (remain at high speed for 3 minutes.) before the next switch.

When the system is operating, you can set the high, medium or low speed manually. (When the sensor is on or off, the system will change the speed 2 seconds after receiving the signal.)

*Louver control: the location for the louver can be set according to your needs.

*Defrosting function: preventing the frosting on the indoor heat exchanger (when cooling or dehumidifying). When the compressor works continuously for 1 to 6 minutes (adaptable in EEPROM) and the temperature of the indoor coils has been below 32°F for 10 seconds, the compressor will be stopped and the malfunction will be recorded in the malfunction list. The indoor system will continue to run. When the temperature of the indoor coil is raised to 45°F, the compressor will be restarted again (the requirement of 3 minutes' delay should be satisfied.)

Dry Mode (Dehumidifying mode)

* temperature control range: 60---86°F

* temperature difference: ±2°F

Control feature: Send the dehumidifying signal to the outdoor system.

When Tr>Ts+4°F, the compressor will be turned on, the indoor fan will operate at the set speed. When Tr is between the Ts and Ts+4°F, the outdoor system will operate at the high dehumidifying frequency for 10 minutes and then at the low dehumidifying mode for six minutes. The indoor fan will operate at low speed.

When Tr< Ts, the outdoor system will be stopped, the indoor fan will be stopped for 3 minutes and then turned to the low speed option.

All the frequency conversions have a $\pm 2^{\circ}F$ difference. * Wind speed control: Automatic: When $Tr \ge Ts + 9^{\circ}F$, high speed. When $Ts + 5^{\circ}F \le Tr < Ts + 9^{\circ}F$, medium speed. When $Ts + 4^{\circ}F \le Tr < Ts + 5^{\circ}F$, low speed. When $Tr < Ts + 4^{\circ}F$, light speed. If the outdoor fan is stopped, the indoor fan will be paused for 3 minutes.

If the outdoor fan is stopped for more than 3 minutes and the outdoor system still operates, the system will be changed into light speed mode.

When the airflow speed has no delay from the high to low switching, the speed should be delayed for 3 minutes (remain at high speed for 3 minutes.) before the next switch.

When the sensor is off or Tr< Ts+5°F, the manual operation can not be made. (obligatory automatic operation.) *Louver location control: the location for the louver can be set according to your needs.

*Defrosting function: preventing the frosting on the indoor heat exchanger (when cooling or dehumidifying). When the compressor works continuously for 16 minutes (adaptable in EEPROM) and the temperature of the indoor coils has been below 32°F for 10 second, the compressor will be stopped and the malfunction will be recorded in the malfunction list. The indoor system will continue to run. When the temperature of the indoor coil is raised to 45°F, the compressor will be restarted again (the requirement of 3 minutes' delay should be satisfied.)

Functions and Controls

Heat Mode mode.

- temperature control range: 60---86°F
- temperature difference: ±2°F

Control feature: the temperature compensation is automatically added and the system will send the heating signals to the outdoor system.

If $Tr \leq Ts$, the outdoor compressor is turned on, the indoor fan will be at the cold air proof mode.

If Tr>Ts+, the outdoor system is turned off, the indoor fan will be at the heat residue sending mode.

If Tr<Ts+, the outdoor system will be turned on again, the indoor fan will be in the cold air proof mode.

Indoor fan control

Manual Control: You can choose high, medium, low and automatic speed control. Automatic:

When Tr<Ts, high speed.

When $Ts \le Tr \le Ts + 4^{\circ}F$, medium speed.

When Tr> Ts+4°F, low speed.

When the airflow speed has no delay from the high to low switching, the speed should be delayed for 3 minutes (remain at high speed for 3 minutes.) before the next switch.

*Louver location control: the location for the louver can be set according to your needs.

Cold air-proof operation

1. The indoor operation within 4 minutes after the start up is as the following diagram, the air speed can be raised only



after the speed has reached a certain level.

2. 4 minutes after the start up of the indoor fan, the light airflow and the low airflow will be turned to the set speed airflow.

3. In the cold air proof operation, the fan won't stop after the start up.

4. During the cold air proof operation, the indoor system will continuously send 'indoor high speed' signals to the outdoor system.

* Residue heat sending. The indoor fan will send the residue heat at a low speed for 12 seconds.

If other conditions are satisfied, when the compressor stops, the indoor system will operate at a light speed. The indoor fan will stop when the coil temperature is below the heat start temp 4'.

* Defrosting. When the system receives the defrosting signal from outdoors, the indoor fan will stop and the indoor temperature display won't change. At thistime, any indoor coil malfunctions will be neglected. When the outdoor defrosting finishes, the coil malfunction will still be neglected until the compressor has been started up for 30 seconds. The indoor temperature display will not change and the system operates at the cold air proof mode.

* Automatic heating temperature compensation: when the system enters the heating mode, the temperature compensation (4) will be added. When the status is switched off, the compensation will be erased.

Timing

You can set 24 hours on/off timing. After setting, the timing indicator will be displayed. Also, the light will turn off after the timing is set. The followings are several timing methods:

1. System ON timing: The timing indicator will be displayed and the indoor system is under the waiting mode. The light will be turned off when the timing is finished and the rest of the system will operate under a normal condition. The timing starts since the last reception of the timing signal.

2. System /OFF timing: When the system is turned on, the timing indicator will be displayed; the rest of the system will operate under normal conditions. When the set time expires, the indicator display will turn off and the system will turn off. If you have set the dormant functions, the order of your settings will be operated according to the timing settings.

3. System ON/OFF timing: The settings will be completed according to the settings.

Indoor Unit Operating Mode Conflicts

Indoor System Mode Conflict

The indoor unit is trying to operate in a mode that is opposite of the mode the outdoor unit is currently operating in. Change the operating mode to either heat or cool, or the indoor unit will shut off.

Outdoor system mode	Indoor system mode	Conflicts	
cooling	heating	yes	
cooling	cooling	no	
cooling	airflow	no	
heating	heating	no	
heating	airflow	yes	
heating	cooling	yes	

Abnormality confirmation approaches

1. Indoor temperature sensor abnormality:

Under the operation, the normal temperature ranges from 120°F to -30°F. When the temperature goes beyond this range, the abnormality can be confirmed. If the temperature goes back into the range, the system will automatically resume.

2. Indoor heat interaction sensor abnormality:

Under the operation, the normal temperature ranges from 120°F to -30°F. When the temperature goes beyond this range, the abnormality can be confirmed. If the temperature goes back into the range, the system will automatically resume.

3. Indoor/Out door malfunction: When the indoor system receives the outdoor malfunction codes, it will store the code into E2 for the malfunction list resume. The indoor system will continue to operate according to the original status, the malfunction code will not be revealed or processed.

4. Transmission abnormality:

If the indoor system can't receive the outdoor system for 8 minutes, the communication abnormality can be confirmed and reported and the outdoor system will be stopped.

Low Load Protection Control

In order to prevent the frosting of the indoor heat interaction device, the outdoor system will be stopped if the indoor heat interaction temperature is 32°F for 5 minutes, but the fan will continue to operate. The outdoor system will be started again when the heat interaction temperature is above 108°F, and the system has been stopped for 3 minutes. The malfunction will be stored in the malfunction resume and will not be revealed.

High Load Protection Control

The outdoor system will be stopped if the coil temperature is above 149°F for 2 minutes. The indoor fan will be controlled by the thermostat. The outdoor system can be restarted when the coil temperature is below 108°F and the system has been stopped for 3 minutes. The malfunction will be stored in the malfunction resume and will not be revealed.

Multi-Zone Outdoor

When the compressor first starts

The compresor will start in low frequency. After a brief time delay, the compressor will come up to operating speed to meet the demand requirement for capacity.

The outdoor fan control (exchange fan)

When adjusting the fan speed, the unit should remain at each speed for 30+ seconds to avoid speed-change malfunctions. In Cooling Mode, the wait time between speed levels should be 15 seconds.

The outdoor fan control when in cooling or dehumidifying mode

Five seconds after compressor starts, the outdoor fan will start running at medium speed. After 30 seconds, it begins to control the fans peed according to the temperature conditions of the outdoor environment.

Multi-Zone Outdoor

The Control of the Outdoor Unit Expansion Valve

When unit starts, the EEV valves will energize and change to a standard opening. When operation starts, the EEV will change position to keep the suction vapor superheat level at around 10°F.

When the unit is shut off the opening size of the expansion valve of the indoor unit is 5 steps;

Four-way valve control

For the details of defrosting four-way valve control, see the defrosting process.

Under heating mode, the four-way valve opens. If the compressor does not start or changes to a non-heating mode, the compressor will be stopped for 2 minutes, and then the four-way valve will shift.

Over-temperature Heat Mode Indoor Coil

The over-temperature routine will protect the system from excessive high indoor coil temperature during heat mode operation. The routine will initiate if the indoor coil temperature sensor reads temperatures in excess of 131F. Conditions that cause high indoor coil temperature include indoor fan failure, dirty indoor coil and operating the system in heat mode when outdoor air temperatures exceed operating limit. (Too warm outside)

Should this routine be initiated, the system will reduce compressor frequency until the indoor coil temperature reaches 117F. Once this is achieved, the system will return to normal operation.



Outdoor Unit Technical Overview

Outdoor Unit Technical Overview

The outdoor unit features a variable speed rotary type compressor that delivers refrigerant flow to indoor units. The system uses R-410A refrigerant mixed with PVE oil. The system is rated to operate at 208/230 volts single phase 60 Hz power.

Indoor units compatible with this model include high wall type, slim duct type and cassette type.

The indoor cassette unit can be controlled by either a remote control or a wired controller. The indoor high wall unit is controlled by infrared remote. The slim duct unit is controlled by wired controller only.

All indoor units must operate together in either heat mode, or cool mode.



Circuit Boards

The Circuit Boards

There are 2 control boards located in the outdoor unit. To access the boards, remove the top cover and the cover located to the right of the outdoor fan motor opening. The boards are the Electronic Control Unit (ECU), Module Circuit Board (MCB). ECU





ECU

MCB

Outdoor Control Board

PCB (1) (Outdoor Control PCB)



OUTDOOR UNIT CONTROLS & COMPONENTS

ENGLISH

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8

3

REFERENCES

Wiring

Outdoor Board Schematic(12K)



REFERENCES

Wiring

Outdoor Board Schematic(18K)



Discharge Temperature Sensor



The Discharge Temperature Sensor is a Negative Coefficient thermistor that senses the temperature of the compressor hot gas. The Main Control Board monitors the temperature of the compressor hot gas and will make inverter speed changes in response to input from this device.

This sensor connects to the Main Control Board at PLUG CN-17.

Defrost Temperature Sensor



The Defrost Temperature Sensor is a negative coefficient thermistor that will change resistance in response to outdoor coil temperature changes. The Main Control Board monitors the temperature of the outdoor coil to determine when the system is needing to perform a defrost cycle. The sensor also monitors outdoor coil temperature during defrost cycles to determine termination conditions.

This sensor connects to the Main Control Board at PLUG CN-19.

Outdoor Ambient Temperature Sensor



The Outdoor Ambient Temperature Sensor is a negative coefficient thermistor that will change resistance in response to outdoor air temperature changes. The Main Control Board monitors the temperature of the outdoor air to determine outdoor fan speed requirements and inverter speed. The sensor also plays a role in calculation of required defrost conditions.

This sensor connects to the Main Control Board at PLUG CN-20.

Suction Line Temperature Sensor



The Suction Line Temperature Sensor is a negative coefficient thermistor that senses the temperature of the suction line. The Main Control Board monitors the temperature of the suction line to determine EEV orifice size in an attempt to maintain proper operating superheat.

This sensor connects to the Main Control Board at PLUG CN-18.

OUTDOOR UNIT CONTROLS & COMPONENTS

4-Way Valve



The 4-Way Valve redirects the flow of refrigerant in the piping circuit to allow the system to swap the functions of the indoor and outdoor coils. When de-energized in COOL MODE, the valve will direct the refrigerant hot gas to the outdoor coil. When energized in HEAT MODE, the valve will direct the hot gas to the indoor coil.

The valve flow direction capability is controlled by an electrical solenoid. When energized by 240 Volts, line voltage, the solenoid will magnetically move an internal slide within the 4-Way Valve to change the direction of refrigerant flow.

The 4-Way Valve is electrically connected to the Main Control Board at PLUG CN-10.

Electronic Expansion Valve



The metering device is an electronic expansion valve type EEV. The valve consists of an electrical operator and a valve body with internal variable size orifice. When operating, the Main Control Board will send pulses of voltage to the electrical operator. The operator will then magnetically move the position of the metering orifice pin to vary its size.

The metering device position is determined by input from a Suction Line Temperature Sensor located in the outdoor unit. The EEV will change the internal orifice size to maintain a superheat level of around 10°F. During COOL MODE operation, the valve meters low pressure refrigerant to the indoor coil. During HEAT MODE operation, the valve meters low pressure refrigerant to the outdoor coil.

Accumulator



The Accumulator is located in the suction line circuit at the entrance to the compressor. The accumulator helps prevent liquid refrigerant from entering the compressor during run operation.

Refrigerant Filters



The system has debris catching filters that protect internal system components from contaminants in the refrigerant. The filter is a permanent part that is not typically replaced.

System Power

The 240 Volt AC power for the system connects to terminals 1(N), 2(L), and ground of the outdoor unit terminal block. This terminal block also has terminals to connect power to the indoor unit.

The voltage readings between terminals 1(N) and ground, and terminals 2(L) and ground should be 120 VAC. The voltage reading between terminals 1(N) and 2(L) should be 240 VAC.

One additional connection on the terminal block (3) is for the communication wire between the indoor and outdoor units.

NOTE: Mis-wiring of these connections may cause improper operation or damage to system components.

Cool Mode

Overview

The temperature control range in cooling mode is 60°F - 86°F. The temperature set by the remote control and the indoor unit ambient temperature sensor will determine if a call for cooling is needed. If a call for cooling is justified, the call is communicated from the indoor unit to the outdoor unit. The indoor unit louver will open using a stepper motor, and the indoor fan will operate at the speed last set. The outdoor unit will determine the position of the EEV and speed (frequency) of the compressor. There can be a delay of up to 3 minutes before the outdoor unit fan and compressor start.

The speed of the indoor fan can be controlled manually by the user or automatically by the system. The speed can be changed between LOW, MEDIUM, and HIGH. The predetermined conditions for automatic control are as follows: (Tr= room temperature Ts= set temperature) High Speed: Tr \leq Ts + 5.4°F Medium Speed: Ts + 1.8°F \leq Tr < Ts + 5.4°F Low Speed: Tr \leq Ts + 1.8°F or when the sensor is off.

There will be a 2 second delay when manually controlling the speed.

The outdoor unit temperature sensors: outdoor ambient, defrost, suction line, and compressor discharge, used in conjunction with the indoor temperature sensors, indoor ambient and tube, provide information to the outdoor control board to monitor the system and regulate the frequency of the compressor, EEV positioning, and outdoor fan speed to achieve the desired room temperature.

When cooling has been satisfied, the outdoor unit compressor will turn off, followed by the outdoor fan. The indoor unit fan will continue to run.

If the system detects a malfunction, it may shut down or show an error code on the indoor unit display board and/or outdoor unit main board LED.



To enter the cool mode, point the infrared remote control at the indoor unit and press the power button, then press the COOL mode button if not already set to cool mode.

The signals received by the infrared receiver are relayed to the main board of the indoor unit to turn the system on and set it to cool mode.

The indoor unit main board will activate the display of the indoor unit, illuminating the display, indicating the room temperature and current status of the unit.

The indoor unit main board will signal the louver stepper motor to open the louver to either a stationary position, or one of several oscillating modes.

As the louver opens, the indoor unit main board will power up the indoor fan motor, operating the fan at the speed last set. The indoor fan motor has a feedback circuit which provides the indoor unit main board with information for controlling the speed of the fan motor.

Temperature sensors

The indoor unit has two sensors that provide temperature information to the indoor unit main board. The sensors: an indoor ambient temperature sensor, and pipe temperature sensor, are used for controlling the system during cool mode. The resistance values of the sensors will vary with temperature. The resistance to temperature values can be found using a temperature / resistance chart specific to the sensor being checked.

Communication

The indoor and outdoor unit main boards communicate via a digital signal on the wire connected to terminal 3 of each unit. A splice or break in this wire will cause a communication error.

When a command is received from the remote control, the indoor unit main board communicates with the outdoor unit main board via the terminal 3 wire to perform the requested function.

Outdoor unit

Upon a request for cooling, the outdoor unit main board applies power to the outdoor fan motor and compressor. Depending on system cycling, there may be up to a 3 minute wait period before the compressor and outdoor fan start.

WARNING: Do not measure compressor voltages, damage to the meter may result.

If the ambient room temperature is less than the set temperature, yet higher than 2°F below the set temperature, the system will adjust the running frequency of the compressor automatically according to changes in ambient temperature. The outdoor unit main board also controls the position of the EEV (Electronic Expansion Valve)

to regulate the flow of refrigerant to the indoor unit evaporator coil.

Temperature sensors

Four temperature sensors located in the outdoor unit provide temperature information to the outdoor unit main board for control of the system during cool mode.

The outdoor ambient temperature sensor provides the temperature of the air drawn into the condenser coil of the outdoor unit.

The defrost temperature sensor provides the temperature sensed at the output of the condenser coil.

The suction line temperature sensor provides the temperature sensed at the incoming suction line pipe.

The compressor discharge sensor provides the temperature sensed at the discharge pipe of the compressor.

Call to Terminate Cooling

The system will call to terminate cooling when the indoor ambient temperature sensor is equal to or lower than 2°F of the room set temperature. The indoor control board will communicate to the outdoor control board to de-energize the compressor. The outdoor fan will run for 60 seconds before stopping.

The indoor fan motor and louver will continue operating after cooling has been terminated.

To stop cool mode, press the power button to turn the system off, or change to another mode.

Freeze protection function

To prevent freezing of the indoor unit coil during cool mode, when the compressor operates continuously for 10 seconds and the temperature of the indoor coil has been below $32^{\circ}F$ for 10 seconds, the compressor will stop, and the error will be recorded in the malfunction list. The indoor unit fan will continue to operate. When the temperature of the indoor coil rises to $45^{\circ}F$ for more than 3 minutes the compressor will restart and the system will continue functioning.

Heat Mode

Overview

The temperature control range in heating mode is 60°F - 86°F. The temperature set by the remote control and the indoor unit ambient temperature sensor will determine if a call for heat is needed. If a call for heat is justified, a temperature compensation adjustment is automatically added to the operating parameter and the call is communicated from the indoor unit to the outdoor unit.

The indoor unit louver will open using a stepper motor. The indoor fan will not operate at this time.

The outdoor unit will shift the 4-way valve to the heat mode position and determine the position of the EEV (if equipped) and speed (frequency) of the compressor. There can be a delay of up to 3 minutes before the outdoor unit fan and compressor start.

(Tr = room temperature Ts = set temperature) If Tr \leq Ts, the outdoor unit will operate and the indoor fan operates in cold air prevention function If Tr > Ts+, the outdoor unit turns off and the indoor fan operates at heat residue sending mode. If Tr < Ts+, the outdoor unit will restart and the indoor fan

The speed of the indoor fan can be controlled manually by the user or automatically by the system. The speed can be changed between HIGH, MEDIUM, and LOW. The predetermined conditions for automatic control are as follows: High Speed: Tr < Ts Medium Speed: Ts \leq Tr \leq Ts + 4°F Low Speed: Tr > Ts + 4°F

When the indoor fan is running in automatic mode and there is no delay when the speed switches from high to low, the indoor fan will maintain high speed for a period of 3 minutes before switching to low speed.

Cold air proof operation

operates in cold air proof mode.

At initial start of heat mode, indoor blower will not be turned on immediately until indoor coil temperature senses a minimum temperature. This period usually takes 30 seconds to 3 minutes depending on the outdoor ambient temperature.



4 minutes after the indoor fan starts, the light or low speed will switch to the set speed.

In cold air proof operation, the fan remains on after startup.

Residual heat sending: the indoor fan will operate on low speed for 12 seconds.

The outdoor unit temperature sensors: outdoor ambient, defrost, suction line, and compressor discharge, used in conjunction with the indoor temperature sensors, indoor

ambient and tube, provide information to the outdoor control board to monitor the system and regulate the frequency of the compressor, EEV positioning, and outdoor fan speed to achieve the desired room temperature.

When heating has been satisfied, the outdoor unit compressor will turn off first and followed by the outdoor fan. The 4-way valve will de-energize 2 minutes after compressor stops.

The indoor unit fan will continue to run at minimum speed until indoor coil temperature reaches a minimum temperature and it will turn off.

If the system detects a malfunction, it may shut down or show an error code on the indoor unit display board and/or outdoor unit main board LED.

Defrost

When the system initiates a call for defrost, the indoor fan motor stops. The indoor unit display will not change. Any indoor unit malfunctions will be ignored at this time. The system will cycle through the defrost operation. Any indoor unit malfunctions will be ignored until the compressor restarts and has been operating for 30 seconds. At the conclusion of the defrost cycle, the indoor fan will enter the cold air proof operation. Heat mode resumes.

Automatic Heating Temperature Compensation

When the system enters heating mode, a temperature compensation adjustment is added to the operating parameter. This adjustment is canceled when exiting heat mode.

Indoor unit

To enter the heat mode, point the infrared remote controller at the indoor unit and press the power button, then press the HEAT mode button if not already set to heat mode.

The signals received by the infrared receiver are relayed to the main board of the indoor unit to turn the system on and set it to heat mode.

The indoor unit main board will activate the display of the indoor unit, illuminating the display, indicating the room temperature and current status of the unit.

The indoor unit main board will signal the louver stepper motor to open the louver to a stationary position.

The indoor unit main board will power up the indoor fan motor after the outdoor unit has started and heating of the indoor coil has taken place (see cold air proof operation). The indoor fan motor has a feedback circuit which provides the indoor unit main board with information for controlling the speed of the fan motor.



Temperature sensors

The indoor unit has two sensors that provide temperature information to the indoor unit main board. The sensors: an indoor ambient temperature sensor, and pipe temperature sensor, are used for controlling the system during heat mode.

The resistance values of the sensors will vary with temperature. The resistance to temperature values can be found using a temperature / resistance chart specific to the sensor being checked.

Communication

The indoor and outdoor unit main boards communicate via a digital signal on the wire connected to terminal 3 of each unit. A splice or break in this wire will cause a communication error.

When a command is received from the remote control, the indoor unit main board communicates with the outdoor unit main board via the terminal 3 wire to perform the requested function.



Outdoor unit

Upon a request for heat, the outdoor unit main board applies power to the 4-way valve, outdoor fan motor and compressor. Depending on system cycling, there may be up to a 3 minute wait period before the compressor and outdoor fan start.)

NOTE: Do not measure compressor voltages, damage to the meter may result.

If the ambient room temperature is above the set temperature, yet lower than 2°F above the set temperature, the system will adjust the running frequency of the compressor automatically according to changes in ambient temperature.

The outdoor unit main board also controls the position of the EEV (Electronic Expansion Valve)

to regulate the flow of refrigerant to the indoor unit evaporator coil.

Temperature sensors

Four temperature sensors located in the outdoor unit provide temperature information to the outdoor unit main board for control of the system during heat mode.

The outdoor ambient temperature sensor provides the temperature of the air drawn into the condenser coil of the outdoor unit.

The defrost temperature sensor provides the temperature sensed at the output of the condenser coil.

The suction line temperature sensor provides the temperature sensed at the incoming suction line pipe.

SEQUENCE OF OPERATION

The compressor discharge sensor provides the temperature sensed at the discharge pipe of the compressor.

Call to Terminate Heating

The system will call to terminate heating when the indoor ambient temperature sensor is equal to or higher than 2°F above the room set temperature. The indoor control board will communicate to the outdoor control board to de-energize the compressor. The outdoor fan will run for 60 seconds before stopping. The 4-way valve will de-energize 2 minutes after the compressor stops.

To stop heat mode, press the power button to turn the system off, or change to another mode.

Auto Mode

With the system turned on, press the AUTO button on the remote control. The system will change to the auto mode of operation.

As the room is cooled or heated, the system will automatically switch between cool mode, fan mode, and heat mode. There is a minimum 15 minute operating time between mode changes.

Dry Mode

Overview

The temperature control range in Dry mode is 60°F - 86°F. This mode is used for the purpose of dehumidification.

(Tr = room temperature Ts = set temperature)

When Tr > Ts + 4°F, the compressor will turn on and the indoor fan will operate at the set speed.

When $Ts \leq Tr \leq Ts + 4^{\circ}F$, the compressor will operate at the high dry frequency for 10 minutes, then at the low dry mode for 6 minutes. The indoor fan will operate at low speed. When Tr < Ts, the outdoor unit will stop, and the indoor fan will stop for 3 minutes, then operate at the low speed option.

Automatic fan speed:

When Tr >= Ts + 9°F, High speed When Ts + 5.4°F \leq Tr < Ts + 9°F, Medium speed When Ts + $3.6^{\circ}F \le Tr < Ts + 5.4^{\circ}F$, Low speed When Tr < Ts + 3.6°F, Light speed Note: TURBO and QUIET mode must be set using the remote controller.

If the outdoor fan is stopped, the indoor fan will pause for 3 minutes

If the outdoor fan is stopped for more than 3 minutes, and the compressor is still operating, the system will change to light speed mode.



To enter the dry mode, point the infrared remote control at

the indoor unit and press the power button, then press the DRY mode button if not already set to dry mode.

The signals received by the infrared receiver are relayed to the main board of the indoor unit to turn the system on and set it to dry mode.

The indoor unit main board will activate the display of the indoor unit, illuminating the display, indicating the room temperature and current status of the unit.

The indoor unit main board will signal the louver stepper motor to open the louver to either a stationary position, or one of several oscillating modes.

As the louver opens, the indoor unit main board will power up the indoor fan motor, operating the fan at the speed last set. The indoor fan motor has a feedback circuit which provides the indoor unit main board with information for controlling the speed of the fan motor.

Temperature sensors

The indoor unit has two sensors that provide temperature information to the indoor unit main board. The sensors: an indoor ambient temperature sensor, and pipe temperature sensor, are used for controlling the system during dry mode. The resistance values of the sensors will vary with temperature. The resistance to temperature values can be found using a temperature / resistance chart specific to the sensor being checked.

Communication

The indoor and outdoor unit main boards communicate via a digital signal on the wire connected to terminal 3 of each unit. A splice or break in this wire will cause a communication error.

When a command is received from the remote control, the indoor unit main board communicates with the outdoor unit main board via the terminal 3 wire to perform the requested function.



Temperature sensors

Four temperature sensors located in the outdoor unit provide temperature information to the outdoor unit main board for control of the system during dry mode.

The outdoor ambient temperature sensor provides the temperature of the air drawn into the condenser coil of the outdoor unit.

The defrost temperature sensor provides the temperature sensed at the output of the condenser coil.

The suction line temperature sensor provides the temperature sensed at the incoming suction line pipe.

The compressor discharge sensor provides the temperature sensed at the discharge pipe of the compressor.

To stop dry mode, press the power button to turn the system off, or change to another mode.

Defrost Operation

Defrost cycle will initiate if any of three conditions are met.

Te = Defrost temperature sensor Tao = Outdoor ambient temperature sensor Tes = Condensation point temperature

1) Tes >= 23° F, and Te $\leq 23^{\circ}$ F 2) 5° F \leq Tes $< 23^{\circ}$ F, and Te \leq Tes 3) Tes $< 5^{\circ}$ F and Te $\leq 5^{\circ}$ F

Tes = C X Tao-a Tao < 32°F, C = .08 Tao > or = 32°F, C = .06 a = 6

The minimum time interval between defrost cycles is 45 minutes.

When the defrost cycle begins, the following conditions take place:

- 1. The compressor will stop for 1 minute
- 2. The outdoor fan will continue to operate at high speed.

3. After 50 seconds, the 4-way valve will shift to the cool mode position.

- 4.5 seconds later the outdoor fan will stop.
- 5. After 1 minute, the compressor will start.

The outdoor unit will now defrost.

The defrost cycle runs continuously for approximately 10 minutes.

The system will exit the defrost cycle if any of the following conditions are met:

1. The condenser maintains a temperature above 45°F for 80

seconds.

2. The condenser maintains a temperature above $54^\circ\mathrm{F}$ for 5 seconds.

Upon exiting the defrost cycle, the following conditions will take place:

1. The compressor will stop.

2. The outdoor fan will operate at high speed.

3. 50 seconds later the 4-way valve will shift to the heat mode position.

4. 60 seconds later the compressor will start.

The system resumes normal operation.

Protection Functions

1. TTC high temperature protection

The compressor discharge pipe sensor (exhaust temp) senses the temperature of the refrigerant exiting the compressor. The sensed temperature received from the sensor by the control circuitry will cause the compressor frequency to increase or decrease. (see chart below). If a temperature of >= 230°F is sensed for 20 seconds, an exhaust overheating protection error code will be indicated at the outdoor unit.



2. Overheating protection for indoor unit

The indoor tube sensor senses the temperature of the indoor heat exchanger.

If the temperature sensed is greater than 133°F, the compressor frequency will decrease to prevent overheating of the heat exchanger.

If Tc >= 133°F for more than 10 seconds, the compressor will stop and an error code will be indicated at the outdoor unit. If the compressor is off for 3 minutes and Tc <118°F, the compressor will restart.

If the temperature sensed is lower than 118°F, the protection function is canceled.

SEQUENCE OF OPERATION

The compressor discharge sensor provides the temperature sensed at the discharge pipe of the compressor.

Call to Terminate Heating

The system will call to terminate heating when the indoor ambient temperature sensor is equal to or higher than 2°F above the room set temperature. The indoor control board will communicate to the outdoor control board to de-energize the compressor. The outdoor fan will run for 60 seconds before stopping. The 4-way valve will de-energize 2 minutes after the compressor stops.

To stop heat mode, press the power button to turn the system off, or change to another mode.

Auto Mode

With the system turned on, press the AUTO button on the remote control. The system will change to the auto mode of operation.

As the room is cooled or heated, the system will automatically switch between cool mode, fan mode, and heat mode. There is a minimum 15 minute operating time between mode changes.

Dry Mode

Overview

The temperature control range in Dry mode is 60°F - 86°F. This mode is used for the purpose of dehumidification.

(Tr = room temperature Ts = set temperature)

When Tr > Ts + 4° F, the compressor will turn on and the indoor fan will operate at the set speed.

When $Ts \leq Tr \leq Ts + 4^{\circ}F$, the compressor will operate at the high dry frequency for 10 minutes, then at the low dry mode for 6 minutes. The indoor fan will operate at low speed. When Tr < Ts, the outdoor unit will stop, and the indoor fan will stop for 3 minutes, then operate at the low speed option.

Automatic fan speed:

When Tr >= Ts + 9°F, High speed When Ts + 5.4°F \leq Tr < Ts + 9°F, Medium speed When Ts + 3.6°F \leq Tr < Ts + 5.4°F, Low speed When Tr < Ts + 3.6°F, Light speed Note: TURBO and QUIET mode must be set using the remote controller.

If the outdoor fan is stopped, the indoor fan will pause for 3 minutes.

If the outdoor fan is stopped for more than 3 minutes, and the compressor is still operating, the system will change to light speed mode.



To enter the dry mode, point the infrared remote control at

the indoor unit and press the power button, then press the DRY mode button if not already set to dry mode.

The signals received by the infrared receiver are relayed to the main board of the indoor unit to turn the system on and set it to dry mode.

The indoor unit main board will activate the display of the indoor unit, illuminating the display, indicating the room temperature and current status of the unit.

The indoor unit main board will signal the louver stepper motor to open the louver to either a stationary position, or one of several oscillating modes.

As the louver opens, the indoor unit main board will power up the indoor fan motor, operating the fan at the speed last set. The indoor fan motor has a feedback circuit which provides the indoor unit main board with information for controlling the speed of the fan motor.

Temperature sensors

The indoor unit has two sensors that provide temperature information to the indoor unit main board. The sensors: an indoor ambient temperature sensor, and pipe temperature sensor, are used for controlling the system during dry mode. The resistance values of the sensors will vary with temperature. The resistance to temperature values can be found using a temperature / resistance chart specific to the sensor being checked.

Communication

The indoor and outdoor unit main boards communicate via a digital signal on the wire connected to terminal 3 of each unit. A splice or break in this wire will cause a communication error.

When a command is received from the remote control, the indoor unit main board communicates with the outdoor unit main board via the terminal 3 wire to perform the requested function.

Outdoor unit

Upon a request for dry mode, the outdoor unit main board applies power to the outdoor fan motor and compressor. Depending on system cycling, there may be up to a 3 minute wait period before the compressor and outdoor fan start.)

WARNING: Do not measure compressor voltages, damage to the meter may result.

The outdoor unit main board also controls the position of the EEV (Electronic Expansion Valve)

to regulate the flow of refrigerant to the indoor unit evaporator coil.

Indoor Unit Technical Overview



Stepper Motor

The wall mounted units act as evaporator coils during cooling mode and condenser coils during heating mode. These units have gravity condensate drain systems. If a condensate pump is needed, it must be field provided and mounted external to the indoor unit.

The wall mount unit is shipped with a wireless controller.



Power to operate the indoor unit comes from the electrical line voltage terminal block at the outdoor unit. The wiring includes 4 wires: 1, 2, 3 and ground. Wires 1 and 3 complete the data path. These wires should always be 14 gauge AWG Stranded type wire. Splices in wires 1 or 3 may cause communication errors.

2 The indoor unit features a multi-speed blower motor that will change speed to match the capacity demand from the outdoor unit. 3 Separate motors located in the indoor unit control the operation of the motorized louvers. All of the louver motors are controlled via commands received from the remote control. The blower motor is controlled by both the remote control and by commands from the outdoor unit ECU. Refer to the Remote Control Information in the Reference section for louver control/remote procedures. Unlike typical air handlers found in the US market, these units have metering devices located in the outdoor unit. The metering devices are EEV type that are controlled by the outdoor unit ECU.

Temperature sensors located within the wall mount unit include a pipe temperature sensor and a return air temperature sensor. 4 The pipe temperature sensor is used to sense the temperature of the indoor coil in both cooling and heating modes. 5 The return air sensor senses the temperature of the air being drawn into the wall mounted unit from the conditioned space. The operating functions of these sensors is explained in the Temperature Sensor Function section of this manual.

6 The indoor unit has a display that communicates system mode, room temperature and diagnostic code information. The diagnostic code information shown on the indoor unit will NOT be the same code that is displayed on the outdoor unit. When servicing a diagnostic error, compare the indoor unit code to the outdoor unit code to make diagnostic decisions. Codes that relate to outdoor unit problems should use the outdoor unit display information as priority.

The indoor unit circuit board controls the switching functions of the indoor unit. All control decisions are made by the outdoor unit ECU. The indoor board has some limited diagnostic capability which will be covered in this manual.

INDOOR UNIT TECHNICAL OVERVIEW

Indoor Wall Mount Unit Circuit Board

The Indoor Unit Circuit Board communicates with the outdoor unit ECU via a connection at Terminal Block screw 3.

The data pulse that sends the communication information can be measured with a voltmeter placed to DCV range. From the ground connection at the Terminal Block to the Number 3 screw connection, the voltage should pulse up and down when data is being transmitted.

This control board has control over the fan louver movement, manual fan blower control, indoor coil temperature and indoor air temperature sensing functions. All operational decisions are controlled by the OUTDOOR UNIT ECU. The connections on the indoor indoor board are shown here in the schematic drawing.

Line voltage to power the indoor unit comes in on Block connections 1 and 2. Power connects from tl nal connections to CN- 52 and CN-21 on the circui the board does not respond to commands and has no uspray, check for line voltage at these connections. When power is present at the indoor board, the RED LED on the circuit board will blink a 2 flash code.

The control board has a replaceable 3.15A 250V fuse that protects against excessive current. If power is present at the board but the board does not work, check for continuity through the fuse. Replace if the fuse is open.

The indoor unit temperature sensors are connected at Plug CN6. When testing the calibration of these sensors, the wires can be released from the plug by pressing on the tension tab on the side of the plug.

The receiver/display unit that is mounted to the front cover of the indoor unit plugs into the circuit board via a connection at Plug CN-7.



the louvers right, left and up/down. These motors connect at CN5, CN11 and CN10. Some units will use one motor to operate the right and left movement function.

The blower motor is connected to the circuit board at plug CN-9.

There is an Emergency Run switch on the edge of the indoor board that will put the system into Auto Mode should the remote control break or be lost. When this switch is pressed and held for 5 seconds, the indoor unit display will beep twice and the system will enter TEST MODE.



Blower Assembly

The blower assembly consists of a plastic blower wheel that is connected to a variable speed indoor blower motor. A set screw holds the blower wheel to the blower motor.



The indoor blower motor is a DC Fan Motor that is connected to the indoor unit control board via Plug CN-9. The wiring from the motor to indoor board consists of 5 wires connected to pins 1, 4, 5, 6 and 7. Pin 1 should have 310 VDC. Pin 4 is ground. Pin 5 +15VDC. Pin 6 is the feedback signal. Pin 7 is the speed control.

During normal operation, the indoor control board will energize the indoor blower motor and request proper speed. The indoor blower motor will control the speed via a command at the Pin 7 speed control. Proper fan speed is verified by the indoor control board via the voltage level at the feedback signal on Pin 6. Should the feedback signal not be present during a call for indoor blower, the indoor control board will indicate a Malfunction Code E14.

Louver motors

See A and B below.

The louver motors are stepper type motors that move the louvers either right/left or up/down. The motors are controlled by pulsed voltage that cannot be measured. If the louver does not move when it should, check for a blockage in the louvers. If the louver is free to move, refer to the Test Procedure Section.

Temperature Sensors

The Piping Temperature Sensor senses indoor coil temperature in the cooling mode and in the heating mode. This sensor is used for Anti Freezing and Anti Cold Blow cycles. The sensor also provides critical temperature information to the ECU that may be used in frequency adjustments. See Temperature Sensor Functions.



The Ambient Temperature Sensor senses room temperature. This sensor provides room temperature information to the ECU for calculation of inverter capacity and temperature control.



Both sensors are negative temperature coefficient type that reduce electrical resistance as temperature rises.



TECHNICAL OVERVIEW

Accessing components/removing cover

- 1. To access components for service, first disconnect power to the outdoor unit. This will de-energize the indoor unit.
- 2. Lift the front cover by prying on the two indented finger holds at each end of the indoor unit.



3. Remove the three Phillips head screws located near the bottom of the indoor unit. These screws are located directly below the bottom of the air filter.



4. Remove the filters.



5. Manually open the louver.



6. Open the 3 caps that cover the screws located behind the bottom of the louver. These caps flip up.



7. Remove the three screws located behind the caps.



8. Remove the two screws that hold the digital display to the front cover. The display can hang free.



9. Release the air temperature sensor from the clip that holds it.



10. Pull upward on the top of the indoor unit cover to free it from the four retaining clips. The cover will pivot downward. The cover should now pull away from the indoor unit.

TESTING

INDOOR WALL MOUNT UNIT TECHNICAL OVERVIEW

Indoor Fan Motor Voltage Check

If the indoor fan motor does not run.

- 1. Remove the front cover and access the circuit board connection CN-9.
- 2. Reset power and turn the remote control fan command to Fan On mode.

Motor Test

- 1. If the motor doesn't run, check for 310VDC between Pins 1 and 3. If it is not present, the indoor board is bad. If voltage is present, continue on.
- 2. Check the voltage between Pins 3 and 4. The voltage should be +15VDC. If it is not present, the board is bad. If voltage is present, continue on.
- 3. Check for voltage between Pins 3 and 6. If no DC voltage is present, the board is bad. If voltage is present, change the motor.

Replace the Blower Motor

Replace the Blower Motor

- **Step 1.** Disconnect the power.
- **Step 2.** With the indoor unit cover removed, remove the two screws on the left plastic evaporator coil bracket.



Step 3. Remove the cover from the electrical box on the right side of the indoor unit.



Step 4. Remove the two screws that hold the electrical box in place.





ENGLISH





INDOOR WALL MOUNT UNIT TECHNICAL OVERVIEW

Step 6. Remove 6 screws that hold the motor bracket and evaporator coil.



Step 7. Lift the evaporator coil and remove the motor bracket.



Step 9. Unplug the motor from the circuit board.



Step 10. Lift and slide the motor away from the blower wheel.



Step 8 Loosen the motor shaft set screw. Phillips head screw.



Step 11. Remove the two black anti vibration mounts from the defective motor and place them on the new motor.



Step 12 Install new motor in reverse order.

Testing Temperature Sensors and Louver Motors

Testing Temperature Sensors

The easiest problems to solve will involve codes that are related to potential failure of temperature sensors. Common problems may include loose connections, open electrically, and out of calibration. Checking the condition of the sensors requires a temperature probe and an ohmmeter.

The Reference Section of this manual contains temperature resistance tables that can be used to check the calibration of the sensors. The measured resistance must be within the tolerances printed on the top of the tables.

To test the electrical condition of a temperature sensor perform the following:

- 1. Confirm the sensor is firmly attached to the circuit board connection plug.
- 2. Remove the sensor wires from the connection plug by releasing holding tension on the plugs tension tab.
- 3. Use an ohmmeter to test the electrical resistance of the sensor.
- Measure the air temperature near the sensor and compare the required resistance against measured resistance. (See chart in reference section) If the sensor is within calibration, the sensor is good. If the sensor is out of calibration, replace the sensor. (Tube Sensors should be removed from socket and exposed to air temperature during test.)

Testing Louver Motors

If the louver does not operate with command from the remote control, either the indoor board is bad, or the louver motor is defective. It is more likely the motor is defective than the



board. (Make sure the louver assembly is not binding and keeping the vanes from moving.)

- 1. Remove power from the unit and remove the indoor unit cover.
- 2. Access the circuit board.



3. Identify on the schematic drawing the inoperable louver motor and disconnect the plug from the circuit board. (The up down louver motor is located on the right side of the indoor unit. The left right louver motor is located bottom center.)



Use an Ohmmeter to test the electrical continuity of the louver motor windings. The proper resistance for each winding can be found in this table. If the mo tor winding resistance is erratic or shows open, the motor is defective. Replace the motor.



If the motor checks out good, replace the indoor control board.



5.

4.

Testing Communication Circuit

Testing Communication Circuit

If an Error E7 occurs, perform the following test to determine if the indoor control board is functioning properly to send data to the outdoor unit.

Perform this test with the unit powered and all wiring connected between indoor and outdoor unit.

Make sure all wiring between the indoor and outdoor unit are correct. There should no splices between the indoor and outdoor unit wiring connecting terminals 1 or 3. Make sure wiring is correct, before performing this test.

1. Measure the DC voltage between terminals 1 and 3 on the indoor terminal block.



- The voltage should fluctuate between 8VDC and 23VDC. The fluctuating signal indicates a good communication path.
- 3. If the voltage does not fluctuate, and the wiring is good, the indoor board is defective.

Antifreezing Protection

Antifreezing Protection

Prevents freeze-up of the indoor coil

The indoor unit coil temperature sensor will shut off the outdoor unit and begin a defrosting routine if the indoor coil is below 32°F for more than 2 minutes. The indoor unit will not report this operation. Once the indoor coil warms up, the system will re-enter cooling mode and operate normally, This protection cycle prevents the indoor coil from developing ice coating during low heat load operation.



INDOOR WALL MOUNT UNIT

Indoor Unit Error Codes

Indoor Unit Error Codes (HSU218VHG Only)

The error codes that are displayed on the indoor units may vary from the outdoor unit codes. The information communicated by the error code will be the SAME for both indoor and outdoor units even though the numbers may differ.

Error Code E7

This code is indicating the indoor and outdoor units have lost communication signal. Check wiring between indoor and outdoor unit. Confirm 14 gauge AWG stranded wire present. Confirm no splices in wires 1 and 3. Go to Test Procedures to solve communication error.

Error Code E1

This code indicates a failure of the room temperature sensor. Go to Test Procedure section to solve.

Error Code E2

This code indicates a failure of the Pipe Temperature Sensor on the indoor unit. Go to Test Procedure section to solve.

Error Code E4

This error indicates an EEPROM Error indoor unit control board. Reset power. If error repeats, replace the indoor circuit board.

Error Code E14

This code indicates the indoor fan motor failed to run. Go to Test Procedure Section to solve.

Error Code F12

This code indicates an OUTDOOR UNIT EEPROM error. Cycle power. If the error does not clear, replace the ECU.

Error Code F1

The module board detected excessive instantaneous current compressor , IPM hardware automatically stopped the Module Board output to protect the compressor.

Potential causes include:

- overcharge
- dirty outdoor coil
- hot conditioned space temperature/high load

- refrigeration circuit restriction
- seized compressor
- Bad Module Board

Error Code F22

Compressor current abnormal: module driver board detected that the compressor current is too large, The Module board software protects it and the compressor.

Possible Causes:

- overcharge
- dirty outdoor coil
- hot conditioned space temperature/high load
- refrigeration circuit restriction
- seized compressor
- Bad Module Board

Error Code F3

This code indicates the Module board is not communicating with the ECU. Check the wiring Plug connection between the two control boards. Make sure the connection is tight. The Module Plug connection is Plug CN-9 and the ECU plug is also Plug CN-9. If the connection is good, yet the boards do not communicate and the code will not clear, replace the MODULE Board.

Error Code F19

This code indicates the operating voltage of the system is either too high or too low. Check line voltage for proper limits. The line voltage supplied to the outdoor unit should be now lower than 187V when the compressor starts. The running voltage should be no lower than 197V. The incoming line voltage to the outdoor unit should never be higher than 253V. If improper voltage is present, check the supply voltage circuit from the building for proper size wiring and good connections. If the voltage is still outside operating limits, contact the power company to have the service corrected.

If the line voltage from the power company is correct, check the output voltage of the Power Circuit Board. This voltage connects to the MODULE board at terminals CN-1 and CN-2. If the voltage is not within specifications shown above, replace the Power Circuit Board.

Error Code F27

This error code indicates the compressor failed to start when a call for operation occurred. Refer to the Test Procedure for Compressor troubleshooting to diagnose the problem.

ERROR CODES

INDOOR WALL MOUNT UNIT

Indoor Unit Error Codes

Error Code F4

This code indicates the temperature of the compressor hot gas is too high. This error would have occurred despite the ECU attempt at reducing operating frequency. Causes of this type of condition are typically a lack of refrigerant in the system, excessive heat in the conditioned space or a restriction in the refrigeration circuit.

Error Code F8

This code indicates the outdoor fan motor is not running. The fault is detected very quickly by the ECU. The system will shut off and display this error code. If this error occurs, reference the Test Procedure for Outdoor Fan Motor.

Error Code F21

This code indicates an electrical failure of the sensor that is used to sense the temperature of the outdoor coil during heat mode operation. This sensor is connected to the ECU via a connection at Plug CN-14.

Error Code F7

This code indicates an electrical failure of the sensor that is used to sense the temperature of the suction gas that enters the compressor. The sensor is connected to the ECU via two wires at Plug CN-14.

Error Code F6

This code indicates an electrical failure of the sensor that is used to sense the temperature of the outdoor air. The sensor is connected to the ECU via two wires at Plug CN-14.

Error Code F25

This code indicates an electrical failure of the sensor that is used to sense the temperature of the compressor hot gas discharge line. The sensor is connected to the ECU via two wires at Plug CN-14.

Error Code F13

The system is low on refrigerant charge. Correct leak and recharge per installation instructions in Reference Section.

Error Code F11

Recycle power and restart the system. If the compressor initially starts but then stops, replace the MODULE board and COMPRESSOR. Error Code F28

Recycle power and restart the system. If the compressor initially starts but then stops, replace the MODULE board and COMPRESSOR.

Error Code F2

The current draw into the compressor is too high. Check compressor windings. If OK, replace the Module Board.

Error Code F23

The current draw into the compressor is too high. Check compressor windings. If OK, replace the Module Board.

Error Code E9

This error indicates the temperature of the indoor coil during heating mode is too high and has exceeded the maximum limit. This code will be indicated when the temperature of the indoor coil exceeds 149 F twice in 30 minutes. Causes include low charge, dirty indoor coil, faulty EEV

Important Service Related Installation Information

Indoor Clearances: If non-compliant may lead to temperature control complaints.

Wire Sizing: If non-compliant may lead to communication errors and inverter irregular operation.

Splices in Field Wiring: Splices between the wires that connect between the outdoor and indoor unit should be avoided. Communication errors may occur if non compliant.

Sealing Penetrations: If penetrations at back of unit are not sealed, unconditioned air may be drawn into the back of the indoor wall mount unit. Temperature control and capacity complaints may occur.

Cassette Unit Technical Overview

Cassette Unit Components

Component Overview

The indoor cassette type units act as evaporator coils during cooling mode and condenser coils during heating mode. These units have a built in condensate pump with an associated condensate level switch. The condensate pump is capable of lifting water out of the indoor unit. If high water lift is needed, the water from the cassette pump should be pumped into a field supplied condensate pump with high lift power.



Cassette type indoor units can be operated with a wired controller or a remote control.

Power to operate the indoor unit comes from the electrical line voltage terminal block at the outdoor unit. The wiring includes 4 wires, 1, 2, 3 and ground. Wires 1 and 3 complete the data path. These wires should always be 14 gauge AWG Stranded type wire. Splices in wires 1 or 3 may cause communication errors.





The indoor unit features a multi speed blower motor that will change speed to match the capacity demand from the outdoor unit. Separate motors located in the indoor unit control the operation of the motorized louvers. All of the louver motors are controlled via commands received from the remote control. The blower motor is controlled by both the remote control and by commands from the outdoor unit ECU. Refer to the Remote Control Information in the Reference section for louver control/remote procedures.

Motor Blower



Unlike typical air handlers found in the US market, these units have metering devices located in the outdoor unit. The metering devices are EEV type that are controlled by the outdoor unit ECU.

Temperature sensors located within the cassette unit include a pipe temperature sensor and a return air temperature sensor. The pipe temperature sensor is used to sense the temperature of the indoor coil in both cooling and heating modes. The return air sensor sense the temperature of the air being drawn into the wall mounted unit from the conditioned space. The operating functions of these sensors is explained in the Temperature Sensor Function section of this manual.



Terminal Block





Ambient Sensor

The indoor unit has a display that communicates system mode. The indoor unit does not display temperatures or diagnostic codes. When a wired controller is used, this information is displayed on the wired controller. It is recommended to use a wired controller with the cassette unit.



When servicing a diagnostic error, ALWAYS refer to the outdoor unit code to make diagnostic decisions.

Cassette Unit Indoor Circuit Board





The indoor unit circuit board controls the switching functions of the indoor unit. All control decisions are made by the outdoor unit ECU. The indoor board has some limited diagnostic capability which will be covered in this manual.

The Indoor Unit Circuit Board communicates with the outdoor unit ECU via a connection at Terminal Block screw 3. The data pulse that sends the communication information can be measured with a voltmeter placed to DCV range. From the ground connection at the Terminal Block to the Number 3 screw connection, the voltage should pulse up and down when data is being transmitted.

This control board has control over the fan louver movement, manual fan blower control, indoor coil temperature and indoor air temperature sensing functions. All operational decisions are controlled by the OUTDOOR UNIT ECU.

The connections on the indoor board are shown here in the schematic drawing.

Line voltage to power the indoor unit comes in on Terminal Block connections 1 and 2. Power connects from these terminal connections to CH- 3 and CH-4 on the circuit board. If the board does not respond to commands and has no display, check for line voltage at these connections. When power is present at the indoor board, the Display Power Indicator will be lit.

The control board has a replaceable 3.15A 250V fuse that protects against excessive current. If power is present at the

(a) CN11 Wired Remote
(b) DIP Switches
(c) CN7 Stepper Motor
(c) CN6 Fan Motor
(c) CN9 Condensate Pump
(c) CN9 Condensate Pump
(c) CN13 Remote Central
(c) CN1 Room Card

board but the board does not work, check for continuity through the fuse. Replace if the fuse is open.

The indoor unit temperature sensors are connected at Plug CN-13. When testing the calibration of these sensors, the wires can be released from the plug by pressing on the tension tab on the side of the plug.

The receiver/display unit that is mounted to the front cover of the indoor unit plugs into the circuit board via a connection at Plug CN-29.

There is one motor that controls the movement of the louvers. The motor connects to the circuit board at Plug CN-14. The motor is located in the over of the louver assembly.

The blower/fan motor is connected to the circuit board at plug CN-11.

The Cassette unit has a built in condensate pump. The pump is connected to the circuit board on Plug CN-9. The pump is energized whenever the Float Switch indicates that water needs to be pumped from the cassette. The float switch connects onto the circuit board via Plug CN-18.

Cassette Unit Wiring Diagram



Cassette Unit DIP Switch Settings

BM1-1	BM1-2	BM1-3	BM1-4	BM1-5	BM1-6	BM1-7	BM1-8	Description
OFF	OFF	OFF						Unit capacity: 9000
ON	OFF	OFF						Unit capacity: 12000
OFF	ON	OFF						Unit capacity: 18000
			OFF					Room card invalid(default)
			ON					Room card valid
				OFF				Heat pump(defult)
				ON				Cooling only
					OFF	OFF	OFF	Cassette(American)

ENGLISH

Cassette Unit Components

The Blower Assembly

The blower assembly consists of a plastic blower wheel that is connected to a PSC indoor blower motor. A set screw holds the blower wheel to the blower motor.

Blower/Fan Assembly



The indoor blower motor is a Multi Speed Fan Motor that is connected to the indoor unit control board via Plug CN-11. The wiring from the motor to indoor board consists of 4 wires connected to pins common, low, medium and high speeds.



During normal operation, the indoor control board will energize the indoor blower motor and request proper speed. The motor has a run capacitor that is located in the Cassette unit's control box. The run capacitor connects to the motor via two orange wires. This capacitor is field replaceable.

Louver motors

The louver motors are stepper type motors that move the louvers up/down. The motors are controlled by pulsed voltage that cannot be measured. If the louver does not move when it should, check for a bind in the louvers. If the louver is free to move, refer to the Test Procedure Section.



Louver motor

The Piping Temperature Sensor senses indoor coil temperature in the cooling mode and in the heating mode. This sensor is used for Anti Freezing and Anti Cold Blow cycles. The sensor also provides critical temperature information to the ECU that may be used in frequency adjustments. See Temperature Sensor Functions.



The Ambient Temperature Sensor senses room temperature. This sensor provides room temperature information to the ECU for calculation of inverter capacity and temperature control.



Both sensors are negative temperature coefficient type that reduce electrical resistance as temperature rises.

Cassette Unit Components

Accessing the blower motor and condensate pump

- A1. Disconnect power to the outdoor unit.
- A2. Remove the louver assembly.
- A3. Disconnect the main power wire to the indoor unit.
- A4. Unplug the condensate pump and float switch from wiring harness.
- A5. Unplug fan motor from wiring harness.
- A6. Remove ground wire from ground screw on electrical box.
- A7. Remove 5 screws holding foam condensate pan bottom in place.
- A8. Slide condensate pan from cassette.

Removing Fan Motor

- RFM1. Remove holding nut from fan blade.
- RFM2. Fan blade will slide off motor shaft.
- RFM3. Remove Phillips head screw holding cover plate over motor wiring leads.
- RFM4. Remove 3 nuts that hold fan motor in place.
- RFM5. Fan motor will come loose.

Removing Condensate Pump

- RCP1. Remove screws holding condensate pump and float switch in position.
- RCP2. Disconnect condensate hose from condensate pump.
- RCP3. Remove assembly.

Louver Assembly





A7. Image shows screw locations








Cassette Unit Testing Procedures: Accessing Components/Removing Cover

Indoor Fan Motor Test Procedure

If the indoor fan motor does not run.

- 1. Disconnect power to the system.
- 2. Remove the return air cover and access the circuit board connection CN-11.
- 3. Reset power and turn the remote control fan command to Fan On mode.

Motor Test

- 1. If the motor doesn't run, check for voltage on the CN-11 between the Plug N Pin to all 3 speed pins. There should be around 230 volts on each motor lead. If voltage is not present, the indoor board is bad. If voltage is present between Pin N to any lead, the motor's internal overload is open. Wait until the motor cools and test the run capacitor.
- 2. Shut the power off to the outdoor unit. Unplug the indoor motor run capacitor.
- 3. Use an ohmmeter to charge and discharge the capacitor. If the capacitor charges and discharges with the ohmmeter, the capacitor is good. If the capacitor does not charge, the capacitor is bad. Replace the capacitor.

If the run capacitor is good, and there is voltage between Pin N and all motor leads, yet the motor doesn't run, replace the motor.







Cassette Unit Sensor Testing Procedures

Testing Temperature Sensors

The easiest problems to solve will involve codes that are related to potential failure of temperature sensors. Common problems may include loose connections, open electrically, and out of calibration. Checking the condition of the sensors requires a temperature probe and an ohmmeter.

The Reference Section of this manual contains temperature resistance tables that can be used to check the calibration of the sensors. The measured resistance must be within the tolerances printed on the top of the tables.

Testing Procedure

To test the electrical condition of a temperature sensor perform the following:

- 1. Confirm the sensor is firmly attached to the circuit board connection plug.
- 2. Remove the sensor wires form the connection plug by releasing holding tension on the plugs tension tab.
- 3. Use an ohmmeter to test the electrical resistance of the sensor.
- 4. Measure the air temperature near the sensor and compare the required resistance against measured resistance. (See chart in reference section) If the sensor is within calibration, the sensor is good. If the sensor is out of calibration, replace the sensor. (Tube Sensors should be removed from socket and exposed to air temperature during test.)







Cassette Unit Testing Procedures: Louver Motor

Testing Louver Motors

If the louver does not operate with command from the remote control, either the indoor board is bad, or the louver motor is defective. It is more likely the motor is defective than the board. (Make sure the louver assembly is not binding and keeping the vanes from moving.)

- 1. Remove power from the unit and remove the indoor unit cover.
- 2. Access the circuit board.
- Identify the inoperable louver motor on the schematic drawing below and disconnect the plug from the circuit board.



- 4. Use an Ohmmeter to test the electrical continuity of the louver motor windings. The proper resistance for each winding can be found in this table. If the motor winding resistance is erratic or shows open, the motor is defective. Replace the motor.
- 5. If the motor checks out good, replace the indoor control board.

Take electric box cover off



Front Panel Connector



Check Louver motor connecto



Cassette Unit Testing Procedures: Communication Circuit, Condensate Pump & Float Switch

Testing Communication Circuit

Check E7

If an Error E7 occurs, perform the following test to determine if the indoor control board is functioning properly to send data to the outdoor unit.

Perform this test with the unit powered and all wiring connected between indoor and outdoor unit.

Make sure all wiring between the indoor and outdoor unit are correct. There should no splices between the indoor and outdoor unit wiring connecting terminals 1 or 3. Make sure wiring is correct, before performing this test.

1. Measure the DC voltage between terminals 1 and 3 on the indoor terminal block.



- 2. The voltage should fluctuate between 8VDC and 23VDC. The fluctuating signal indicates a good communication path.
- 3. If the voltage does not fluctuate, and the wiring is good, the indoor board is defective.

Test Condensate Pump and Associated Float Switch

If the internal condensate pump does not operate, the pump may be bad or the float switch may be defective. Perform the following test:

Float Switch and Condensate Pump

- 1. Access the electrical control box.
- 2. Unplug the float switch from the circuit board. Plug CN-18.
- 3. The pump should start.
- 4. If the pump does not start, check for voltage to the pump at connector CN-9. There should be 230 Volts AC to the pump. If there is not, the circuit board is defective. If there is proper voltage to the pump, either the pump or associated pump wiring is defective.







Slim Duct Unit Technical Overview

Slim Duct

The Slim Duct Indoor Unit will act as evaporator coils during cooling mode and condenser coils during heating mode. This unit can operate with a motorized supply air louver or it can have a LIMITED amount of ducting added to the unit's return and supply air duct connection flanges. The return air ducting can be connected to the end of the cabinet or the bottom blank off plate can be removed for bottom return configuration.

DIP Switches on the unit's circuit board configure the fan power to match the ducting configuration.

The Slim Duct cabinet is insulated so that it can be installed in unconditioned air. The unit is well suited for mounting in soffits, attics, and garages.

These units have a built in condensate pump with an associated condensate level switch. The condensate pump is capable of lifting water out of the indoor unit. If high water lift is needed, the water from the cassette pump should be pumped into a field supplied condensate pump with high lift power.

Slim Duct units are controlled by a wired controller only.



Basic Duct Configurations

Here are the typical duct configurations that can be used with the unit.





Duct work Installation

Roof Installation



Long Duct









SLIM DUCT OVERVIEW

Slim Duct Components

Layout of Components

The layout of the system is very straightforward and components are easily accessed should service be required.

- The circuit board is located under the electrical control box cover.
- The blower motor and blower assemblies and room air temperature sensor are accessed at the rear of the unit.
- The evaporator coil and piping temperature sensor are located under the top cover.
- The condensate pump and float switch are accessed under the removable panel next to the electrical control box.

Power to operate the indoor unit comes from the electrical line voltage terminal block at the outdoor unit. The wiring includes 4 wires, 1, 2, 3 and ground. Wires 1 and 3 complete the data path. These wires should always be 14 gauge AWG Stranded type wire. Splices in wires 1 or 3 may cause communication errors.



The indoor unit features a multi speed blower motor that will change speed to match the capacity demand from the outdoor unit. The motor is a dual shaft type that powers two individual blower assemblies.



Separate motors located in the accessory supply air louver control the operation of the motorized louvers. All of the louver motors are controlled via commands received from the remote control. The blower motor is controlled by both the remote control and by commands from the outdoor unit ECU. Refer to the Remote Control Information in the Reference section for louver control/remote procedures.

Unlike typical air handlers found in the US market, these units have metering devices located in the outdoor unit. The metering devices are EEV type that are controlled by the outdoor unit ECU.

Drain Ports

The indoor unit has the option for either gravity drain systems or the use of an internal condensate pump with float switch. The pump is capable of minimal lift. If high lift is required, the water



from the Slim Duct unit should be pumped to a field supplied condensate pump that is capable of high lift.

Temperature sensors located within the slim duct unit include a pipe temperature sensor and a return air temperature sensor. The pipe temperature sensor is used to sense the temperature of the indoor coil in both cooling and heating modes. The return air sensor sense the temperature of the air being drawn into the wall mounted unit from the conditioned space.



The wired controller can be configured to sense room air temperature. The operating functions of these sensors is explained in the Temperature Sensor Function section of this manual.

All operating status and information is displayed on the wired controller. The Slim Duct unit does not have a display.

There is no option for use with remote control.

When servicing a diagnostic error, ALWAYS refer to the outdoor unit code to make diagnostic decisions.

TECHNICAL OVERVIEW

Slim Duct Components

Indoor Unit Circuit Board

The indoor unit circuit board controls the switching functions of the indoor unit. All control decisions are made by the outdoor unit ECU. The indoor board has some limited diagnostic capability which will be covered in this manual.





The Indoor Unit Circuit Board communicates with the outdoor unit ECU via a connection at Terminal Block screw 3. The data pulse that sends the communication information can be measured with a voltmeter placed to DCV range. From the ground connection at the Terminal Block to the Number 3 screw connection, the voltage should pulse up and down when data is being transmitted.

This control board has control over the fan louver movement, manual fan blower control, indoor coil temperature and indoor air temperature sensing functions. All operational decisions are controlled by the OUTDOOR UNIT ECU.

The connections on the indoor board are shown here in the schematic drawing. Line voltage to power the indoor unit comes in on Terminal Block connections 1 and 2. Power connects from these terminal connections to CH- 1 and CH-2 on the circuit board. If the board does not respond to commands and has no display, check for line voltage at these connections. When power is present at the indoor board, the wired controller will be energized.

The control board has a replaceable 5A 250V fuse that protects against excessive current. If power is present at the board but the board does not work, check for continuity through the fuse. Replace if the fuse is open.

The indoor unit temperature sensors are connected at Plug CN-13. When testing the calibration of these sensors, the wires can be released from the plug by pressing on the tension tab on the side of the plug.

There 3 motors that control the directional movement of the accessory louver. The motor connects to the circuit board at Plug CN-14, CN-15 and CN-16. The motors are located in the louver assembly.

The blower motor is connected to the circuit board at plug CN-6.

The Slim Duct unit has a built in condensate pump. The pump is connected to the circuit board on Plug CN-9. The pump is energized whenever the Float Switch indicates that water needs to be pumped from the cassette. The float switch connects onto the circuit board via Plug CN-18.



The float switch and pump are located behind the removable insulated cover next to the electrical control box. The pump is hermetically sealed and requires no maintenance. The float switch is a normally closed switch, that opens as water rises. The float switch requires no maintenance.

The connection for the wired controller is made via Plug CN1

SLIM DUCT TECHNICAL OVERVIEW

Slim Duct Components

SW1 DIP Switches



There are two sets of DIP switches on the Circuit Board. SW3 is for factory use only. SW1 is used to set the configuration of the indoor unit operation. The first three switches SW1-1, SW1-2 and SW1-3 select the indoor unit capacity.

Air Delivery Power is set with DIP Switches SW1-4 and SW1-5. The settings are shown in Hydrostatic Selection of OPa, up to 30Pa. SW1-7 and SW1-8 define the unit type. The conversions are as follows:

0Pa=0"w.c.

10Pa= .04"w.c.

20Pa=.08"w.c.

30Pa=.12"w.c.

- Recommended settings are for motorized Louver set to 10Pa.
- Ducting limited to a total of .12"w.c. External Static set to 30Pa.

Accessory Louver Motors

The louver motors are stepper type motors that move the louvers up/down. The motors are controlled by pulsed voltage that cannot be measured. If the louver does not move when it should, check for a bind in the louvers. If the louver is free to move, refer to the Test Procedure Section.





Temperature Sensors



The Piping Temperature Sensor senses indoor coil temperature in the cooling mode and in the heating mode. This sensor is used for Anti Freezing and Anti Cold Blow cycles. The sensor also provides critical

temperature information to the ECU that may be used in frequency adjustments. See Temperature Sensor Functions.



temperature control.

The Ambient Temperature Sensor senses room temperature. This sensor provides room temperature information to the ECU for calculation of inverter capacity and

The Blower Assembly

The blower assembly consists of 2 plastic blowers. The blower motor is a DC variable speed dual shaft type. A set screw holds each blower wheel to the blower motor.



The indoor blower

PAGE 44

motor is a Multi Speed Fan Motor that is connected to the indoor unit control board via Plug CN-6. The wiring from the motor to indoor board consists of 5 wires connected to pins that deliver line voltage, speed, and feedback information.

During normal operation, the indoor control board will energize the indoor blower motor and request proper speed. Fan power should be set using the DIP Switches SW1 settings.

Both sensors are negative temperature coefficient type that reduce electrical resistance as temperature rises.

Test Condensate Pump and Associated Float Switch

If the internal condensate pump does not operate, the pump may be bad or the float switch may be defective. Perform the following test:

Float Switch and Condensate Pump

- 1. Access the electrical control box.
- Unplug the float switch from the circuit board. Plug CN-18.



- 3. The pump should start.
- If the pump does not start, check for voltage to the pump at connector CN-9. There should be 230 Volts AC to the pump. If there is not, the circuit



board is defective. If there is proper voltage to the pump, either the pump or associated pump wiring is defective.

Testing Temperature Sensors Procedure

To test the electrical condition of a temperature sensor perform the following:

- 1. Confirm the sensor is firmly attached to the circuit board connection plug.
- 2. Remove the sensor wires from the connection plug by releasing holding tension on the plugs tension tab.



3. Use an ohmmeter to test the electrical resistance of the sensor.

Testing Temperature Sensors

The easiest problems to solve will involve codes that are related to potential failure of temperature sensors. Common problems may include loose connections, open electrically, and out of calibration. Checking the condition of the sensors requires a temperature probe and an ohmmeter.

The Reference Section of this manual contains temperature resistance tables that can be used to check the calibration of the sensors. The measured resistance must be within the tolerances printed on the top of the tables.





Measure the air temperature near the sensor and compare the required resistance against measured resistance. (refer to charts in reference section) If the sensor is within calibration, the sensor is good. If the sensor is out of calibration, replace the sensor. (Tube Sensors should be removed from socket and exposed to air temperature during test.)

4.

SLIM DUCT TESTING PROCEDURES

Testing Communication Circuit

If an Error E7 occurs, perform the following test to determine if the indoor control board is functioning properly to send data to the outdoor unit.

Perform this test with the unit powered and all wiring connected between indoor and outdoor unit.

Make sure all wiring between the indoor and outdoor unit are correct. There should no splices between the indoor and outdoor unit wiring connecting terminals 1 or 3. Make sure wiring is correct, before performing this test.

- 1. Measure the DC voltage between terminals 1 and 3 on the indoor terminal block.
- 2. The voltage should fluctuate between 8VDC and 23VDC. The fluctuating signal indicates a good communication path.
- 3. If the voltage does not fluctuate, and the wiring is good, the indoor board is defective.



Wired Controller YR-E17

WIRED CONTROL PANEL FUNCTIONS

Features and Interface

7				
088:88		Clock; Parameter setting/Inquiry; Malfunction display		
₿.88:88 ∞⊶⊷∞		Timer ON/OFF; Sleep function; Parameter setting/Inquiry; Malfunction display		
		ROOM/SET temp. and humidity display, each step is 0.5°C (1°F). For example, if the temp is 25°C (77°F), it will display 25.°C (77°F). Humidity display function is reserved.		
EC	0	Energy Saving function. This icon will be dis- played only when energy saving function is set.		
E	E	Filter Cleaning		
\odot		Child Lock		
		Lock/Central		
8	3	Motion Sensing (Reserved)		
1	<u>r</u>	Left/Right Swing. This icon is displayed only when in swing function		
Ņ	V	Up/Down Swing. This icon is displayed only when in swing function		
-				
Ð	Sleep f sleep f the top	unction. This icon is displayed when setting the unction. Remaining sleeping time is displayed in o right corner.		
	Heat F settin	Reclaim Ventilation. This icon is displayed when g the heat reclaim ventilation.		
Electrical Heating. This icon is displayed when electheating is set on DC wired control.		cal Heating. This icon is displayed when electrical g is set on DC wired control.		
\mathcal{C}	Intellig	gent Modeautomatic cycling.		
83	Coolir	ng Mode		

Heating Mode Q. Fan Mode Ж Dry Mode Θ :::: K :::: Quiet



Fan speed will be changed in sequence as : Quiet \rightarrow Low \rightarrow Medium \rightarrow High \rightarrow Turbo \rightarrow Auto



User Friendly: Back light; Room temperature display

Functions: Clock; Timer; Sleep Function; Heat Reclaim Ventilation; ECO; Filter Cleaning; Error Code display; Child Lock; Parameter Inquiry; Unit NO. Setting; Static Pressure Grade Inquiry; Temp. Compensation setting; Forced Cooling/Heating



WIRED CONTROLLER INSTALLATION

Wired Controller Wiring Instructions

Step By Step Guide To Slim Duct Unit Installation

There are three methods to connect the wired controller to the indoor units.

A. One wired controller controls one indoor unit; the indoor unit connects with the wired controller through a 3 conductor shielded cable.



B. One wired controller can control up to 16 sets of indoor units (max); A 3 conductor shielded cable must connect the wired controller and the master unit (the indoor unit connected to the wire controller directly). The others connect to the master unit through a 2 conductor shielded cable.



C. Two wired controllers control one indoor unit. The wired controller that connects with the indoor unit is called the master controller, the other is called the slave controller. The master wired controller and the indoor unit (as well as the master controller and the slave controller) are all connected through 3 conductor shielded cables.



Communication Wiring

3				
Communication Wiring Length	Dimension of Wiring			
0~100 ft (0~30m)	22AWG(0.3mm ²)x3-core shielded wire			
100~200 ft (30~60m)	20AWG(0.5mm ²)x3-core shielded wire			
200~300 ft (0~90m)	18AWG(0.75mm²)x3-core shielded wire			
300-400 ft (90~120m)	16AWG(1.25mm²)x3-core shielded wire			
400~500 ft (120~150m)	14AWG(2mm ²)x3-core shielded wire			





1. Put communication wire through the hole in the back cover as shown.

2. Mount the back cover in the desired location, making sure not to pinch the communication wire. Then connect the communication wire to CON1 port of the wired controller. Replace the cover onto the unit to complete the installation.



WIRED CONTROLLER INSTALLATION

Wired Controller Wiring Instructions

Dimensions

Unit: inch (mm)



Dip Switch

Dip Switch	ON/OFF	Function	Default Setting
SW/1_1	ON	Set as the slave controller	0.55
2001-1	OFF	Set as the master controller	
SW/1 2	ON	Ambient temp. display available	0.55
5001-2	OFF	Ambient temp. display unavailable	
SW1 Z ON Display ambient temp. from PCB of indoor			
2001-2	OFF	Display ambient Temp. from wired controller	
S\N/1_4	ON	Auto-restart invalid	
5 VV 1-4	OFF	Auto-restart valid	
S\W1_E	ON	Fahrenheit	055
21112	OFF	Celsius	
S)//1_C	ON	Swing angle adjustment available	055
21110	OFF	Swing angle adjustment unavailable	
S\N/1 7	ON	Up/Down and Left/Right swing	
SVV1-/	OFF	Up/Down swing	
C\\/1_9	ON	Fresh Air unit	
SVV1-0	OFF	General unit	

WIRED CONTROLLER OPERATION

Settings & Functions

Initialization



The wired controller will momentarily display all display icons upon powering up or when resetting the system.

During the initialization process, the controller will display, in a repeating order: 88:88 (upper left corner), 88:88 (upper right corner) 88.8 (main temperature).

This cycle keeps repeating until initialization is complete. The green ON/OFF LED will also flash continuously until initialization is complete.

If the wired controller is unable to communicate with the indoor unit PCB after powering on, initialization will terminate in 4 minutes. The communication malfunction can be checked using the malfunction inquiry function. (See Malfunction Display)

Mode Setting

NOTE: This function requires the ON/OFF key LED to be turned OFF and the screen backlight to be illuminated. Press and hold the MODE key for 5 seconds, the number of the mode currently being used will display in the upper left corner of the screen. (Default is 0) Press the $\blacktriangle \nabla$ keys to change to one the different modes available: 0, 1, 2, or 3. Press SET to confirm the setting.

NOTE: Corresponding modes

- 0 [Intelligent] [Cooling] [Heating] [Fan] [Dry]
- 1-[Cooling] [Heating] [Fan] [Dry]
- 2 [Cooling] [Fan] [Dry]
- 3 [Cooling] [Heating] [Fan] [Dry] (same as 1)

Error Code Display

Note: This function requires the ON/OFF key LED to be turned OFF and the screen backlight to be illuminated.

Press and hold the TIME key for 10 seconds. The unit number will display in the upper left corner of the screen. The error code/historical error code will display in the upper right corner of the screen. Press $\blacktriangle \nabla$ keys to select the unit number to view its error codes. Under Error Code display screen, press and hold the TIME key for 5 seconds to clear the fault codes of all the units.

Press the MODE, FAN, TIME, SET, or ON/OFF key to exit the function. If no key is pressed in 10 seconds, the function will also exit. If there are no current errors or historical error codes, "--" will be displayed.

Switching between Fahrenheit & Celsius

To switch from Celsius to Fahrenheit, select the mode you wish to operate (COOL, HEAT, DRY, INTELLIGENT/AUTO). Press and hold the \blacktriangle key to reach 30 °C then continue holding the \blacktriangle key for 15 seconds until the display reads 86 °F. Use the \bigstar keys to adjust to desired temperature.

To switch from Fahrenheit to Celsius, select the mode you wish to operate (COOL, HEAT, DRY, INTELLIGENT/AUTO). Press and hold the \triangledown key to reach 60 °F then continue holding the \triangledown key for 15 seconds until the display reads 16 °C. Use the \blacktriangle keys to adjust to desired temperature.

Clock Function



The clock is displayed in 24 Hour time
It cannot be set for AM/PM.
The clock function cannot be set when SLEEP function or a timer function is currently set.

When the system is first powered up, after initialization, the clock will default to 12:00. Within 10 seconds of the clock being displayed, the time can be set. The clock icon and minutes portion of the time display will be flashing. Press the $\blacktriangle \nabla$ keys to adjust the minutes. (Pressing and holding the $\bigstar \nabla$ keys will accelerate the time adjustment.) With the minutes set, press the TIME key. The clock icon and hours portion of the time display will now begin flashing. Press the $\bigstar \nabla$ keys to adjust the hours. Press the SET key to confirm the setting.

To set the clock after initial power up or reset time has expired, press and hold the TIME key for 5 seconds. The clock icon and minutes portion of the time display will begin flashing. Press the $\blacktriangle \nabla$ keys to adjust the minutes. With the minutes set, press the TIME key. The clock icon and hours portion of the time display will now begin flashing. Press the $\bigstar \nabla$ keys to adjust the hours. Press the SET key to confirm the setting. If neither $\bigstar \nabla$ key is pressed within 10 seconds, or if the MODE, FAN, or ON/OFF keys are pressed prior to pressing the SET key, the setting function is canceled and the time reverts back to the previous setting.

Screen Saving

With the system turned off, tap the TIME key to activate the screen backlight (if not already lit).

1. Press and hold the TIME and $\mathbf{\nabla}$ keys for 5 seconds to set the backlight "on" time. The set time will be displayed in the upper right corner of the screen.

2. Press the $\blacktriangle \forall$ keys to adjust the time. Set times available are: 0 seconds (backlight always on), 15 seconds, 30 seconds, and 60 seconds. Initial default time is 15 seconds.

3. With time selection made, press the SET key to confirm the setting.

If neither $\blacktriangle \nabla$ key is pressed within 10 seconds, or if the MODE, FAN, or ON/OFF keys are pressed prior to pressing the SET key, the setting function is canceled and reverts back to the previous setting.

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Settings & Functions

ECO Energy Saving Function

NOTE: This function requires the ON/OFF key LED to be turned ON and the screen backlight to be illuminated.



Press the SET key. The swing louver function icon will be displayed. Press the ▲▼ keys to advance through the functions to select ECO function. (The icon will

be flashing) Press the SET key to confirm the setting. The ECO icon will remain on.

To cancel ECO function, repeat the above steps.

NOTE: The energy saving default parameters are listed below: 74°F Lowest temperature limit of Cooling and Dry mode. 78°F Highest temperature limit of Heating mode.

74°F – 86°F Temperature adjustment range in Cooling and Dry mode.

60°F – 78°F Temperature adjustment range in Heating mode.

ECO Parameter Setting

NOTE: This function requires the ON/OFF key LED to be turned ON and the screen backlight to be illuminated.

For Cooling

Under Cooling mode, set the temperature to 86°F. Press and hold the FAN key for 5 seconds. The Cooling ECO parameter (flashing) will be displayed in the upper left corner of the screen. Default temperature is 74°F. Press the $\blacktriangle \nabla$ keys to adjust the lowest target cooling temperature. Press the SET key to confirm the setting and exit setup.

For Heating

Under Heating mode, set the temperature to 60°F. Press and hold the FAN key for 5 seconds. The Heating ECO parameter (flashing) will be displayed in the upper right corner of the screen. Default temperature is 78°F. Press the $\blacktriangle \nabla$ keys to adjust the highest target heating temperature. Press the SET key to confirm the setting and exit setup.

Static Pressure Grade Inquiry & Adjustment

NOTE: This function requires the ON/OFF key LED to be turned ON and the screen backlight to be illuminated.

Press and hold the SET and FAN keys for 5 seconds. The current static pressure will be displayed in the upper right corner of the screen and the "Static Pressure" icon will begin to flash.

Press the TIME key to shift the unit no. displayed in the upper left corner of the screen. The unit numbers are from 00-15. Press the $\blacktriangle \nabla$ keys to change the static pressure grade, shown in the upper right corner of the screen. Number range is 01-04. Press the SET key to confirm the setting. Press the MODE, FAN, or ON/OFF key to exit the function. If no key is pressed in 10 seconds, the function will also exit.

Timer Function Setting



NOTE: The display backlight must be illuminated before proceeding. To turn the backlight on, press any key (MODE, FAN, $\blacktriangle \nabla$, TIME, or SET) located at the bottom of the display, or press the ON/OFF key located at the top of the display.

Timer ON

Press the TIMER key once, the ON timer icon will appear in the upper right corner of the screen. The ON icon and hour position are flashing. Press the $\blacktriangle \nabla$ keys to set the hour. Press the TIMER key again, the ON icon and minutes position are now flashing. Press the $\blacktriangle \nabla$ keys to set the minutes. Press the SET key to confirm the setting.

Timer OFF

Press the TIMER key 3 times, the OFF timer icon will appear in the upper right corner of the screen. The OFF icon and hour position are flashing. Press the $\blacktriangle \nabla$ keys to set the hour. Press the TIMER key again, the OFF icon and minutes position are now flashing. Press the $\blacktriangle \nabla$ keys to set the minutes. Press the SET key to confirm the setting.

Timer ON/OFF

Press the TIMER key 5 times, the ON/OFF timer icon will appear in the upper right corner of the screen. The ON icon and hour position are flashing. Press the $\blacktriangle \nabla$ keys to set the hour. Press the TIMER key again, the ON icon and minutes position are now flashing. Press the $\bigstar \nabla$ keys to set the minutes. Press the TIMER key again, the OFF icon and hour position are now flashing. Press the $\bigstar \nabla$ keys to set the hour. Press the TIMER key again, the OFF icon and hour position are now flashing. Press the $\bigstar \nabla$ keys to set the hour. Press the TIMER key again, the OFF icon and hour position are now flashing. Press the $\bigstar \nabla$ keys to set the hour. Press the TIMER key again, the OFF icon and minutes position are now flashing. Press the $\bigstar \nabla$ keys to set the minutes. Press the SET key to confirm the setting. Based on the times set, the indoor unit will determine which event happens first (ON-OFF or OFF-ON) and adjusts the arrow direction accordingly.

If neither $\blacktriangle \nabla$ key is pressed within 10 seconds, or if the MODE, FAN, or ON/OFF keys are pressed prior to pressing the SET key, the setting function is canceled and reverts back to the previous setting.

Timer Cancel

Press the TIME key up to 9 times to cycle through the timer settings. When the timer icon disappears, the timer function is canceled.

Note: An active timer function will remain displayed on screen until the set time has been reached and command completed.

WIRED CONTROLLER OPERATION

Settings & Functions

Left/Right/Up/Down Swing



The swing function determines air circulation.

 Press SET key to access Swing function circulation.
Use ▲ ▼keys to select desired swing function.

If **SW7** is on, air will circulate **UP/DOWN/LEFT/RIGHT.**

3. Press SET key to confirm swing function selection.

Parameter Inquiry

NOTE: This function requires the screen backlight to be illuminated. The ON/OFF key LED can be either On or Off.

Press and hold the SET key for 5 seconds. The unit number will be displayed in the upper left corner of the screen. The data type and current data will be displayed in the upper right corner of the screen.

Press the $\blacktriangle \nabla$ keys to scroll through the data types. (See chart for data type/current data)

Press the MODE, FAN, SET, or ON/OFF key to exit the function. If no key is pressed in 10 seconds, the function will also exit.

Data	Type meaning	System
Α	Indoor sensor Tai temp.	Actual value, decimal sys.
b	Indoor sensor Tc1 temp.	Actual value, decimal sys.
С	Indoor sensor Tc2 temp.	Actual value, decimal sys.
d	Indoor unit PMV opening/2	Actual value, decimal sys.
E	Indoor unit address	Actual value, hexadecimal sys.
F	Indoor unit central address	Actual value, hexadecimal sys.

Unit Number Setting

NOTE: This function requires the screen backlight to be illuminated. The ON/OFF key LED can be either On or Off.

Press and hold the SET key for 10 seconds. The wired controller address and communication address between the indoor and outdoor unit are displayed in the upper left corner of the screen. The central address is displayed in the upper right corner of the screen.

Press the $\blacktriangle \forall$ keys to select the indoor unit number: 0 - 3F. Press the SET key to confirm the setting. Press the MODE, FAN, or ON/OFF key to exit the function. If no key is pressed in 10 seconds, the function will also exit.

Forced Cooling/Heating

Note: This function requires the ON/OFF key LED to be turned OFF and the screen backlight to be illuminated.

Forced Cooling

When the system is turned off in cooling mode, press and hold the ON/OFF key for 10 seconds. The system will enter forced cooling. The temperature display will display a flashing "LL". Press the ON/OFF key to exit forced cooling mode.

Forced Heating

When the system is turned off in heating mode, press and hold the ON/OFF key for 10 seconds. The system will enter forced heating. The temperature display will display a flashing "HH". Press the ON/OFF key to exit forced heating mode.

NOTE: When in forced cooling or heating, all keys are disabled except for the ON/OFF key.

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4	Ċ	كر	

Child Lock Function

NOTE: This function requires the screen backlight to be illuminated. The ON/OFF key LED can be either On or Off.

Child Lock can be used to prevent unintended operation of the control unit.

1. Press SET and the $\mathbf{\nabla}$ keys together for 5 seconds to activate the Child Lock function. The child lock icon will be displayed on the left side of the screen. All normal functions of the keys will be disabled.

2. To unlock the Child Lock function, press the SET key and the \checkmark arrow together for 5 seconds. The child lock icon will disappear from the screen. All normal functions of the keys will be restored.

Temperature Compensation Setting

Note: This function requires the ON/OFF key LED to be turned OFF and the screen backlight to be illuminated.

Press and hold the FAN keys for 5 seconds, the current temperature compensation value is displayed in the upper right corner of the screen. (The default value is 00). Press the $\blacktriangle \nabla$ keys to change the temperature compensation value. The adjustment range is -07°F to +07°F. Press the SET key to confirm the setting. Press the MODE, FAN, TIME, or ON/OFF key to exit the function. If no key is pressed in 10 seconds, the function will also exit.

NOTE: The compensation value is used for ambient temperature and is valid only for the wired controller sensor.

Settings & Functions

Sleep Function

NOTE: This function requires the ON/OFF key LED to be turned ON and the screen backlight to be illuminated.



Press the SET key. The swing louver function icon will be displayed. Press the $\blacktriangle \nabla$ keys to advance through the functions to select the SLEEP func-

tion. The Sleep and Sleep "off" time icons will be displayed. (The Sleep icon will be flashing) Press the TIME key, the "off" icon will begin to flash. Press the $\blacktriangle \nabla$ keys to set the "off" time. (Time range is 0.5h to 72h) Press the SET key to confirm the setting. The Sleep function and "off" time icons will remain on.

If neither $\blacktriangle \nabla$ key is pressed within 10 seconds, or if the MODE, FAN, or ON/OFF keys are pressed prior to pressing the SET key, the setting function is canceled and reverts back to the previous setting.

To cancel the Sleep function. Press the SET key. The swing louver function icon will be displayed. Press the $\blacktriangle \nabla$ keys to advance through the functions to select the SLEEP function. The Sleep and Sleep "off" time icons will be displayed. (The Sleep icon will be flashing) Press the SET key to cancel the function.

Filter Cleaning

NOTE: This function requires the ON/OFF key LED to be turned ON and the screen backlight to be illuminated.



The Filter Cleaning icon will start flashing when the indoor unit has reached 500 hours of operating time.

After cleaning or replacing the filter, press the SET key to clear the icon and reset the operating time.

Heat Reclaim Ventilation

NOTE: This function requires the ON/OFF key LED to be turned ON and the screen backlight to be illuminated.



Press the SET key. The swing louver function icon will be displayed. Press the $\blacktriangle \nabla$ keys to advance through the functions to select the Heat Reclaim Ventilation function. (The icon will be flashing) Press the SET key to confirm the setting.

To cancel the Heat Reclaim Ventilation function, repeat the above steps.

If neither $\blacktriangle \nabla$ key is pressed within 10 seconds, or if the MODE, FAN, or ON/OFF keys are pressed prior to pressing the SET key, the setting function is canceled and reverts back to the previous setting.

This function is reserved for future models.

Other Functions

Note: These functions require the ON/OFF key LED to be turned OFF and the screen backlight to be illuminated.

Auto Restart

Setting DIP switch SW1-4 located on the PCB of the wired control to the "on" position will disable the auto restart function. When the switch is in the "off" position, auto-restart is enabled (default position). When the switch is in the "on" position, auto-restart is disabled.

Information retained in auto-restart are: Mode, Fan Speed, Temperature Setting, Swing State, and Heat Reclaim Ventilation function.

Communication Error of Wired Controller

If there is no communication between the wired controller and indoor unit for 4 minutes, when checking error codes, "07" will be displayed in the upper right corner of the display.

Wireless Remote Controller Note:

Functions



Power Button

Press the ON/OFF () button on the remote control to start the unit.

2 **TURBO/QUIET Button**

The TURBO function is used for fast heating or cooling.

Press the TURBO/QUIET button once and the remote control will display the TURBO side of the remote display and switch the unit to the TURBO function.

The QUIET function may be used when silence is needed for fast rest or reading. Press the TURBO/QUIET button again to switch to QUIET mode and the remote control will display the QUIET Micon on the bottom left side of the remote display.

Press the TURBO/QUIET button a third time to cancel TURBO/QUIET and return to normal operation.

TURBO/QUIET modes are only available when the unit is under cooling or heating mode (not for auto or fan mode).

Running the unit in QUIET mode for a long period of time may cause the room temperature to not reach the set temperature. If this occurs, cancel QUIET mode and set the fan speed to a higher setting.

3 **COOL** Button

In COOL mode, the unit operates in cooling. When FAN is set to AUTO, the air conditioner automatically adjusts the

fan speed according to room temperature. The 🗱 will be displayed during COOL mode.

HEAT Button

In HEAT mode, warm air will blow out after a short period of the time due to cold-air prevention function. When FAN is set to AUTO, the air conditioner automatically adjusts the

fan speed according to room temperature. The 🔅 will be displayed during HEAT mode.

5 **DRY Button**

DRY mode is used to reduce humidity. In DRY mode, when room temperature becomes lower than temp. setting +2°F, unit will run intermittently at LOW speed regardless of FAN

setting. The will be displayed during DRY mode.

6 Temperature +/- Buttons

- Temp + Every time the button is pressed, the temperature setting increases.
- Temp Every time the button is pressed, temperature setting decreases.
- The operating temperature range is 60°F-86°F.

AUTO Button

Under the mode of auto operation, the air conditioner will automatically select Cool, Heat, or Fan operation according to set temperature. When FAN is set to AUTO the air conditioner automatically adjusts the fan speed according to room temperature. The \Im will be displayed during AUTO mode.

8 **FAN Button**

Fan speed selection

Press the FAN (\mathbb{K}) button. For each press, fan speed changes as follows:

Remote control:



The air conditioner fan will run according to the displayed fan speed.

When FAN is set to AUTO, the air conditioner automatically adjusts the fan speed according to room temperature.

9 Louver SWING Button - Vertical

Air Flow Direction Adjustment

Press the SWING UP/DOWN button to choose the position of the vertical airflow louvers.

Status display of air flow COOL/DRY: $\rightarrow \sqrt{2} \rightarrow \sqrt{2} \rightarrow \sqrt{2} \rightarrow \sqrt{2} \rightarrow \sqrt{2}$



Caution:

• It is advisable not to keep the vertical louver in the downward position for an extended period of time in COOL or DRY mode, otherwise condensate water may form on the louver.

Note:

When turning the unit on, the remote control will automatically return the louver to the previous set swing position. When turning the unit off, the louver will rotate to the full open position prior to closing.

10 Louver SWING Button - Horizontal

Press the SWING UP/DOWN button to choose the position of the horizontal airflow louvers.

Status display of air flow



Caution:

• When humidity levels are high, condensate water may occur at the air outlet if all horizontal louvers are adjusted to left or right.

Note:

When turning the unit on, the remote control will automatically return the louver to the previous set swing position. When turning the unit off, the louver will rotate to the full open position prior to closing.

11 Timer ON Button

On-Off Operation

- 1. Start the unit and select the desired operating mode.
- 2. Press the TIMER ON button to enter the TIMER ON mode. The remote control will start flashing "ON".
- 3. Every time the TIMER ON button is pressed the length of time increases in 0.5 hour increments between hours 0 and 12, and 1 hour increments for times between hours 12 and 24.

4. Once the desired length of time is selected for the unit to turn on, press the CONFIRM/CANCEL to confirm this setting.

The remote control display changes as follows:

→ ON →	► OFF →	ON ◀- OFF →	► OFF ◀ ON	BLANK
0.5h	0.5h	0.5h	0.5h	
TIMER ON	TIMER OFF	TIMER ON-OFF	TIMER OFF-ON	

Cancel TIMER ON setting:

With a TIMER ON set, press the CONFIRM/CANCEL button once to cancel the TIMER ON.

Turning the unit ON with the TIMER from it being OFF will look like this on the remote control display:



Note:

Holding the TIMER ON button down will rapidly cycle the time. After replacing batteries or a power failure occurs, the time setting will need to be reset.

According to the Time setting sequence of TIMER ON or TIMER OFF, either Start-Stop or Stop-Start can be achieved.



On-Off Operation

- 1. Start the unit and select the desired operating mode.
- 2. Press the TIMER OFF button to enter the TIMER OFF mode. The remote control will start flashing "OFF".
- 3. Every time the TIMER OFF button is pressed the length of time decreases in 0.5 hour increments between hours 0 and 12, and 1 hour increments for times between hours 12 and 24.
- 4. Once the desired length of time is selected for the unit to turn off, press the CONFIRM/CANCEL to confirm this setting.

The remote control display changes as follows:

I	→ ON →	► OFF →	ON ◀-OFF →	► OFF ◀— ON →	BLANK-
	0.5h	0.5h	0.5h	0.5h	
	TIMER ON	TIMER OFF	TIMER ON-OFF	TIMER OFF-ON	

Cancel TIMER OFF setting:

With a TIMER OFF set, press the CONFIRM/CANCEL (button once to cancel the TIMER OFF.

Turning the unit OFF with the TIMER from it being ON will look like this on the remote control display:

Note:

Holding the TIMER OFF button down will rapidly cycle

the time. After replacing batteries or a power failure occurs, the time setting will need to be reset.

According to the Time setting sequence of TIMER ON or TIMER OFF, either Start-Stop or Stop-Start can be achieved.

13 SLEEP Button

Sleep mode

Press the Extra Function button to enter additional options, cycle the button to display the \bigcirc icon, the \bigcirc icon will flash. Press the Confirm/Cancel button to enter the sleep function.

Sleep Operation Mode

1. SLEEP mode during COOL, DRY modes

One hour after SLEEP mode starts, the temperature will rise 2°F above set temperature, after another hour, the temperature rises an additional 2°F. The unit will run for an additional six hours, then turns off. The final temperature is 4°F higher than the initial set temperature. Using this feature will help with achieving maximum efficiency and comfort from your unit while you sleep.



2. SLEEP mode during HEAT mode

One hour after SLEEP mode starts, the temperature will decrease 4°F below set temperature, after another hour, the temperature will decrease an additional 4°F. After an additional three hours, the temperature will rise by 2°F. The unit will run for an additional three hours, then turns off. The final temperature is 6°F lower than the initial set temperature. Using this feature will help with achieving maximum efficiency and comfort from your unit while you sleep.



3. In AUTO mode

The unit operates in corresponding sleep mode adapted to the automatically selected operation mode.

Note:

-When the unit is set to sleep mode, the fan speed will be set to low speed and cannot be changed.

-When the TIMER function is set, the sleeping function cannot be set. If the sleeping function has been set, and the user sets the TIMER function, the sleeping function will be canceled, and the unit will be set to the timer function.

14 EXTRA FUNCTION Button

Function:

A) Refresh air - Feature not available on this series.

B) A-B Yard - This will allow you to control two separate units with a single remote control.

Note: this feature would be setup at the time of installation by the contractor.

C) Fan Mode - Is indicated by the Sicon. Only the fan will operate in this mode. See section 8 "FAN Button" for changing the fan settings.

D) Intelligent upward airflow, E) Intelligent downward airflow, F) Reset intelligent airflow position

1. Press the ON/OFF button on the remote control to turn the unit on.

Select the desired operating mode.

2. Setting the intelligent airflow function

Press the EXTRA FUNCTION button to enter additional options. Press this button repeatedly to access the louver settings. The louver icon will cycle through the following three settings.



Select the desired position, then press the CONFIRM/ CANCEL button to set the function.

3. Canceling the intelligent airflow function

Press the EXTRA FUNCTION button to enter additional options. Press this button repeatedly to access the louver settings. Cycle the button to the louver icon "present" position, then press the CONFIRM/CANCEL button to cancel the function.

Notice: Do not reposition the horizontal louver by hand. This may cause the louver to run incorrectly and not match the icon displayed on the remote control. If the louver is not running correctly, turn the unit off for one minute, then back on, and adjust the louver setting with the remote control.

Note:

1. After setting the intelligent airflow function, the louver position is fixed.

2. In cooling, it is better to select the 📝 mode.

3. In heating, it is better to select the ಶ mode.

4. In cooling and dry modes, using the air conditioner for a long period of time under high humidity conditions, condensate water may form on the grille/louver.

WIRELESS REMOTE CONTROLLER OPERATION

G) Fahrenheit/Celsius mode shift on unit and remote -

To switch between Fahrenheit and Celsius press the EXTRA FUNCTION button until either Celsius or Fahrenheit is displayed. Press the CONFIRM/CANCEL button to apply the change.

H) 50°F low temperature heating - Feature not available on this series.

I) Electrical heating - Feature not available on this series.

15 HEALTH Button

Feature not available on this series.

16 Confirm/Cancel Button

Function: Setting and canceling timer and other functions.

17 LOCK Button

Used to lock buttons and LCD display

18 LIGHT Button

Turns indoor unit display on and off

19 RESET Button

If the remote control is not functioning properly, use a pen point or similar object to depress this button to reset the remote.

Troubleshooting

Trouble shooting

Outdoor		Wired controller	Cassette indoor	display outdoor	
LED	Outdoor unit fault possible reasons	display(Hex)for	Timer lamn	Running Jamp	Wall mounted
dicalay		duct	flach time	flach time	indoor display
uispiay		45	iidsii tiille	iidsii tiille	P10
1	Faulty of outdoor unit EEPROM	15	2	1	F12
2	IPM overcurrent or short circuit	16	2	2	F1
4	Communication failure between Module and ECU	18	2	4	F3
5	Module, operated overload	19	2	5	F20
6	Module low or high voltage	10	2	6	F10
0	Discharging tomporature overheating lack of	74	2	0	115
8	refrigerant,	1C	2	8	F4
	ambient temperature too nign or PIVIVS blocked.	15	-		70
9	Malfunction of the DC fan motor	1D	2	9	F8
10	Malfunction of defrosting temp. sensor	1E	3	0	F21
11	Malfunction of compressor suction temp. sensor	1F	3	1	F7
12	Malfunction of ambient temp. sensor	20	3	2	F6
13	Malfunction of compressor discharge temp.	21	3	3	F25
15	Communication failure between indoor&outdoor unit	23	3	5	E7
16	Lack of refrigerant or discharging	24	3	6	F13
17	4-way valve switching failure	25	2	7	F14
10	4-way valve switching failure	25	2	, ,	F11
18	Loss of synchronism detection	26	3	8	FII
20	Indoor thermal overload	28	4	0	E9
21	Indoor frosted	29	4	1	E5
23	Module thermal overload	2B	4	3	F5
24	Compressor start failure	2C	4	4	F2
25	Module input overcurrent	2D	4	5	F23
26	MCII reset	2F	Λ	6	F9
20	Modulo surrent detect sircuit malfunction	20	4	7	F24
27		2F	4	/	Γ24
28	Malfunction of liquid pipe temp. sensor for indoor unit A	30	4	8	F10
29	Malfunction of liquid pipe temp. sensor for indoor unit B	31	4	9	F16
30	Malfunction of liquid pipe temp. sensor for indoor unit C	32	5	0	F17
31	Malfunction of liquid pipe temp. sensor for indoor unit D	33	5	1	F18
32	Malfunction of gas pipe temp. sensor for indoor unit A	34	5	2	F29
33	Malfunction of gas pipe temp. sensor for indoor unit B	35	5	3	F30
34	Malfunction of gas pipe temp. sensor for indoor unit C	36	5	4	F31
35	Malfunction of gas pipe temp. sensor for indoor unit D	37	5	5	F32
36	Malfunction of gas pipe temp. sensor for indoor unit E	38	5	6	F26
38	Malfunction of module temp.sensor Momentary power failure detection	ЗA	5	8	F35
39	Malfunction of condensing temp. sensor	3B	5	9	F36
	Malfunction of liquid pipe temp, sensor for				
40	indoor unit E	3C	6	0	F33
41	iviaitunction of Toci'temp. sensor	30	6	1	F38
42	System high pressure switch off	3E	6	2	F39
43	System low pressure switch off	3F	6	3	F40
44	System high pressure protection.Refrigerant overabundance, High condensing temp. or malfunction of fan motor.	40	6	4	F41
45	System low pressure protection.Refrigerant shortage, Low defrosting temp., or malfunction of fan motor	41	6	5	F42

REFERENCES

Resistance Values for Wall Mounted, Ducted, and Cassette Units

	Wall	Mount Fan Mot	tor Resistanc	e Values	
	Yellow	Blue	White	Black	Red
Yellow		Infinity Ω	345K Ω	238K Ω	Infinity 9
Blue			4.7K Ω	4.54M Ω	Infinity 9
White				107K Ω	Infinity 9
B lack					Infinity 9
Red					

	Wall Mount Horizontal Louver Motor Resistance Values					
	Blue	Violet	Yellow	Orange	Red	
Blue		393 Ω	394 Ω	395 Ω	196 Ω	
Violet			396 Ω	397 Ω	198 Ω	
Yellow				398 Ω	199 Ω	
Orange					200 Ω	
Red						

Wall Mount Vertical Louver Motor Resistance Values						
	Blue	Violet	Yellow	Orange	Red	
Blue		383 Ω	388 Ω	390 Ω	951 Ω	
Violet			381 Ω	385 Ω	189 Ω	
Yellow				388 Ω	193 Ω	
Orange					196 Ω	
Red						

Outdoor Unit Fan Motor Resistance Values						
	Red	Black	White	Yellow	Blue	
Red		Infinity 🤉	2 Infinit	yΩ Infi	nity Ω I	
Black			1.23K Ω	211.5K Ω	4.75M Ω	
White				212.7K Ω	4.75M Ω	
Yellow					5.05M Ω	
Blue						

EEV Stepper Motor Resistance Values					
	Blue	Violet	Yellow	Orange	Red
Blue		47 Ω	46 Ω	46 Ω	46 Ω
Violet			92 Ω	92 Ω	92 Ω
Yellow				91 Ω	91 Ω
0range					91 Ω
Red					

	Cassette Fan Motor Resistance Values					
	Orange	Orange	Red	Brown	Yellow	Blue
0range		758 Ω	758 Ω	159 Ω	189 Ω	233 Ω
0 range			0 Ω	600 Ω	570 Ω	526 Ω
Red				600 Ω	570 Ω	526 Ω
Brown					31 Ω	75 Ω
Yellow						45 Ω
Blue						

	Duc	ted Fan Motor	Resistance V	/alues	
	Red	Black	White	Yellow	Blue
Red		Infinity 9	lnfinit	yΩ Infi	nity Ω I
Black			1.23K Ω	211.5K Ω	4.75M Ω
White				212.7K Ω	4.75M Ω
Yellow					5.05M Ω
Blue					

	Casselle Louver Motor Resistance			e values	
	Orange	Yellow	Blue	Violet	Red
Orange		398 Ω	398 Ω	399 Ω	200 Ω
Yellow			396 Ω	397 Ω	198 Ω
Blue				399 Ω	199 Ω
Violet					200 Ω
Red					

Ducted Horizontal Louver Motor Resistance Values					
	Blue	Violet	Yellow	Orange	Red
Blue		298 Ω	297 Ω	297 Ω	149 Ω
Violet			299 Ω	299 Ω	151 Ω
Yellow				298 Ω	149 Ω
Orange					150 Ω
Red					

	Ducted Vertical Louver Motor Resistance Values				
	Blue	Violet	Yellow	Orange	Red
Blue		590 Ω	596 Ω	591 Ω	297 Ω
Violet			593 Ω	588 Ω	294 Ω
Yellow				595 Ω	300 Ω
0range					295 Ω
Red					

Error Detection

The LED flashes when any of the following errors are detected:

1. When a protection device of the indoor or the outdoor unit activated or when the thermistor malfunctions, disabling equipment operation

2. When a signal transmission error occurs between the indoor and outdoor units. In either case. conduct the appropriate diagnostic procedures.

	Code indication		
	Indoor displaying panel code indication	Outdoor (LED1 flash times)	fault description
Indoor and Outdoor	E7	15	Communication fault between indoor and outdoor units
Indoor Malfunction	E1	4	Room temperature sensor failure
	E2	H	Heat-exchange sensor failure
	E4	(404)	indoor EEPROM error
	E14	÷	Indoor fan motor malfunction
Outdoor Malfunction	F12	1	Outdoor EEPROM error
	F1	2	The protect of IPM
	F22	3	Overcurrent protection of AC electricity for the outdoor model
	F3	4	Communication fault between the IPM and outdoor PCB
	F19	6	Power voltage is too high or low
	F4	8	Overheat protection for Discharge temperature
	F8	9	Outdoor DC fan motor fault
	F21	10	Defrost temperature sensor failure
	F7	11	Suction temperature sensor failure
	F6	12	Ambient temperature sensor failure
	F25	13	Discharge temperature sensor failure
	F11	18	deviate from the normal for the compressor
	F28	19	Loop of the station detect error
	F2	24	Overcurrent of the compressor
	F23	25	Overcurrent protection for single-phase of the compressor
	E9	21	High work-intense protection

Error Codes and Description indoor display



Problems & Solutions

Problem	Check Item	Details of Measure
None of the units	Check the power supply.	Check to make sure that the rated voltage is supplied.
operates	Check the indoor PCB	Check to make sure that the indoor PCB is broken
Operation sometimes stops.	Check the power supply.	A power failure of 2 to 10 cycles can stop air conditioner operation.
Equipment operates but does not cool, or does not heat (only for heat pump)		Set the units to cooling operation, and compare the temperatures of the liquid side connection pipes of the connection section among rooms to check the opening and closing operation of the electronic expansion valves of the individual units.
	Diagnosis by service port pressure and operating current.	Check for insufficient gas.
Large operating noise and vibrations	Check the installation condition.	Check to make sure that the required spaces for installation (specified in the Technical Guide, etc.) are provided.

Piping Length Limits

Model	Maximum Line Length Ft / m	Maximum Height Ft/m
1U12	50/15	33/10
1U18	83/25	50/15

Component Ratings

NO	Name	Parameter	Picture
1	Compressor	Rated voltage:220-230V Rated current:8.4A Rated frequency:50/60Hz Resistance:0.93Ω	
2	Fan motor	Rated voltage:220-230V Rated current:0.2A Rated frequency:50/60Hz Resistance:14.5Ω	
3	Reactor	Rated voltage:29.4V±10% Rated current:18.0A Rated frequency:50Hz Rated ductance:5.2mH±10%	
4	4-way valve	Rated voltage:230V Rated current:0.1A Rated frequency:50Hz Rated inductance:2.1KΩ	

Duct Work Installation

Roof Installation

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Use rivet to connect the air return duct on the air return inlet of the indoor unit, then connect the other end with the air return.

REFERENCES

Wiring

1U12LC2VHA



Wiring

1U12LC2VHA



Wiring

1U18LC2VHA



Wiring

AW12LC2VHA



AW18LC2VHA



REFERENCES

Wiring

AB09SC2VHA

VHA AB12SC2VHA AB18SC2VHA



SWING MOTOR 0150515412 GREEN SWING MOTOR Y/G: YELLOW B: BLACK W: WHITE REMOTE RECEIVER 1 1 R: RED J. 1 I L I. I t 1 I Ī unavailable 1 1 Room card I available (2) t 1 I PANNEL CONTROLLER | 1 1 J ī SW1-6 OFF t NO Ì 1 CN29 CN29 CN29 min mm I I \$INO GINO LEND Middle pressure duct 1 Slim duct (America) 87654321 SW1 1 E-Type define t Convertible HEAT SWING Silm duct CN4 E REMOTE CENTRAL CN19 1 FUSE R T5A/250VAC 4321 SW1-8 CH1 CH2 CN9 OFF OFF NO NO CN18 SWITCH FLOAT TO OUT DOOR SW2 0N 2(3)(6) 5-1-12 OFF OFF R NO NO U-HOME В PŪMP -Hydrostatic CN7 3 selection 10 Pa 20 Pa 40 Pa ≥? 0 Pa ROOMCARD **E**SS **CN23** Ð **CN36** CONTROLLER 际 SW1-5 OFF **PF** CN1 ABG ABC NO NO TEMP. SENSOR WIRED ROOM SW1-4 **CN13** OFF щ NO З ППП NO ONE WIRED CONTROLLER CONTROL MORE THE BRIDGE (CN22 CN23) ON SLAVE UNITS PCB SHOULD BE CUT OFF WHEN PIPING TEMP. 28000 48000 18000 24000 36000 12000 60000 SW1 AND SW2 WITHOUT GUIDANCE. 7000 0006 BTU SENSOR USER SHOULD NOT TO SET DASHED PARTS ARE SW1-2 SW1-3 OFF OFF OFF OFF OFF NO NO DC FAN MOTOR NO NO \geq OFF OFF OFF OFF HAN ONE UNIT. OFF NO NO NO NO PT I ONAL. SW1-1 OFF OFF OFF IOTE: OFF NO NO NO NO NO

AD07SL2VHA AD09SL2VHA AD12SL2VHA AD18SL2VHA

Wiring

CIRCUIT DIAGRAMS





REFERENCES

CIRCUIT DIAGRAMS

Outdoor unit control board Circuit Diagrams(1U12)


CIRCUIT DIAGRAMS





CIRCUIT DIAGRAMS

Outdoor unit control board Circuit Diagrams(1U18)



WIRING DIAGRAMS

Outdoor unit module board Circuit Diagram (1U12)



WIRING DIAGRAMS

Indoor unit Board Circuit Diagrams (AW12/18)





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Section A - Outdoor Unit Installation

Step 1 - Installation of the Outdoor Unit

Attaching Drain Elbow to Outdoor Unit

(Heat Pump models only)

1.1 Step - 1.1

If attaching the supplied drain elbow to the outdoor unit, do so prior to attaching the refrigerant lines and wiring. Extension piping to attach to this fitting is field supplied.

Electrical Connections for the Outdoor Unit

1.2 Step - 1.2

Remove the cover plate of the outdoor unit to expose the terminal block connections.

1.3 Step - 1.3

Connect the wiring for both the power source and indoor wiring.

Wire the system according to applicable national / local codes.

Verify that the wiring connections for the indoor unit match wire for wire.

(1-1, 2-2, 3-3, Gnd-Gnd). Failure to wire the system correctly may lead to improper operation or component damage.



Replace the cover plate.





Step 1.1

Step1.2





Step 1.3

Step 1.4

Step 2 - Interconnecting the Indoor and Outdoor Units

*See indoor section A, B, or C for electrical connections.

Piping

The standard lineset length is 25ft. If the installation length is different, adjust the refrigerant charge by .2 oz / ft. for 12K, 18K model. (Illustration 4)

Cut the lineset to length, flare and attach the piping to the outdoor unit valves.

Torque the fittings to the specifications shown in the torque chart.

2.1 Step - 2.1

Refrigerant piping connections for the mini-split system are made utilizing flare connections. Follow standard practices for creating pipe flares. When cutting and reaming the tubing, use caution to prevent dirt or debris from entering the tubing. Remember to place the nut on the pipe before creating the flare.

2.2 Step - 2.2

To join the lineset piping together, directly align the piping flare to the fitting on the other pipe, then slide the nut onto the fitting and tighten. Misalignment may result in a leaking connection.



Illustration 4



Step 2.1

Step 2.2



Thermistor resistance check method:

Remove the connector of the thermistor from the PCB and measure the resistance of the thermistor using an ohmmeter. The relationship between normal temperature and resistance is shown the indoor thermistor chart located in the reference section.



REFERENCES

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EEPROM abnormal

Indoor Display outdoor display	E4: Indoor EEPROM error F12: Outdoor EEPROM error; Outdoor LED flashes 1 time
Method of malfunction detection	The Data detected by the EEPROM are used to determine MCU
Malfunction detection conditions	When the data of the EEPROM is in error or the EEPROM is damaged
Supposed causes	Faulty EEPROM dataFaulty EEPROMFaulty PCB
Troubleshooting	Caution: Be sure to turn power switch off before connecting or disconnecting the connector, or parts may sustain damage.

Replace the indoor or outdoor main board

Indoor fan motor malfunction

Indoor Display	E14						
Method of Malfunction Detection	The rotation speed detected by the Hall IC during fan motor operation is used to determine abnormal fan motor operation						
Malfunction Decision Conditions	When the detection rotation signal is not received in 2 minutes						
Supposed Causes	 Operation halts due to broken connections inside the fan motor Fan motor overheat protection Operation halts due to broken fan motor lead wires 						
Troubleshooting	Detection error due to faulty indoor unit PCB Caution: Be sure to turn power switch off before connecting or disconnecting the connector, or parts may sustain damage.						
How to Check the	Fan Motor (DC)						
	1. Check connector connection.						
	Check motor power supply voltage output (pins 1-4).						
	Check motor control voltage (pins 4-5).						
	Check rotation command voltage output (pins 4-6).						

5. Check rotation pulse input (pins 4-7).

1	$0 \rightarrow$	Motor power supply voltage
2	0	Unused
3	0	Unused
4	0-	P.0V (reference potential)
5	$0 \rightarrow$	Motor control voltage (15 VDC)
6	$0 \rightarrow$	Rotation command voltage (1~ 6 VDC)
7	0+	Rotation pulse input

Note: When the unit is operating, do not remove or insert plugs in order to avoid damage to the motor.







9.4.5 IPM protection

LED 1 flashes 2 times
IPM protection is detected by checking the operating condition of the compressor
 The sytem leads to IPM protection due to overcurrent A compressor fault leads to IPM protection Circuit component of IPM is broken and leads to IPM protection
 IPM protection due to compressor fault IPM protection due to faulty PCB of IPM module Circuit component of IPM is broken and caused IPM protection
Caution: Be sure to turn power switch off before connecting or disconnecting the connector, or par may sustain damage.



1. The system may have been over or under charged with refrigerant, which can be determined by evaluating the pressure of the system

2. The shaft of the compressor is seized, and the compressor needs to be replaced.

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Over-current of the compressor

Outdoor diplay	LED1 flashes 3 , 24, 25 times			
Method of malfunction detection	The current of the compressor is too high			
Malfunction detection conditions	When the IPM module is damaged or the compressor is damaged. The power supply voltage is too high or too low.			
Supposed causes	 Faulty IPM Module Faulty compressor Faulty power supply 			
Troubleshooting	Caution: Be sure to turn power switch off before connecting or disconnecting the connector, or parts may sustain damage.			



9.4.7 The communication fault between IPM and outdoor PCB



9 .4.8 Power Supply Over or under voltage fault

Outdoor diplay	LED1 flashes 6 times The power supply is over voltage
Method of malfunction detection	An abnormal voltage rise or fall is detected by checking the specified voltage detection
Malfunction detection conditions	A voltage signal is fed from the voltage detection circuit to the microcomputer
Supposed causes	 Improper supply voltage The IPM Module is defective The outdoor PCB is defective
Troubleshooting	Caution: Be sure to turn power switch off before connecting or disconnecting the connector, or parts may sustain damage.



9.4.9 Overheat Protection For Discharge Temperature

Outdoor diplay	LED1 flashes 8 times
Method of malfunction detection	The Discharge temperature control is checked with the temperature being detected by the Discharge pipe thermistor
Malfunction detection conditions	When the temperature compressordischarge temperature is above 230°F
Supposed causes	 Electronic expansion valve defective Faulty thermistor Faulty PCB
Troubleshooting	Caution: Be sure to turn power switch off before connecting or disconnecting the connector, or parts may sustain damage.



The communication fault between indoor and outdoor

indoor diplay E7 Outdoor diplay LED1 flashes 15 times Method of Communication is detected by checking the indoor PCB and the outdoor PCB malfunction detection • A defective outdoor PCB can cause communication errors Malfunction detection A defective indoor PCB can cause communication errors conditions •The indoor PCB is defective •The outdoor PCB is defective Supposed causes • The Module PCB is defective Communication wiring is disconnected Caution: Be sure to turn power switch off before connecting or disconnecting the connector, or Troubleshooting parts may sustain damage.



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	FLOW CHARTS
Loss of syr	nchronism detection
Inverter side	current detection is abnormal
Outdoor diplay	LED1 flash 18 times LED1 flash 19 times
Method of malfunction detection	The position of the compressor rotor can not detected normally
Malfunction detection conditions	when the wiring of compressor is wrong or the connection is poor; or the compressor is damaged
Supposed causes	 Faulty The wiring of compressor Faulty compressor Faulty PCB
Troubleshooting	Caution: Be sure to turn power switch off before connecting or disconnecting the connector, or parts may sustain damage.



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SENSORS

Value of Thermistor - Indoor Unit

Temp.((°F))	Max.(KΩ)	Normal(KΩ)	Min.(KΩ)	Tolerance(°F)	
-54	165.2170	147.9497	132.3678	-3.94	3.15
-52.2	155.5754	139.5600	125.0806	-3.47	3.13
-50.4	146.5609	131.7022	118.2434	-3.44	3.11
-48.6	138.1285	124.3392	111.8256	-3.40	3.08
-14.8	130.2371	117.4366	105.7989	-3.37	3.06
-45	122.8484	110.9627	100.1367	-3.33	3.04
-43.2	115.9272	104.8882	94.8149	-3.29	3.01
-41.4	109.4410	99.1858	89.8106	-3.26	2.99
-39.6	103.3598	93.8305	85.1031	-3.24	2.95
-37.8	97.6556	88.7989	80.6728	-3.20	2.93
-36	92.3028	84.0695	76.5017	-3.17	2.92
-34.2	87.2775	79.6222	72.5729	-3.13	2.88
-32.4	82.5577	75.4384	68.8710	-3.10	2.86
-30.6	78.1230	71.5010	65.3815	-3.06	2.83
-28.8	73.9543	67.7939	62.0907	-3.02	2.79
-27	70.0342	64.3023	58.9863	-2.99	2.77
-25.2	66.3463	61.0123	56.0565	-2.95	2.74
-23.4	62.8755	57.9110	53.2905	-2.92	2.72
-21.6	59.6076	54.9866	50.6781	-2.88	2.68
-19.8	56.5296	52.2278	48.2099	-2.84	2.65
-18	53.6294	49.6244	45.8771	-2.81	2.63
-16.2	50.8956	47.1666	43.6714	-2.77	2.59
-14.4	48.3178	44.8454	41.5851	-2.72	2.56
-12.6	45.8860	42.6525	39.6112	-2.68	2.52
-10.8	43.5912	40.5800	37.7429	-2.65	2.50
-9	41.4249	38.6207	35.9739	-2.61	2.47
-7.2	39.3792	36.7676	34.2983	-2.57	2.43
-5.4	37.4465	35.0144	32.7108	-2.54	2.39
-3.6	35.6202	33.3552	31.2062	-2.48	2.36
-1.8	33.8936	31.7844	29.7796	-2.45	2.32
0	32.2608	30.2968	28.4267	-2.41	2.30
1.8	30.7162	28.8875	27.1431	-2.38	2.27

		SENSO	RS		
3.6	29.2545	27.5519	25.9250	-2.32	2.23
5.4	27.8708	26.2858	24.7686	-2.29	2.20
7.2	26.5605	25.0851	23.6704	-2.25	2.16
9	25.3193	23.9462	22.6273	-2.21	2.12
10.8	24.1432	22.8656	21.6361	-2.16	2.09
12.6	23.0284	21.8398	20.6939	-2.12	2.05
14.4	21.9714	20.8659	19.7982	-2.07	2.02
16.2	20.9688	19.9409	18.9463	-2.03	1.96
18	20.0176	19.0621	18.1358	-2.00	1.93
19.8	19.1149	18.2270	17.3646	-1.94	1.89
21.6	18.2580	17.4331	16.6305	-1.91	1.85
23.4	17.4442	16.6782	15.9315	-1.85	1.82
25.2	16.6711	15.9601	15.2657	-1.82	1.78
27	15.9366	15.2770	14.6315	-1.76	1.73
28.8	15.2385	14.6268	14.0271	-1.73	1.69
30.6	14.5748	14.0079	13.4510	-1.67	1.66
32.4	13.9436	13.4185	12.9017	-1.64	1.62
34.2	13.3431	12.8572	12.3778	-1.58	1.57
36	12.7718	12.3223	11.8780	-1.55	1.53
37.8	12.2280	11.8126	11.4011	-1.49	1.49
39.6	11.7102	11.3267	10.9459	-1.46	1.44
41.4	11.2172	10.8634	10.5114	-1.40	1.40
43.2	10.7475	10.4216	10.0964	-1.35	1.35
45	10.3000	10.0000	9.7000	-1.35	1.35
46.8	9.8975	9.5974	9.2980	-1.37	1.37
48.6	9.5129	9.2132	8.9148	-1.44	1.44
50.4	9.1454	8.8465	8.5496	-1.51	1.49
52.2	8.7942	8.4964	8.2013	-1.57	1.55
54	8.4583	8.1621	7.8691	-1.64	1.62
55.8	8.1371	7.8428	7.5522	-1.71	1.67
57.6	7.8299	7.5377	7.2498	-1.76	1.75
59.4	7.5359	7.2461	6.9611	-1.84	1.80
61.2	7.2546	6.9673	6.6854	-1.91	1.87
63	6.9852	6.7008	6.4222	-1.98	1.93
64.8	6.7273	6.4459	6.1707	-2.03	2.00
66.6	6.4803	6.2021	5.9304	-2.11	2.05
68.4	6.2437	5.9687	5.7007	-2.18	2.12
70.2	6.0170	5.7454	5.4812	-2.25	2.20
72	5.7997	5.5316	5.2712	-2.32	2.25
73.8	5.5914	5.3269	5.0704	-2.39	2.32
75.6	5.3916	5.1308	4.8783	-2.47	2.39
77.4	5.2001	4.9430	4.6944	-2.54	2.45
79.2	5.0163	4.7630	4.5185	-2.61	2.52

		SENSORS	;		
81	4.8400	4.5905	4.3500	-2.68	2.59
82.8	4.6708	4.4252	4.1887	-2.75	2.65
84.6	4.5083	4.2666	4.0342	-2.83	2.72
86.4	4.3524	4.1145	3.8862	-2.90	2.79
88.2	4.2026	3.9686	3.7443	-2.97	2.86
90	4.0588	3.8287	3.6084	-3.06	2.92
91.8	3.9206	3.6943	3.4780	-3.13	2.99
93.6	3.7878	3.5654	3.3531	-3.20	3.06
95.4	3.6601	3.4416	3.2332	-3.28	3.13
97.2	3.5374	3.3227	3.1183	-3.37	3.20
99	3.4195	3.2085	3.0079	-3.44	3.28
100.8	3.3060	3.0989	2.9021	-3.51	3.33
102.6	3.1969	2.9935	2.8005	-3.60	3.40
104.4	3.0919	2.8922	2.7029	-3.67	3.47
106.2	2.9909	2.7948	2.6092	-3.74	3.55
108	2.8936	2.7012	2.5193	-3.83	3.62
109.8	2.8000	2.6112	2.4328	-3.91	3.69
111.6	2.7099	2.5246	2.3498	-4.00	3.76
113.4	2.6232	2.4413	2.2700	-4.07	3.83
115.2	2.5396	2.3611	2.1932	-4.16	3.91
117	2.4591	2.2840	2.1195	-4.25	3.98
118.8	2.3815	2.2098	2.0486	-4.32	4.05
120.6	2.3068	2.1383	1.9803	-4.41	4.12
122.4	2.2347	2.0695	1.9147	-4.48	4.21
124.2	2.1652	2.0032	1.8516	-4.57	4.28
126	2.0983	1.9393	1.7908	-4.66	4.36
127.8	2.0337	1.8778	1.7324	-4.73	4.43
129.6	1.9714	1.8186	1.6761	-4.82	4.50
131.4	1.9113	1.7614	1.6219	-4.91	4.57
133.2	1.8533	1.7064	1.5697	-5.00	4.64
135	1.7974	1.6533	1.5194	-5.09	4.73
136.8	1.7434	1.6021	1.4710	-5.18	4.81
138.6	1.6913	1.5528	1.4243	-5.26	4.88
140.4	1.6409	1.5051	1.3794	-5.35	4.95
142.2	1.5923	1.4592	1.3360	-5.44	5.04
144	1.5454	1.4149	1.2942	-5.53	5.11
145.8	1.5000	1.3721	1.2540	-5.62	5.18
147.6	1.4562	1.3308	1.2151	-5.71	5.27
149.4	1.4139	1.2910	1.1776	-5.80	5.35
151.2	1.3730	1.2525	1.1415	-5.89	5.42
153	1.3335	1.2153	1.1066	-5.98	5.51
154.8	1.2953	1.1794	1.0730	-6.08	5.58
156.6	1.2583	1.1448	1.0405	-6.17	5.67



158.4	1.2226	1.1113	1.0092	-6.26	5.74
160.2	1.1880	1.0789	0.9789	-6.35	6.83
162	1.1546	1.0476	0.9497	-6.44	6.90
163.8	1.1223	1.0174	0.9215	-6.55	6.99
165.6	1.0910	0.9882	0.8942	-6.64	6.07
167.4	1.0607	0.9599	0.8679	-6.73	6.16
169.2	1.0314	0.9326	0.8424	-6.84	6.23
171	1.0030	0.9061	0.8179	-6.93	6.32
172.8	0.9756	0.8806	0.7941	-7.02	6.39
174.6	0.9490	0.8558	0.7711	-7.13	6.48
176.4	0.9232	0.8319	0.7489	-7.22	6.55
178.2	0.8983	0.8088	0.7275	-7.33	6.64
180	0.8741	0.7863	0.7067	-7.42	6.73
181.8	0.8507	0.7646	0.6867	-7.52	6.80
183.6	0.8281	0.7436	0.6672	-7.61	6.89
185.4	0.8061	0.7233	0.6484	-7.72	6.98
187.2	0.7848	0.7036	0.6303	-7.81	7.06
189	0.7641	0.6845	0.6127	-7.92	7.15
190.8	0.7441	0.6661	0.5957	-8.03	7.24
192.6	0.7247	0.6482	0.5792	-8.12	7.33
194.4	0.7059	0.6308	0.5632	-8.23	7.42
196.2	0.6877	0.6140	0.5478	-8.33	7.49
198	0.6700	0.5977	0.5328	-8.44	7.58
199.8	0.6528	0.5820	0.5183	-8.53	7.67
201.6	0.6361	0.5667	0.5043	-8.64	7.76
203.4	0.6200	0.5518	0.4907	-8.75	7.85
205.2	0.6043	0.5374	0.4775	-8.86	7.94
207	0.5891	0.5235	0.4648	-8.96	8.01
208.8	0.5743	0.5100	0.4524	-9.07	8.10
210.6	0.5600	0.4968	0.4404	-9.18	8.19
212.4	0.5460	0.4841	0.4288	-9.29	8.28
214.2	0.5325	0.4717	0.4175	-9.40	8.37
216	0.5194	0.4597	0.4066	-9.50	8.46

SENSORS

Discharging Sensor

R176°F=50K $\Omega \pm$ 3%

B77/176°F=4450K±3%

Temp.((°F))	Max.(KΩ)	Normal(KΩ)	Min.(KΩ)	Tolerance(°F)	
-54	14646.0505	12061.7438	9924.4999	-5.33	4.41
-52.2	13654.1707	11267.8730	9290.2526	-5.31	4.39
-50.4	12735.8378	10531.3695	8700.6388	-5.27	4.39
-48.6	11885.1336	9847.7240	8152.2338	-5.26	4.37
-46.8	11096.6531	9212.8101	7641.8972	-5.24	4.36
-45	10365.4565	8622.8491	7166.7474	-5.22	4.36
-43.2	9687.0270	8074.3787	6724.1389	-5.18	4.34
-41.4	9057.2314	7564.2244	6311.6413	-5.17	4.34
-39.6	8472.2852	7089.4741	5927.0206	-5.15	4.32
-37.8	7928.7217	6647.4547	5568.2222	-5.11	4.30
-36	7423.3626	6235.7109	5233.3554	-5.09	4.30
-34.2	6953.2930	5851.9864	4920.6791	-5.08	4.28
-32.4	6515.8375	5494.2064	4628.5894	-5.04	4.27
-30.6	6108.5393	5160.4621	4355.6078	-5.02	4.27
-28.8	5729.1413	4848.9963	4100.3708	-4.99	4.25
-27	5375.5683	4558.1906	3861.6201	-4.97	4.23
-25.2	5045.9114	4286.5535	3638.1938	-4.95	4.21
-23.4	4738.4141	4032.7098	3429.0191	-4.91	4.21
-21.6	4451.4586	3795.3910	3233.1039	-4.90	4.19
-19.8	4183.5548	3573.4260	3049.5312	-4.86	4.18
-18	3933.3289	3365.7336	2877.4527	-4.84	4.16
-16.2	3699.5139	3171.3148	2716.0828	-4.81	4.14
-14.4	3480.9407	2989.2460	2564.6945	-4.79	4.12
-12.6	3276.5302	2818.6731	2422.6139	-4.75	4.10
-10.8	3085.2854	2658.8058	2289.2164	-4.73	4.10
-9	2906.2851	2508.9126	2163.9230	-4.70	4.09
-7.2	2738.6777	2368.3158	2046.1961	-4.68	4.06
-5.4	2581.6752	2236.3876	1935.5371	-4.64	4.05
-3.6	2434.5487	2112.5459	1831.4826	-4.61	4.03
-1.8	2296.6230	1996.2509	1733.6024	-4.59	4.01
0	2167.2730	1887.0018	1641.4966	-4.55	4.00
1.8	2045.9191	1784.3336	1554.7931	-4.54	3.98
3.6	1932.0242	1687.8144	1473.1460	-4.50	3.96
5.4	1825.0899	1597.0431	1396.2333	-4.46	3.94
7.2	1724.6540	1511.6468	1323.7551	-4.45	3.91
9	1630.2870	1431.2787	1255.4324	-4.41	3.89
10.8	1541.5904	1355.6163	1191.0048	-4.37	3.87
12.6	1458.1938	1284.3593	1130.2298	-4.34	3.85
14.4	1379.7528	1217.2282	1072.8813	-4.32	3.83
16.2	1305.9472	1153.9626	1018.7481	-4.28	3.82

18 128.4792 1094.3200 967.6334 4.23 3.80 19.8 1171.0715 1038.0743 919.333 4.23 3.76 21.6 1100.4661 965.0146 837.359 4.19 3.73 22.4 1051.4228 984.9440 830.670 4.16 3.73 25.2 996.7169 807.6792 798.863 4.12 3.71 27 946.1404 843.0466 751.3077 4.09 3.67 28.8 868.4981 800.8822 714.830 4.07 3.65 30.6 850.6008 761.0603 680.3265 4.03 3.64 32.4 807.3024 723.4134 647.6580 4.00 3.80 342 766.4126 6617.627 3.66 3.68 3.83 3.83 35.6 661.668.679 582.1831 533.0344 3.84 3.83 35.6 564.4275 511.0760 462.316 3.37 3.40 44.5 564.4275 511.	SENSORS					
19.8 1171.0715 1038.0743 919.3533 4.23 3.76 21.6 1008.4661 965.0146 677.359 4.19 3.74 23.4 1051.4226 934.9440 430.62101 4.16 3.73 25.2 966.7169 687.6792 789.8683 4.12 3.71 27 945.1404 643.0486 751.3077 4.09 3.67 28.8 896.4981 600.8922 771.418380 4.67 3.64 34.2 766.4212 667.4205 616.7552 -3.96 3.53 36 727.87172 6551.1566 587.4271 -3.92 3.65 37.8 691.3524 622.3161 559.6944 -3.89 3.53 30.6 656.8979 52.1811 633.3034 -3.85 3.41 41.4 624.3202 553.6904 -3.78 3.46 45. 564.4275 511.0760 442.316 -3.78 3.42 46.8 536.9965 466.3352 441.1516 <td>18</td> <td>1236.4792</td> <td>1094.3200</td> <td>967.6334</td> <td>-4.25</td> <td>3.80</td>	18	1236.4792	1094.3200	967.6334	-4.25	3.80
21.6 1108.4661 985.0146 873.7359 4.19 3.74 23.4 1051.4226 934.440 830.6210 4.16 3.73 25.2 996.7169 887.6792 798.883 4.12 3.71 27 945.1404 943.0486 751.3077 4.09 3.67 28.8 896.4981 800.8922 714.8380 4.07 3.65 30.6 850.6086 761.0603 603.265 4.03 3.64 24.4 807.3024 723.4134 647.5569 4.03 3.68 36.6 727.8172 654.1596 587.4271 3.82 3.58 37.8 661.3524 622.3161 533.634 3.82 3.47 43.2 583.54650 444.778 53.78 3.42 44.8 536.5400 442.778 3.77 3.44 44.5 511.0105 446.3352 441.1516 -3.78 3.44 45.6 54.4275 511.0760 420.2280 3.61 3	19.8	1171.0715	1038.0743	919.3533	-4.23	3.76
23.4 10514226 934.9440 830.6210 -4.16 3.73 25.2 996.7169 887.6722 789.8833 -4.12 3.71 27 945.1404 84.30486 751.3077 -4.09 3.67 28.6 986.481 800.9822 71.4.8580 -4.07 3.65 30.6 850.6066 761.0603 880.3265 -4.03 3.64 32.4 807.3024 723.4134 647.6580 -4.00 3.69 34.2 766.4212 687.8205 616.7262 -3.96 3.58 36 727.8172 654.1569 587.4271 -3.92 3.66 37.8 691.5524 622.3161 553.8604 -3.89 3.53 41.4 624.329 553.6604 484.7736 -3.78 3.46 45 554.4275 511.0760 442.349 -3.78 3.42 46.8 535.965 488.9352 441.1516 -3.78 3.42 46.8 536.965 448.6351	21.6	1109.4661	985.0146	873.7359	-4.19	3.74
25.2 996.7169 887.6792 789.6583 4.12 3.71 27 945.1404 843.088 751.3077 4.00 3.65 28.8 986.4981 800.9922 774.8360 4.03 3.64 30.6 650.6086 761.0603 680.3266 4.00 3.64 32.4 807.3024 723.4134 647.6580 4.00 3.66 342 766.4212 687.8205 557.4271 -3.92 3.53 353 727.812 691.3624 652.181 533.334 -3.85 3.47 342 593.6464 553.65640 484.7796 -3.78 3.47 342 593.5466 566.4275 511.0760 462.3510 3.78 3.42 44.5 564.4275 511.0760 442.349 401.9146 -3.78 3.37 54 446.151 442.3499 401.9146 -3.68 3.32 55.8 420.1431 390.1301 -3.58 3.29 55.8	23.4	1051.4226	934.9440	830.6210	-4.16	3.73
27 945.1404 843.0486 751.3077 4.09 3.67 28.8 866.4881 800.8922 714.8360 4.07 3.65 30.6 850.086 771.0803 680.3255 4.03 3.64 32.4 807.3024 723.4134 647.6368 4.00 3.68 34.2 766.4212 667.8205 616.7252 -3.96 3.58 35.8 691.5241 532.181 53.3634 -3.82 3.51 34.6 660.897 552.181 53.3634 -3.82 3.47 44.1 624.3328 553.6604 484.776 -3.82 3.47 45.5 564.475 511.0760 482.376 -3.83 3.37 50.4 486.4151 442.089 441.1616 -3.73 3.36 54.4 441.0635 402.2430 366.5175 -3.68 3.37 54.4 441.0635 402.2430 366.5175 -3.68 3.26 55.8 420.1431 333.501 <t< td=""><td>25.2</td><td>996.7169</td><td>887.6792</td><td>789.8583</td><td>-4.12</td><td>3.71</td></t<>	25.2	996.7169	887.6792	789.8583	-4.12	3.71
28.8 896.4981 800.882 714.8380 -4.07 3.85 30.6 660.6086 761.6063 680.3265 -4.03 3.64 32.4 807.3024 723.4134 647.6580 -4.00 3.69 34.2 766.412 667.8205 616.7252 -3.96 3.85 36 727.8172 664.1596 587.4271 -3.82 3.56 37.8 691.3524 622.3161 553.3664 -3.82 3.47 44.4 624.3275 551.6604 508.4261 -3.82 3.47 44.3 564.4275 511.0760 442.3510 -3.76 3.42 45. 564.4275 511.0760 442.3510 -3.76 3.42 46.8 510.1055 442.3499 401.9146 -3.65 3.35 52.2 443.1208 442.7683 383.7626 -3.82 3.31 54 440.635 40.2430 366.5175 -3.68 3.29 55.8 420.1431 338.7163	27	945.1404	843.0486	751.3077	-4.09	3.67
30.6 850.6066 761.603 660.3265 4.03 3.64 32.4 807.3024 723.4134 667.6502 3.06 3.06 34.2 766.4212 667.805 616.7252 3.96 3.86 36 727.8172 664.1696 567.4714 3.32 3.53 37.8 691.3524 622.3161 533.6344 3.85 3.51 34.1 624.3328 558.6604 494.7766 3.78 3.46 43.2 539.544 558.6504 444.7766 3.78 3.42 44.5 566.4275 511.0760 462.3510 3.73 3.40 44.8 536.9865 446.3352 441.1516 3.73 3.40 44.8 511.0760 442.3510 3.42 3.31 3.50 50.4 448.4151 442.349 411.615 3.62 3.35 52.2 463.1208 422.430 366.5175 3.58 3.29 55.8 420.1431 384.7161 3.54.	28.8	896.4981	800.8922	714.8380	-4.07	3.65
32.4 807.3024 723.4134 667.6650 -4.00 3.60 34.2 766.4212 667.8205 616.7252 -3.66 3.58 36 727.8172 664.1596 567.4271 -3.92 3.53 37.8 691.3224 652.3161 550.6642 -3.89 3.51 33.6 686.8979 592.1831 533.3634 -3.82 3.47 41.4 624.3228 563.6640 404.7796 -3.78 3.40 45 564.425 511.0760 462.3510 -3.76 3.40 448.8 551.0760 462.3510 -3.76 3.37 50.4 486.4151 442.2499 401.9146 -3.65 3.28 55.4 440.1535 402.2430 366.1265 -3.58 3.28 55.4 440.1355 402.2430 366.1265 -3.42 -3.51 3.28 55.8 420.1431 383.7151 335.614 -3.58 3.28 55.4 430.327 33.5614	30.6	850.6086	761.0603	680.3265	-4.03	3.64
34.2 768.4212 667.205 616.7252 3.96 3.58 36 727.8172 64.1996 567.4271 3.92 3.56 37.8 691.3524 622.3161 559.6943 3.85 3.51 33.6 665.897 552.181 533.834 3.85 3.47 41.4 624.3328 563.6540 444.7786 3.78 3.46 43.2 533.5446 550.6540 444.37786 3.78 3.47 44.8 556.9565 446.352 441.4165 3.42 3.37 456.4 551.0760 442.3510 3.73 3.37 55.4 466.31006 441.42.499 401.146 3.65 3.35 52.2 463.1208 402.2430 366.576 3.62 3.31 54.4 440.5243 383.7626 3.62 3.26 55.8 440.3242 386.125 3.34 542 3.51 3.24 55.4 316.550 349.4341 319.7460 3.42 3.11	32.4	807.3024	723.4134	647.6580	-4.00	3.60
36 727.8172 664.1596 587.4271 -3.92 3.56 37.8 691.6274 522.3161 559.6694 -3.89 3.53 39.6 656.8779 593.846 533.6604 508.4261 -3.82 3.47 41.4 624.3328 553.6664 484.7796 -3.78 3.46 45 593.5446 536.6540 484.7796 -3.78 3.42 46.8 554.4275 511.0760 462.3510 -3.76 3.42 46.8 511.0105 446.0500 421.0258 -3.62 3.31 50.4 486.4151 442.3499 401.9146 -3.65 3.29 51.5 443.1208 421.7683 383.7626 -3.62 3.31 54 441.0535 402.2430 366.5175 -3.58 3.29 55.6 400.3242 366.1295 334.5542 -3.51 3.20 54 441.0535 404.431 319.7460 -3.42 3.17 56.4 363.7176	34.2	766.4212	687.8205	616.7252	-3.96	3.58
37.8 691.3524 622.3161 559.6694 -3.89 3.53 33.6 656.8979 592.1831 533.3634 -3.85 3.51 41.4 624.3328 563.6640 508.4261 -3.82 3.46 43.2 553.5446 536.6540 444.7796 -3.76 3.42 46.8 536.8655 446.352 441.1518 -3.73 3.40 48.6 511.0105 444.0500 421.0258 -3.62 3.31 54.4 466.411 442.3499 401.9140 -3.62 3.31 55.4 440.1535 402.2430 366.5175 -3.88 3.29 55.8 420.1431 383.7161 350.1301 -3.55 3.26 57.6 400.3242 366.1295 334.5542 -3.51 3.24 56.8 420.1431 383.7151 350.5451 -3.47 3.20 57.6 400.3242 366.1295 334.5542 -3.51 3.15 56.8 30.7839 30.42.151<	36	727.8172	654.1596	587.4271	-3.92	3.56
39.6 666.879 592.1831 533.3634 -3.85 3.51 41.4 624.3328 653.6604 508.4261 -3.82 3.47 43.2 593.5446 536.6840 484.7796 -3.78 3.42 46.5 564.4275 511.0700 462.3510 -3.78 3.42 46.8 511.0105 466.0500 421.0258 -3.69 3.37 50.4 496.4151 442.3499 401.9146 -3.62 3.31 50.4 496.4151 442.3499 401.9146 -3.62 3.37 51.4 441.0535 402.2430 383.7652 -3.62 3.29 55.8 420.1431 333.7151 350.1301 -5.55 3.26 57.6 400.3242 366.125 334.5542 -3.51 3.21 54.4 430.3739 304.2151 279.5286 -3.35 3.11 64.8 307.789 30.42151 279.5286 -3.35 3.11 64.8 301.1254 277.6976 </td <td>37.8</td> <td>691.3524</td> <td>622.3161</td> <td>559.6694</td> <td>-3.89</td> <td>3.53</td>	37.8	691.3524	622.3161	559.6694	-3.89	3.53
41.4 624.3328 563.6604 508.4261 -3.82 3.47 43.2 593.5446 536.5540 484.7796 -3.78 3.46 45 564.4275 511.0760 462.3510 -3.78 3.42 46.8 536.9865 486.9352 441.1516 -3.73 3.40 48.6 511.0105 446.4500 421.0258 -3.69 3.37 50.4 486.4151 442.3499 401.9146 -3.65 3.35 52.2 463.1208 421.7683 383.7626 -3.62 3.31 54 441.0555 402.2430 366.5175 -3.58 3.29 55.8 420.1431 383.7151 360.1301 -3.561 3.24 59.4 400.3242 366.1295 3.345 -3.47 3.20 61.2 363.7176 313.5601 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.15 64.8 30.7639 304.2151	39.6	656.8979	592.1831	533.3634	-3.85	3.51
43.2 593.5446 536.6540 484.7796 -3.78 3.46 45 564.4275 511.0760 462.3510 -3.76 3.42 46.8 536.9865 446.9352 441.1516 -3.73 3.40 48.6 511.0105 464.0500 421.0258 -3.69 3.37 50.4 468.4151 442.3499 401.9146 -3.65 3.35 52.2 463.1208 421.7683 383.7626 -3.62 3.31 54 441.0535 402.2430 366.5175 -3.58 3.29 55.8 420.1431 383.7151 350.1301 -3.55 3.26 57.6 400.3242 366.1295 334.5542 -3.47 3.20 61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.15 64.8 30.7839 304.2151 279.5286 -3.24 3.02 70.2 287.4128 285.4119	41.4	624.3328	563.6604	508.4261	-3.82	3.47
45 564.4275 511.0760 462.3510 -3.76 3.42 46.8 556.9865 486.3352 441.1516 -3.73 3.40 48.6 611.0105 464.0500 421.0258 -3.69 3.37 50.4 486.4151 442.3499 401.9146 -3.65 3.36 52.2 463.1208 421.7633 383.7626 -3.62 3.31 54 441.0535 402.2430 366.1757 -3.58 3.29 55.8 420.1431 383.7151 350.1301 -3.65 3.26 57.6 400.3242 366.1255 334.5542 -3.51 3.24 59.4 381.5550 349.4341 319.7460 -3.47 3.20 61.2 363.7176 333.5601 305.6645 -3.42 3.17 63.3 346.8176 318.5216 292.2709 -3.38 3.15 64.8 30.1254 277.6976 255.8620 -3.24 3.02 70.2 287.43905 253.7288 <td>43.2</td> <td>593.5446</td> <td>536.6540</td> <td>484.7796</td> <td>-3.78</td> <td>3.46</td>	43.2	593.5446	536.6540	484.7796	-3.78	3.46
448.8 536.9865 448.6352 441.1516 -3.73 3.40 48.6 511.0105 464.0500 421.0258 3.69 3.37 50.4 486.4151 442.3499 401.9146 3.65 3.35 52.2 463.1208 421.7683 383.7626 -3.62 3.31 54 441.0535 402.2430 366.5175 -3.58 3.29 55.8 420.1431 383.7151 330.51301 -3.55 3.26 57.6 400.3242 366.125 3.345542 -3.51 3.24 59.4 381.5350 349.4341 319.7400 -3.47 3.20 61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.11 64.8 330.7839 304.2151 279.5266 -3.24 3.06 70.2 287.4128 290.6199 267.4031 -3.14 3.08 71.2 287.4128 265.4119 <td>45</td> <td>564.4275</td> <td>511.0760</td> <td>462.3510</td> <td>-3.76</td> <td>3.42</td>	45	564.4275	511.0760	462.3510	-3.76	3.42
48.6 511.0105 464.0500 421.0258 -3.69 3.37 50.4 486.4151 442.3499 401.9146 -3.65 3.35 52.2 463.1208 421.7683 393.7626 -3.62 3.31 54 441.0535 402.2430 366.5175 -3.58 3.29 55.8 420.1431 383.7151 350.1301 -3.56 3.24 55.8 420.1431 383.7151 350.1301 -3.47 3.20 55.8 420.1431 383.7162 345.54 -3.51 3.24 55.8 420.3242 366.1295 334.542 -3.47 3.20 61.2 363.7176 318.5216 292.2709 -3.38 3.15 64.8 330.7839 304.2151 279.5286 -3.35 3.11 66.6 315.5622 290.6199 267.4031 -3.24 3.02 70.2 287.4128 285.4119 244.8745 -3.24 3.02 77.4 230.0983 221.9825 <td>46.8</td> <td>536.9865</td> <td>486.9352</td> <td>441.1516</td> <td>-3.73</td> <td>3.40</td>	46.8	536.9865	486.9352	441.1516	-3.73	3.40
50.4 486.4151 442.3499 401.9146 -3.65 3.35 52.2 463.1208 421.7683 383.7626 -3.62 3.31 54 441.0555 402.2430 366.5175 -3.58 3.29 55.8 420.1431 383.7151 350.1301 -3.55 3.26 57.6 400.3242 366.1295 334.5542 -3.51 3.24 59.4 381.5350 349.4341 319.7460 -3.47 3.20 61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.11 66.3 315.5682 290.6199 267.4031 -3.31 3.08 66.4 301.1254 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.4119 244.8745 -3.24 3.02 77 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.02676 232.20436 <td>48.6</td> <td>511.0105</td> <td>464.0500</td> <td>421.0258</td> <td>-3.69</td> <td>3.37</td>	48.6	511.0105	464.0500	421.0258	-3.69	3.37
52.2 463.1208 421.7683 383.7626 -3.62 3.31 54 441.0535 402.2430 366.5175 -3.58 3.29 55.8 420.1431 383.7151 350.1301 -3.55 3.26 57.6 400.3242 366.1295 334.5542 -3.51 3.24 59.4 381.5350 349.4341 319.7460 -3.47 3.20 61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.11 66.6 315.5682 290.6199 267.4031 -3.31 3.06 70.2 287.4128 206.619 267.4031 -3.24 3.02 71.2 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.465 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 230.9983 221.925	50.4	486.4151	442.3499	401.9146	-3.65	3.35
54 441.0535 402.2430 366.5175 -3.58 3.29 55.8 420.1431 383.7151 350.1301 -3.55 3.26 57.6 400.3242 366.1295 334.5542 -3.51 3.24 58.4 381.550 349.4341 319.7460 -3.47 3.20 61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.876 318.5216 292.2709 -3.38 3.15 64.8 330.7839 304.2151 279.5286 -3.35 3.11 66.6 315.5682 290.6199 267.4031 -3.31 3.06 70.2 287.4128 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.119 244.8745 -3.24 3.02 71.2 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.465 -3.17 2.95 75.6 208.6267 243.6161	52.2	463.1208	421.7683	383.7626	-3.62	3.31
55.8 420.1431 383.7151 350.1301 -3.55 3.26 57.6 400.3242 366.1295 334.5542 -3.51 3.24 59.4 381.5350 349.4341 319.7460 -3.47 3.20 61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.15 64.8 330.7839 304.2151 279.5286 -3.35 3.11 66.6 315.5682 290.6199 267.4031 -3.31 3.08 70.2 287.4128 265.4119 244.8745 -3.24 3.02 712 274.3905 253.7288 234.4118 -3.20 2.99 73.8 265.0267 232.0436 214.9529 -3.03 2.93 75.6 250.2676 232.0436 214.9529 -3.04 2.86 75.4 239.0983 221.9825 206.59 -3.04 2.86 75.4 28.809 212.4060	54	441.0535	402.2430	366.5175	-3.58	3.29
57.6 400.3242 366.1295 334.5542 -3.51 3.24 59.4 381.5350 349.4341 319.7460 -3.47 3.20 61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.15 64.8 330.7839 304.2151 279.5286 -3.35 3.11 66.6 315.5682 290.6199 267.4031 -3.31 3.08 68.4 301.1254 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.4119 244.8745 -3.24 3.02 71.2 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.465 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 239.0983 221.9825 205.9065 -3.08 2.90 79.2 228.4809 212.4060 </td <td>55.8</td> <td>420.1431</td> <td>383.7151</td> <td>350.1301</td> <td>-3.55</td> <td>3.26</td>	55.8	420.1431	383.7151	350.1301	-3.55	3.26
59.4 381.5350 349.4341 319.7460 -3.47 3.20 61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.15 64.8 330.7839 304.2151 279.5286 -3.35 3.11 66.6 315.5682 290.6199 267.4031 -3.31 3.08 68.4 301.1254 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.4119 244.8745 -3.24 3.02 77 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.4655 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 239.0983 221.9825 205.9065 -3.08 2.90 79.2 228.409 212.4060 197.2844 -3.04 2.86 81 218.3860 203.2887	57.6	400.3242	366.1295	334.5542	-3.51	3.24
61.2 363.7176 333.5801 305.6645 -3.42 3.17 63 346.8176 318.5216 292.2709 -3.38 3.15 64.8 330.7839 304.2151 279.5286 -3.35 3.11 66.6 315.5682 290.6199 267.4031 -3.31 3.08 68.4 301.1254 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.4119 244.8745 -3.24 3.02 72 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.4655 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 239.0983 221.9825 205.9065 -3.08 2.90 79.2 228.4809 212.4060 197.2844 -3.04 2.86 81 218.3860 203.2887 189.0648 -3.01 2.83 82.8 208.7855 194.6066	59.4	381.5350	349.4341	319.7460	-3.47	3.20
63 346.8176 318.5216 292.2709 -3.38 3.15 64.8 330.7839 304.2151 279.5286 -3.35 3.11 66.6 315.5682 290.6199 267.4031 -3.31 3.08 68.4 301.1254 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.4119 244.8745 -3.24 3.02 72 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.4655 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 239.0983 221.9825 205.9065 -3.08 2.90 79.2 228.409 212.4060 197.2844 -3.04 2.86 81 218.3860 203.2887 189.0648 -3.01 2.83 82.8 208.7855 194.6066 181.2273 -2.97 2.79 84.6 199.6531 186.3369	61.2	363.7176	333.5801	305.6645	-3.42	3.17
64.8 330.7839 304.2151 279.5286 -3.35 3.11 66.6 315.5682 290.6199 267.4031 -3.31 3.08 68.4 301.1254 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.4119 244.8745 -3.24 3.02 72 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.4655 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 239.0983 221.9825 205.9065 -3.08 2.90 79.2 228.4809 212.4060 197.2844 -3.04 2.83 82.8 208.7855 194.6066 181.2273 -2.97 2.79 84.6 199.6531 186.3369 173.7524 -2.93 2.77 86.4 190.9639 178.4584 166.6217 -2.88 2.74 88.2 182.6945 170.9508<	63	346.8176	318.5216	292.2709	-3.38	3.15
66.6 315.5682 290.6199 267.4031 -3.31 3.08 68.4 301.1254 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.4119 244.8745 -3.24 3.02 72 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.4465 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 239.0983 221.9825 205.9065 -3.08 2.90 79.2 228.4809 212.4060 197.2844 -3.04 2.86 81 218.3860 203.2887 189.0648 -3.01 2.83 82.8 208.7855 194.6066 181.2273 -2.97 2.79 84.6 199.6531 186.3369 173.7524 -2.93 2.77 86.4 190.9639 178.4584 166.6217 -2.84 2.70 90 174.8228 163.7951	64.8	330.7839	304.2151	279.5286	-3.35	3.11
68.4 301.1254 277.6976 255.8620 -3.28 3.06 70.2 287.4128 265.4119 244.8745 -3.24 3.02 72 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.4465 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 239.0983 221.9825 205.9065 -3.08 2.90 79.2 228.4809 212.4060 197.2844 -3.04 2.86 81 218.3860 203.2887 189.0648 -3.01 2.83 82.8 208.7855 194.6066 181.2273 -2.97 2.79 84.6 199.6531 186.3369 173.7524 -2.93 2.77 86.4 190.9639 178.4584 166.6217 -2.88 2.74 88.2 182.6945 170.9508 159.8181 -2.84 2.66 91.8 167.3280 156.9733 <td>66.6</td> <td>315.5682</td> <td>290.6199</td> <td>267.4031</td> <td>-3.31</td> <td>3.08</td>	66.6	315.5682	290.6199	267.4031	-3.31	3.08
70.2 287.4128 265.4119 244.8745 -3.24 3.02 72 274.3905 253.7288 234.4118 -3.20 2.99 73.8 262.0206 242.6161 224.4465 -3.17 2.95 75.6 250.2676 232.0436 214.9529 -3.13 2.93 77.4 239.0983 221.9825 205.9065 -3.08 2.90 79.2 228.4809 212.4060 197.2844 -3.04 2.86 81 218.3860 203.2887 189.0648 -3.01 2.83 82.8 208.7855 194.6066 181.2273 -2.97 2.79 84.6 199.6531 186.3369 173.7524 -2.93 2.77 86.4 190.9639 178.4584 166.6217 -2.88 2.74 90 174.8228 163.7951 153.3249 -2.81 2.66 91.8 167.3280 156.9733 147.1268 -2.75 2.63 93.6 160.1904 150.4683	68.4	301.1254	277.6976	255.8620	-3.28	3.06
72274.3905253.7288234.4118-3.202.9973.8262.0206242.6161224.4465-3.172.9575.6250.2676232.0436214.9529-3.132.9377.4239.0983221.9825205.9065-3.082.9079.2228.4809212.4060197.2844-3.042.8681218.360203.2887189.0648-3.012.8382.8208.7855194.6066181.2273-2.972.7984.6199.6531186.3369173.7524-2.932.7786.4190.9639178.4584166.6217-2.882.7490174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.56	70.2	287.4128	265.4119	244.8745	-3.24	3.02
73.8262.0206242.6161224.44653.172.9575.6250.2676232.0436214.9529-3.132.9377.4239.0983221.9825205.9065-3.082.9079.2228.4809212.4060197.2844-3.042.8681218.3860203.2887189.0648-3.012.8382.8208.7855194.6066181.2273-2.972.7984.6199.6531186.3369173.7524-2.932.7786.4190.9639178.4584166.6217-2.882.7488.2182.6945170.9508159.8181-2.842.7090174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.56	72	274.3905	253.7288	234.4118	-3.20	2.99
75.6250.2676232.0436214.9529-3.132.9377.4239.0983221.9825205.9065-3.082.9079.2228.4809212.4060197.2844-3.042.8681218.3860203.2887189.0648-3.012.8382.8208.7855194.6066181.2273-2.972.7984.6199.6531186.3369173.7524-2.932.7786.4190.9639178.4584166.6217-2.882.7488.2182.6945170.9508159.8181-2.842.7090174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.5697.2146.9136138.3454130.1598-2.652.52	73.8	262.0206	242.6161	224.4465	-3.17	2.95
77.4239.0983221.9825205.9065-3.082.9079.2228.4809212.4060197.2844-3.042.8681218.3860203.2887189.0648-3.012.8382.8208.7855194.6066181.2273-2.972.7984.6199.6531186.3369173.7524-2.932.7786.4190.9639178.4584166.6217-2.882.7488.2182.6945170.9508159.8181-2.842.7090174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6395.4153.3914144.2641135.5577-2.682.5697.2146.9136138.3454130.1598-2.652.52	75.6	250.2676	232.0436	214.9529	-3.13	2.93
79.2228.4809212.4060197.2844-3.042.8681218.3860203.2887189.0648-3.012.8382.8208.7855194.6066181.2273-2.972.7984.6199.6531186.3369173.7524-2.932.7786.4190.9639178.4584166.6217-2.882.7490174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.5697.2146.9136138.3454130.1598-2.652.52	77.4	239.0983	221.9825	205.9065	-3.08	2.90
81218.3860203.2887189.0648-3.012.8382.8208.7855194.6066181.2273-2.972.7984.6199.6531186.3369173.7524-2.932.7786.4190.9639178.4584166.6217-2.882.7488.2182.6945170.9508159.8181-2.842.7090174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.5697.2146.9136138.3454130.1598-2.652.52	79.2	228.4809	212.4060	197.2844	-3.04	2.86
82.8208.7855194.6066181.2273-2.972.7984.6199.6531186.3369173.7524-2.932.7786.4190.9639178.4584166.6217-2.882.7488.2182.6945170.9508159.8181-2.842.7090174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.5697.2146.9136138.3454130.1598-2.652.52	81	218.3860	203.2887	189.0648	-3.01	2.83
84.6199.6531186.3369173.7524-2.932.7786.4190.9639178.4584166.6217-2.882.7488.2182.6945170.9508159.8181-2.842.7090174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.5697.2146.9136138.3454130.1598-2.652.52	82.8	208.7855	194.6066	181.2273	-2.97	2.79
86.4190.9639178.4584166.6217-2.882.7488.2182.6945170.9508159.8181-2.842.7090174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.5697.2146.9136138.3454130.1598-2.652.52	84.6	199.6531	186.3369	173.7524	-2.93	2.77
88.2182.6945170.9508159.8181-2.842.7090174.8228163.7951153.3249-2.812.6691.8167.3280156.9733147.1268-2.752.6393.6160.1904150.4683141.2090-2.722.5995.4153.3914144.2641135.5577-2.682.5697.2146.9136138.3454130.1598-2.652.52	86.4	190.9639	178.4584	166.6217	-2.88	2.74
90 174.8228 163.7951 153.3249 -2.81 2.66 91.8 167.3280 156.9733 147.1268 -2.75 2.63 93.6 160.1904 150.4683 141.2090 -2.72 2.59 95.4 153.3914 144.2641 135.5577 -2.68 2.56 97.2 146.9136 138.3454 130.1598 -2.65 2.52	88.2	182.6945	170.9508	159.8181	-2.84	2.70
91.8 167.3280 156.9733 147.1268 -2.75 2.63 93.6 160.1904 150.4683 141.2090 -2.72 2.59 95.4 153.3914 144.2641 135.5577 -2.68 2.56 97.2 146.9136 138.3454 130.1598 -2.65 2.52	90	174.8228	163.7951	153.3249	-2.81	2.66
93.6 160.1904 150.4683 141.2090 -2.72 2.59 95.4 153.3914 144.2641 135.5577 -2.68 2.56 97.2 146.9136 138.3454 130.1598 -2.65 2.52	91.8	167.3280	156.9733	147.1268	-2.75	2.63
95.4 153.3914 144.2641 135.5577 -2.68 2.56 97.2 146.9136 138.3454 130.1598 -2.65 2.52	93.6	160.1904	150.4683	141.2090	-2.72	2.59
97.2 146.9136 138.3454 130.1598 -2.65 2.52	95.4	153.3914	144.2641	135.5577	-2.68	2.56
	97.2	146.9136	138.3454	130.1598	-2.65	2.52

		SENSORS	5		
99	140.7403	132.6980	125.0027	-2.59	2.48
100.8	134.8559	127.3081	120.0746	-2.56	2.45
102.6	129.2457	122.1630	115.3645	-2.52	2.41
104.4	123.8956	117.2504	110.8618	-2.47	2.38
106.2	118.7926	112.5589	106.5564	-2.43	2.34
108	113.9241	108.0776	102.4388	-2.38	2.30
109.8	109.2784	103.7961	98.5000	-2.34	2.27
111.6	104.8443	99.7046	94.7315	-2.30	2.21
113.4	100.6112	95.7939	91.1253	-2.25	2.18
115.2	96.5692	92.0553	87.6735	-2.21	2.14
117	92.7088	88.4805	84.3690	-2.16	2.11
118.8	89.0211	85.0614	81.2048	-2.12	2.07
120.6	85.4976	81.7908	78.1744	-2.07	2.02
122.4	82.1303	78.6615	75.2715	-2.03	1.98
124.2	78.9116	75.6668	72.4902	-1.98	1.94
126	75.8343	72.8004	69.8249	-1.94	1.91
127.8	72.8916	70.0561	67.2703	-1.89	1.85
129.6	70.0770	67.4283	64.8213	-1.85	1.82
131.4	67.3844	64.9115	62.4731	-1.80	1.78
133.2	64.8080	62.5006	60.2211	-1.76	1.73
135	62.3423	60.1906	58.0609	-1.71	1.69
136.8	59.9821	57.9770	55.9885	-1.66	1.66
138.6	57.7223	55.8552	53.9998	-1.62	1.60
140.4	55.5583	53.8210	52.0912	-1.57	1.57
142.2	53.4856	51.8706	50.2591	-1.53	1.51
144	51.5000	50.0000	48.5000	-1.53	1.51
145.8	49.7063	48.2057	46.7083	-1.53	1.53
147.6	47.9835	46.4842	44.9911	-1.60	1.60
149.4	46.3286	44.8323	43.3452	-1.67	1.62
151.2	44.7385	43.2468	41.7672	-1.73	1.71
153	43.2105	41.7248	40.2540	-1.80	1.78
154.8	41.7386	40.2604	38.7996	-1.85	1.84
156.6	40.3241	38.8545	37.4048	-1.93	1.91
158.4	38.9643	37.5045	36.0668	-2.00	1.96
160.2	37.6569	36.2078	34.7831	-2.05	2.03
162	36.3996	34.9622	33.5513	-2.12	2.09
163.8	35.1903	33.7653	32.3689	-2.20	2.14
165.6	34.0269	32.6151	31.2338	-2.27	2.21
167.4	32.9075	31.5096	30.1438	-2.34	2.29
169.2	31.8302	30.4467	29.0970	-2.39	2.34
171	30.7933	29.4246	28.0915	-2.47	2.41
172.8	29.7950	28.4417	27.1254	-2.54	2.47
174.6	28.8337	27.4961	26.1970	-2.61	2.54
176.4	27.9078	26.5864	25.3048	-2.68	2.59
178.2	27.0160	25.7110	24.4470	-2.75	2.66

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180	26.1569	24.8685	23.6222	-2.83	2.74
181.8	25.3290	24.0574	22.8291	-2.90	2.79
183.6	24.5311	23.2765	22.0662	-2.97	2.86
185.4	23.7620	22.5245	21.3323	-3.04	2.93
187.2	23.0205	21.8002	20.6261	-3.11	2.99
189	22.3055	21.1025	19.9465	-3.19	3.06
190.8	21.6159	20.4303	19.2924	-3.26	3.13
192.6	20.9508	19.7825	18.6626	-3.33	3.19
194.4	20.3091	19.1582	18.0563	-3.40	3.26
196.2	19.6899	18.5564	17.4723	-3.47	3.33
198	19.0924	17.9761	16.9098	-3.56	3.40
199.8	18.5157	17.4166	16.3680	-3.64	3.47
201.6	17.9590	16.8769	15.8458	-3.71	3.53
203.4	17.4214	16.3564	15.3427	-3.78	3.60
205.2	16.9023	15.8542	14.8577	-3.87	3.67
207	16.4010	15.3696	14.3902	-3.94	3.74
208.8	15.9167	14.9020	13.9394	-4.01	3.82
210.6	15.4489	14.4506	13.5047	-4.09	3.89
212.4	14.9968	14.0149	13.0855	-4.18	3.94
214.2	14.5599	13.5942	12.6811	-4.25	4.01
216	14.1376	13.1879	12.2909	-4.34	4.09
217.8	13.7294	12.7955	11.9144	-4.41	4.16
219.6	13.3347	12.4165	11.5510	-4.50	4.23
221.4	12.9531	12.0503	11.2003	-4.57	4.30
223.2	12.5840	11.6965	10.8617	-4.64	4.37
225	12.2270	11.3545	10.5348	-4.73	4.45
226.8	11.8817	11.0240	10.2191	-4.82	4.52
228.6	11.5475	10.7046	9.9142	-4.90	4.59
230.4	11.2242	10.3957	9.6197	-4.99	4.66
232.2	10.9112	10.0970	9.3352	-5.06	4.73
234	10.6084	9.8082	9.0602	-5.15	4.81
235.8	10.3151	9.5288	8.7945	-5.24	4.88
237.6	10.0312	9.2586	8.5378	-5.31	4.95
239.4	9.7563	8.9971	8.2895	-5.40	5.04
241.2	9.4901	8.7441	8.0495	-5.49	5.11
243	9.2322	8.4993	7.8175	-5.56	5.18
244.8	8.9824	8.2623	7.5931	-5.65	5.26
246.6	8.7404	8.0329	7.3760	-5.74	5.33
248.4	8.5059	7.8108	7.1660	-5.83	5.40
250.2	8.2787	7.5958	6.9629	-5.92	5.47
252	8.0584	7.3875	6.7664	-5.99	5.56



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