Model LL357D4 Lead/Lag Controller

The Marvair® LL357D4 is a complete control package designed to operate a fully or partially redundant air conditioning system. It consists of a two-stage heat and cool electronic thermostat and a solid state timer. It can be used with either the Marvair ComPac® I vertical packaged wall mount air conditioner, our unique ComPac® II air conditioner with built-in economizer and many of the Marvair Environmental Control Units (ECU). The LL357D4 provides environmental control and the security demanded by the communication shelter industry for a back-up unit. The lead/lag controller insures equal wear on both air conditioners while allowing the lag unit to assist upon demand. Phasing of air conditioners is not required for proper operation. The environmentally safe, mercury-free LL357D4 is factory wired, tested and mounted in an enclosure for quick installation. The LL357D4 when used with the heat pump adapter, Model LL357H, provides control of redundant heat pump systems. Refer to the Heat Pump Adapter Product Bulletin for details.

Specification/Features

Operational Specifications

- Thermostat Range: 45ºF to 90ºF (7ºC to 32ºC)
- Accuracy: ±1ºF (± ½ºC)
- Changeover Temperature Differential (separation between the heat set point and the cool set point): 2ºF to 9ºF (1.0ºC to 4.5ºC)
- First Stage Temperature Differential (number of degrees between the set point temperature and the "turn on" temperature): 1ºF to 3ºF (.5ºC to 1.5ºC)
- Second Stage Temperature Differential (number of degrees between when stage 1 turns on and when stage 2 turns on): 1ºF to 6ºF (.5ºC to 3.0ºC).
- Minimum Cool Temperature Set Point: Adjustable from 45ºF to 75ºF (7ºC to 24.0ºC).
- Maximum Heat Temperature Set Point: Adjustable from 55ºF to 90ºF (13ºC to 32.0ºC)
- Staged OFF Outputs: Air conditioners will turn off independently.

Electrical Specifications

- Compatible with standard 24-volt AC, 2 stage heating/cooling systems.

- 24 Volt control (18 to 30 VAC).
- 1 amp maximum per terminal.
- 4 amp maximum total load.

Ease of Use

- Back lighting of the large display makes the Liquid Crystal Display (LCD) easy to read.
- Most frequently used keys are located by the LCD for quick & easy access to information.
- Easy installation, setup and system tests saves time.
- Setpoints are permanently held in memory and retained during power outages - no batteries required.
- Programming not required.
- Digital display shows temperature in °F or °C.
- Room Temperature Offset: Used to calibrate displayed room temperature with actual room temperature
- Filter Check Time: Set fan run time (in hours) when *Check Filter* is displayed.
- Status Indicator Light: Indicates which stage is running. Green light means cooling & red light means heating.

Specification/Features (cont'd)

Ease of Installation

- Wiring connections insensitive to the phasing of the air conditioners.

- Temperature sensor built into the unit (optional remote sensor available).

- Easy terminal connections for thermostat wire.

Timing Device

- Solid state timer with both 3.5 and 7 day changeover capability. Timing accuracy ±5%.

- Momentary push button for accelerated manual timer advance. (7 seconds = 7 days)

- Light emitting diodes indicate power on and identifies the lead unit.

Enclosure

- 16 gauge appliance white, pre-painted aluminum.

- Provides low profile thermostat mounting.

- Openings in cover for "LED" indication of power on and for lead unit.

- Doubles as junction box for control wiring to air conditioners.
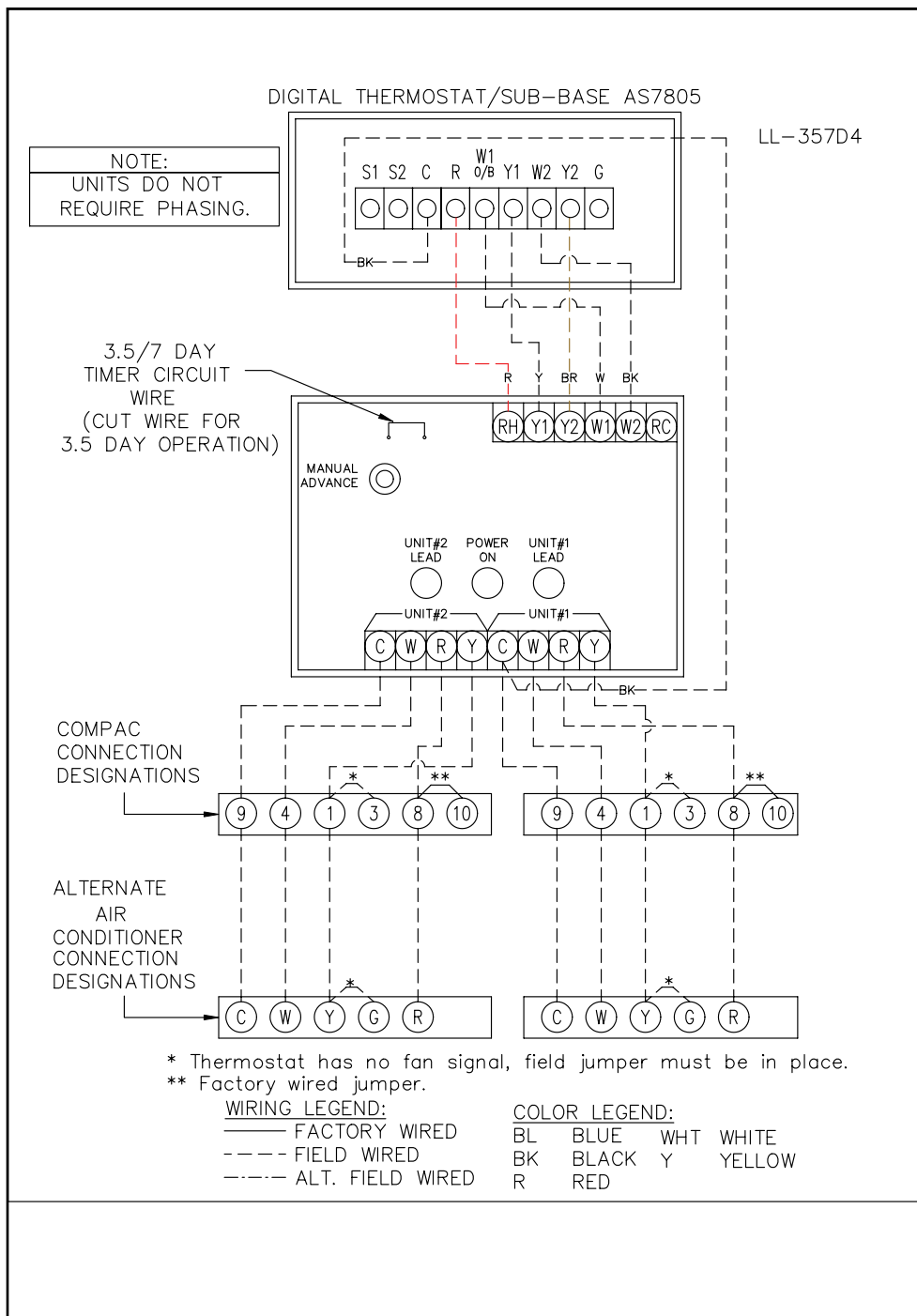
Low Voltage Wiring

1. All wiring must comply with local codes and ordinances.

2. Disconnect power to prevent electrical shock or equipment damage.

3. On dual units, wire the air conditioners according to the wiring detail.

4. Provide power to the controller.

NOTE:

- Terminals 5 and 7 on the ComPac® I & ComPac® II air conditioner's terminal board are dry contacts which can be used for remote signalling in the event of equipment cut-off on refrigerant pressure limit.

- For continuous indoor fan operation, install a jumper between terminals 8 and 3 and remove jumper between 1 and 3.

- Also, terminals 8 and 10 can be connected to a normally closed smoke or fire detector to cause equipment shutdown when the circuit is opened. (Remove factory jumper.)

LED Operation

- Green (middle light) means power on to both units.

- Red (left and right lights) indicates the lead unit.

DIGITAL THERMOSTAT/SUB−BASE AS7805

LL−357D4

NOTE:
UNITS DO NOT REQUIRE PHASING.

S1 S2 C R W1 0/B Y1 W2 Y2 G

BK

R Y BR W BK

3.5/7 DAY TIMER CIRCUIT WIRE (CUT WIRE FOR 3.5 DAY OPERATION)

RH Y1 Y2 W1 W2 RC

MANUAL ADVANCE

UNIT#2 LEAD   POWER ON   UNIT#1 LEAD

UNIT#2   UNIT#1
C W R Y   C W R Y

BK

COMPAC CONNECTION DESIGNATIONS

9 4 1 * 3 8 ** 10   9 4 1 * 3 8 ** 10

ALTERNATE AIR CONDITIONER CONNECTION DESIGNATIONS

C W Y * G R   C W Y * G R

* Thermostat has no fan signal, field jumper must be in place.
** Factory wired jumper.

WIRING LEGEND:
——— FACTORY WIRED
− − − − FIELD WIRED
—·—·— ALT. FIELD WIRED

COLOR LEGEND:
BL   BLUE   WHT   WHITE
BK   BLACK   Y   YELLOW
R   RED

Important Safety Precautions

WARNING!: *Always turn off power at the main power supply before installing, cleaning, or removing thermostat*.

- This thermostat is for 24 VAC applications only; do not use on voltages over 30 VAC
- Do not short across terminals of system control to test operation; this will damage your thermostat and void your warranty
- All wiring must conform to local and national electrical and building codes
- Use this thermostat only as described in this manual

Sub-base Illustration
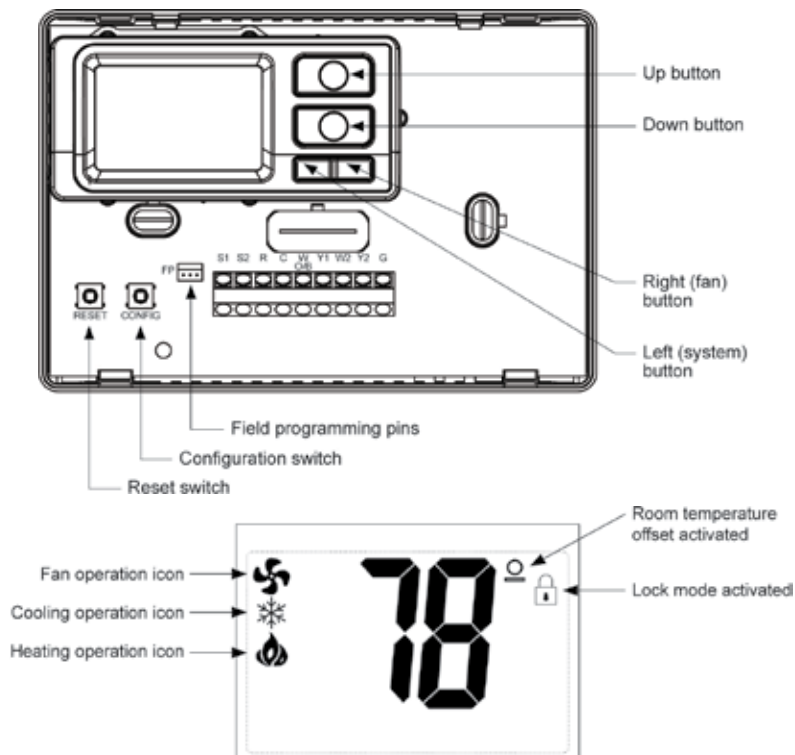
To Install LL357D4 Thermostat/Controller

ELECTRICAL SHOCK HAZARD – *Turn off power at the main service panel by removing the fuse or switching the appropriate circuit breaker to the OFF position before removing the existing thermostat.*

IMPORTANT: Thermostat installation must conform to local and national building and electrical codes and ordinances.

Note: Mount the thermostat about five feet above the floor. Do not mount the thermostat on an outside wall, in direct sunlight, behind a door, or in an area affected by a vent or duct.

1. Turn off power to the heating and cooling system by removing the fuse or switching off the appropriate circuit breaker.
2. Put thermostat base against the wall where you plan to mount it (Be sure wires will feed through the wire opening in the base of the thermostat).
3. Mark the placement of the mounting holes.
4. Using a drill bit, drill holes in the places you have marked for mounting.
5. Align thermostat base with mounting holes and feed the control wires through wire opening.
6. Use screws to mount thermostat base to wall.
7. Insert stripped, labeled wires in matching wire terminals. See Wiring Diagrams. CAUTION!: Be sure exposed portion of wires does not touch other wires.
8. Tighten screws on terminal block. Gently tug wire to be sure of proper connection. Double check that each wire is connected to the proper terminal.

9. Seal hole for wires behind thermostat with non-flammable insulation or putty.

10. Replace cover on thermostat.

11. Turn on power to the system at the main service panel.

12. Test thermostat operation as described in "Testing the Thermostat" (Page 6).

Remote Sensor Installation (optional)

1. Remove cover from remote sensor housing.

2. Select an appropriate location for mounting the remote sensor.

3. Mount remote sensor unit using hardware provided.

4. Install two wires between remote sensor and thermostat (use shielded cable that is adequately grounded).

    • Wire 1 should run between the S1 terminal on the thermostat and the S1 terminal on the remote sensor

    • Wire 2 should run between the S2 terminal on the thermostat and the S2 terminal on the remote sensor

5. Disable the main sensor (R12) on the thermostat by cutting it from the circuit board.

Remote Sensor
(Optional)

Cut R12 from circuit board
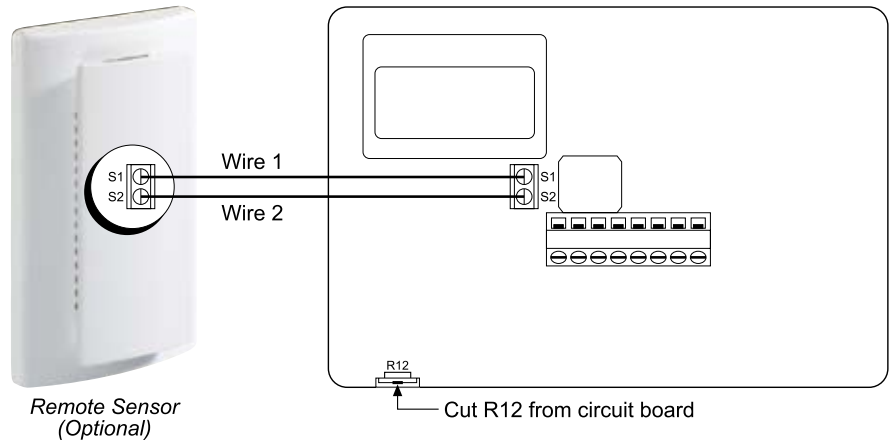
Configuration Mode

The configuration mode is used to set the LL357D4 thermostat to match your heating/cooling system. The LL357D4 functions with air conditioners with electric heat systems.

To configure the LL357D4, perform the following steps:

1. Verify that the LL357D4 is in the OFF mode. Press the SYS (left) button until mode displays.

2. Remove the cover of the thermostat by gently pulling near one of the corners at the top of the thermostat.

3. Press the **CONFIG** button for one second while the thermostat is in the OFF mode.

    Use the **Up** and **Down** buttons to change settings within each screen.

    Press the **Right** button to advance to the next screen.

    Press the **Left** button to return to previous screen.

4. To exit Configuration Mode, press the **CONFIG** switch for 1 second.
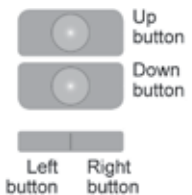
Configuration Mode Settings

The setup screens for the Configuration Mode follow:

1. Temperature Scale (°F or °C)
   Choose Fahrenheit or Celsius.

    Press the **Up** or **Down** button to select scale.

    Press the **Right** button to advance to the next screen.

2. **1st Stage Temperature Differential** (1°F to 5°F) (0 .5°C to 2 .5°C)
   Set the number of degrees between your "setpoint" temperature and your "turn on" temperature. Marvair recommends 2ºF.

    Press the **Up** or **Down** button to set differential value.

    Press the **Right** button to advance to the next screen.
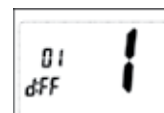
3. **2nd Stage Temperature Differential** (1°F to 5°F) (0 .5°C to 2 .5°C)
   Set the number of degrees between when stage 1 turns on and when stage 2 turns on. Marvair recommends 2ºF.

   Press the **Up** or **Down** button to select differential.

   Press the **Right** button to advance to the next screen.
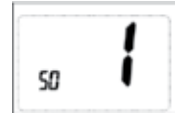
4. **Staged Off Outputs**
   Select whether the outputs for heating and cooling are staged off independently or are satisfied simultaneously. Select "1", outputs staged independently.

   1 = outputs staged off independently

   0 = outputs off simultaneously

   Press the **Up** or **Down** button to select.

   Press the **Right** button to advance to the next screen.

5. **Minimum Deadband** (1°F to 9°F) (1°C to 5°C)
   Set the minimum separation between heat setpoint and cool setpoint in Auto Changeover Mode. Marvair recommends 3ºF.

   Press the **Up** or **Down** button to set deadband value.

   Press the **Right** button to advance to the next screen.

6. **System** – Set for heat pump, non-Heat Pump (air conditioner), reversing valve operation and number of compressors in your system. Set up for "Non-Heat Pump" and Type of Heat "Electric".

   Press the **Up** or **Down** button to select scale.

Choose System		Reversing Valve Active	Number of Compressors or Compressor Stages	Type of Heat
Heat Pump	HP	O	1	
	HP	b	1	
	HP	O	2	
	HP	b	2	
Non-Heat Pump	Heat			Gas
	Heat			Electric

   Press the **Right** button to advance to the next screen.

   Press the **Up** or **Down** button to select.

   Press the **Right** button to advance to the next screen.

7. **Auxiliary Delay ON** – (0-30 minutes)
   Set the delay time in minutes for auxiliary heat to be locked out after a call for second stage. This extra savings feature is used to temporarily lock out auxiliary heat devices, allowing just heat pump to try to satisfy heat call. Set to 0 minutes.

   Press the **Up** or **Down** button to select.

   Press the **Righ**t button to advance to the next screen.

8. **Lockout** (0-8°, COOL-HEAT)
   Select the number of degrees set temperature can be changed during keypad lockout. COOL-HEAT lockout allows adjustment of the set temperatures to the maximum heat set temperature selected in Step 9 and minimum cool set temperature selected in Step 10.

    Note: The mode cannot be changed when the thermostat is locked.

    Press the **Up** or **Down** button to select.

    Press the Right button to advance to the next screen.

Configuration Mode Settings (cont'd)

9. **Maximum Heat Setpoint** (45°F to 90°F) (7°C to 32°C)
Adjust to control the maximum heat set temperature allowed. Marvair recommends a max. heat setpoint of 78ºF (25.6ºC)

    Press the **Up** or **Down** button to select.

    Press the **Right** button to advance to the next screen.

10. **Minimum Cool Setpoint** (45°F to 90°F) (7°C to 32°C)
Adjust to control the minimum cool set temperature allowed. Marvair recommends a minimum cool setpoint of 68ºF (20ºC).

    Press the **Up** or **Down** button to select.

    Press the **Right** button to advance to the next screen.

11. **Room Temperature Offset** (+9°F to -9°F) (+4 .5°C to -4 .5°C)
Adjust to calibrate displayed room temperature to match actual room temperature. Note: When not set to 0, º will display.

    Press the **Up** or **Down** button to select.

    Press the **Right** button to advance to the next screen.

12. **Temperature Sensor** (1-3)

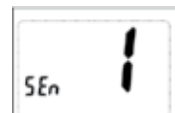   1. Only on-board sensor determines room temperature.

    2. Only remote sensor determines room temperature.

    3. Average temperature of on-board and remote sensor.

    Note: If there is no remote sensor, option 1 must be selected.

    Press the **Up** or **Down** button to select.

    Press the **Right** button to advance to the next screen.

13. **Cooling Fan Delay Off Time** (0, 30, 60, 90 seconds)
Select the fan purge time for cooling. Marvair recommends 0 seconds.

    Press the **Up** or **Down** button to select.

    Press the **Right** button to advance to the next screen.
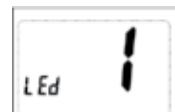
14. **Status Indicator Light** (Led 0, 1, 2)
Marvair recommends 1.

    0 = Status indicator never on

    1 = Status indicator on with first stage

    2 = Status indicator on with second stage

    Press the **Up** or **Down** button to select.

Press the **CONFIG** button for 2 seconds to exit configuration.

Testing the Thermostat

Note: The LL357D4 does not require the units to be in phase.

Procedure: (A/C Testing with LL357D4 Lead/Lag Control for Two Units)

UP - Used to increase the time, set temperatures and to adjust configuration settings.

DOWN - Used to decrease the time, set temperatures and to adjust configuration settings.

SYS (left) - Used to change from OFF, HEAT, COOL and AUTO changeover modes.

FAN (right) - Used to turn on and off the indoor fan.

UP, SYS and FAN - Held in simultaneously for 10 seconds to lock and unlock the thermostat.

DOWN and SYS - Pressed simultaneously to display outdoor temperature if outdoor remote sensor is connected.
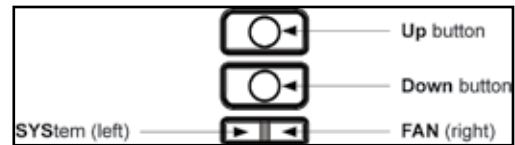
1. Set the cooling temperature on the wall thermostat to a point higher than the ambient temperature. Set the heating temperature to a temperature that is lower than the ambient temperature. Turn the selector switch to the "off" position.

2. Set the time delay on unit No. 1 to "3" minutes, and No. 2 to "5" minutes.

3. Set the change over setting of the enthalpy control to the "d" setting (ComPac® II A/C only).

4. Provide power to A/C units and turn disconnects on.

5. Check incoming power to each unit. For units designed for operation on 208/230v, 60hz power supply, the transformer is factory wired for a 230 power supply. For a 208 power supply remove the orange lead from the transformer and connect the red lead. Insulate the orange lead.

6. Cooling. Use the SYS switch to set the thermostat to "AUTO". Slowly lower the cooling temperature until the switch closes. The indoor fan should operate on the lead unit. Once the indoor fan turns on, allow approximately 3 to 5 minutes for the compressor to start. Note that the outdoor fan may not come on immediately because it is cycled by refrigerant pressures. Next, lower the temperature until the switch closes. Follow the above procedures for the lag unit.

   The green light on the lead lag control should be on. One amber light will be on to identify the lead unit. The other light should be off. If the lag unit comes on with the lead unit the light for the lag unit will not come on. You should never have all 3 lights on at one time.

   Allow the units to run for 2 to 3 minutes then check the temperature differential between the return air and the supply air with digital thermometer. The temperature differential should be between 12 and 20 degrees depending on ambient temperature.

   Next, slowly raise the cooling temperature until the switch opens. The compressor and outdoor fan should turn off. The indoor fan will continue to run for "90" seconds until the fan purge times out. Raise the temperature until the switch opens. The lead unit will shut down accordingly to the same procedures as outlines above.

   Note: (ComPac® II A/C only) To check the system operation under different ambient conditions, the air temperature and enthalpy sensors must be "tricked". When outdoor ambient conditions are higher than the control setting, a component cooler aerosol may be sprayed directly into the enthalpy sensor to stimulate low enthalpy conditions, causing the economizer damper to open.

   Alternately, when outdoor conditions are lower than the set point, a source of heat such as a hair dryer can be directed on the enthalpy sensor to simulate warm conditions, which will bring on mechanical cooling and start the compressor.

7. Heating. Slowly raise the heating temperature until the switch closes. The fan and electrical heat should immediately cycle on. The unit should start blowing warm air in 2 to 3 minutes. Next, raise the temperature until the switch closes. Follow the above procedures for lag unit.

   Hold the manual advance button in for nine seconds the lead lag lights should switch. Next, slowly lower the temperature until the switches open. The lag unit should shut down immediately. Next, slowly lower the temperature until the switch opens, the lead unit should shut down immediately.

8. Replace thermostat cover and panels on the unit.

Mode of Operation

For an unmanned site, Auto MUST be selected as the Operating Mode. Since the control module in the LL357D4 does not have a "G" input, the fan selector switch on the thermostat is not functional. In normal operation, the fan and the compressor operate simultaneously. For continuous fan on dual unit installations, install a jumper wire between terminals 8 and 3 and remove the jumper wire between 1 and 3. These terminals are on the low voltage terminal board in the air conditioner control box.

There are four possible operating modes for the LL357D4, Off, Cool, Heat, and Cool & Heat (auto-changeover). Modes are accessed by pressing the SYS (left) button.

OFF Mode

• In this mode, the thermostat will not heat or cool.

Heat Mode

• In this mode, the thermostat controls the heating system. When the heat is on, the flame icon appears on the display .

Cool Mode

• In this mode, the thermostat controls the cooling system. When the the unit is cooling, the snowflake icon appears on the display .

Cool and Heat Mode (Auto Changeover)

• In this mode, the thermostat controls the cooling and heating systems, automatically changing over from one to the other as needed .

• The timing display alternates with the set temperature every 10 seconds in the cool and heat mode.

Lockout Feature

The thermostat has a button lockout feature so the mode cannot be changed and the temperature adjustment is limited . Select the appropriate lockout from Configuration Mode Settings.

To activate the LOCK feature:

1. Simultaneously press the SYS, FAN and UP buttons for 10 seconds.

2. The lockout icon will display and the lockout function will be enabled .

To deactivate the LOCK feature, repeat steps 1 and 2 above.

Troubleshooting

Symptom	Remedy
No display	Check for 24 VAC at thermostat; display is blank when 24 VAC is not present.
Indoor blower does not turn on	Verify wiring is correct. Check settings in Config Mode, No. 6, "Settings".
All thermostat buttons are inoperative.	Verify 24 VAC is present; unit locks out when 24 VAC not present.
No response when first button is pressed.	First button pressed only activates backlight.
Air conditioners turns On and Off too frequently (short cycles)	Increase temperature differential. See Config Mode, steps 2 & 3.
Status indicator light does not come on during call for Cooling or Heating.	Turn status indicator light function on. See Config Mode, Step 14.
Room temperature is not correct.	Calibrate thermostat. See Config Mode, step 11.
Lock icon is displayed when any button is pressed.	Thermostat has the lockout function activated. See Lockout Feature and Config Mode, step 8.
Er on display instead of SEn temperature	Check for a bad connection at S1 and S2 terminals. See Config Mode, step 12
Air conditioner is not cooling or heating.	Verify wiring is correct. Gently pull on each wire to verify there is a good connection at the terminal bloc.
Problem not listed above	Press Reset once. Time and day are reset; configurations settings are not changed.

Configuration Mode

To enter Configuration mode:

1. Verify that the thermostat is in the OFF mode.
2. Press the SYS (left) button until the off mode displays.
3. Remove the thermostats cover by gently pulling on one corner at the top of the thermostat.
4. Press the CONFIG button for 1 second.
5. Press the up or down button to change the settings within each screen.
6. Press the right button to advance to the next screen. Press the left button to return to previous

Screen Number	Description	Marvair Recommended Selection	Default
1	Temperature Scale °F or °C	As desired	F
2	1st Stage Temperature Differential 1°F to 3°F (0.5°C to 1.5°C)	2°F	1°
3	2nd Stage Temperature Differential 1°F to 6°F (0.5°C to 3.0°C)	2°F	2°
4	Staged Off Outputs 1= outputs staged off independently 2= outputs staged off simultaneously	Select 1[1]	1
5	Minimum Deadband 2°F to 9°F (1.0°C to 4.5°C)	3°F	5°
6	System Choose from heat pump, non-heat pump (air conditioner), reversing valve and number of compressors.	Select "non-heat pump" and "Electric"[1]	GAS
7	Auxiliary Delay On Set the time delay (in minutes) for aux. heat to be locked out after a call for second stage	Set to 0 minutes.[1]	0:00
8	Lockout Select the number of degrees that the set temperature can be changed during keypad lockout.	As desired	00
9	Maximum Heating Setpoint 55°F to 90°F (13°C to 232.0°C)	No higher than 78°F (25.6°C)	90°
10	Minimum Cooling Set point 45°F to 75°F (7.0°C to 24.0°C)	No lower than 68°F (20°C)	45°
11	Room Temperature Offset +9°F to -9°F (+4.5°C to -4.5°C)	As desired	0°
12	Temperature Sensor 1 = On board temperature sensor 2 = Only remote sensor 3 = Avg. temperature of on-board sensor and remote sensor	As desired	1
13	Cooling fan Delay Off Time 0, 30, 60, 90 seconds	0 seconds	0
14	Status indicator light 0= status indicator never on 1= status indicator on with first stage 2= status indicator on with second stage	Select 1	1

To exit the Configuration Mode, press the CONFIG switch for 1 second.

Note: The red light indicates the unit(s) is in the heating cycle and the green light indicate that the unit(s) is in the cooling cycle.

[1]Settings and selections in italics are required settings/selections.

As part of the Marvair® continuous improvement program, specifications are subject to change without notice.