LUTRON

Using the LR-HVAC-230-S Thermostat w/ HomeWorks QS

1.0   Overview

Fan coil unit (FCU), split system, and radiant floor systems are commonly used for Heating, Ventilation, and Air Conditioning (HVAC). With the addition of the Lutron LR-HVAC-230-S Thermostat, the HomeWorks QS system can easily integrate with various types of HVAC equipment that are common in the marketplace. This application note details how to interface the LR-HVAC-230-S Thermostat with HomeWorks QS for the control of HVAC systems.

Table of Contents

2.0   MODBUS Introduction

The Lutron LR-HVAC-230-S thermostat can communicate with a HomeWorks QS system and control of various types of HVAC equipment globally. MODBUS is a messaging structure or communication protocol developed by Modicon in 1979, used to establish client-server communication between intelligent devices in a system. The thermostat supports this protocol over serial or RS-485 communication. The data from this thermostat can be sent to the HomeWorks QS Processor using MODBUS serial communication or via TCP/IP, using a converter to convert from RS-485 to TCP/IP.

2.1   Features when using the LR-HVAC-230-S w/ HomeWorks QS

LR-HVAC-230-S Integration Capabilities		Supported?
Controls and Triggers	Palladiom Thermostat	No
	seeTouch Keypad	Yes
	seeTemp Keypad	Yes
	Sensors	Yes
	Timeclock	Yes
	Lutron Connect App	Yes
Fan Speeds	Auto	Yes
	On	No
	Cycle	No
	High	Yes
	Medium	Yes
	Low	Yes
	Top	No
Operating Modes	Heat (Comfort Mode)*	Yes
	Cool (Comfort Mode)*	Yes
	Auto (Comfort Mode)*	Yes†
	Off (Protection Mode)*	Yes
	Fan	Yes
	Dry (Economy Mode)*	Yes†
Advanced Programming	Green Mode	No
	Conditional Logic based on MODBUS Status	Yes
	7 Day Scheduling	Yes
* See section 3.2 for more information on the Operating Modes of the LR-HVAC-230-S		
† Not supported in 7.0. Contact Lutron for more information.		

2.2 Connecting the LR-HVAC-230-S to the HomeWorks QS System

There are two ways to connect the MODBUS thermostat to a HomeWorks QS system: using an RS-485 serial to Ethernet converter to connect thermostats to the Local Area Network or connected to one of the configurable links on the Processor (MODBUS link type)

2.2.1 RS-485 to Ethernet Converter Connection
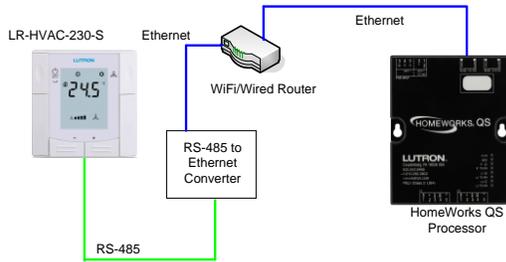
Connecting LR-HVAC-230-S thermostats to the network requires an RS-485 to Ethernet converter. A maximum of 5 Ethernet integration connections are allowed per Processor. This allows for a total of 80 RS-485 to Ethernet converters per HomeWorks QS system, each capable of connecting to 32 thermostats maximum. The default baud rate and parity is 19200bps and even. Refer to the Setup Document for more information on changing parameter settings (P68 and P70): http://www.lutron.com/TechnicalDocumentLibrary/041459.pdf

2.2.2 MODBUS Configurable Link Connection

NOTE: This feature is supported in version 8.0 or newer of the HomeWorks QS software. Contact Lutron for more information.


LR-HVAC-230-S	HWQS Link
REF	Common
n/c	V+
+	$\underline{mux}$
-	$\overline{mux}$
n/c	D (Drain)

It is recommended that Lutron wired link run specifications are followed when connecting MODBUS thermostats to the configurable link. A maximum run per link of 1000ft can be attained using one pair of 18AWG wire for common and another pair, twisted and shielded, of 22AWG is utilized for communication. The 18AWG red wire, for V+, is not used in this application. A maximum of 32 thermostats are allowed per MODBUS link.

2.3   Configuring an LR-HVAC-230-S in a HomeWorks QS Database

2.3.1   Adding 3rd Party HVAC Zones to a HomeWorks QS Database

To add a 3rd Party HVAC zone to the database, go to the **Design** tab of the software and use the dropdown menu to select **Loads**. Next, find the **3rd Party HVAC** tab on the right hand side of the screen.
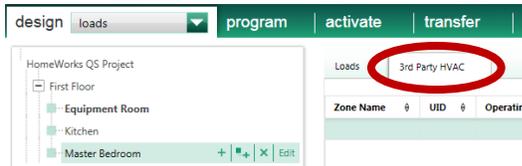
Click on Add Load at the bottom of the screen.

Provide a Zone Name, select Operating Modes, and select the Fan Speeds that are applicable to the zone being created. Unchecked modes are hidden when using the Home Control+ app, Dynamic Keypad, and when programming. Only check off the modes that are necessary so the app is simpler for the end user. The zone name is important for the same reason.


UID is the unique address provided to each thermostat on the link. UIDs less than 10 will require a leading zero to maintain proper numerical order. For example, a UID of 8 would appear as 08. The UID is set on the thermostat via parameter 81 (P81). Refer to the section 2.3.2 for how to change the value for P81.

### 2.3.2   Setting the UID on the LR-HVAC-230-S

1. Press buttons + and – simultaneously for 3 seconds. Release and press button – again for 3 seconds within 2 seconds. The display shows "P01" and service.

2. Repeatedly press the + or – button to select the required parameter, P81.

3. Press + and – simultaneously. The current value of the parameter will flash, allowing you to change the value by pressing + or –.

4. Press + or – until "End" is displayed, and then press + and – simultaneously to save the change and exit parameter entry mode.

### 2.3.3   Adding an LR-HVAC-230-S to a HomeWorks QS Database

To add an LR-HVAC-230-S to the database, go to the **Design** tab of the software and use the dropdown menu to select **Equipment**. Next, find the **3rd Party HVAC** device in your toolbox and click on the plus sign to add the device. (Note: the default toolbox does not contain this device by default so it is necessary to edit or create a toolbox to include the 3rd Party HVAC device)
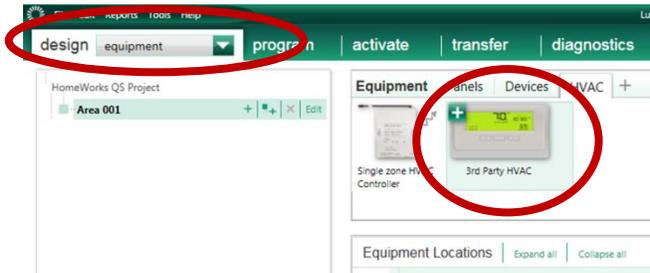

Once the 3rd Party HVAC control has been added to the **Equipment Locations** area, provide a name for the HVAC control and select **Lutron Thermostat** as the Manufacturer. *Note: when adding the 3rd Party HVAC interface, a zone is automatically added by default. All zones should be created as seen in the previous section and this auto-created zone can be deleted.*
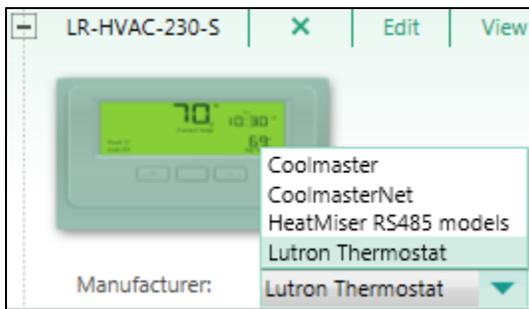
Choose the connection type as MODBUS (for a MODBUS configurable link connection) or Ethernet Interface (for an RS-485 converted to Ethernet connection).
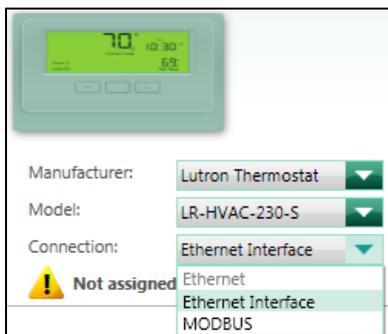
Next, **Assign** HVAC zones using the **Output** tab.
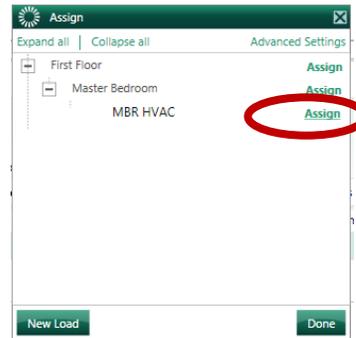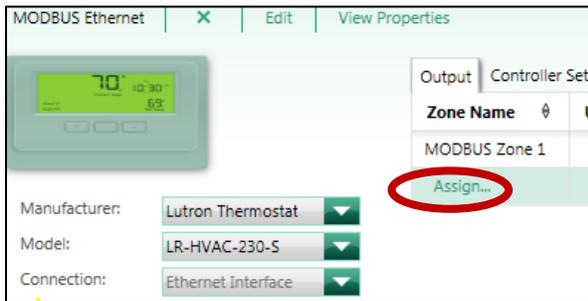
The final step on the Output tab is to assign any seeTemps that will be used to also control the setpoints and modes for the zones. Click on Assign under the Assigned Devices field. Note that the seeTemp keypads are not available in every country. seeTemp controls require either a 24VAC or 120VAC input voltage and they communicate using the 431-437MHz band of ClearConnect wireless communication. To find out if they are available in a specific country, contact Lutron's customer service at www.lutron.com.

Then click on Assign on the seeTemp(s) that will control the zone. Multiple can be assigned.
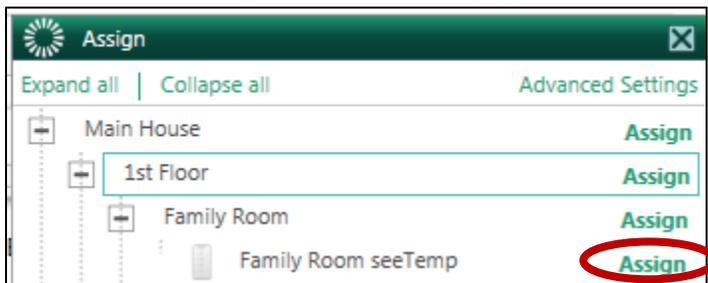
The name of the seeTemp control station should now be visible in the seeTemps field.

The MODBUS thermostat will live on the network when using an RS-485 to TCP/IP converter. The converter is assigned an IP address, port number, and potentially a username and password if the converter utilizes Telnet. Settings will vary by converter. Set the IP address of the converter outside of the DHCP range of the router that it is tied to. The IP Address, Port Number, and Username/Password (if necessary) are typed into the **Controller Settings** tab.

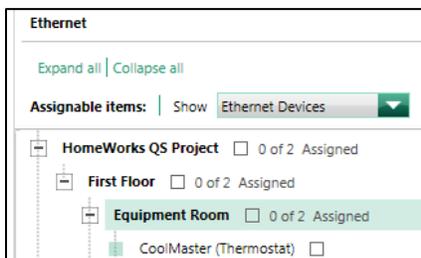| Output	Controller Settings		
Address	Port Number	Username	Password
192.168.1.203	2101		

2.3.4   Link Assigning the LR-HVAC-230-S to Processor Ethernet Connections

The LR-HVAC-230-S communicates to the HomeWorks QS Processor by sending RS-485 communication through an RS-485 to Ethernet adapter or directly by sending MODBUS commands to the MODBUS configurable link. Thermostats using the RS-485 serial to Ethernet converter appear as a network device to the HomeWorks QS Processor and must then be assigned to an Ethernet connection on one of the 16 possible Processors.

To assign a thermostat to an Ethernet connection, first select **Link Assignment** from the Design tab drop down menu. Click on **Ethernet** under the Processor that is having the thermostat assigned to it.

HomeWorks QS Project
- First Floor
  - Equipment Room
    - Processor LV21
      - Processor 1
        - Link 1 (HWQS RF)
        - Link 2 (QS)
        - Ethernet
          - ☐ Disable Home Control+ Remote Access
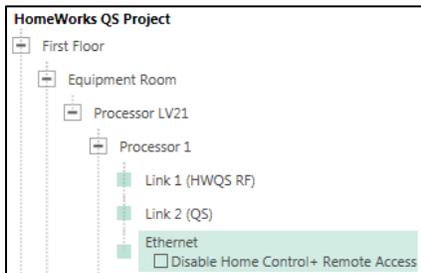
Select **Ethernet Device**s from the Show filter on the **Assignable Items** window on the right-hand side of the screen.

Ethernet

Expand all | Collapse all

Assignable items: Show Ethernet Devices ▼

- HomeWorks QS Project ☐ 0 of 2 Assigned
  - First Floor ☐ 0 of 2 Assigned
    - Equipment Room ☐ 0 of 2 Assigned
      - CoolMaster (Thermostat) ☐

Check the box for the zone that you would like to Assign to an Ethernet Connection and it will appear in the list of assigned Ethernet Devices in the lower right-hand corner of the software.

Customize columns

Item Description	Type	IP Address	Port	Username	Password
Remote Access					
Remote Access					
First Floor ▸ Equipment Room ▸ CoolMaster	Thermostat	192.168.1.203	2101		

The IP Address and Port numbers are the numbers used by the RS-485 to Ethernet converter. If the converter communicates using Telnet, the converter would have a Username and Password that the Processor would require in order to send data.

Each 3rd party HVAC interface, as well as any other 3rd party device, counts as 1 outbound connection in the HWQS system. In HWQS versions 7.0 and later, each processor is capable of communicating to a maximum of 5 Ethernet devices. For the first processor in the system, 2 of the 5 available Ethernet devices are reserved for remote access (without a VPN) for the Home Control+ app. If remote access (without a VPN) is not being used, you can disable that option in order to free up the first two Ethernet device slots on the first processor. To disable Home Control+ remote access, you'll need to check the box next to "Disable Home Control+ Remote Access" under the Ethernet link for the first processor on the "Design > Link Assignment" screen:


Or under the Home Control+ Remote Access field on the "Activate > Processors" screen:


2.3.5 Changing Setpoints and Modes from Keypad Buttons, Contact Closure Inputs, Sensors, or Timeclock Events

The first step, as with any keypad button or CCI, is to select the Program Type, Button Type, and LED Logic for the button. *Note: the Lutron LR-HVAC-230-S currently supports single setpoint changes. Heat and cool setpoints cannot be set at the same time.*
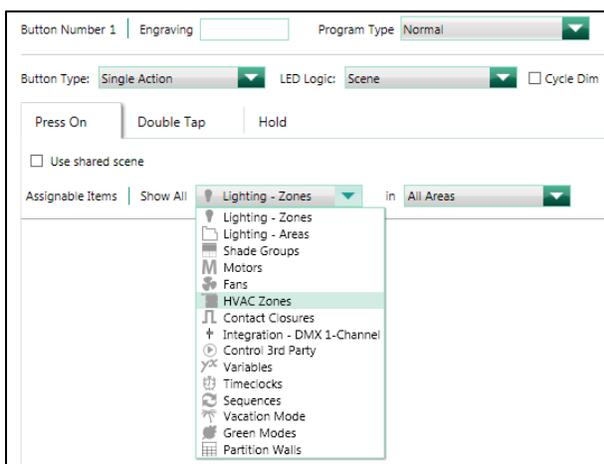

After the button has been configured, select HVAC zones from the Assignable Items drop down menu. Find the zone that you would like to add to the button and roll your cursor over top of the checkbox to the right of the zone name. Select the parameters that need to change based on

the button press. You can adjust setpoints, operating modes, and fan speeds from keypad button presses and CCIs.
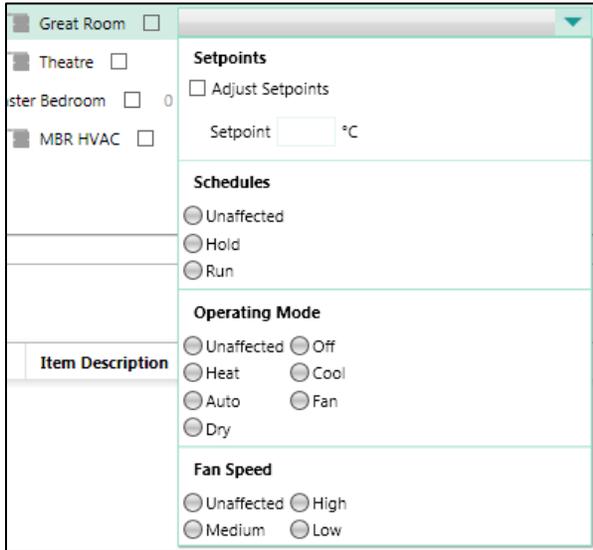

To program an Occupancy or Vacancy sensor to control an LR-HVAC-230-S thermostat, be sure to select Occupancy from the Program tab drop down menu and then select the sensor that is to be programmed.
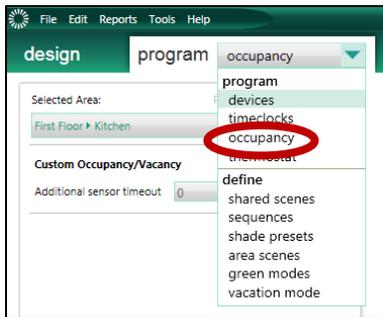

You can adjust setpoints, operating modes, and fan speeds from sensors.
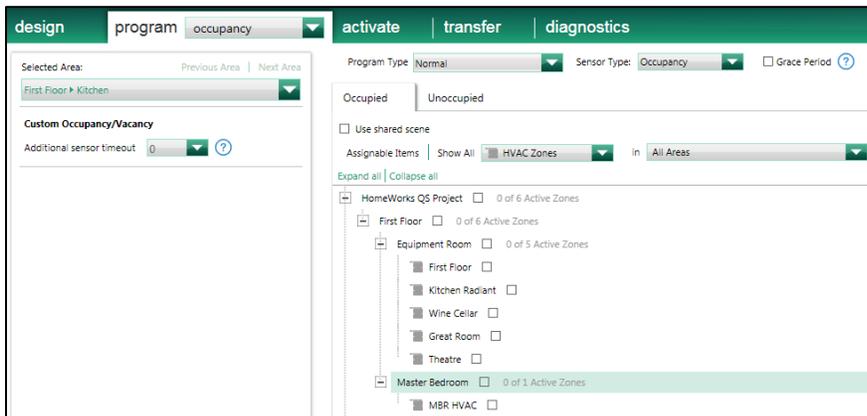
To program a Timeclock Event to control an LR-HVAC-230-S thermostat, select Timeclocks from the Program tab drop down menu.
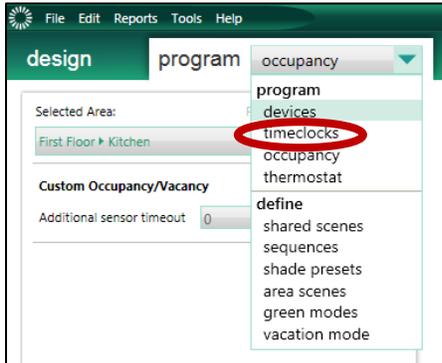
Create a new Timeclock event, setting the name, days of week, and time of the event. On the right hand side, select the Program Type. Select the HVAC zones to be affected by the event. Timeclock events can be used to adjust setpoints, operating modes, and fan speeds.
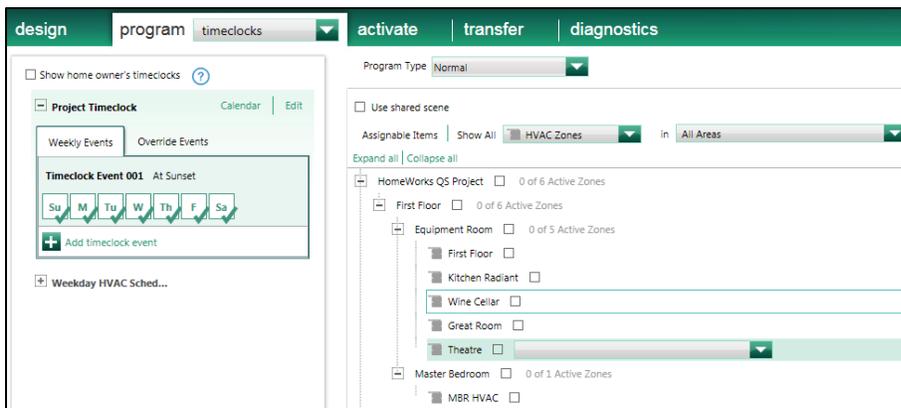

2.3.6 Programming 7 Day Schedules

The HomeWorks QS Programming Software can be used to create 7 day schedules which allow for automatic control of HVAC set points, up to 4 times per day, with the aim of maximizing energy efficiency and comfort. Schedule programming is executed on a zone by zone basis although copying schedules from one zone to another is allowed for faster programming.

To program an HVAC Schedule to control an LR-HVAC-230-S zone, select Thermostat from the Program tab drop down menu.

Next, select the HVAC zone that requires schedule programming.
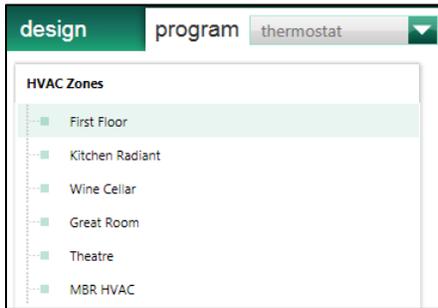
On the right-hand side of the screen you have the option of clicking on the "+" sign to add a new Schedule or edit an existing Schedule. Each zone can have 1 schedule run per day for a total of 7 maximum independent Schedules per zone each with a maximum of 4 events that trigger at fixed times throughout the schedule.
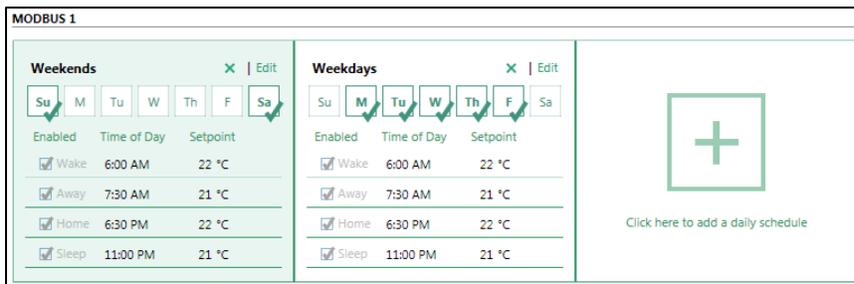
Schedules for each HVAC zone in the system are programmed independently. Copying and pasting of schedules is allowed to increase programming efficiency. To copy a schedule, right click on the name of the HVAC Zone, with the schedule to be copied. Click on Copy Schedules.
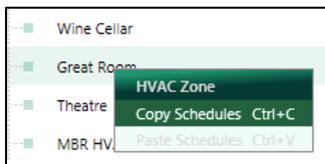
Click on the zone to be programmed and click on Paste Schedules to copy the schedule to the zone.
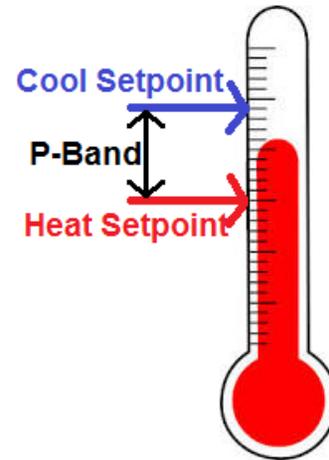
3.0   Energy Saving Modes

3.1   Energy Savings in the Lutron HVAC Model

In the Lutron HVAC model, energy savings can be accomplished in the HVAC system by raising the Cool Setpoint when in Cool (or Auto) mode, or lowering the Heat Setpoint when in Heat (or Auto) mode. The temperature range between the Heat Setpoint and the Cool Setpoint is known as the Proportional Band, or **P-Band**.

When the ambient temperature drifts above the Cool Setpoint and the HVAC system is in Cool or Auto mode, Cooling is turned on until the temperature dips back below the Cool Setpoint. Similarly, when the ambient temperature drifts below the Heat Setpoint and the HVAC system is in Heat or Auto mode, Heat is turned on until the temperature rises back above the Heat Setpoint.

The ambient temperature can drift around the P-Band without any intervention (Heat or Cool) from the HVAC system. Energy saving in the HVAC system increases as the P-Band grows larger but this comes at the cost of occupant comfort because the ambient temperature is allowed to drift more.

System triggers or events (keypad button presses, timeclock events, sequences, CCIs, etc.) can be programmed to vary Heat and Cool setpoints.

3.2   The LR-HVAC-230-S Energy Saving Model

The LR-HVAC-230-S features the following Operating Modes (not part of the Operating Modes of the Lutron HVAC Model, see section 2.1 for mode cross reference):

1. **Comfort mode**: This is the default mode, designed to be used when the space is occupied. In comfort mode, the LR-HVAC-230-S has just one setpoint, known as the Comfort Setpoint. The Comfort Setpoint is changeable from the buttons on the front of the thermostat without entering any special modes, or via HomeWorks QS system triggers. In comfort mode, the P-band extends just 0.5°C (roughly 1°F) above the setpoint, and 1°C (roughly 2°F) below the setpoint. If the ambient temperature gets 0.5°C hotter than the setpoint, Cooling is invoked. If the ambient temperature gets 1°C colder than the setpoint, Heating is invoked. In the Homeworks QS programming software, Comfort Mode is mapped to Heat, Cool, and Auto modes.

2. **Protection mode:** A deep energy saving mode designed to be used when the space is known to be unoccupied for a long period of time, providing maximum energy savings without allowing dangerous cold (frozen pipes) or heat (safety

hazards such as fire risk). An example of this is a hotel room that is currently checked out (unsold). Another example is a vacation home when it's not vacation time and it's going to be empty for days/weeks/months. In protection mode, the LR-HVAC-230-S features yet another two setpoints: the Protection Cool Setpoint, and the Protection Heat Setpoint. The two setpoints can each be set to anything, as long as the Protection Heat Setpoint remains below (i.e. lower temperature than) the Protection Cool Setpoint and the Economy Cool Setpoint, and as long as the Protection Cool Setpoint remains above (i.e. higher temperature than) the Protection Heat Setpoint and the Economy Cool Setpoint. In other words, the Protection mode P-band must be larger than the Economy mode P-band. The two protection setpoints can again be individually set over MODBUS, or through the Advanced Programming Mode of the thermostat. This mode is supported in HWQS 7.1 software and newer.

3. **Economy mode:** Economy mode is designed to be used when the space is unoccupied but with the potential to become occupied at any time, providing some energy savings without drifting too far from the comfortable temperature because the occupants might return at any moment. An example of this is a hotel room that is currently checked in, but the guest is not in their room. Another example is a house in the middle of the day when all the tenants are at work or school. In economy mode, the LR-HVAC-230-S features two setpoints: the Economy Cool Setpoint, and the Economy Heat Setpoint. The two setpoints can each be set to anything, as long as the Economy Heat Setpoint remains below (i.e. lower temperature than) the Economy Cool Setpoint. The two economy setpoints can be individually set over MODBUS, or through the Advanced Programming Mode of the thermostat. This mode is supported in HWQS 7.2 software and newer.