SIEMENS

Technical Instructions
Document No. 155-327P25
January 17, 2007

RCU15U, RCU50U and RCU50.2U

Room Temperature Controllers for CAV Systems

RCU50U/RCU15U

RCU50.2U

Description

The RCU microprocessor controlled CAV room controller is designed for air only, or air and water heating and/or cooling systems. Controllers have two-position, pulse width modulation (PWM), or proportional response.

Features

- Choice of two-position (RCU15U) or modulating PI (RCU50U and RCU50.2U) control.
- 0 to 10 Vdc output for heating or cooling (RCU50U and RCU50.2U).
- ON/OFF or PWM outputs for heating and cooling (RCU15U).
- Control depending on room or return air temperature (RCU15U).
- Automatic heating/cooling changeover (RCU15U and RCU50U).
- Manual heating/cooling changeover (RCU50.2U).
- Operating modes: Normal, Energy Saving, Frost Protection and Standby (RCU15U and RCU50U).
- Operating modes: Normal and OFF (RCU50.2U).
- Active 0 to 10 Vdc input for setpoint shifting (RCU50U).
- Operating mode changeover input for remote control (RCU50U).
- Adjustable minimum limitation for cooling output (RCU50U).
- Operating voltage 24 Vac.

Application

Controlling individual room temperature in HVAC installations that are heated or cooled.

Controlling these types of equipment:

- Valve actuators.
- Air damper actuators.

Product Numbers

Table 1.

Product Number	Output	Heat/Cool Changeover
RCU15U	(2) On/Off or PWM	Automatic
RCU50U	(1) 0 to 10 Vdc	Automatic
RCU50.2U	(1) 0 to 10 Vdc	Manual

Ordering

The temperature sensor, changeover mounting kit, and valve and damper actuators must be ordered separately.

Table 2. Equipment Combinations.

Product Number	Description	Technical Instructions
QAH11.1	Remote Cable Temperature sensor	155-329P25
GDE16…	44 lb-in NSR Air damper actuator	155-187P25
GLB16…	88 lb-in NSR Air damper actuator	
SSB61U	Valve actuator	155-192P25
SSC61U SSC61.5U	Valve actuator	155-313P25
SQS65U SQS65.5U	Valve actuator	155-190P25

Function

The controller measures the room temperature with its integrated sensor and maintains the setpoint by delivering control commands. The RCU50U and RCU50.2U provide P-control. With the RCU50U, the proportional band can be 2°F or 7°F (1°C or 4°C) in heating mode and 1°F or 3.5°F (0.5°C or 2°C) in cooling mode (selectable with DIP Switch No. 4). With the RCU50.2U, the proportional band is fixed, 7°F (4°C) in heating mode and 3.5°F (2°C) in cooling mode.

- RCU15U – The controller acquires the room temperature with its integrated sensor or return air temperature sensor (QAH11.1), if used, and maintains the setpoint by delivering control commands. It is possible to choose PI control with PWM actuating commands or two-position control with ON/OFF actuating commands.
- RCU50U – When in the heating mode, on increase in temperature, the output signal goes down (Reverse Acting - R.A.) from 10 to 0 volts. When in cooling mode, on increase in temperature, the output signal goes up (Direct Acting - D.A.) from 0 to 10 volts.
- RCU50.2U – The output signal can be reversed 0 to 10 or 10 to 0 volts via the DIP switch.

Heating-Cooling

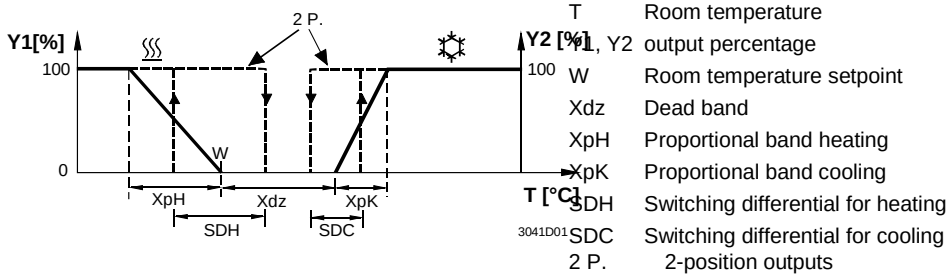
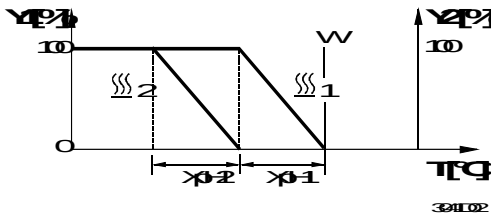


Figure 1. RCU15U Function Diagram.

Heating-Heating with PWM Output

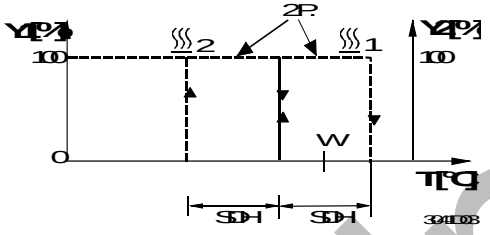


T	Room temperature
Y1	Heating sequence output 1
Y2	Heating sequence output 2
W	Room temperature setpoint
XpH1	Proportional band heating 1
XpH2	Proportional band heating 2

NOTE: When two heating sequences are selected, the two outputs cannot be switched ON at the same time. Switch on one output, wait at least 10 seconds, and then switch on the second output. In case of setpoint change, the two heaters are allowed to switch OFF together.

Figure 2. RCU15U Function Diagram.

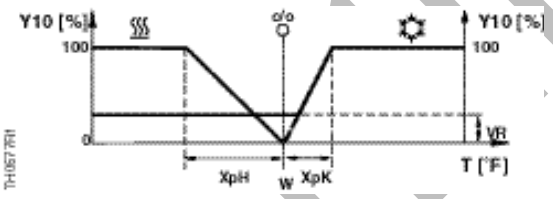
Heating-Heating with Two-position Output



T	Room temperature
Y1	Heating sequence output 1
Y2	Heating sequence output 2
W	Room temperature setpoint
SDH	Switching differential for heating
2 P.	2-position outputs

Figure 3. RCU15U Function Diagram.

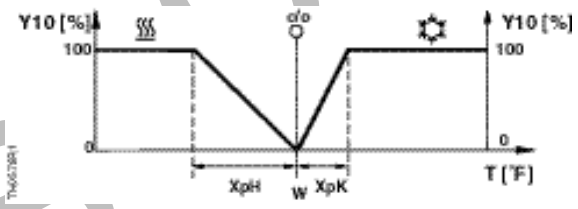
Heating-Cooling with Minimum Limitation Cooling



T	Room temperature
Y10	Output percentage
W	Room temperature setpoint
XpH	Proportional band heating
XpK	Proportional band cooling
VR	0 to 100% minimum limitation of cooling output
c/o	Changeover

Figure 4. RCU50U Function Diagram.

Heating-Cooling



T	Room temperature
Y10	Output percentage
W	Room temperature setpoint
XpH	Proportional band heating
XpK	Proportional band cooling
c/o	Changeover

Figure 5. RCU50.2U Function Diagram.

Pulse Width Modulation

If actuating signal "Pulse Width Modulation" (PWM) is selected with DIP Switches Number 5 and 6, the output is activated and deactivated for a certain period of time, proportional to the calculated, manipulated variable and following an interval.

The interval of the PWM actuating signal can be selected as follows:

Heating and cooling (DIP Switch 7 on position ON)
Y1 interval can be selected with DIP Switch 8 and is either 240 or 90 seconds.
Y2 interval is 240 seconds and cannot be changed.

Heating two-stage (DIP Switch 7 on position OFF)
Y1 interval is 240 seconds and cannot be changed.
Y2 interval can be selected with DIP Switch 8 and is either 240 or 90 seconds.

NOTE: Output Y1 (heating) when used in connection with thermic actuators, the selected interval should be 240 seconds. When using electric heaters, it should be 90 seconds.

CAUTION:

- Do not use PWM actuating signals driving electric actuators.
- When used in connection with electric valve actuators, DIP Switches number 5 and 6 must be set to ON for two-position control.

Return Air Temperature or External Room Temperature

The RCU15U provides control depending on the temperature acquired either by its integrated sensor, external room sensor or return air temperature sensor in the fan coil unit. Changeover is automatic if a QAH11.1 cable temperature sensor.

Minimum Limitation of Cooling Signal

RCU50U

Using the potentiometer located on the circuit board, the cooling signal output can be limited to a minimum value of between 0 and 100%. This can be used to ensure a minimum supply air volume. When used in connection with a VAV controller, this setting must be taken into account. To set minimum limitation, use a screwdriver to adjust the potentiometer (see Figure 6). Values on the scale are percentage of full operation.

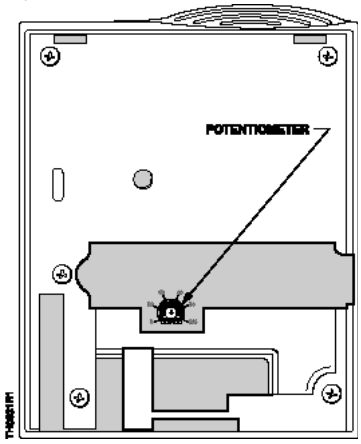


Figure 6. Potentiometer Location (RCU50U).

Inversion of Output Signal

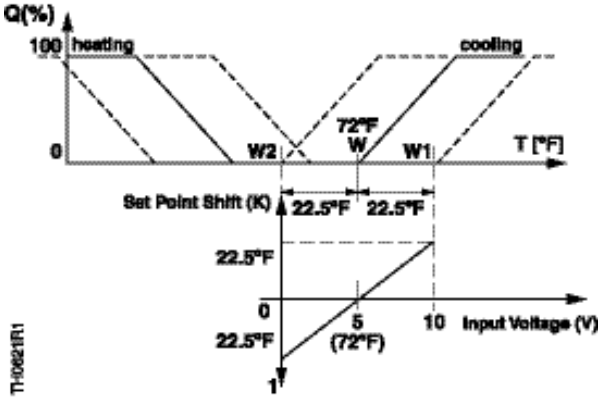
RCU50.2U

With the RCU50.2U, the output signal can be inverted with the help of DIP Switch No. 1. If set to ON, 0V corresponds to 0% travel and 10V to 100% travel. In position OFF, 0V corresponds to 100% travel and 10V to 0% travel.

Setpoint Shifting

RCU50U

Signal Input 1 and 2 is used for outside temperature compensation. Using a 0 to 10 Vdc signal, the setpoint can be shifted by ±22.5°F at 72°F setpoint. The neutral position is at 5 Vdc and means no setpoint shift.



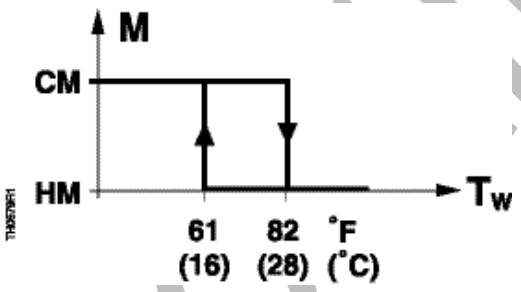
W Original setpoint
W1 Highest setpoint at 10V input
W2 Lowest setpoint at 0V input setpoint shift
T Temperature
(V) Input voltage

Figure 7. Setpoint Shifting (RCU50U).

Automatic Changeover

RCU50U

The water temperature measured by the changeover sensor (QAH11.1) is used by the controller to switch from heating to cooling mode, or vice versa. When the water temperature is above 82°F (28°C), the controller switches to heating mode; below 61°F (16°C), it switches to cooling mode.



CM Cooling mode
HM Heating mode
M Operating mode
T_W Water temperature

Figure 8. Automatic Changeover Mode.

Setpoint Limit Stops

The room temperature setpoint can be limited in increments of 2°F (1°C) by using the minimum and maximum setpoint limit stops. This prevents arbitrary setpoint readjustments.

To set limit stops, remove the setpoint knob by pulling it straight off the shaft. Reposition gray tabs for high and low stops in the holes around the perimeter of knob as required. See Figure 9.

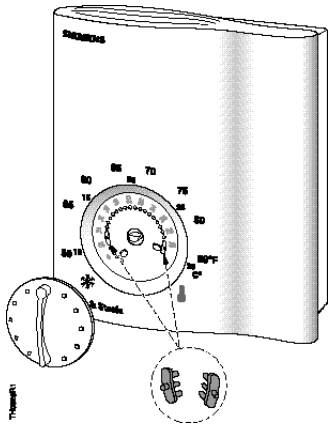


Figure 9. Setpoint Limit Stops.

Operating Modes

When dry contact (D1 and Ground) is open, the setpoint knob setting takes over control and normal mode is initiated.

Normal Mode

Frost Protection Mode
(RCU15U and RCU50U)

Frost protection mode can be initiated by activating the external operating mode changeover switch, if DIP Switch No. 1 is set to OFF.

If the room temperature falls below 46°F (8°C), the controller will automatically switch to frost protection mode. In that case, the heating valve opens and the room temperature is maintained at a setpoint of 46°F (8°C). The setpoint adjusted by the user will be ignored.

Energy Saving Mode
(RCU15U and RCU50U)

Energy saving mode can be initiated by activating the external operating mode changeover switch, if DIP Switch No. 1 is set to ON.

In energy saving mode, the heating setpoint is 61°F (16°C) and the cooling setpoint is 82°F (28°C), independent of the position of the setpoint knob.

Operating Mode Changeover Switch

(RCU15U and RCU50U)

A changeover switch can be connected to status input D1–GND. When the switch closes its contact (caused by an open window, for instance), the operating mode changes from normal operation or standby to energy saving mode (if DIP Switch No. 1 is set to ON), or from normal operation or energy saving mode to standby (if DIP Switch No. 1 is set to OFF).

The operating action of the switch (NC or NO) can be selected.

Mechanical Design

The unit consists of two parts:

- Plastic housing which accommodates the electronics, the operating elements and the built-in room temperature sensor.
- Controller base.

The housing snaps into the top and bottom of the mounting base.

The screw terminals are mounted on the base. The DIP switches and the potentiometer are located at the rear of the unit. To access the DIP switches, remove the controller from the controller base. See Figure 10.

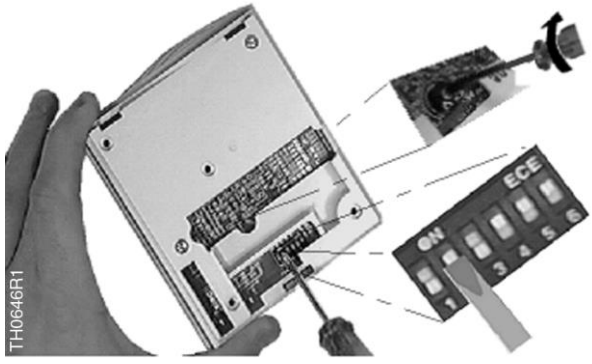


Figure 10. DIP Switch Setting.

Table 3. RCU15U DIP Switches.

DIP Switch No.	Meaning	Position ON	Position OFF
1	Operating mode changeover via external switch	Changeover between normal operation or standby and energy saving mode	Changeover between normal operation or energy saving and standby[1]
2	Operating action of switch for external operating mode changeover	Changeover activated when contact of switch is closed (NO)[1]	Changeover activated when contact of switch is open (NC)
3	Switching different or P-band	1.8°F (1°C) in heating mode 0.9°F (0.5°C) in cooling mode	7.2°F (4°C) in heating mode[1] 3.6°F (2°C) in cooling mode[1]
4	Dead zone in Normal operation	3.6°F (2°C)	9°F (5°C)
5	Signal output Terminal 7 (Heating)	ON/OFF[1]	PWM
6	Signal output Terminal 8 (Heating or Cooling)	ON/OFF[1]	PWM
7	Operating action of output Terminal 8	Cooling[1]	Heating
8	PWM signal interval for outputs Heating and Cooling (DIP Switch 7 set on position ON) Terminal 7 (Heating) Terminal 8 (Cooling) PWM signal interval for outputs Heating 2-stage (DIP switch on Position OFF) Terminal 7 (Heating) Terminal 8 (Heating)	 240 s[1] 240 s (not selectable) 240 s (not selectable) 240 s	 90 s 90 s

1. Factory setting

Table 4 RCU50U DIP Switches.

DIP Switch No.	Meaning	Position ON	Position OFF
1	Operating mode changeover via external switch	Changeover between normal operation and energy saving mode	Changeover between normal operation, energy saving and standby[1]
2	Operating action of switch for external operating mode changeover	Changeover activated when contact of switch is closed (NO)[1]	Changeover activated when contact of switch is open (NC)
3	Standby	OFF	Frost protection mode (heating output ON at a setpoint of 46°F (8°C)[1]
4	P-band	2°F (1°C) in heating mode 1°F (0.5°C) in cooling mode	7°F (4°C) in heating mode[1] 3.5°F (2°C) in cooling mode[1]
5	Cooling signal output in energy saving mode	Active	Inactive[1]

Table 5 RCU50.2U DIP Switches.

DIP Switch No.	Meaning	Position ON	Position OFF
1	Signal inversion 0 to 10 Vdc	Output signal 0 to 10 Vdc[1]	Output signal 10 to 0 Vdc

1 Factory setting

Accessories

ARG70 Adapter Plate for 2-inch × 4-inch or 4-inch × 4-inch conduit boxes
QAH11.1 Changeover/remote sensor

Notes (RCU50U and 50.2U)

- In systems without automatic changeover, the temperature sensor can be replaced by an external switch for manual changeover.
- In systems with cooling only operation, the controller changeover input (terminals 2 and 3) must be bridged.
- In systems with heating only operation, do not connect sensor to, or bridge controller changeover input (terminals 2 and 3).
- Check the settings of DIP Switches No. 1 through No. 5 and of the potentiometer of the RCU50U, and of DIP Switch No. 1 of the RCU50.2U and change them, if required.
- After applying power, the controller is ready to operate after a three-second reset.
- Locate the controller on a wall of the room to be conditioned. Do not mount in direct sunlight or near other heat or refrigeration sources.
- Mount the unit approximately 60 inches (150 cm) above the floor. (See Figure 11.)
- Run the connecting wires to the controller from a recessed conduit box.
- Only authorized personnel should open the controller.

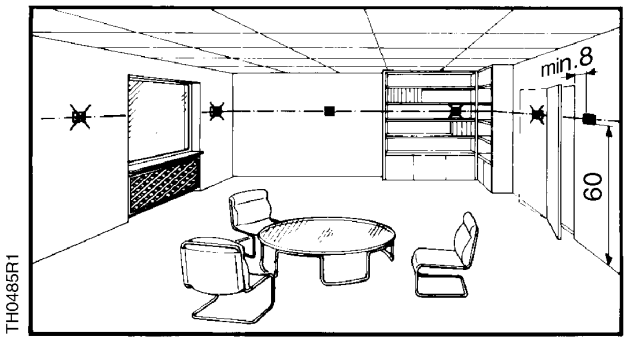


Figure 11. Acceptable Mounting Height.

- When mounting the unit, attach the controller base first. Then, make the electrical connections and fit and secure the cover.
- The controller must be mounted on a flat wall and in compliance with local regulations.
- Any radiator valves in the room must be set to their fully open positions upon start-up.
- User input via setpoint knob or operating mode/fan speed selector (RCU50.2U only) results in instantaneous response. There is a one-minute delay before changes made to temperature sensing and changeover are implemented.

Drywall Mounting

1. Insert a small screwdriver into the bottom of the controller and press in the tab located in center of the controller.
2. Lift the bottom of the controller from the controller base and push up to remove cover from two tabs located at the top of the controller base.
3. Separate the controller base from the controller.

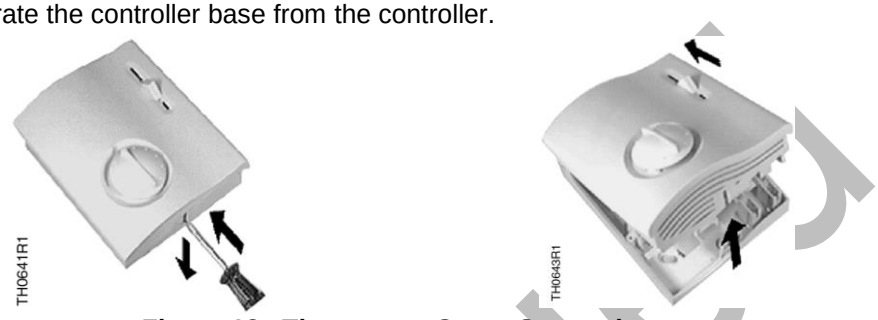


Figure 12. Thermostat Cover Separation.

4. Using the controller base as a template, mark the hole locations with a pencil.
5. Drill two 1/4-inch diameter holes for plastic wall anchors.
6. Using a mallet, tap in the plastic wall anchors flush with wall.
7. Pull the wiring through the opening in the upper portion of the controller base.
8. Level mounting plate.
9. Using the two wood screws provided, fasten controller base to wall. Thermostat is not position sensitive.
10. Pull the wiring through the controller base.
11. Position controller housing over the two mounting lugs located at the top of the controller base, and press down on cover until bottom lugs snap in place.
12. Terminate wires per wiring instructions located above the terminal block.

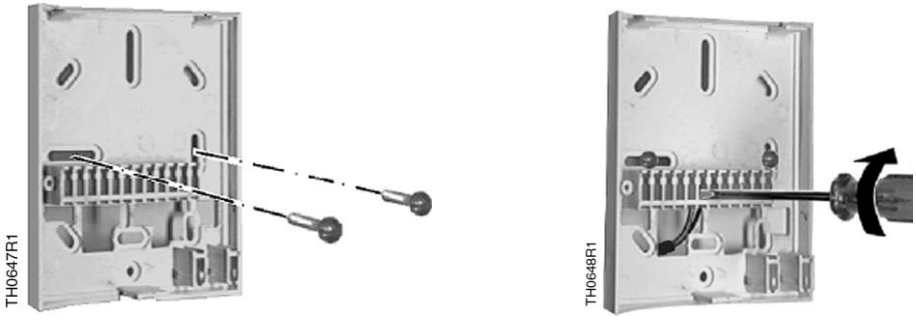


Figure 13. Wiring Termination.

13. Reattach the controller to the controller base.

Drywall Mounting, Continued

Figure 14. Controller Reattachment.

14. Return selector switches to the normal position (RCU50.2U only). Adjust setpoint dial to desired setting.

The installation is now complete.

4 × 4-inch Electrical Wall Box Mounting

An ARG70 wall plate adapter is required to mount an RCU50U or RCU50.2U controller to a 4 × 4-inch electrical wall box. The ARG70 wall plate adapter is included with electrical wall box mount models.

1. Insert a small screwdriver into the bottom of the controller and press in the tab located in center of the controller.
2. Lift the bottom of the controller from the controller base and push up to remove cover from two tabs located at the top of the controller base.
3. Separate the controller base from the controller.
4. Using the four screws provided, fasten wall box adapter (3) to plaster ring (2). (Plaster ring supplied by others.)
5. Flex adapter mask (4) and snap in place inside wall box adapter (3).
6. Fasten the controller base (5), included with controller, to wall box adapter assembly (3) and (4) with the two screws provided.
7. Pull wires through plaster ring (2).
8. Follow *Drywall Mounting Steps 11* through *14*.

The installation is now complete.

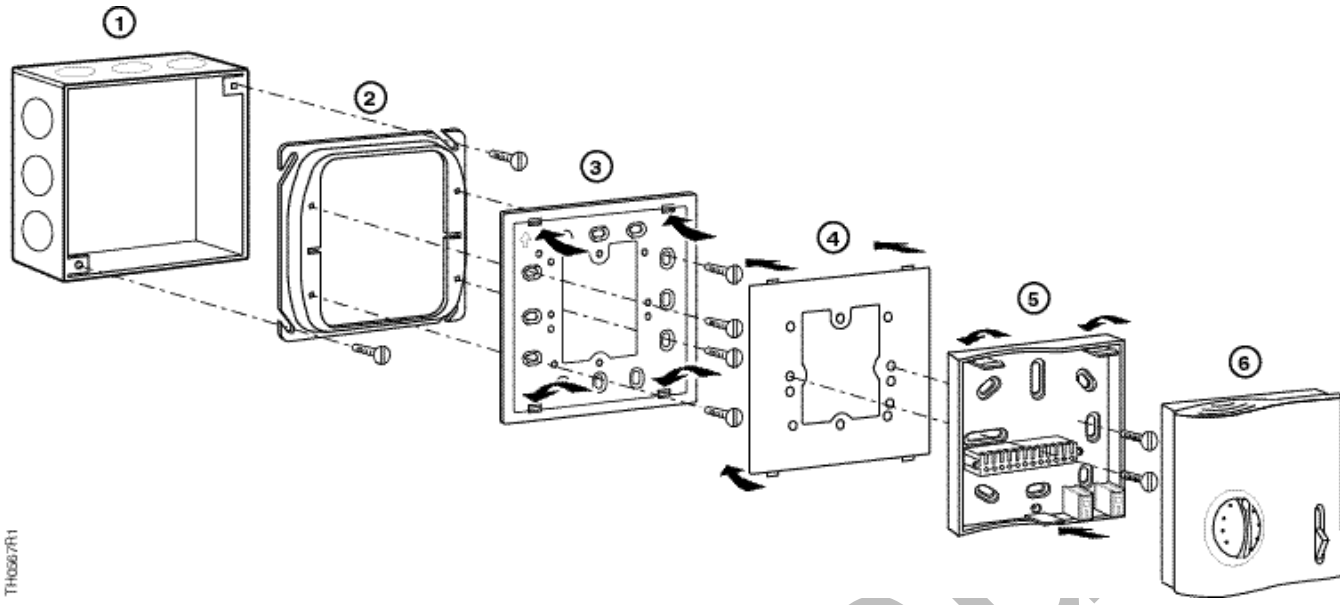


Figure 12. 4 × 4-inch Electrical Wall Box Installation.

1 Electrical wall box
2 Plaster ring
3 Wall box adapter *
4 Adapter mask *
5 Controller base
6 Controller

* Included with ARG70

2 × 4-inch Electrical Wall Box Mounting

An ARG70 wall plate adapter is required to mount an RCU50U or RCU50.2U controller to a 2 × 4-inch electrical wall box. The ARG70 wall plate adapter is included with electrical wall box mount models.

1. Insert a small screwdriver into the bottom of the controller and press in the tab located in center of the controller.
2. Lift the bottom of the controller (6) from the controller base (5) and push up to remove cover from two tabs located at the top of the controller base.
3. Separate the controller base (5) from the controller (6).
4. Using the two screws provided, fasten wall box adapter (3) to wall box (1).
5. Flex adapter mask (4) and snap in place inside wall box adapter (3).
6. Pull wires through wall box adapter (3) and adapter mask (4).
7. Fasten the controller base (5) to wall box adapter assembly (3) and (4) with the two screws provided.
8. Follow *Drywall Mounting Steps 10* through *14*.

The installation is now complete.

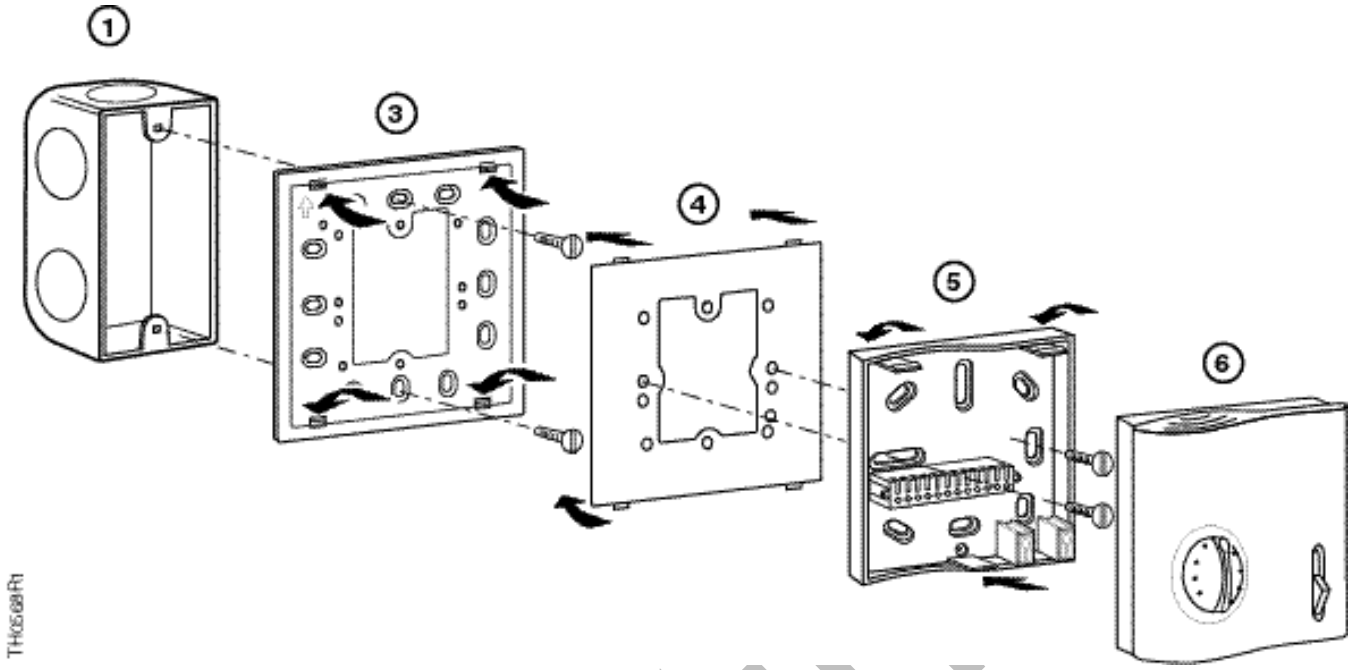


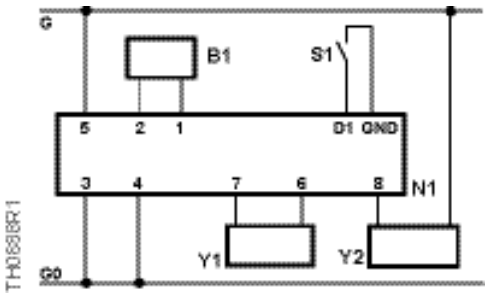
Figure 15. 2 × 4-inch Electrical Wall Box Installation.

1	Electrical wall box	5	Controller base
3	Wall box adapter *	6	Controller
4	Adapter mask *		

* Included with ARG70

Specifications **Power Supply**	Operating voltage Frequency	24 Vac ±20% 50/60 Hz
Functional Data	Setpoint setting range	50°F to 85°F (10°C to 30°C)
	P-band in heating mode	
	RCU50U	2°F or 7°F (1°C or 4°C)
	RCU50.2U (fixed)	7°F (4°C)
	P-band in cooling mode	
	RCU50	1°F or 3.5°F (0.5°C or 2°C)
	RCU50.2 (fixed)	3.5°F (2°C)
	Setpoint (Energy Saving Mode ☾), heating	61°F (16°C)
	Setpoint (Energy Saving Mode ☾), cooling	82°F (28°C)
	Setpoint Frost Protection	46°F (8°C)
	Setpoint shift temperature @ 72°F (22°C)	±22.5°F (±12.5°C)
	Control action	RCU15U – On/Off/PWM RCU50U & RCU50.2U - Proportional
	Control outputs, terminals 4 and 5 (RCU 50…)	
	Voltage	0 to 10 Vdc
	Current	±1 mA

Functional Data, Continued	Control outputs, terminals 7 and 8 (RCU15U)	PWM or ON/OFF
	Voltage	24 Vac ± 20%
	Current	0.02 to 1A
	Cycle time PWM (selectable for terminal 7)	20s or 90s
	Status input D1 (RCU50U)	
	Contact sensing	6 to 15 Vdc/3 to 6 mA
	Insulation against live voltage	4 kV
	Maximum number of contacts connected in a panel	50
	Status inputs 1 and 2 (RCU50U)	
	Setpoint shift of ± 22.5°F @ 72°F (22°C)	0 to 10 Vdc
	Neutral position (no setpoint shift)	5 Vdc
	Signal input terminals 2 and 3 for changeover sensor	QAH11.1 safety class 2
	NTC resistor 3K Ω @ 77°F (25°C)	
	Maximum copper cable length 16 AWG	
	For Input Signal terminals 1 & 2 (RCU50U)	262 feet (80m)
	For Input Signal D1 (RCU50U)	262 feet (80m)
Environmental Conditions	Operation	
	Temperature	32°F to 122°F (0°C to 50°C)
	Humidity	<95% rh
	Shipping and storage	
	Temperature	–13°F to 158°F (–25°C to 70°C)
	Humidity	<95% rh
Agency Approvals	UL listed	UL 873 Conforms to CE requirements cUL certified to Canadian Standard C22.2 No. 24-93
General	Connection terminals	Use solid wires or prepared stranded wires. 2 × 16 AWG or 1 × 14 AWG Maximum 20 AWG
	Weight	0.5 lb (0.23 kg)
	Housing color - Cover	White
	Base	Gray



1	Measuring neutral “external room tempera-temperature sensor or return air temperature sensor"
2	Status input “external room temperature sensor or return air temperature sensor”
G0, 3, 4	24 Vac, negative
G, 5, 6	24 Vac, positive
7	Control signal PWM/two-position 24 Vac
8	Control signal PWM/two-position 24 Vac
D1,GND	Status input for potential-free operating mode changeover switch
B1	External room temperature sensor (QAH11.1)
N1	RCU Controller
S1	Time clock or switch
Y1	Heating Actuator
Y2	Heating or Cooling Actuator

Figure 16. RCU15U Wiring Diagram.

Wiring Diagrams

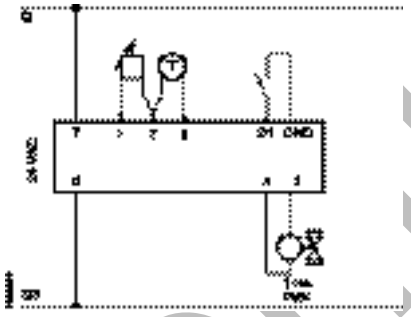


Figure 17. RCU50U Wiring Diagram.

1	Signal input setpoint shift
2	Measuring neutral
3	Heat/cool "changeover sensor" input
4	0 to 10 Vdc control signal
5	Ground for control signal

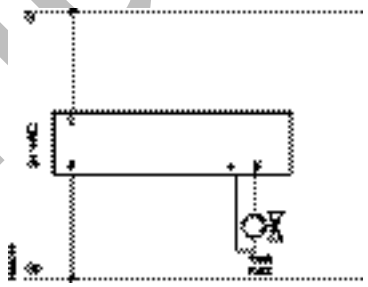


Figure 18. RCU50.2U Wiring Diagram.

D1, GND	Signal input for potential-free operating mode changeover switch
G0, 6	24 Vac, negative
G, 7	24 Vac, positive

Dimensions

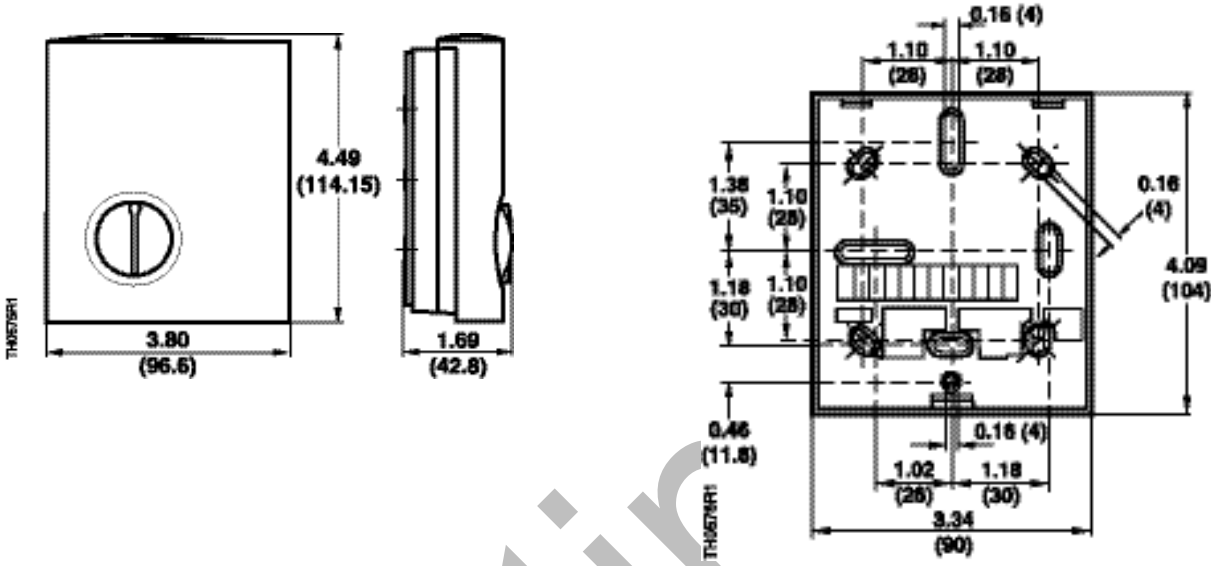


Figure 19. Controller and Baseplate Dimensions in Inches (Millimeters).