

RDU20U, RDU50U and RDU50.2U

Room Temperature Controllers with LCD for Heating and Cooling Systems



RDU20U and RDU50U



RDU50.2U

Description The RDU Series Room Controller with LCD is designed for heating and cooling systems.

- Features**
- Modulating Proportional + Integral (P+I) control
 - Control depending on room or remote air temperature
 - Output for a 0 to 10 Vdc actuator (RDU50U and RDU50.2U)
 - Output for a floating (3-position) or on/off output actuator (RDU20U)
 - Adjustable actuator run time (RDU20U)
 - Automatic heating/cooling changeover (RDU20U and RDU50U)
 - Manual heating/cooling changeover (RDU50.2U)
 - Operating modes: Normal, Energy Saving and Off
 - Operating mode changeover input for remote control
 - Selectable installation and control parameters
 - Adjustable minimum limitation for cooling output
 - Optional selectable Direct Acting or Reverse Acting output
 - Selectable display of room temperature or setpoint
 - Fahrenheit or Celsius selectable
 - Minimum and maximum setpoint limitation
 - Operating voltage, 24 Vac

Application

- Individual room temperature control in heating or cooling HVAC applications.
- Control of that are heated or cooled.

Product Numbers

Table 1.

Product Numbers	Features
RDU20U	Automatic heating/cooling changeover
RDU50U	Automatic heating/cooling changeover
RDU50.2U	Manual heating/cooling changeover switch

Accessories

ARG70	Adapter Plate for 4-inch × 4-inch conduit boxes
QAH11.1	Changeover/Remote Temperature Sensor
141-570	Lockable Thermostat Guard

Ordering

The temperature sensor, valves, and damper actuators must be ordered separately.

Table 2. Equipment Combinations.

	Product Number	Description	Technical Instructions
RDU50U and RDU50.2U	SSB61U..	0 to 10 Vdc valve actuators	155-192P25
	SSC61U..		155-313P25
	SQS65U		
	SSC61.5U		
	SQS65.5U		
	GDE16...	44 lb-in NSR air damper actuators	155-187P25
	GLB16...	88 lb-in NSR air damper actuators	155-187P25
RDU20U	SSB81U..	Floating control valve actuators	155-195P25
	SSC61U..		155-314P25
	SSC81U		
	SQS65.5U		
	GDE131...	44 lb-in NSR air damper actuators	155-187P25
	GLB131...	88 lb-in NSR air damper actuators	155-187P25
All Models	Powermite MZ Series	Two-way globe zone valves	155-198P25
	Powermite MZ Series	Three-way globe zone valves	155-199P25
	Powermite MT Series	Two-way globe zone valves	155-196P25
	Powermite MT Series	Three-way globe zone valves	155-197P25
	Powermite 599 Series	Two-way ball valves	155-704P25

Function

The controller measures the room temperature with its integrated sensor or via a remote return air temperature sensor (QAH11.1) and maintains the setpoint by delivering continuous control commands to the actuators (0 to 10 Vdc [RDU50U and RDU50.2U] or 24 Vac on/off, or three-position [RDU20U]). The controller provides P+I control. The factory setting for the proportional band in heating mode is 3.6°F (2°C), and in cooling mode 1.8°F (1°C) (adjustable). The integral action time is five minutes (adjustable). Motor run time for the RDU20U is adjustable from 50 to 150 seconds in 10-second increments.

RDU20U

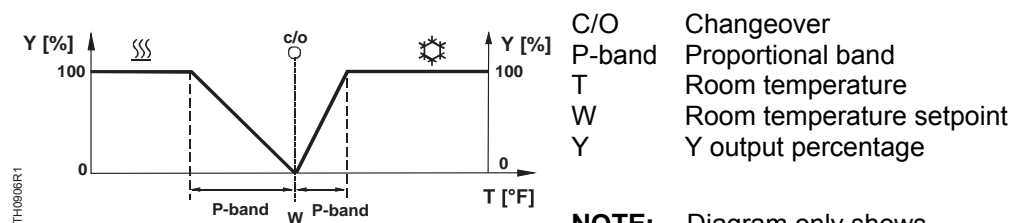


Figure 1. Heating/Cooling Modes.

Function, Continued

RDU50U and RDU50.2U

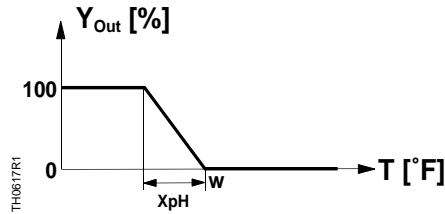


Figure 2. Heating Mode, RA.
(DIP Switch 2 in ON Position)

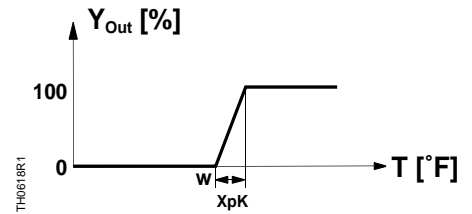


Figure 3. Cooling Mode, RA.
(DIP Switch 2 in ON Position)

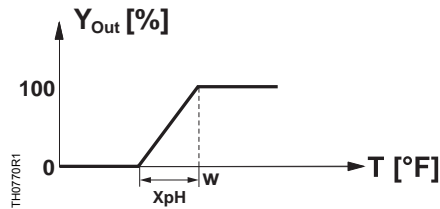


Figure 4. Heating Mode, DA.
(DIP Switch 2 in OFF Position)

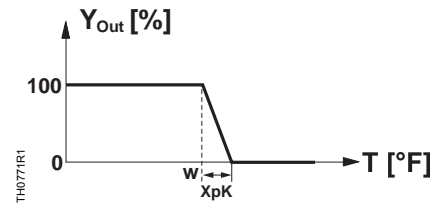


Figure 5. Cooling Mode, DA.
(DIP Switch 2 in OFF Position)

T Room temperature
XpH Proportional band heating
XpK Proportional band cooling

W Room temperature setpoint
YOut Output percentage

NOTE: The diagrams only show the proportional part of the P+I controller.

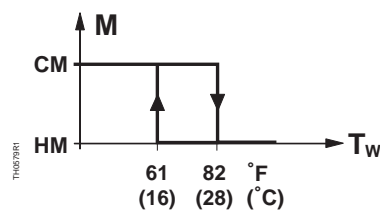
Automatic Changeover

RDU50U and RDU20U

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.

If immediately after switching on, the temperature is between the two changeover points, the controller will start in Heating mode. The medium temperature is measured at half-minute intervals and the operational status updated. The value of the current temperature reading and the mode can be visualized temporarily by selecting parameter P14.

In systems without automatic changeover, the temperature sensor can be replaced by an external switch for manual changeover. In systems with continuous heating mode, no sensor will be connected to the controller's input. With continuous cooling mode, the controller changeover input must be bridged.



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

Figure 6. Automatic Changeover Mode.

Inversion of Output Signal

RU50U and RDU50.2U

The output signal can be inverted with the help of DIP Switch No. 2. If set to ON, 0V corresponds to 0% travel and 10V to 100% travel (reverse acting heating/reverse acting cooling). In the OFF position, 0V corresponds to 100% travel and 10V to 0% travel (direct acting heating/direct acting cooling). See Figure 7 and Figure 8 for control characteristics.

Heating-Cooling with Minimum Limitation Cooling

RU50U and RDU50.2U

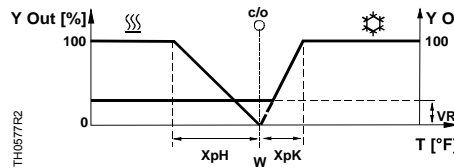


Figure 7. Reverse Acting Heating/Reverse Acting Cooling Function Diagram.

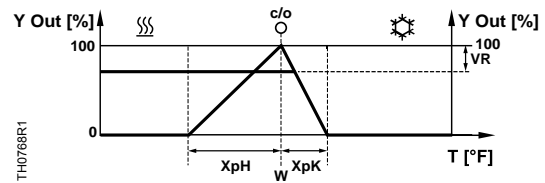


Figure 8. Direct Acting Heating/Direct Acting Cooling Function Diagram.

T Room temperature
 YOut 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

Minimum Limitation of Cooling Signal

Using parameter P11, the cooling signal output can be limited to a minimum value between 0 and 100% (0 to 10 Vdc). 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. See VR in Figure 7 and Figure 8.

Return Air Temperature

The RDU Controllers provide control depending on either the measured room temperature or the return air temperature. The return air temperature measurement overrides the internal measurement automatically if a QAH11.1 cable temperature sensor is connected to input 4–3 (RDU50U and RDU50.2U) or 8–9 (RDU20U). Parameter P12 shows which temperature sensor is currently active.

Display (See Table 5)

- The settings for Parameters P12, P13, and P14 cannot be changed; they are for displaying information settings only.
- The RDU50.2U Controller does not have a parameter setting or display for Parameter P14.
- Parameter P14 (RDU20U and RDU50U) displays the current heat/cool changeover temperature 32°F to 120°F (0°C to 49°C), and
 100 = Input open or no sensor connected–Heating mode
 00 = Input bridged–Cooling mode.
- For Parameter P12:
 01 = The room temperature sensor is active.
 02 = The return air temperature sensor is active.
- Parameter P13 displays the current room temperature 32°F to 120°F (0°C to 49°C).

Operating Modes

Normal Mode

Heating or cooling mode with automatic changeover. The controller maintains the adjusted setpoint in normal operation.

Energy Saving Mode

A changeover switch can be connected to the dry contact (D1–GND). When the switch closes its contact (due to an open window, for instance), the operating mode will change from normal operation to Energy Saving mode. In this operating mode, the heating or cooling setpoints are maintained (setting of control parameters P01 and P02). If the Energy Saving mode setpoints are set to OFF, the controller will turn OFF when the switch closes its contact.

When activated, the status input (D1–GND) overrides the RDU20U/RDU50U/RDU50.2U setpoints as follows:

- Heating Mode → Parameter 01 becomes active
- Cooling Mode → Parameter 02 becomes active
- OFF → No effect

Mechanical Design

- The unit consists of two parts:
 - Plastic housing–accommodates the electronics, the operating elements, and the built-in room temperature sensor.
 - Base plate–houses the wire terminations.
- The housing engages in the controller base and is secured with two screws.
- The screw terminals are mounted on the base plate.
- The DIP switches are located on the circuit board, which is accessible through the rear of the housing. To access the DIP switches, remove the housing from the base plate. See Figure 9.

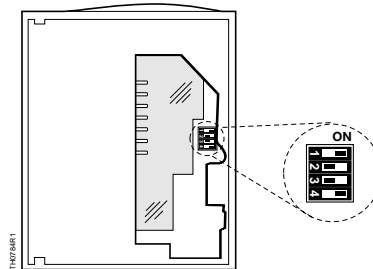


Figure 9. DIP Switch Setting.

Table 3. RDU20U DIP Switches.

DIP Switch No.	Description	Position ON	Position OFF
1	LCD display	Room (return air) temperature	Setpoint*
2	Control Algorithm	3-P modulating PI control*	ON/OFF control
3	Not used		
4	Temperature scale	°Fahrenheit*	Celsius

Table 4. RDU50U and RDU50.2U DIP Switches.

DIP Switch No.	Description	Position ON	Position OFF
1	LCD display	Room temperature*	Setpoint
2	0 to 10 Vdc output logic	Cooling – RA Heating – RA	Cooling – DA* Heating – DA
3	Not used	N/A	N/A
4	Temperature scale	Celsius	Fahrenheit*

* Factory setting

Setting and Operating Elements

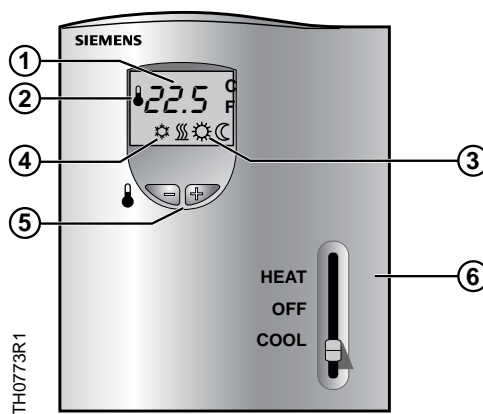







Figure 10.

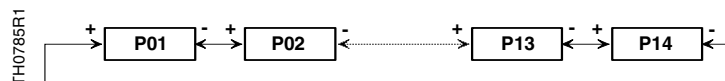
- 1 Display of the room or return air temperature, setpoints, and control parameters
- 2  Symbol used when displaying the current room temperature
- 3  Normal operation
 Energy Saving mode
- 4  Cooling valve open
 Heating valve open
- 5 Buttons for adjusting the setpoints and the control parameters
- 6 Slider switch for manual heat-off-cool setting (RDU50.2U only)

Setting the Control Parameters

A number of control parameters can be set to optimize the control performance. These parameters can also be set during operation without opening the unit. A 24 Vac supply to the controller is required to enable parameter adjustment.

The parameters can be changed as follows:

1. Press buttons "+" and "-" simultaneously for a minimum of three seconds and a maximum of five seconds. Release the buttons and then press button "+" again for approximately three seconds until the display shows "P01".
2. Select the required parameter by repeatedly pressing buttons "+" or "-".



3. Press buttons "+" and "-" simultaneously. The current value of the selected parameter appears, which can be changed by repeatedly pressing either button.
4. Press buttons "+" and "-" simultaneously again, or five seconds after the last press of a button, to store the new value and display the parameter.
5. Repeat steps 2 through 4 to display and change additional parameters.
6. Wait ten seconds after the last display or setting. All changes will be stored and the controller returns to normal operation.

Table 5. Control Parameters.

Parameter	Meaning	Setting Range	Factory Setting
P01	Setpoint of heating in energy saving mode (operating mode changeover switch activated)	OFF 41°F to 64°F (5°C to 18°C) (in increments of 1.0°F [0.5°C])	61°F (16°C)
P02	Setpoint of cooling in energy saving mode (operating mode changeover switch activated)	OFF 75°F to 95°F (24°C to 35°C) (in increments of 1.0°F [0.5°C])	82°F (28°C)
P03	Minimum setpoint limitation in normal mode	41°F to 68°F (5°C to 20°C) (in increments of 1.0°F [0.5°C])	41°F (5°C)
P04	Maximum setpoint limitation in normal mode	70°F to 95°F (21°C to 35°C) (in increments of 1.0°F [0.5°C])	95°F (35°C)
P05*	Heat-cool changeover switching point cooling	50°F to 77°F (10°C to 25°C) (in increments of 1.0°F [0.5°C])	61°F (16°C)
P06*	Heat-cool changeover switching point heating	81°F to 104°F (27°C to 40°C) (in increments of 1.0°F [0.5°C])	82°F (28°C)
P07	Sensor calibration	-3 K to 3 K (1 Kelvin = 2°F)	0K
P08	P-band in heating mode (RDU50U and RDU50.2U)	0.5 K to 4 K (1 Kelvin = 2°F) (in increments of 1°F [0.5 K])	2K
P08	P-band in heating mode/switching differential when ON/OFF output is selected (RDU20U)	0.5 K to 4 K (1 Kelvin = 2°F) (in increments of 1°F [0.5 K])	2K
P09	P-band in cooling mode (RDU20 when ON/OFF output selected)	0.5 K to 4 K (1 Kelvin = 2°F) (in increments of 1°F [0.5 K])	1K
P10	Integration time	1 to 10 min. (in increments of 1 min.)	5 minutes
P11	Minimum output limitation in cooling mode (normal operation) (RDU50U and RDU50.2U)	0 to 100% (in increments of 10%)	0%
P11	Actuator running time (RDU20U)	50 to 150 s (in increments of 10 s)	N/A
P12	Active temperature sensor (no setting, display only)	01 = room temperature sensor active 02 = return air temperature sensor active	N/A
P13	Current room temperature reading (no setting, display only)	32°F to 120°F (0°C to 49°C) = current temperature value	N/A
P14*	Current heat-cool changeover temperature reading including indication of current mode (⚙️, 🌡️) (no setting, display only)	<ul style="list-style-type: none"> 100 = input open (no sensor connected, heating mode (🌡️)) 41°F to 104°F (5°C to 40°C) = current temperature value 0 = input bridged, cooling mode (⚙️) 	N/A
P15	Test mode for checking the actuator direction NOTE: P15 can be turned off only if the setting is back at “---” and by pressing buttons + and – simultaneously (RDU20U only).	“---” = Output Y1 and Y2 OFF. “OPE” = Output Y1 forced open “CLO” = Output Y2 forced open	“---”

* Not applicable for RDU50.2U; LCD shows N/A.

Engineering Notes

RDU50U with heating-cooling changeover input 2–3 and
RDU20U with heating-cooling changeover input 7–8:

- In systems without automatic changeover, the temperature sensor can be replaced by an external switch for manual changeover.
- In systems with Heating only mode, do not connect a sensor to the controller's input.
- With Cooling only mode, the controller input must be bridged.

Mounting, Installation and Commissioning Notes

- Check the position of the DIP switches and change them, if necessary.
- After applying power, the controller makes a reset, which takes approximately three seconds; it is then ready to operate.
- Mount the unit on a wall of the room to be heated or cooled. Do not mount in direct sunlight or near other heat or refrigeration sources. (See Figure 11.)
- Mounting height is approximately 60 inches (150 cm) above the floor. (See Figure 11.)
- The connecting wires can be run to the controller from a recessed conduit box.

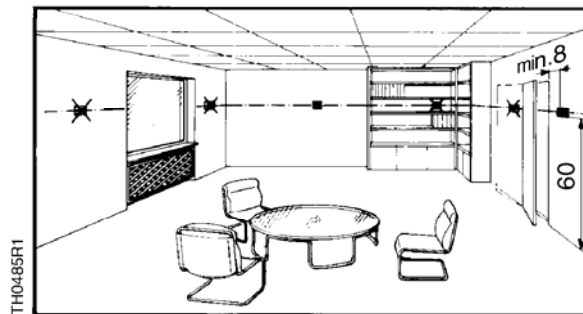


Figure 11. Acceptable Mounting Locations.

- Prior to fitting the changeover sensor on a pipe, thermal conductive paste must be applied to the location on the pipe where the sensor is to be placed.
- The cables used must satisfy the insulation requirements for 24 Vdc potential.
- To access the wire terminal block, loosen the cover screw and open the plastic cover. See Figure 12.

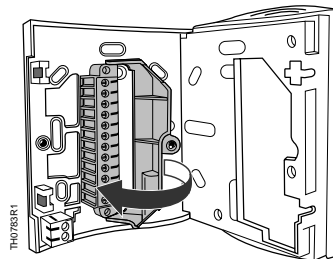
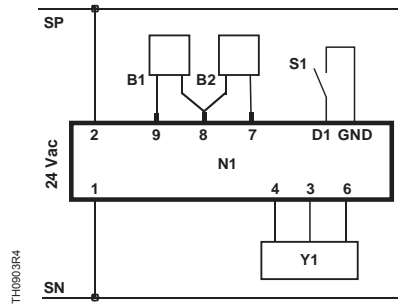


Figure 12. Accessing the Wire Terminal Block.

- Sensor inputs 4–3 and 2–3 (RDU50U and RDU50.2U) and 8–9 and 8–7 (RDU20U) carry 24 Vdc potential. If the sensor's cables must be extended, they must be suited for 24 Vdc voltage.
- Complete installation instructions are included with the controller.

Specifications Power Supply	Operating voltage	24 Vac $\pm 20\%$
	Frequency	50/60 Hz
	Power consumption	Maximum 4 VA
	Control output 1–5 (RDU50U and RDU50.2U)	0 to 10 Vdc
	Resolution	39 mV
	Effective current	Maximum ± 1 mA
	Control output 4–6 (RDU20U)	24 Vac
	Return air temperature input 4–3	QAH11.1 safety class 2
	Changeover temperature input 2–3 (RDU50U) and RDU20U 8–7 (RDU20U)	NTC resistor 3K ohm at 77°F (25°C)
	Dry contact D1 and GND	
	Contact sensing	6 to 15 Vdc/3 to 6 mA
Operating action	Normally Open (NO)	
Maximum cable length 16 AWG for connection to terminals 4, 2 and D1	262 feet (80 m)	
Operational data	Setpoint setting range	41°F to 95°F (5°C to 35°C)
	Control deviation at 77°F (25°C)	Maximum $\pm 1.6^\circ\text{F}$ (0.9°C)
	P-band in heating mode, adjustable in 0.5K increments (1 Kelvin = 2°F)	0.5K to 4K
	Factory setting	2K
	P-band in cooling mode, adjustable in 0.5K increments (1 Kelvin = 2°F)	0.5K to 4K
	Factory setting	1K
	Integral action time, adjustable	1 to 10 minutes
	Factory setting	5 minutes
Setpoint (Energy Saving Mode C), heating	41°F to 65°F (5°C to 18°C)	
Setpoint (Energy Saving Mode C), cooling	75°F to 95°F (24°C to 35°C)	
Environmental Conditions	Operation	
	Temperature	32°F to 122°F (0°C to 50°C)
	Humidity	<95% rh
	Shipping and storage	
	Temperature (RDU50U and RDU50.2U) (RDU20U)	-13°F to 158°F (-25°C to 70°C) -13°F to 140°F (-25°C to 60°C)
Humidity	<95% rh	
Agency Approvals		Conforms to CE requirements NEMA 1
General	Connection terminals	Use solid wires or prepared stranded wires. 2 \times 16 AWG or 1 \times 14 AWG Maximum 20 AWG
	Weight	0.5 lb (0.23 kg)
	Housing color	
	Cover	White
	Base	Gray

Wiring Diagrams



- 1 Operating voltage, 24 Vac negative
- 2 Operating voltage, 24 Vac positive
- 3 Operating voltage, 24 Vac positive
- 4 Control signal, opening 24 Vac
- 6 Control signal, closing, 24 Vac
- 7 Changeover, heat/cool input
- 8 Measuring neutral (sensors)
- 9 Remote temperature sensor
- D1, Signal input for potential-free
GND operating mode changeover

Figure 13. RDU20U Wiring Diagram.

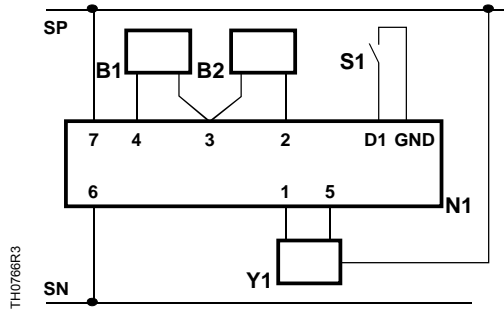


Figure 14. RDU50U Wiring Diagram.

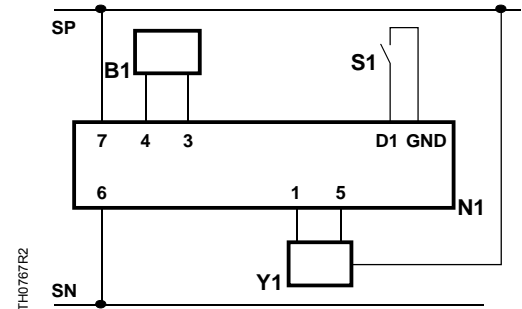


Figure 15. RDU50.2U Wiring Diagram.

- D1, GND Signal input for potential- free operating mode changeover switch
- 1 0 to 10 Vdc output
- 2 Heat/cool changeover sensor input
- 3 Measuring neutral
- 4 Remote temperature sensor input
- 5* Ground for control signal
- 6* Operating voltage, 24 Vac Neg
- 7 Operating voltage, 24 Vac Pos

* 5 and 6 are connected internally

Dimensions

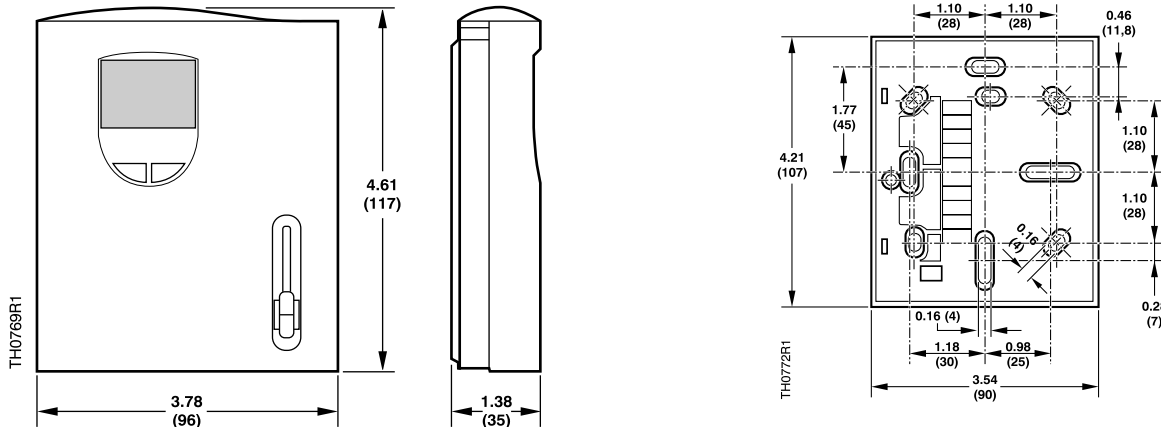


Figure 16. Controller and Base Plate Dimensions in Inches (Millimeters).

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