



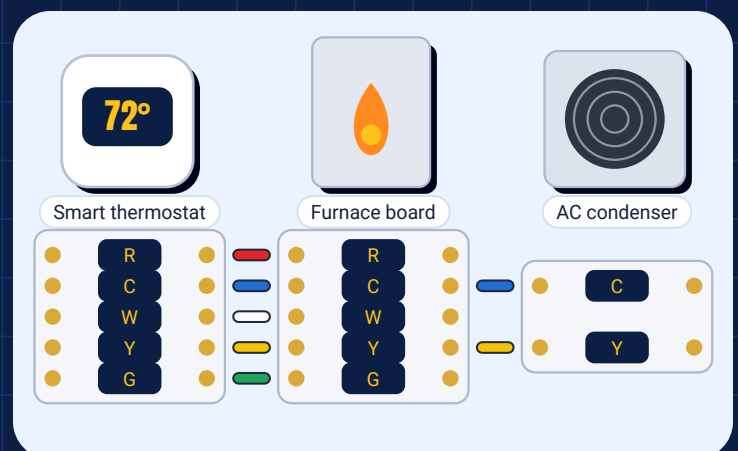
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FREE PRINTABLE GUIDE · US HVAC

10 THERMOSTAT THERMOSTAT DIAGRAMS WIRING

R, W, Y, G, C, O/B, heat pumps and 2-stage systems, with real wire colors

- ✓ What every letter means (R, C, W, Y, G, O/B, E)
- ✓ Furnace + AC, heat pump, aux and emergency heat
- ✓ Two-stage heating and cooling
- ✓ Rh/Rc jumper and C-wire options
- ✓ Line-voltage 240 V baseboard thermostats



BEFORE YOU START

Two kinds of thermostats: know which one you have before touching anything.

1 TURN IT OFF

Switch off the furnace/air handler AND the outdoor disconnect.

2 24 V OR 240 V?

Thin wires on a furnace = 24 V. Thick wires with wire nuts on a baseboard heater = 120/240 V.

3 PHOTO FIRST

Take a picture of the old wiring and label each wire with its letter.

4 CHECK THE MANUAL

Brands use different terminals. When the label and this guide disagree, the label wins.



24 V



120 / 240 V



SAFETY FIRST

Breaker off, test before touching



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Check your local code



PRO TIPS

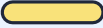
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WHAT EACH LETTER MEANS

Terminal	Usual color	What it does
 R / Rh / Rc	Red	24 V power (Rh heating, Rc cooling)
 C	Blue or black	Common: powers smart thermostats
 W / W1	White	Heat, first stage
 W2 / AUX	Brown or any	Heat second stage / heat strips
 E	Any	Emergency heat (heat pump)
 Y / Y1	Yellow	Cooling (compressor), first stage
 Y2	Light yellow or any	Cooling second stage
 G	Green	Blower fan
 O	Orange	Reversing valve, energized in COOLING
 B	Dark blue / brown	Reversing valve, energized in HEATING

Wire colors are a convention, not a rule. Always trust the letter where the wire is connected.



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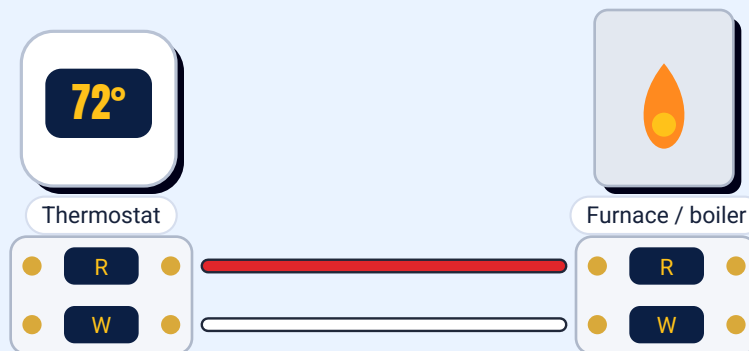
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HEAT ONLY, 2 WIRES (R AND W)

Old furnaces and boilers often have only two wires: the thermostat closes R to W and the heat turns on.



✓ STEP BY STEP

- 1 Turn off power to the furnace (switch or breaker).
- 2 Take a photo of the old wiring and label each wire.
- 3 R to R (24 V power) and W to W (heat call).
- 4 Most smart thermostats need a C wire: see the C-wire options page.

✗ WATCH OUT

If the two wires are thick and connected with wire nuts, it may be a 120/240 V line-voltage thermostat: see diagram 10.



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HEAT WITH FAN, 3 WIRES (R, W, G)

Adds the G wire so you can run the blower fan by itself (FAN ON).



 R / Rh / Rc
24 V power

 C
Common

 W
Heat

 Y
Cooling

 G
Fan

 O / B
Heat pump valve

✓ STEP BY STEP

- 1 Power off at the furnace.
- 2 R to R, W to W, G to G at the control board.
- 3 Set the thermostat type to 'conventional' and 'gas/oil' (or electric).
- 4 Test: HEAT on, then FAN ON alone.

✗ WATCH OUT

On gas furnaces the board runs the fan by itself during heating; on electric heat the thermostat may need to call the fan (setting 'electric').



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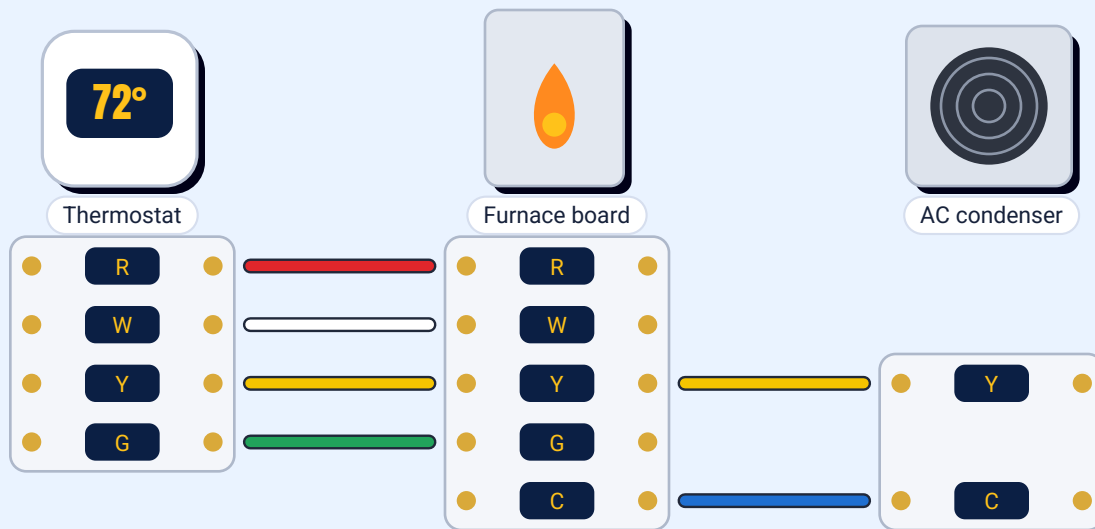


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HEAT AND AC, 4 WIRES (NO C)

The classic US system: furnace inside, AC condenser outside. Y calls cooling, G the fan, W the heat.



R / Rh / Rc
24 V power

C
Common

W
Heat

Y
Cooling

G
Fan

O / B
Heat pump valve

✓ STEP BY STEP

- 1 Power off at the furnace AND at the outdoor disconnect.
- 2 Thermostat R, W, Y, G to the same letters on the board.
- 3 Outdoor unit: two wires from the board, Y and C, go to the contactor coil.
- 4 Without C the thermostat runs on batteries or 'power stealing'.

✗ WATCH OUT

A smart thermostat without C can make the AC contactor chatter or reboot. The fix is adding a C wire.



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HEAT AND AC WITH C WIRE (5 WIRES)

The best setup for a smart thermostat: the C wire gives it constant 24 V power.



R / Rh / Rc
24 V power

C
Common

W
Heat

Y
Cooling

G
Fan

O / B
Heat pump valve

✓ STEP BY STEP

- 1 Power off. Check the label on the board: R and C come from the 24 V transformer.
- 2 Connect the 5 wires letter to letter.
- 3 The outdoor unit gets Y and C from the board.
- 4 Turn power on and run the thermostat setup: heat, cool and fan.

✗ WATCH OUT

Never let R touch C with the power on: it blows the 3 A fuse on the furnace board.



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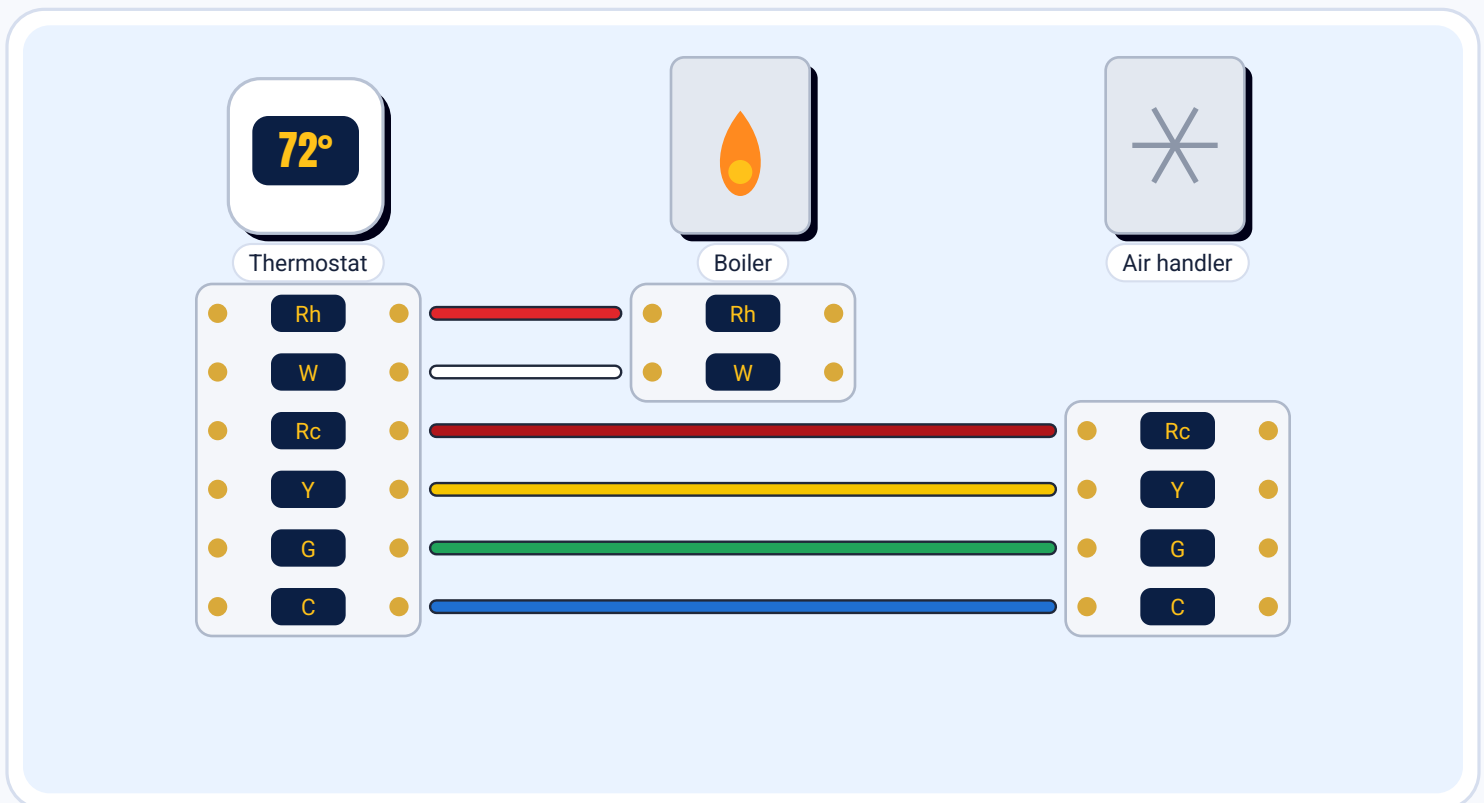


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SEPARATE HEATING AND COOLING (RH AND RC)

Two systems with two transformers, like a boiler for heat and an air handler for AC. Remove the Rh-Rc jumper.



R / Rh / Rc
24 V power

C
Common

W
Heat

Y
Cooling

G
Fan

O / B
Heat pump valve

✓ STEP BY STEP

- 1 Find which red wire comes from the boiler (Rh) and which from the air handler (Rc).
- 2 Remove the jumper between Rh and Rc on the thermostat.
- 3 Boiler: Rh and W. Air handler: Rc, Y, G and C.
- 4 The C must come from the same transformer as Rc.

✗ WATCH OUT

Leaving the jumper with two transformers connects them together and can burn a transformer.



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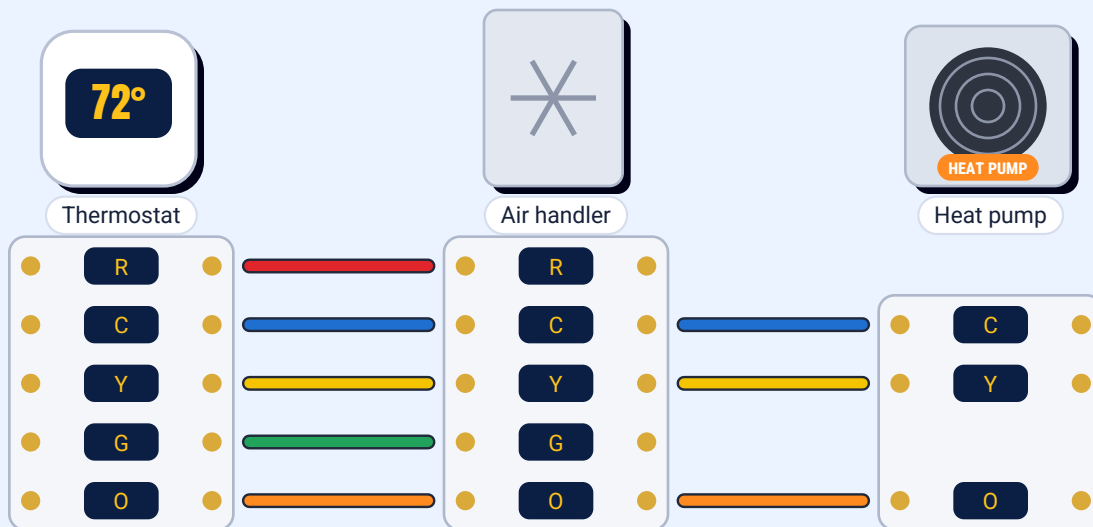
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HEAT PUMP (R, C, Y, G, O/B)

A heat pump makes heat and cold with the same compressor. The O (or B) wire moves the reversing valve.



R / Rh / Rc
24 V power

C
Common

W
Heat

Y
Cooling

G
Fan

O / B
Heat pump valve

✓ STEP BY STEP

- 1 Set the thermostat type to 'heat pump'.
- 2 Y runs the compressor in BOTH heating and cooling.
- 3 O energizes the reversing valve in cooling (most brands). B energizes it in heating (some brands, like Rheem/Ruud).
- 4 If you get warm air when you ask for cooling, switch O to B in the settings.

✗ WATCH OUT

There is no W in a basic heat pump: heat comes from Y + reversing valve.



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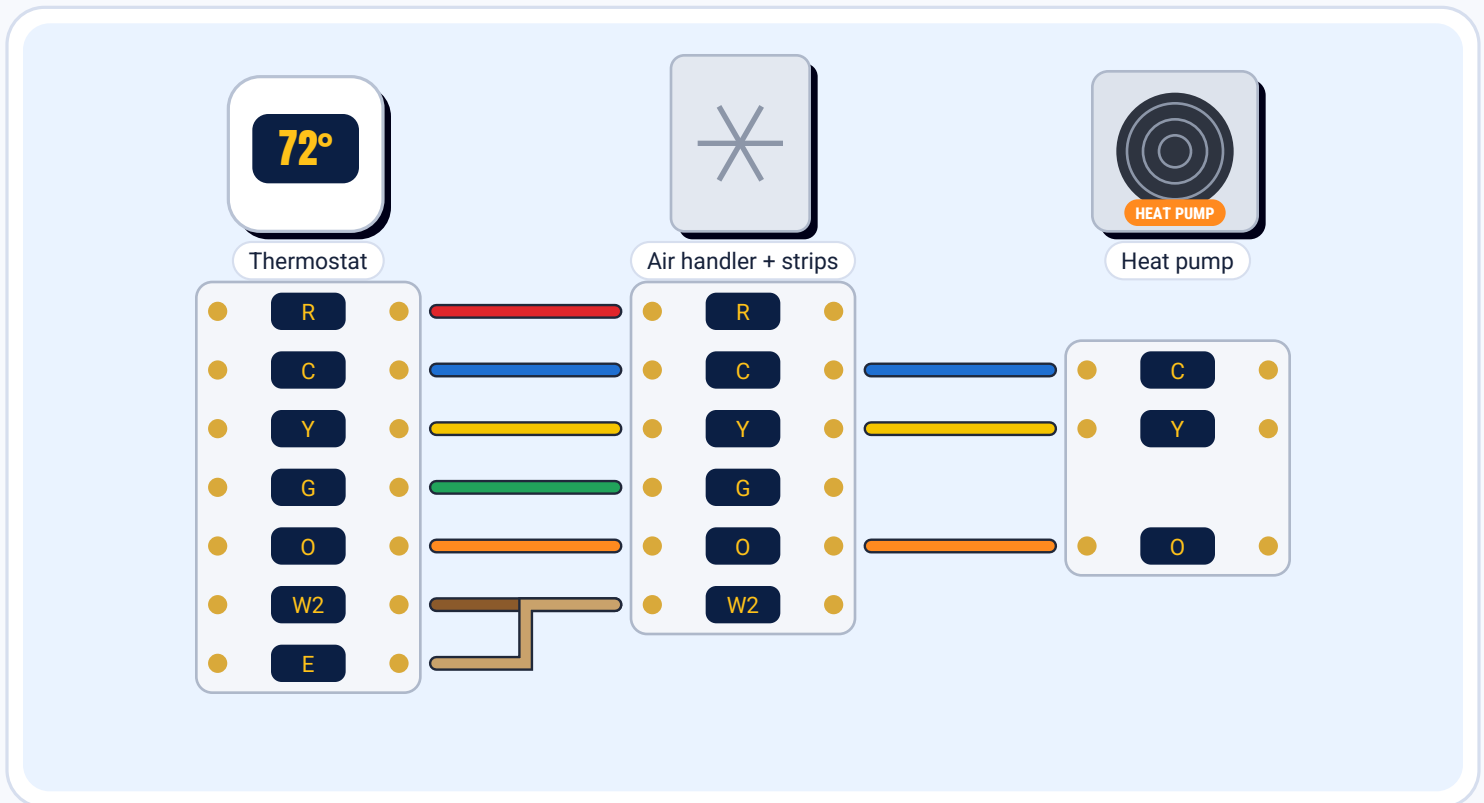
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QUICK WIRING GUIDE · DIAGRAM 07

HEAT PUMP WITH AUX AND EMERGENCY HEAT

Electric heat strips help the heat pump when it is very cold (AUX) or replace it if it fails (EMERGENCY).



 R / Rh / Rc
24 V power

 C
Common

 W
Heat

 Y
Cooling

 G
Fan

 O / B
Heat pump valve

✓ STEP BY STEP

- 1 W2 / AUX goes to the heat strip terminal (often W2 or W1 on the air handler).
- 2 E (emergency) usually goes to the same terminal as W2: one wire or a jumper at the thermostat.
- 3 Set 'heat pump with aux heat' in the thermostat.
- 4 Test cooling, heating, then emergency heat.

✗ WATCH OUT

If AUX runs all the time, the heat pump may be low on refrigerant or the outdoor sensor setting is wrong.



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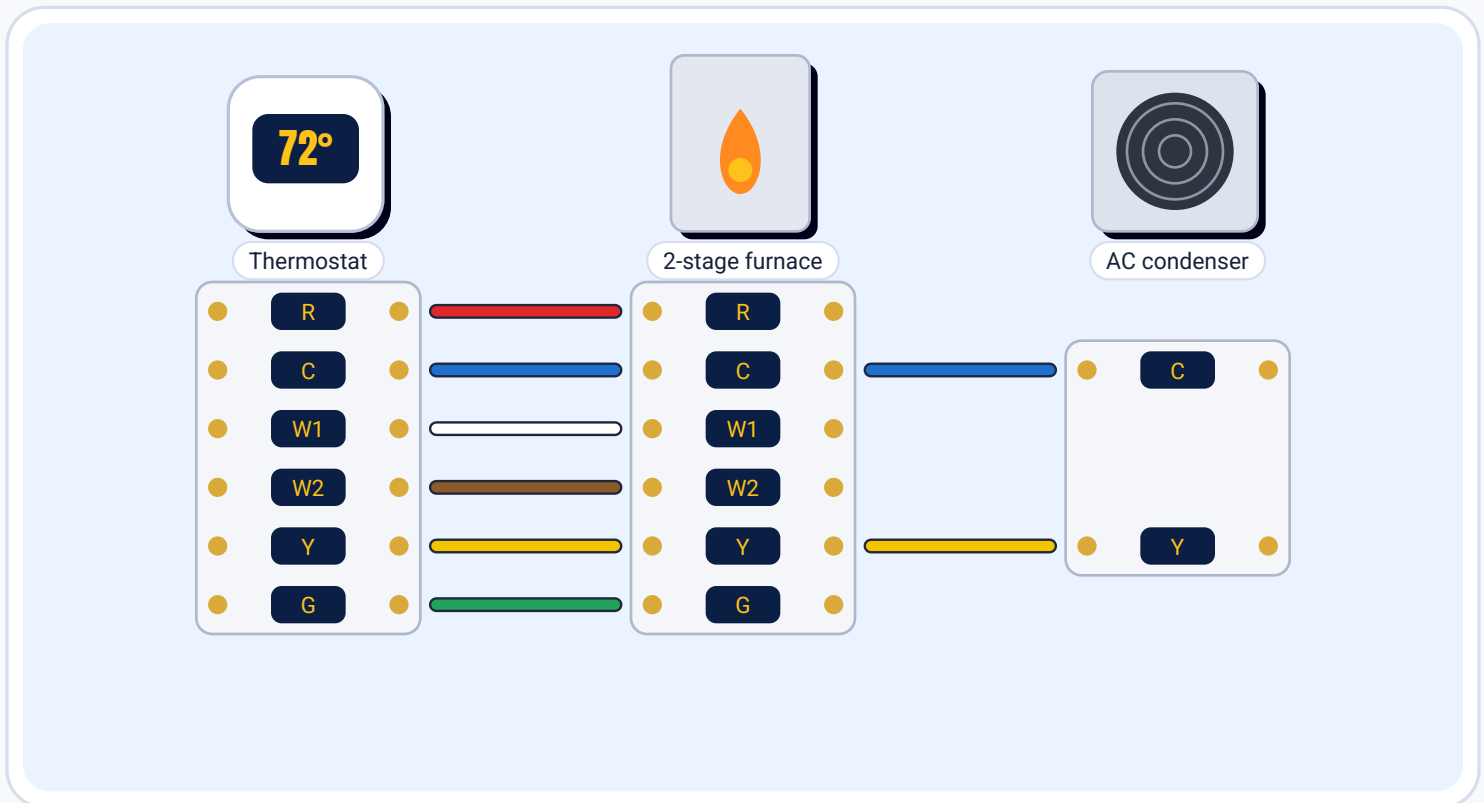


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TWO-STAGE HEAT, ONE-STAGE COOLING

Two-stage furnaces run on low most of the time (W1) and go to high (W2) on cold days.



— R / Rh / Rc 24 V power
 — C Common
 — W Heat
 — Y Cooling
 — G Fan
 — O / B Heat pump valve

✓ STEP BY STEP

- 1 W1 = first stage (low fire), W2 = second stage (high fire).
- 2 Check the furnace: some have a dip switch that lets the board decide the stage with one W wire.
- 3 Set '2 heat stages' in the thermostat.
- 4 Outdoor unit wired as usual (Y and C).

✗ WATCH OUT

Using W2 when the furnace is set to 'auto stage' can cause both settings to fight. Read the furnace manual.



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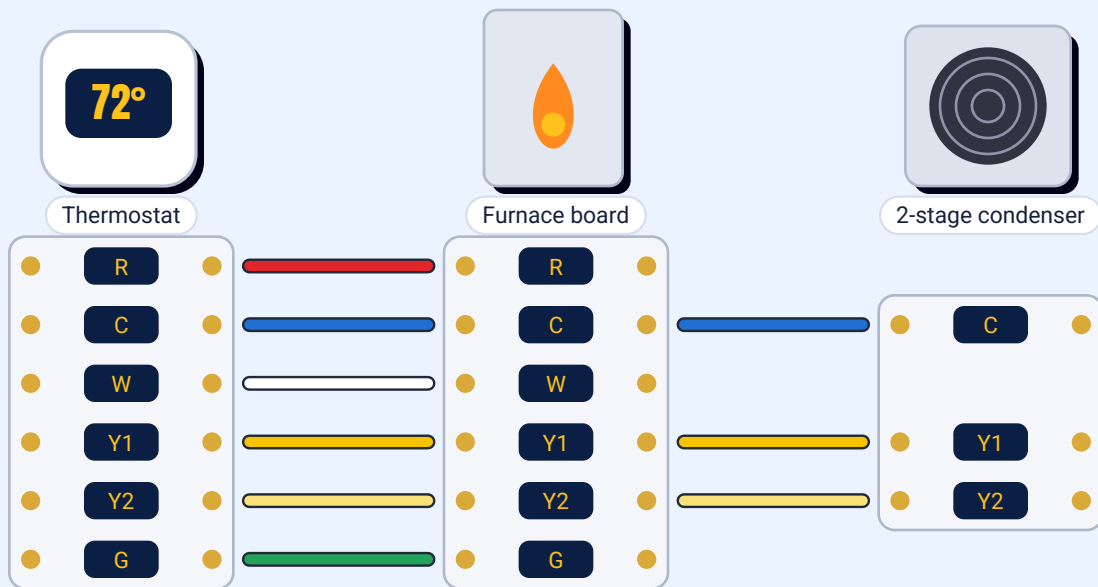


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TWO-STAGE COOLING (Y1 AND Y2)

Two-stage AC runs on low capacity (Y1) most of the time and full capacity (Y2) on hot days.



R / Rh / Rc
24 V power

C
Common

W
Heat

Y
Cooling

G
Fan

O / B
Heat pump valve

✓ STEP BY STEP

- 1 The outdoor cable needs 3 conductors: C, Y1 and Y2.
- 2 Y1 and Y2 also go to the furnace board so the blower changes speed.
- 3 Set '2 cooling stages' in the thermostat.
- 4 Test low and high cooling.

✗ WATCH OUT

Many old outdoor cables have only 2 wires. A 2-stage unit needs a new 3-wire cable.



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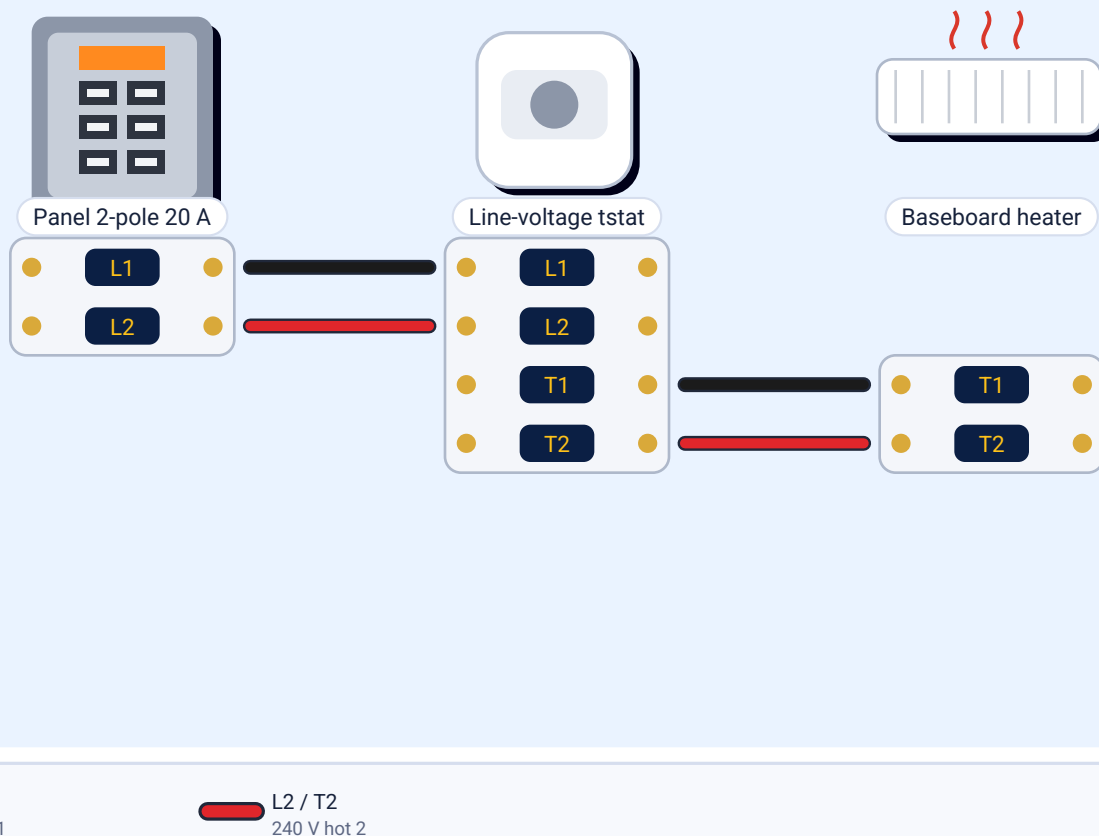
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QUICK WIRING GUIDE · DIAGRAM 10

LINE-VOLTAGE BASEBOARD THERMOSTAT (240 V)

Electric baseboard heaters use a thermostat at 120 or 240 V, not 24 V. Totally different and dangerous.



✓ STEP BY STEP

- 1 Turn off the 2-pole breaker and TEST: 240 V can kill.
- 2 LINE wires (from the panel) go to L1 and L2.
- 3 LOAD wires (to the heater) go to T1 and T2.
- 4 Use a thermostat rated for the heater's amps and voltage (often 2-pole, double-line break).

✗ WATCH OUT

Never install a 24 V smart thermostat on a 240 V baseboard circuit: it will burn instantly.



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NO C WIRE? 4 OPTIONS

1

USE A SPARE WIRE

Look behind the thermostat and at the furnace: there is often an unused wire (often blue) in the cable. Connect it to C on both ends.

2

RUN A NEW CABLE

Pull an 18/5 or 18/8 thermostat cable. Best long-term option.

3

C-WIRE ADAPTER

A power extender kit at the furnace creates a C over the existing 4 wires.

4

24 V TRANSFORMER PLUG

Some brands sell a wall transformer that powers the thermostat directly.



Avoid using the G wire as C: the fan will no longer run by itself.



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TROUBLESHOOTING

The problems that show up most after a new thermostat is installed.



Thermostat screen is blank



No 24 V: blown 3 A fuse on the furnace board, door switch open or R/C loose.



AC runs but blows warm air (heat pump)



O and B set wrong: change the reversing valve setting.



Thermostat reboots or contactor chatters



No C wire and power stealing. Add a C wire.



Fan runs all the time



Fan set to ON, or G and R shorted at the board.



Heat does not turn on



W not connected, wrong system type set, or flame sensor/igniter problem on the furnace.



Fuse on board blows again



A short between R and C, often a nicked wire at the outdoor unit.



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WIRED RIGHT, RUNNING RIGHT

- ✓ Label every wire before you remove the old thermostat.
- ✓ Set the system type (conventional or heat pump) in the setup.
- ✓ Test heat, cooling and fan before closing everything.
- ✓ If in doubt, call a licensed HVAC technician.

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