



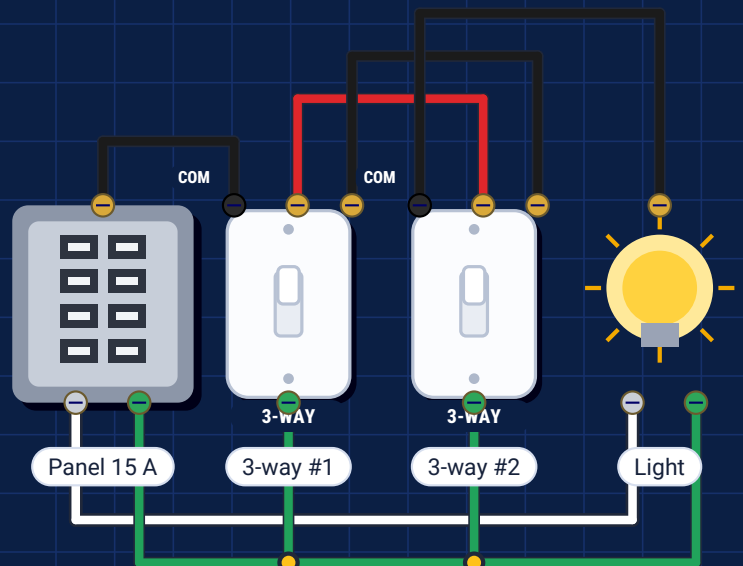
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FREE PRINTABLE GUIDE · US HOME WIRING

15 WIRING DIAGRAMS SWITCHES & OUTLETS

15 wiring diagrams, step by step, with real wire colors

- ✓ Single-pole, 3-way and 4-way switches
- ✓ Dimmers, smart switches and timers
- ✓ Outlets, split outlets and GFCI protection
- ✓ Ceiling fans and bathroom fans
- ✓ 240 V water heater and dryer outlet



BEFORE YOU START

Read this page first. Electricity does not give second chances.

1 TURN IT OFF

Switch off the breaker and lock or tape it so nobody turns it back on.

2 TEST IT

Check every wire with a non-contact tester or a multimeter, even after the breaker is off.

3 RIGHT PARTS

Use devices and wire rated for the circuit: 15 A on 14 AWG, 20 A on 12 AWG.

4 KNOW THE CODE

Follow the NEC edition adopted in your area. Many jobs need a permit or a licensed electrician.

TOOLS YOU NEED

- ✓ Non-contact voltage tester
- ✓ Outlet tester (3-light)
- ✓ Insulated screwdrivers
- ✓ Multimeter
- ✓ Wire stripper 10-18 AWG
- ✓ Wire nuts and electrical tape



SAFETY FIRST

Breaker off, test before touching



NEC BASED

Check your local code



PRO TIPS

From the field



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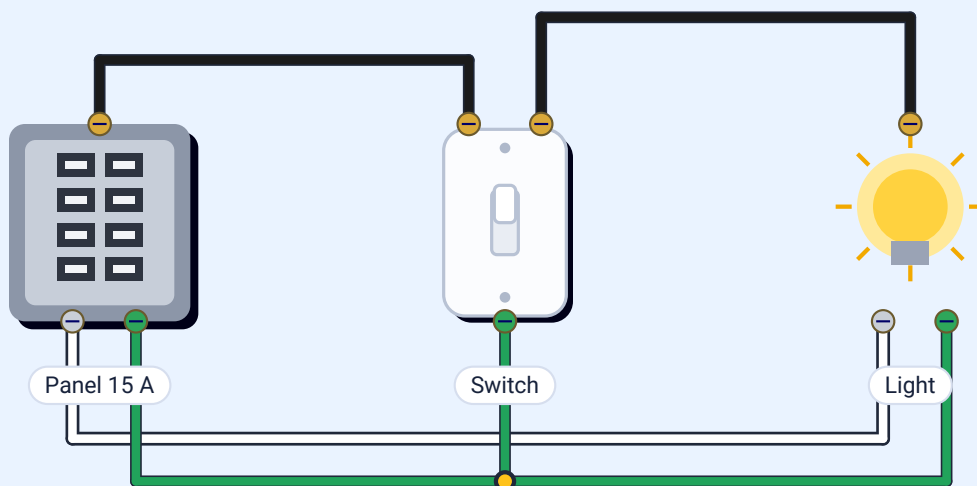
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QUICK WIRING GUIDE · DIAGRAM 01

SINGLE-POLE SWITCH CONTROLLING A LIGHT

The most common circuit in any house: one switch turns one light (or a group of lights) on and off.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 NM-B from panel to switch box
- 14/2 from switch box to light

STEP BY STEP

- 1 Turn off the breaker and test the wires with a non-contact tester.
- 2 Connect the black wire from the panel to one brass screw of the switch.
- 3 Connect the other brass screw to the black wire going to the light.
- 4 Splice the white wires together in the switch box (never on the switch). Connect all grounds and pigtail one to the green screw.

WATCH OUT

Current code (NEC 404.2(C)) asks for a neutral in most switch boxes. Leave it there even if the switch does not use it: a future smart switch will need it.



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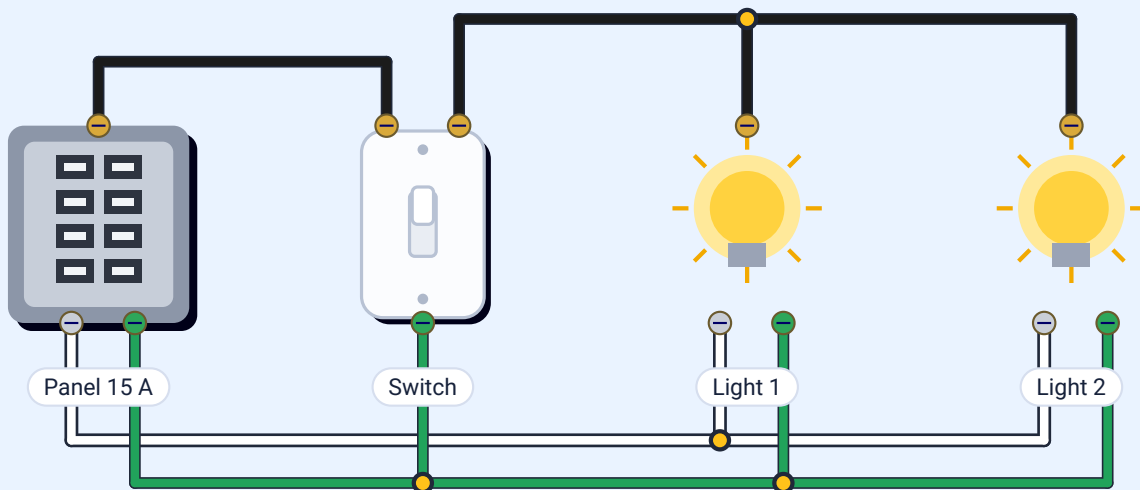
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QUICK WIRING GUIDE · DIAGRAM 02

ONE SWITCH, TWO LIGHTS

One switch controls two or more fixtures at the same time, like two ceiling lights in a long room.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to switch
- 14/2 switch to light 1
- 14/2 light 1 to light 2

STEP BY STEP

- 1 Wire the switch exactly like diagram 01.
- 2 At light 1, splice the switched black wire with the black going to light 2 and a pigtail to the fixture.
- 3 Do the same with the whites (neutral) and the grounds.
- 4 Lights are connected in PARALLEL: each one gets the full 120 V.

WATCH OUT

Add up the watts of all fixtures: a 15 A circuit should carry about 1,440 W continuous (80%).



SAFETY FIRST

Breaker off, test before touching



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PRO TIPS

From the field



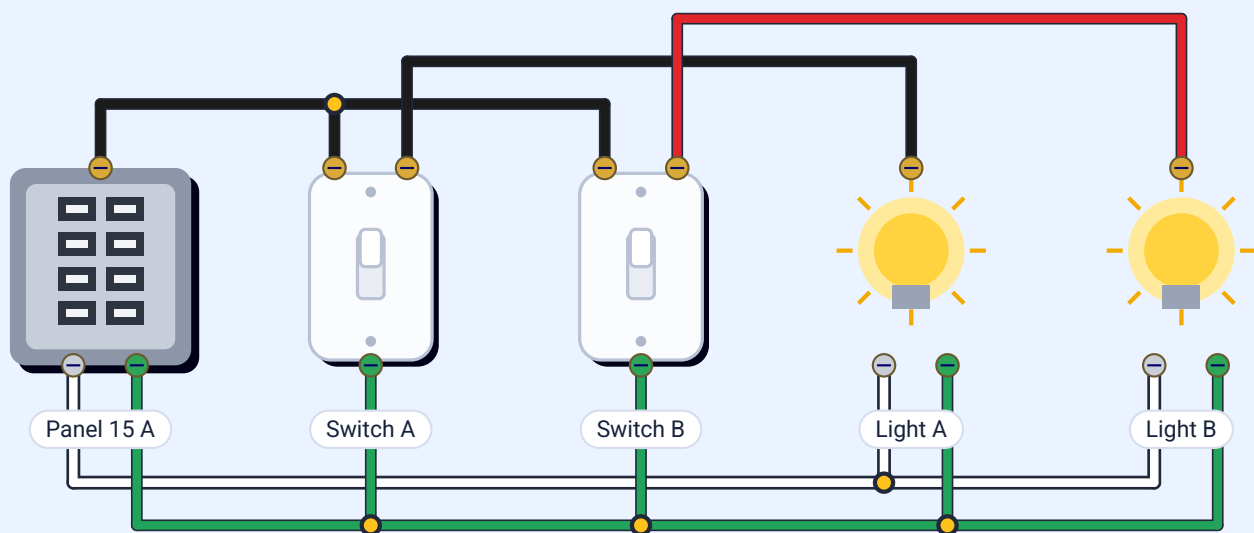
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QUICK WIRING GUIDE · DIAGRAM 03

DOUBLE SWITCH: TWO SWITCHES, TWO LIGHTS

Two switches in the same box, each one controlling its own light. Common for a light and a fan, or for two zones.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to switch box
- 14/3 (black, red, white) from switch box to the lights

STEP BY STEP

- 1 Bring the hot (black) from the panel and make a pigtail to feed both switches.
- 2 Switch A sends power on the black wire to light A.
- 3 Switch B sends power on the red wire to light B.
- 4 One white neutral serves both lights; all grounds together.

WATCH OUT

Many double switches have a breakaway tab joining the two hot screws. Leave it in place when one hot feeds both switches.



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Breaker off, test before touching



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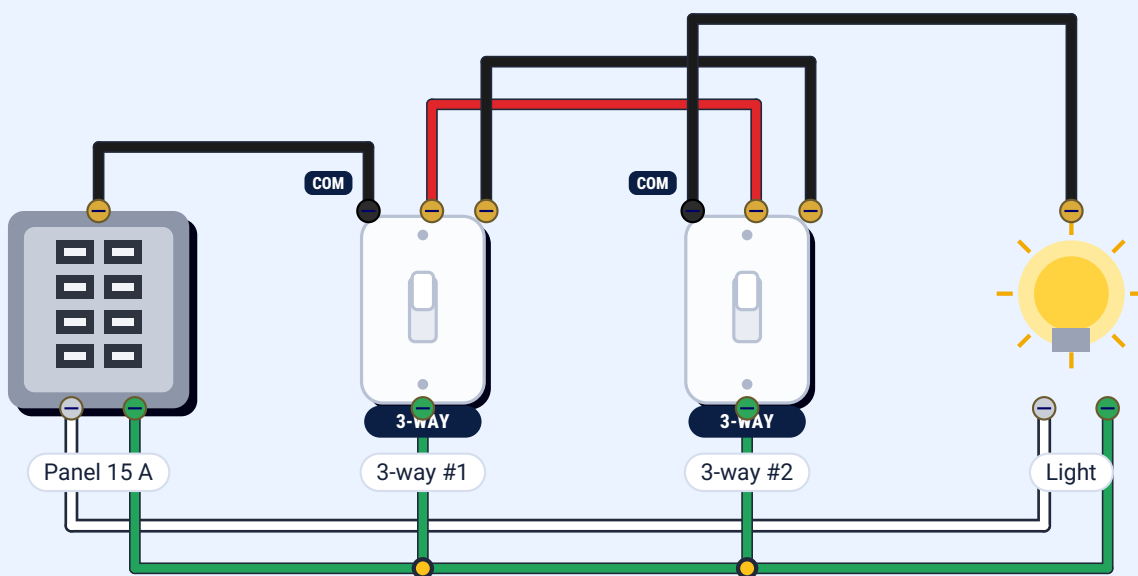
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QUICK WIRING GUIDE · DIAGRAM 04

3-WAY SWITCHES: CONTROL A LIGHT FROM TWO PLACES

Two 3-way switches let you turn the same light on and off from two places, like the top and bottom of a staircase.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to switch 1
- 14/3 between the two switches (2 travelers)
- 14/2 switch 2 to the light

STEP BY STEP

- 1 Find the COMMON screw on each 3-way switch: it is the darker (black) screw.
- 2 Switch 1: the hot from the panel goes to the COMMON.
- 3 Run the two travelers (red and black of the 14/3) between the brass screws of both switches.
- 4 Switch 2: the COMMON goes to the light. Neutrals and grounds as usual.

WATCH OUT

If the light only works with one switch in a certain position, the COMMON is swapped with a traveler. 90% of 3-way problems are this.



SAFETY FIRST

Breaker off, test before touching



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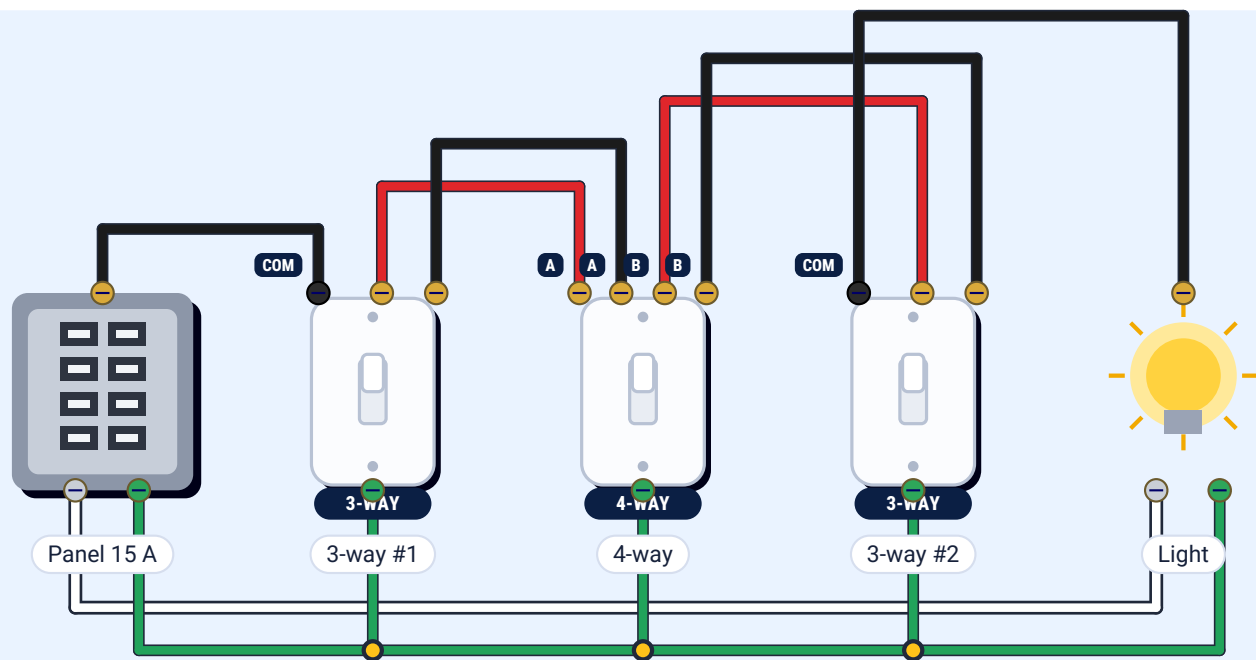
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QUICK WIRING GUIDE · DIAGRAM 05

4-WAY SWITCH: CONTROL A LIGHT FROM THREE PLACES

Put one 4-way switch between two 3-way switches to add a third (or fourth, fifth...) control point, like in long hallways.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to first 3-way
- 14/3 from 3-way to 4-way
- 14/3 from 4-way to the other 3-way
- 14/2 to the light

STEP BY STEP

- 1 The two 3-way switches go at the ends, wired like diagram 04.
- 2 The 4-way has 4 brass screws: one PAIR is input (A), the other pair is output (B).
- 3 Travelers from switch 1 go to the A pair; travelers to switch 2 leave from the B pair.
- 4 Check the switch body: most 4-way switches mark the pairs by screw color or position.

WATCH OUT

Never put the hot or the light wire on a 4-way switch: it only receives travelers.



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Breaker off, test before touching



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PRO TIPS

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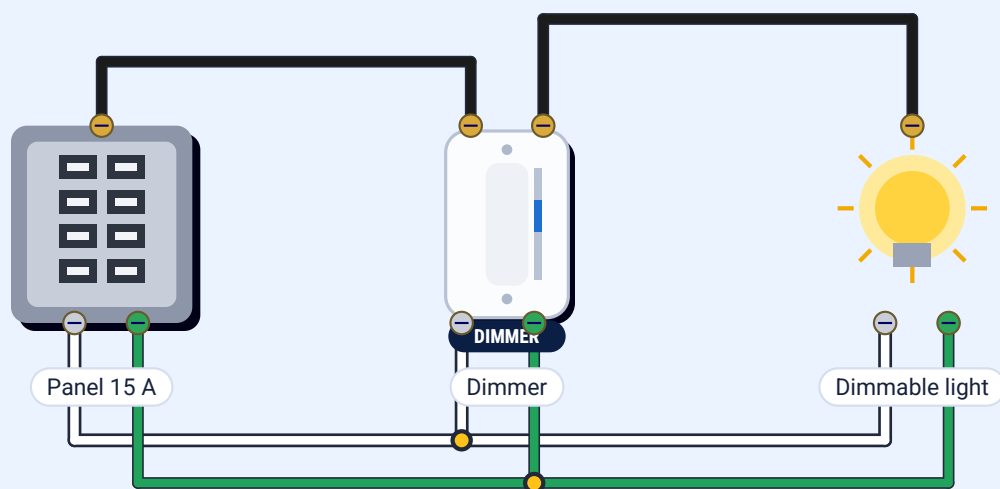


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DIMMER SWITCH

A dimmer replaces a single-pole switch and adjusts the brightness. Use a dimmer rated for LED if the bulbs are LED.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to dimmer box
- 14/2 dimmer to light

STEP BY STEP

- 1 Turn off the breaker and remove the old switch.
- 2 Connect the line (hot from panel) and the load (wire to the light) to the dimmer leads, as marked.
- 3 If the dimmer has a white lead, connect it to the neutral bundle.
- 4 Connect the green lead to ground and fold the wires carefully: dimmers are deeper than switches.

WATCH OUT

LED flicker or buzzing usually means the dimmer is not LED-compatible or the minimum load is too low. Check the manufacturer's compatibility list.



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Breaker off, test before touching



NEC BASED

Check your local code



PRO TIPS

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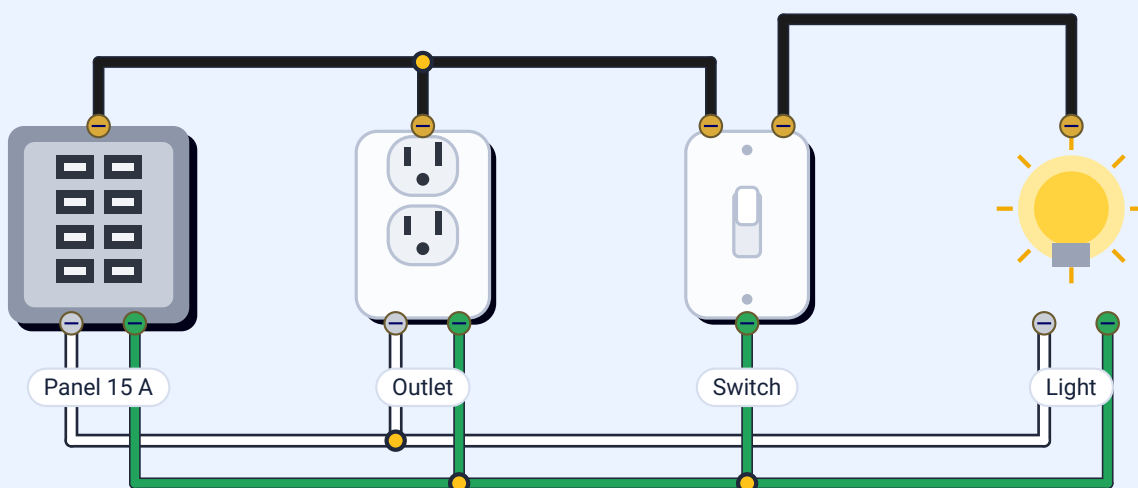


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SWITCH AND OUTLET IN THE SAME BOX

A combo device or two devices in one box: the outlet is always on, and the switch controls a light.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to the box
- 14/2 box to the light

STEP BY STEP

- 1 Make a pigtail from the incoming hot (black): one goes to the outlet brass screw, the other to the switch.
- 2 The switch output goes to the light (black).
- 3 Neutral: pigtail to the silver screw of the outlet and splice with the white to the light.
- 4 Grounds: all together, with a pigtail to each device.

WATCH OUT

Brass screw = hot, silver screw = neutral, green screw = ground. Reversing hot and neutral makes the outlet work but is a shock hazard.



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Breaker off, test before touching



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PRO TIPS

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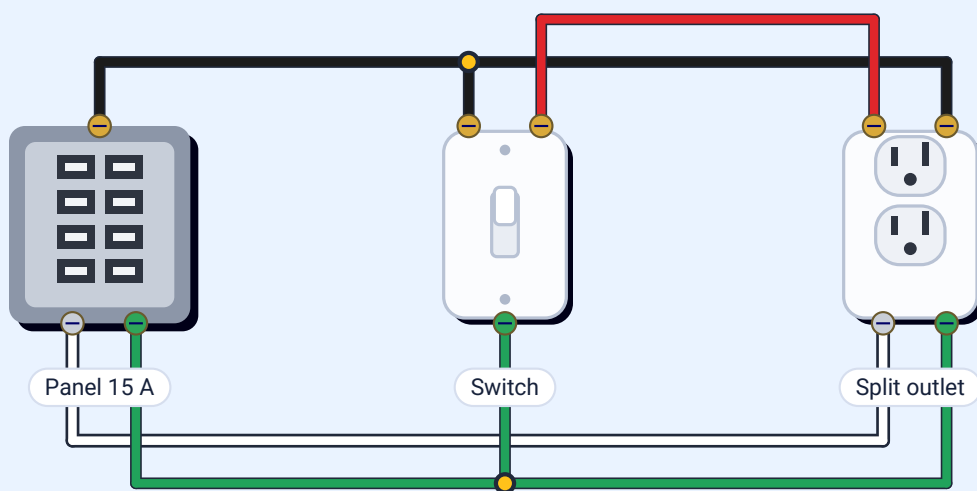


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HALF-SWITCHED OUTLET (ONE PLUG CONTROLLED BY A SWITCH)

The top plug is controlled by a wall switch (for a lamp) and the bottom plug is always on. Very common in living rooms and bedrooms.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to switch box
- 14/3 switch box to outlet (black = always on, red = switched)

STEP BY STEP

- 1 Break off the tab between the two BRASS screws of the outlet. Leave the tab on the silver side.
- 2 Red (switched) goes to the brass screw of the top plug.
- 3 Black (always on) goes to the brass screw of the bottom plug.
- 4 The white goes to a silver screw; ground to the green screw.

WATCH OUT

If both plugs turn off with the switch, the brass tab is still in place.



SAFETY FIRST

Breaker off, test before touching



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Check your local code



PRO TIPS

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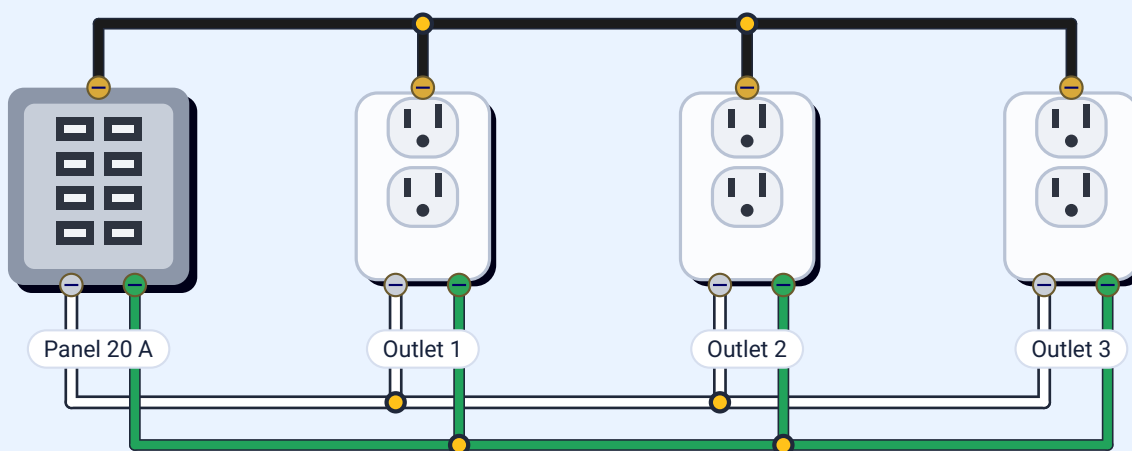


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OUTLETS IN A ROW (PIGTAIL METHOD)

Several outlets on the same circuit, each one fed by a pigtail so that one bad outlet does not cut power to the others.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 12/2 NM-B for 20 A (or 14/2 for 15 A) from box to box

STEP BY STEP

- In each box, splice incoming and outgoing blacks with a short pigtail to the brass screw.
- Do the same with the whites to the silver screw.
- Grounds: all together, pigtail to the green screw and to a metal box if there is one.
- Avoid the push-in holes on the back of cheap outlets: use the screws.

WATCH OUT

12 AWG wire on a 20 A breaker, 14 AWG on a 15 A breaker. Never put a 20 A breaker on 14 AWG wire.



SAFETY FIRST

Breaker off, test before touching



NEC BASED

Check your local code



PRO TIPS

From the field



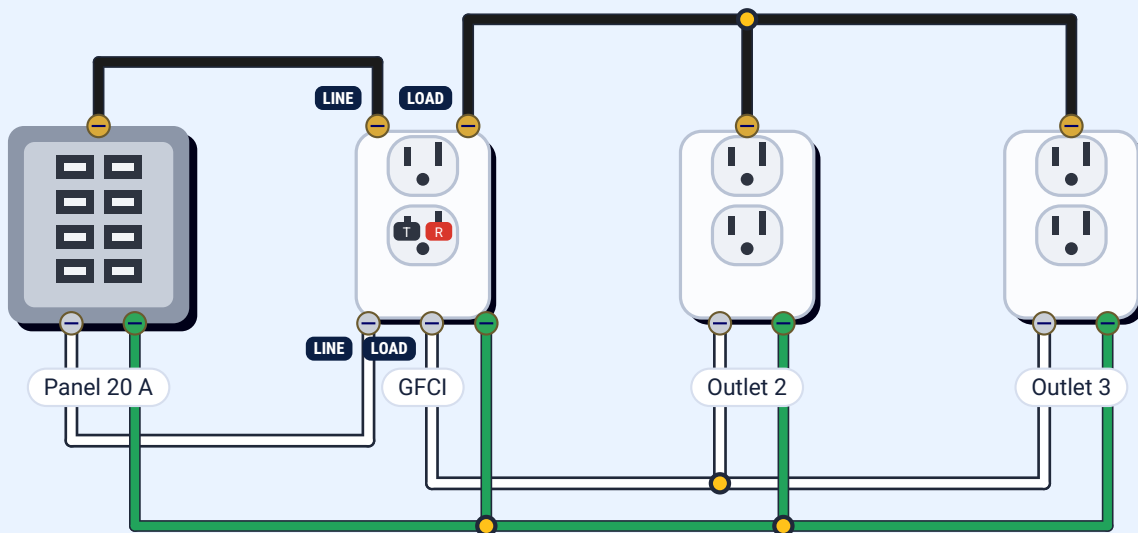
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QUICK WIRING GUIDE · DIAGRAM 10

GFCI PROTECTING THE OUTLETS AFTER IT

One GFCI outlet protects all the outlets wired from its LOAD terminals. Required in bathrooms, kitchens, garages, outdoors and more.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 12/2 panel to the GFCI
- 12/2 from the GFCI LOAD side to the next outlets

STEP BY STEP

- 1 Find the wires that come from the PANEL (test with the breaker on, carefully): they go to the LINE terminals.
- 2 The wires to the next outlets go to the LOAD terminals (remove the sticker).
- 3 Brass = hot, silver = neutral on both LINE and LOAD.
- 4 Turn on the breaker, press TEST (power goes off) and RESET. Stick 'GFCI protected' labels on the outlets downstream.

WATCH OUT

If the GFCI will not reset, LINE and LOAD are probably swapped. Most new GFCIs refuse to work wired backwards.



SAFETY FIRST

Breaker off, test before touching



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Check your local code



PRO TIPS

From the field



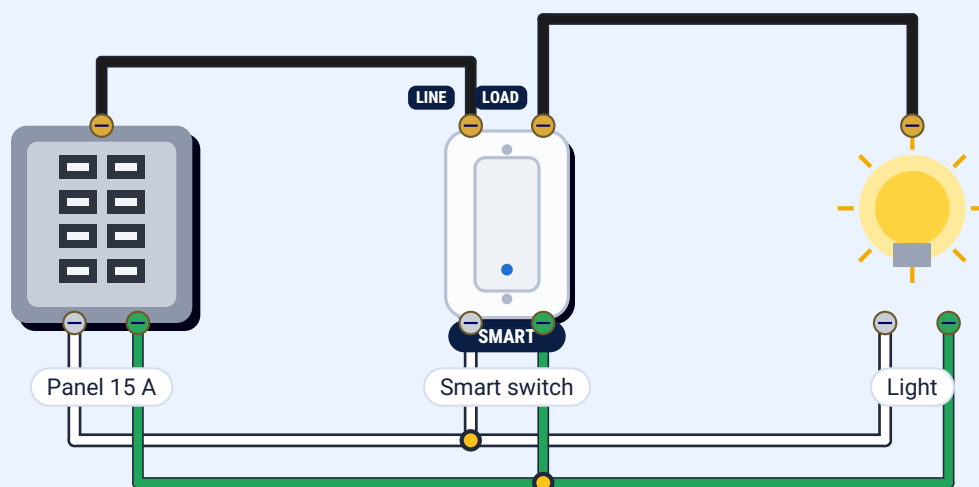
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QUICK WIRING GUIDE · DIAGRAM 11

SMART SWITCH (NEEDS A NEUTRAL)

Wi-Fi and smart switches need a neutral to stay powered. This diagram shows the most common 4-wire smart switch.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to switch box (with neutral)
- 14/2 to the light

STEP BY STEP

- 1 Confirm there is a white bundle in the switch box: that is the neutral.
- 2 LINE = black from the panel; LOAD = black to the light.
- 3 Connect the smart switch's neutral lead to the white bundle with a pigtail.
- 4 Ground to the bare/green bundle, then set up the app.

WATCH OUT

No neutral in the box? Look for a 'no-neutral' model or run a new cable. Never use the ground wire as a neutral.



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Breaker off, test before touching



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Check your local code



PRO TIPS

From the field



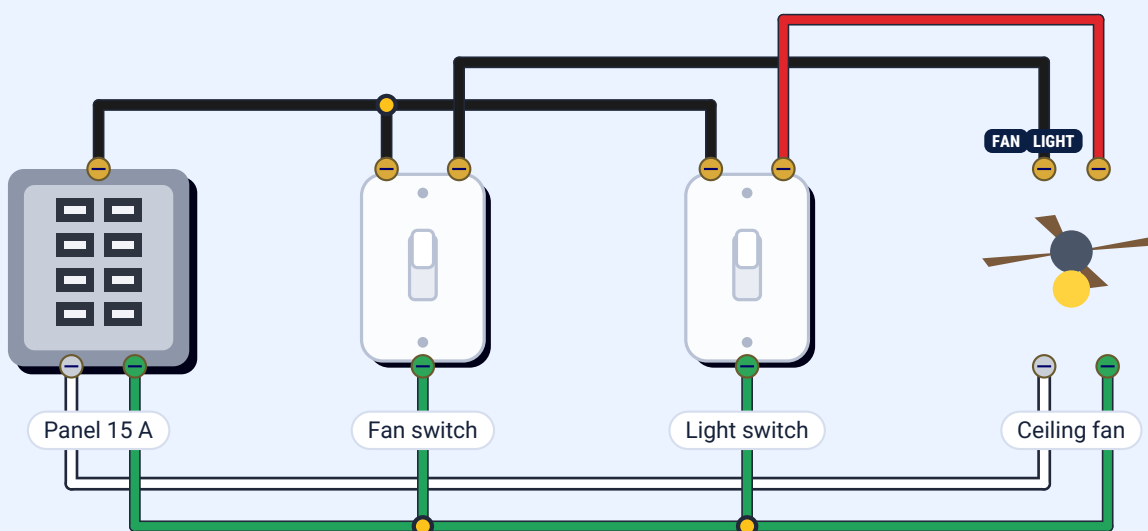
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QUICK WIRING GUIDE · DIAGRAM 12

CEILING FAN WITH LIGHT ON TWO SWITCHES

One switch for the fan motor and another for the fan light, using a 14/3 cable to the ceiling.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 14/2 panel to the switch box
- 14/3 switch box to the fan (fan-rated ceiling box)

STEP BY STEP

- 1 Feed both switches from the hot with a pigtail.
- 2 Fan switch black of the 14/3 fan motor wire (usually black).
- 3 Light switch red of the 14/3 fan light wire (usually blue).
- 4 White to the fan white; grounds together, including the fan bracket.

WATCH OUT

The ceiling box must be marked 'acceptable for fan support'. A regular light box can pull out of the ceiling.



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PRO TIPS

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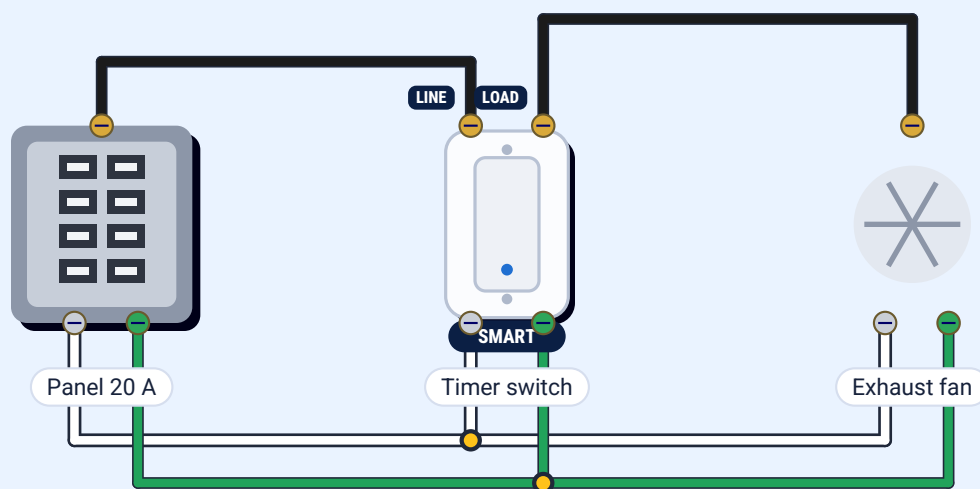
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QUICK WIRING GUIDE · DIAGRAM 13

BATHROOM FAN ON A TIMER SWITCH

A timer switch runs the exhaust fan for a set time and turns it off by itself, removing humidity after a shower.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 12/2 from the bathroom circuit to the switch box
- 12/2 or 14/2 (per fan instructions) to the fan

STEP BY STEP

- 1 Most digital timers need a neutral: check for the white bundle in the box.
- 2 LINE = hot from the panel; LOAD = black to the fan.
- 3 White lead of the timer to the neutral bundle.
- 4 Ground the timer and the fan housing. Vent the fan to the outside, not into the attic.

WATCH OUT

Bathroom receptacles need GFCI protection; check your local code for the fan if it is over a tub or shower.



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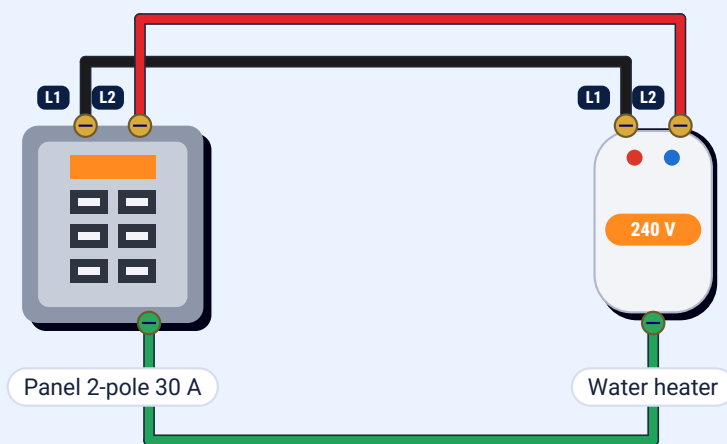
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240 V WATER HEATER

An electric water heater uses two hots (240 V) and a ground; it does not need a neutral.



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 10/2 NM-B (black, white re-marked as hot, bare) on a 2-pole 30 A breaker for a typical 4,500 W heater

STEP BY STEP

- 1 Turn off the 2-pole breaker and confirm 0 V between both hots and ground.
- 2 Connect each hot to one of the two terminals in the heater junction box.
- 3 When using 10/2 cable, mark the white with black or red tape at both ends: it is a hot here.
- 4 Connect the ground to the green screw of the heater. Fill the tank with water BEFORE turning on the breaker.

WATCH OUT

Turning on an empty water heater burns out the elements in seconds.



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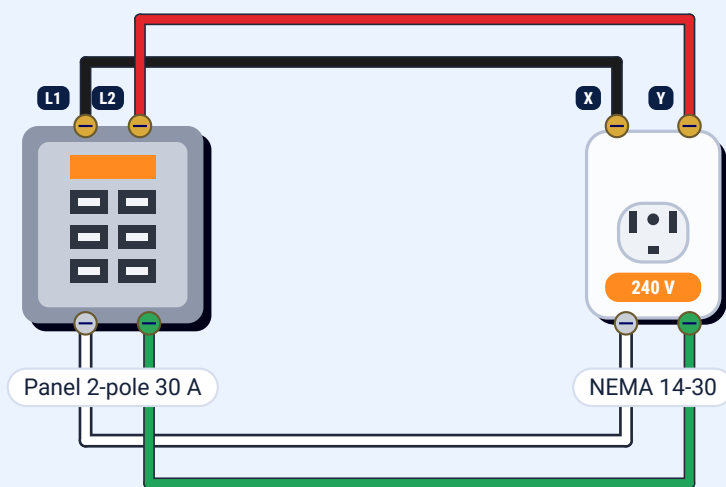
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QUICK WIRING GUIDE · DIAGRAM 15

240 V DRYER OUTLET (NEMA 14-30, 4 WIRES)

Modern dryers use a 4-wire outlet: two hots, neutral and ground. The neutral feeds the 120 V parts (timer, light, motor).



BLACK
Hot

RED
Hot / traveler

WHITE
Neutral

GREEN / BARE
Ground

CABLES YOU NEED

- 10/3 NM-B with ground (black, red, white, bare) on a 2-pole 30 A breaker

STEP BY STEP

- Black to terminal X, red to terminal Y (brass).
- White to the neutral terminal W (silver, the L-shaped slot).
- Bare/green to the ground terminal G (the round slot).
- On the dryer, remove the bonding strap between neutral and frame when you use a 4-wire cord.

WATCH OUT

Old 3-wire outlets (NEMA 10-30) have no separate ground. When replacing one, run a new 10/3 cable with ground.



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WIRE COLORS, CABLES AND BREAKERS

The quick reference every DIYer and apprentice keeps on the phone.

			
BLACK Hot	RED Hot / traveler	WHITE Neutral	GREEN / BARE Ground

SCREW COLORS

 BRASS Hot (black or red)	 SILVER Neutral (white)	 GREEN Ground (green or bare)	 DARK / BLACK COMMON on a 3-way switch
--	--	--	---

COMMON CABLES (NM-B)

Cable	Wires inside	Typical use
14/2	black, white, bare	15 A lights and outlets
14/3	black, red, white, bare	3-way switches, fan + light
12/2	black, white, bare	20 A outlets, kitchen, bath
12/3	black, red, white, bare	20 A split circuits
10/2	black, white, bare	30 A water heater (240 V)
10/3	black, red, white, bare	30 A dryer (120/240 V)

WIRE SIZE x BREAKER (copper)

Wire	Max breaker	Example
14 AWG	15 A	Bedroom lights and outlets
12 AWG	20 A	Kitchen, bathroom, laundry
10 AWG	30 A	Water heater, dryer
8 AWG	40 A	Electric range (cooktop)
6 AWG	55 A (NM-B)	Range, subpanel



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WHERE GFCI PROTECTION IS USUALLY REQUIRED



Bathrooms



Kitchens



Garages and accessory buildings



Outdoors



Basements and crawl spaces



Laundry areas



Within 6 ft of any sink



Boathouses, pools and spas

AFCI protection is also required in most living areas (bedrooms, living rooms, kitchens, laundry). Rules change by NEC edition and city: always check locally.



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TROUBLESHOOTING

The 6 problems that show up most, and where to look first.



Half the outlets in a room are dead



A GFCI upstream tripped (bathroom, garage, kitchen or outside). Press RESET on each GFCI.



3-way light works only from one switch



The COMMON is swapped with a traveler. Find the dark screw on each switch.



GFCI will not reset



LINE and LOAD are reversed, or there is no power on LINE.



Lights flicker or dim



Loose neutral or a back-stab connection. Move the wires to the screws.



LED buzzes on the dimmer



Dimmer not LED-compatible or load below minimum.



Breaker trips right away



Hot touching ground or neutral. Check for pinched wires in the box.



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KEEP IT SAFE, KEEP IT SIMPLE

- ✓ Do one circuit at a time and label it in the panel.
- ✓ Take a photo of the old wiring before you remove anything.
- ✓ Test with the outlet tester after every job.
- ✓ When in doubt, call a licensed electrician.

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