

Switches, Dimmers, and Lighting Faults

YES Electric • NEC 2026 with NEC 2023 numbers in parentheses

Draft 1 (October 2026). This chapter is under review. Code numbers are NEC 2026. Your local inspector may use an earlier edition, so ask your journeyman which one applies. Boxes marked "Picture coming" will get drawings and photos in a later version.

Phase 2, Troubleshooting and Service Calls.

Before this module: R2.1 (the service call routine), R2.2 (meters and testers), and R1.4 and R1.7 (how switches, receptacles, and lights are installed). You must be able to read voltage to ground and use the continuity setting on your meter.

Code edition. Code references are NEC 2026. In the 2026 book, most of the switch rules moved from Article 404 into Article 406. Where a section moved, the NEC 2023 number is in parentheses. The local inspector (the AHJ) may enforce an earlier edition, so ask your journeyman which one applies.

Learning Objectives

When you finish this module you will be able to:

1. Find a miswired three-way or four-way switch and fix it from your meter readings, not by guessing.
2. Work a dimmer problem: wrong dimmer type, a lamp that is not dimmable, a load below the dimmer's minimum, an overloaded dimmer, and a smart dimmer that needs a neutral.
3. Fix a light that stays on, stays off, or is dim.
4. Find a bad lamp holder, a loose splice in the fixture, or a failed LED driver, in that order.

Background: How Switches and Lights Fail

What a switch does

A switch opens and closes the hot wire going to a light. When the switch is on, current flows from the panel, through the switch, to the light, and back to the panel on the neutral. When the switch is off, the hot wire is broken at the switch and the light has no power.

The code requires the switch to be in the hot (ungrounded) wire, not the neutral (NEC 406.30(B), switches shall not disconnect the grounded conductor). If someone wires a switch into the

neutral, the light goes off, but the lamp socket stays live. Someone changing a bulb can get shocked. You will find this in houses where an amateur did the work.

The switch types you will see

Type	Terminals (not counting ground)	What it does	Kuhlman page
Single-pole	2 brass	On/off from one place. Either wire can go on either screw.	p. 13
Three-way	1 common (dark screw) + 2 travelers (light screws)	Two three-ways control one light from two places	pp. 13–20
Four-way	4 (two pairs of travelers)	Goes between two three-ways for a third, fourth, or more location	p. 21
Two-pole	4	Switches both hots of a 240 V load, such as a water heater or baseboard heat	p. 22
Dimmer	2 or 3 wires or screws, plus ground; smart dimmers add a neutral	Controls brightness	pp. 22–26
Fan speed control	Like a dimmer, but made for motors	Controls a ceiling fan motor	—
Smart switch / timer / occupancy sensor	Line, load, neutral, ground, and sometimes a traveler	Electronics inside need power all the time	—

How a three-way circuit works

The two three-way switches are connected to each other by two wires called travelers. Each switch has one common terminal, which is usually the dark or black screw. The common on the first switch connects to the incoming hot. The common on the second switch connects to the wire going to the light. Each switch connects its common to one traveler or the other, depending on which way the handle is flipped. The light is on when both switches pick the same traveler and off when they pick different ones.

Kuhlman points out that three-way problems are almost always wiring mistakes, most often a traveler and a common mixed up (p. 14). His quick rule for spotting the travelers: in most installs, the two wires that come from the same cable (usually the red and black of a 14/3) are the travelers, and the one wire that comes from its own cable is the common (p. 14).

He shows several three-way layouts you will find (pp. 15–20):

Layout	Where the feed is	What you see in the boxes
Feed at first switch, light past second switch	First switch box	14/2 in and 14/3 out at switch 1; 14/3 in and 14/2 out at switch 2
"Dead end" three-way	First switch box has both the feed and the cable to the light	The far switch has only a 14/3. In it, the white is often used as a traveler or common.
Feed at the light	Light box	Older homes; a 14/2 from the light to one switch carries the hot on the white
Same feed at both switch boxes	Both switch boxes (two-gang boxes with other switches)	A 14/2 can be used between switches as travelers

Kuhlman notes that the feed-at-the-light layout cannot be installed new under the current code, because one switch location in a three-way or four-way system must have a neutral (p. 17). That rule is now 406.30(C) in the 2026 code. He also warns about a common mistake in the two-gang layout: splicing the neutrals together in both boxes, which makes a parallel neutral with two paths back to the panel (p. 20). That causes AFCI and GFCI trips (R2.4).

Picture coming: Three-way circuit drawn twice, side by side. Left: wired correctly, feed into switch 1 common (black screw), red and black travelers between switch 1 and switch 2, switch 2 common to the light, white neutral spliced through both boxes to the light. Right: the same circuit with the incoming hot landed on a traveler screw at switch 1 and the black traveler landed on the common. Under each switch, in each of its two handle positions, a small table of voltage-to-ground at each of the three screws (120 V or 0 V).

How dimmers work and fail

A standard dimmer cuts off part of each AC wave so the lamp gets less power. That is called phase control. The dimmer turns some of that cut-off power into heat, which is why dimmers get warm. Kuhlman says customers often call worried about a warm dimmer. Warm is normal. A plate too hot to keep your hand on means the dimmer is overloaded (p. 26).

Dimmers come in types matched to the load (Kuhlman, pp. 22-23):

Dimmer type	Made for	Example Kuhlman names
Standard incandescent/halogen	Incandescent and halogen lamps, some LEDs	Lutron DV-600P
CL / LED	Dimmable LED and CFL lamps, plus incandescent and halogen. Has a low-end trim adjustment.	Lutron DVCL-153P
Magnetic low voltage (MLV)	Magnetic low-voltage transformers (heavy, iron-core)	Lutron DVLV-10P
Electronic low voltage (ELV)	Electronic low-voltage transformers and many LED drivers	Lutron DVELV-300P

The most important rule for dimmers is to match the dimmer to the load. The lighting manufacturer's spec sheet lists the dimmers that work with its product (Kuhlman, p. 22). The most common dimmer call Kuhlman sees is a customer who put in LED bulbs and now the dimmer does not work right: it won't dim all the way down, it shuts off when turned down, or it flickers when dimmed (p. 22).

Dimmer ratings and the side tabs

Every dimmer has a maximum load in watts. Kuhlman's example: a 600 W dimmer running twelve 65 W incandescent cans is 780 W, which overloads it (p. 23). The dimmer gets very hot and eventually fails.

The metal fins (tabs) on the sides of many dimmers help get rid of heat. When dimmers are side by side in one box, you break off tabs so they fit, and each dimmer loses some of its rating. Kuhlman's example for a 600 W dimmer: one side removed drops it to 500 W, both sides removed drops it to 400 W (p. 23). The derating printed on the dimmer or its instructions is the number to use for any other model.

Picture coming: Three dimmers in a three-gang box, seen from the front with the plate removed. The left and right dimmers have their inside tabs broken off and are labeled "one side removed – 500 W." The middle dimmer has both tabs broken off and is labeled "both sides removed – 400 W." A callout reads "Example from a 600 W dimmer. Read the derating on the dimmer you have."

LED lamps, drivers, and minimum load

An LED lamp or fixture has a small power supply called a driver. The driver turns 120 V AC into the low-voltage DC that the LEDs need. When an LED flickers, buzzes, or will not dim smoothly, the driver and the dimmer are usually not getting along. Kuhlman says most LEDs buzz a little, some louder than others, and a wrong dimmer pairing makes it worse (p. 50).

Many dimmers need a minimum load to work smoothly. An old dimmer made for incandescent lamps may need a load of 25 to 40 W or more (Arc Guide, Symptom 8). One 9 W LED lamp is under that, so the dimmer flickers or will not turn the lamp all the way off. Read the minimum load on the dimmer's instructions; it varies by model.

Smart switches and the neutral

A plain switch only opens and closes the hot. A smart switch, timer, or occupancy sensor has electronics inside that need a little power all the time, even when the light is off. The clean way to get that power is from the hot and the neutral. That is why the code now requires a neutral at most switch locations: 406.30(C) (2023: 404.2(C)) requires the neutral to be installed where switches control lighting in bathrooms, hallways, stairways, and habitable rooms, with a few exceptions. The informational note says the neutral is there to complete the circuit for electronic lighting controls.

Older houses often have no neutral in the switch box. A switch loop (a 14/2 from the light to the switch with the white used as a hot) has only two wires in the box, both hot or switched hot.

Some smart dimmers are sold as "no neutral" models. They get their standby power by leaking a small current through the light itself. That works with some lamps and not with others. With low-wattage LEDs, the small leak through the lamp can make it glow, flicker, or blink when it should be off. Some retrofit devices send their standby current through the ground wire. NEC 406.50 (2023: 404.22) says electronic control switches shall not put current on the equipment grounding conductor in normal operation, except devices listed and marked for replacement or retrofit use where 406.30(C)'s exception applies (switch locations from before local adoption of the neutral rule, where a neutral can't be added without removing finish materials).

Part A: Single-Pole Switch Problems

Symptom

The light does not come on, stays on, or works only sometimes. The switch is a single-pole: one switch controls the light from one place.

Questions to ask the customer

1. "Did the light ever work from this switch? When did it stop?"
2. "Did you or anyone change the bulb, the fixture, or the switch recently?" Kuhlman says the most common human cause on any call is the customer trying to change a light, outlet, or switch (p. 75).
3. "Does the switch feel different, loose, or make a crackling sound?"
4. "Is anything else on this wall or in this room dead?" If yes, this may be a dead circuit, not a switch problem. Go to R2.3.
5. "Did you change to LED bulbs?" (If the switch is a dimmer, go to Part D.)

Tests, in order

Test A1. Try a known-good lamp. 1. Take the bulb out and put in a lamp you know works (carry one). If the light now works, the bulb was the problem. 2. Look in the socket with a flashlight. A center tab pushed flat or covered in black carbon is a common cause. Go to Part F.

Test A2. Read voltage at the switch, power on.

Safety: You are reading inside a live box. Turn the switch to OFF first. Pull the switch out of the box by its mounting strap without touching the screws. Use insulated meter probes, keep one hand on the meter, and wear safety glasses. Do this live only after your journeyman has watched you do it right.

1. Set the meter to AC volts (V~). If it is not autoranging, pick the range above 120 V, such as 200 V or 600 V.

- Put the black probe on the bare ground wire or the metal box (if the box is grounded). If there is no ground in the box, put the black probe on the neutral (white wires spliced together in the back of the box), if there is one.
- Put the red probe on one switch screw, then the other. Take readings with the switch OFF, then ON.

Switch OFF: screw 1	Switch OFF: screw 2	Switch ON: both screws	Meaning
120 V	0 V	120 V on both	Normal. The switch is working. If the light is still dead, the problem is past the switch: the wire to the light, the light's splice, the socket, or the neutral. Go to Test A3.
120 V	0 V	120 V on one, 0 V on the other	The switch is not closing. Replace the switch (Arc Guide, Job 9; Kuhlman, p. 13).
120 V	120 V	120 V on both	The switch is shorted closed inside, or the light is stuck on by a different path. Replace the switch and retest (Arc Guide, Job 9).
0 V	0 V	0 V on both	No power reaching the switch. Check the breaker and any GFCI, then work it as a dead circuit (R2.3).

Test A3. Read at the light, switch ON.

Safety: Same live-box precautions. Work off a stable ladder. If the fixture is heavy, have a helper hold it or hang it from its own bracket before you open splices.

- Turn the switch on.
- Drop the fixture canopy so you can see the splices.
- Read hot-to-neutral on the fixture's incoming splices (the black or switched wire to the white). Read hot-to-ground too.

Hot-Neutral at light	Hot-Ground at light	Meaning
About 120 V	About 120 V	Power is getting to the fixture. The problem is inside the fixture: the socket, the fixture wire, or an LED driver. Go to Part F.
0 V	About 120 V	The switched hot arrives but the neutral is open. Look for a loose neutral splice in this box or upstream.
0 V	0 V	The switched hot is not arriving. The switch-to-light wire or a splice is open. With power off, check continuity on that wire (Test A4).

Test A4. Continuity on the switch leg, power off. 1. Turn the breaker off. Prove dead with live-dead-live (R2.1). 2. At the switch, disconnect the wire that goes to the light (the switch leg). 3. At the light, disconnect the same wire from the fixture. 4. Set the meter to continuity or ohms.

5. At the light, touch one probe to the switch leg and the other to the bare ground. At the switch, touch the switch leg to the ground with a short jumper (a test lead with clips). You should hear the beep at the light. No beep means the wire is broken or a splice in between is open.

This is the same idea as using a long test lead, except the house ground stands in for the second wire.

The fix

Cause	Fix
Failed switch	Replace with a switch of the same type and rating. Put wires under screws, not in backstab holes. NEC 2026 406.10(3) allows push-in terminals only on 15 A or smaller circuits with 14 AWG solid copper (earlier editions left this to the UL listing); YES uses the screws on every circuit. Torque terminals to the value in the instructions (NEC 110.14(D)). The Arc Guide gives 12 in-lb as a typical value for device screws; use the number printed on the switch's package or instructions.
Backstabbed wire loose	Move it to the screw terminal (Kuhlman, p. 13). Inspect the wire end; cut back and re-strip if it is darkened.
Switch installed upside down	Flip it so ON is up. Kuhlman notes upside-down single-poles read "NO" (p. 13).
Open switch leg in the wall	Fish a new cable. This is a scope for the office if it needs wall work (R3.1).
White wire used as hot not marked	Mark it with black tape at both ends and anywhere it is visible. NEC 200.8(C)(1) (2023: 200.7(C)(1)) allows a white in a cable to be re-identified as a hot. In a switch loop, the re-identified white may only be the supply to the switch, never the return from the switch to the light.

Part B: Three-Way Switch Faults

Symptom

One of these:

- The light works from one switch only.
- The light works from one switch only when the other switch is in a certain position.
- The light does not work from either switch.
- The light stays on (or off) from both switches.
- A switch that was just replaced "made it worse."

Questions to ask the customer

1. "Did it ever work right? Since when has it been like this?"

2. "Did anyone replace a switch or the light?" A three-way that stopped working right after a switch replacement almost always has the common and a traveler swapped (Arc Guide, Job 3).
3. "Which switch does what? Show me." Have the customer stand at each switch and work it while you watch the light.
4. "Is there a third switch anywhere that controls this light?" (That would make it a four-way system, Part C.)

Find both switch boxes first

Before you open anything, find every switch that controls the light. Turn the light on and off from each one and write down which switch does what. Look for switches at the top and bottom of stairs, at each end of a hall, and at each door of a room with two doors.

Test B1. Find the constant hot, power on

This test tells you which switch has the incoming feed and whether the hot is on the right screw.

Safety: Both switch boxes will be live. Turn the light off with a switch first if you can. Pull each switch out by its strap without touching screws. Insulated probes, safety glasses, one hand.

1. Set the meter to AC volts.
2. At switch 1, put the black probe on ground (bare wire or grounded metal box).
3. Touch the red probe to each of the three screws: the common (dark screw) and the two travelers (lighter screws). Write the reading.
4. Flip switch 1 and read all three screws again.
5. Do the same at switch 2. Leave switch 1 in one position while you take both of switch 2's readings.

Correct wiring, feed at switch 1, light after switch 2:

Switch	Screw	Handle position A	Handle position B
1	Common	120 V	120 V
1	Traveler 1	120 V	0 V
1	Traveler 2	0 V	120 V
2	Traveler 1	Same as switch 1 traveler 1	Same
2	Traveler 2	Same as switch 1 traveler 2	Same
2	Common	120 V when switch 2 picks the live traveler, 0 V when it picks the dead one	—

The line switch is the one where one screw reads 120 V no matter which way either switch is flipped. On a correctly wired line switch, that screw is the common.

What the readings tell you:

What you see	What it means	Fix
At switch 1, a traveler (light-colored) screw reads 120 V in both positions, and the common does not	The incoming hot is on a traveler screw. The light only works from switch 2 when switch 1 is in one position.	Turn the breaker off. Move the always-hot wire to the common screw. Move the wire that was on the common to the empty traveler screw.
At switch 2, the common reads 120 V in some combinations but the light stays off, and a traveler screw at switch 2 goes to the light	The wire to the light is on a traveler screw at switch 2, and a traveler is on the common.	Turn the breaker off. Find the wire to the light (Test B2) and put it on the common. Put the travelers on the two traveler screws.
Neither box has any screw at 120 V in every position	The feed is not at either switch. It is probably at the light (an older layout, Kuhlman pp. 16–17), or the circuit is dead.	Check for voltage at the light box. If the circuit is dead, work it with R2.3. Otherwise use Test B2 to map the wires.
Readings flip correctly at both switches but the light never comes on	The switches are fine. The problem is the wire from switch 2 to the light, the light's neutral, or the fixture.	Go to Part A, Test A3, at the light.
One switch's common never changes which traveler it connects to	That switch has failed inside.	Replace it. Confirm with Test B3.

Test B2. Map the wires with power off (when Test B1 is not clear)

Use this when the readings are confusing, when the feed is at the light, or when someone has rewired the switches more than once.

1. Turn the breaker off. Prove dead at both switch boxes and at the light with live-dead-live.
2. Take both switches out of their boxes. Disconnect all wires from both switches. Keep the wires apart.
3. At each box, write down every cable that enters (14/2, 14/3) and its colors.
4. Use Kuhlman's rule as a starting guess: at each switch, the two wires from the same 3-wire cable are probably the travelers (p. 14).
5. Prove it. At switch 1, twist the two suspected travelers together (or clip them together with a jumper lead).
6. At switch 2, set the meter to continuity and touch the two suspected travelers there. A beep proves they are the same pair of wires.
7. Untwist the travelers at switch 1.

8. Find the wire to the light. At the light, disconnect the fixture's black lead and clip the house wire that fed it to the bare ground. At each switch box, check continuity from the remaining non-traveler wire to ground. The one that beeps goes to the light.
9. The wire that is left at the other switch box is the feed. Confirm it later with power on: it is the one that reads 120 V to ground.
10. Remove the jumpers before you turn power back on.

Test B3. Test the three-way switch itself, power off

1. With the switch out and disconnected, set the meter to continuity.
2. Touch one probe to the common (dark screw).
3. Touch the other probe to traveler 1, then traveler 2. One should beep and the other should not.
4. Flip the handle. Now the other traveler should beep.
5. If it beeps on the same traveler in both positions, or on neither, the switch has failed. Replace it (Arc Guide, Symptom 7, Step 5).

The fix

1. Turn the breaker off and prove dead.
2. Put the feed (or, at switch 2, the wire to the light) on the common screw of each switch.
3. Put the two travelers on the two traveler screws. Which traveler goes on which traveler screw does not matter.
4. Connect the grounds. Every switch must be connected to the equipment ground (406.40(B), 2023: 404.9(B)).
5. Torque terminal screws to the switch instructions (110.14(D)).
6. Mark any white wire used as a traveler or a hot with black tape at both ends (200.8(C)(1), 2023: 200.7(C)(1)).
7. If you find neutrals from two different cables spliced together in both switch boxes, find out whether they are the same circuit. If they are, splicing them in both boxes makes a parallel neutral (Kuhlman, p. 20). Separate them so the neutral has only one path back to the panel.
8. Turn the power on and test all four handle combinations: down-down, down-up, up-down, up-up. The light should change every time either switch is flipped.

Replacing a working three-way. When you replace a three-way, mark the wire on the old switch's common with a piece of tape before you take any wire off. That marked wire goes on the new switch's common (Arc Guide, Job 3). Most callbacks on three-ways come from skipping this step.

Part C: Four-Way Switch Faults

Symptom

Three or more switches control one light. The light works from some switches and not others, or one switch "reverses" the others.

Background

A four-way switch goes between the two three-ways. It has two pairs of traveler terminals: one pair for the travelers coming in and one pair for the travelers going out. Kuhlman notes that the two white wires in the two 14/3 cables at a four-way are usually neutrals spliced together, that one cable's red and black go on one pair of screws and the other cable's red and black go on the other pair, and that every four-way switch shows which two screws go together (p. 21). You can put any number of four-ways between two three-ways (p. 21).

The common mistake is putting one traveler from each cable on the same pair of screws, mixing the travelers between cables (Kuhlman, p. 21).

Tests, in order

1. Work the three-ways first using Part B. Confirm the feed is on switch 1's common and the light is on switch 2's common.
2. Turn the breaker off and prove dead.
3. Take the four-way out. Check the marking on the switch or its package for which screws are a pair. On many models, the two screws of one color are a pair (for example, both dark or both brass).
4. Use the twist-and-beep method from Test B2 to prove which two wires in the four-way box are the pair from the switch 1 side and which two are the pair from the switch 2 side.
5. Test the four-way itself, power off: in one handle position, each "in" terminal connects straight across to one "out" terminal; in the other position, they cross. On continuity, you should see the connections change when you flip the handle. If they never change, replace it.

The fix

1. Land one cable's pair of travelers on one pair of screws and the other cable's pair on the other pair.
 2. Ground the switch.
 3. Power on and test every combination of every switch. With three switches there are eight combinations. The light should change state every time any one switch is flipped.
-

Part D: Dimmer Problems

Symptom

Pick the one the customer describes:

What the customer says	Most likely cause	Go to
"The dimmer doesn't do anything"	No power, failed dimmer	D1
"The lights flicker or buzz when I dim them"	LED and dimmer mismatch, load below minimum	D2
"It won't turn all the way down" or "It shuts off before it gets low"	Low-end trim not set, wrong dimmer type	D3
"The lights glow when the switch is off"	Leakage through a no-neutral dimmer or a lighted switch	D4
"The dimmer is hot"	Overloaded, derated by broken tabs, controlling a fan	D5
"The new smart dimmer doesn't work right"	No neutral, wrong wiring, not paired	D6

Questions to ask the customer

1. "Did you change the bulbs recently? To what kind?" Read the bulb package or the base: does it say "dimmable"?
2. "How many bulbs or fixtures are on this dimmer?"
3. "Was it working with these bulbs before, or did it start when the bulbs changed?"
4. "Does it do it at every brightness or only when it is turned down low?"
5. "Is a ceiling fan on this control?"

Read the dimmer before you test anything

Pull the dimmer out (power off first if you will touch it) or look at the label through the plate opening. Write down:

- The brand and model.
- The maximum load in watts, and whether it lists separate LED and incandescent ratings.
- Whether any side tabs have been broken off.
- Whether it has a neutral wire.
- Whether it is single-pole or three-way.

Then read the lamp or fixture: dimmable or not, watts per lamp, and number of lamps. Total LED watts = watts per lamp × number of lamps.

D1. Dimmer does nothing

1. Check the breaker and any GFCI upstream (R2.1, Part C).
2. Set the meter to AC volts. With the dimmer out of the box by its strap and the meter's black probe on ground, read the dimmer's line wire. It should read about 120 V (Arc Guide, Symptom 8, Step 1).
3. If there is 120 V on the line side and the light does not come on at full brightness, turn the breaker off and test the light with a plain switch or a jumper. If the light works with a plain switch, the dimmer has failed. Replace it with a dimmer rated for the actual load type (Arc Guide, Symptom 8).
4. If there is 0 V on the line side, work it as a dead circuit (R2.3).

D2. Flicker or buzz when dimmed

1. Check whether the lamps say "dimmable." A non-dimmable LED on a dimmer flickers and can fail early. The fix is dimmable lamps or a plain switch.
2. Check that the dimmer is rated for LED loads. An old incandescent-only dimmer (such as a standard 600 W rotary) is a common cause. Kuhlman's fix for LED dimming trouble is replacing the dimmer with the correct one, unless the LED is non-dimmable (p. 22).
3. Check the total load against the dimmer's minimum. One or two low-watt LEDs on a dimmer that needs a larger minimum load will flicker at the bottom of the range (Arc Guide, Symptom 8, Step 2). The fix is a dimmer rated for low LED loads or more lamps on the circuit.
4. Check the lighting manufacturer's compatibility list. Kuhlman says to always use the dimmer the lighting manufacturer lists (p. 22).
5. For buzzing, try another dimmer model known to work with that lamp. Kuhlman notes most LEDs buzz a little, some buzz louder when dimmed, and a correct pairing reduces it (p. 50). In one case, a customer with very sensitive hearing heard buzzing from some recessed trims with the correct dimmers; Kuhlman swapped trims one at a time until the customer was satisfied (p. 50).
6. If the flicker happens at full brightness too, and on lights not on a dimmer, it is not a dimmer problem. Go to R2.5.

D3. Will not dim low, or shuts off before it gets low

1. Find the low-end trim adjustment. On many LED dimmers it is a small slider or dial behind the faceplate or on the side of the dimmer (Kuhlman, p. 22; Arc Guide, Symptom 8, Step 4).
2. Turn the light to the lowest setting. Adjust the trim until the light stays on, steady, at the lowest setting. Then turn it off and on at the low setting to make sure it starts.
3. If the trim does not fix it, the dimmer type is wrong for the load. Replace it with one the lighting manufacturer lists.

D4. Lights glow or blink when off

1. Check whether the dimmer or switch is a no-neutral smart model or has a lighted handle (a locator light). These leak a small current through the lamp to power themselves.
2. Check whether the lamps are low-watt LEDs. The small leak can be enough to make an LED glow or blink.
3. If there is a neutral in the box, replace the device with one that uses the neutral. Connect the neutral to the device.
4. If there is no neutral, options are: add a neutral by running a new cable (scope for the office), use a model the manufacturer says works with that low load, or add the bypass or load accessory that some manufacturers sell for this purpose and install it per their instructions. Note the option on the job board for pricing.

D5. Hot dimmer

1. Feel the faceplate after the light has been on for 15 minutes at mid brightness. Warm is normal. Too hot to keep your hand on means trouble (Kuhlman, p. 26).
2. Add up the load. For incandescent or halogen, add the lamp watts. For LED, add the LED watts and compare to the LED rating on the dimmer, which is often lower than its incandescent rating.
3. Check for broken tabs. If tabs are broken off, use the derated value (Kuhlman, p. 23). If the derated value is less than the load, the dimmer is overloaded.
4. Check whether the dimmer controls a ceiling fan motor. A light dimmer on a fan motor can overheat the motor (Arc Guide, Symptom 8, Step 3). NEC 406.46(D) (2023: 404.14(E)) says general-use dimmers shall only control permanently connected loads such as incandescent luminaires unless listed for other loads. A fan motor needs a fan speed control listed for fans.
5. The fix is a dimmer with a rating above the load (Kuhlman mentions a 1,000 W model for larger loads, p. 23), splitting the load between two dimmers, or a fan speed control for a fan.

Safety: If the dimmer is discolored, melted, or smells burned, turn off the breaker and treat it as an R2.7 heat call.

D6. Smart dimmer or smart switch will not work right

1. Read the installation instructions for the exact model. Smart devices differ in how they wire.
2. Check for a neutral in the box. Look for white wires spliced together in the back of the box. Confirm with the meter: from the suspected neutral to ground should read 0–2 V, and from the hot to the suspected neutral should read about 120 V.
3. If the device needs a neutral and the box has none, the device will not work as designed. It may not power up, may reboot, or may flicker the light. Options: a no-neutral model that the manufacturer says will work with the actual load, or adding a neutral (scope for the office).

4. If there is a neutral, confirm it is connected to the device's neutral lead and that the line and load are not reversed. Many smart devices only work with line on the line terminal.
5. For three-way smart setups, check whether the system uses a companion (remote) device at the other location, and whether the companion needs a traveler or a neutral. Wire per the manufacturer's diagram. Old three-way switches cannot be mixed into many smart systems.
6. Pair the device with its app or hub per the instructions. Pairing is the customer's account and phone. Help them through it but do not set up accounts in your own name.

Do not use the ground as a neutral. Never land a smart switch's neutral lead on the bare ground wire. That puts current on the grounding system, which is what 406.50 prohibits for normal operation. If the device is listed and marked for retrofit use and puts a small current on ground by design, it may be used only where 406.30(C)'s exception applies.

Picture coming: Smart dimmer wiring in a single-gang box, drawn twice. Left: box with a neutral bundle; the smart dimmer's line lead to the incoming black, load lead to the black going to the light, neutral lead pigtailed into the white bundle, ground to the bare bundle. Right: switch-loop box with only a 14/2 (white re-marked black and black) and a bare ground, no neutral; a no-neutral smart dimmer connected to line and load only, with a callout "standby current flows through the lamp; low-watt LEDs may glow or blink." A red X over a wire drawn from the neutral lead to the ground bundle with the label "never use the ground as a neutral."

Part E: Light Stays On, Stays Off, or Is Dim

E1. Light stays on with the switch off

Questions: "Did someone just change the switch or the fixture? Is it on all the time, or does it come on by itself?"

Tests, in order:

1. Set the meter to AC volts. With the switch OFF, read each switch screw to ground (Part A, Test A2). If both screws read 120 V with the switch off, either the switch is shorted inside or the light is fed some other way.
2. Turn the breaker off. Take the switch out and test it on continuity. A single-pole switch should beep in ON and not beep in OFF. If it beeps in OFF, it has failed. Replace it.
3. If the switch tests good, the light is being powered without going through the switch. Look at the light box. Someone may have tied the fixture's black to an always-hot wire passing through the box instead of to the switch leg. Map the wires in the light box with Part B's twist-and-beep method.
4. For a smart switch or dimmer, a failed device can stay on. Pull the air-gap switch (a small tab most smart dimmers have) or turn off the breaker, wait 30 seconds, and power back up. If it stays on, replace the device.

E2. Light goes off but the socket is still live (switched neutral)

How you find it: With the light switch off, put the non-contact tester on the lamp socket's threaded shell or read the socket with your meter (black probe on ground, red probe on the threaded shell and then the center contact). If either reads 120 V with the switch off, the switch may be in the neutral.

Test: 1. At the switch, switch OFF, read each screw to ground. If neither screw reads 120 V but the light works when the switch is on, the switch is probably in the white (neutral) wire. 2. Turn the breaker off. Map the wires at the switch and the light.

Fix: Rewire so the switch opens the hot (406.30(B)). The neutral goes straight to the fixture's white lead (the socket shell). This is a safety finding. Write it on the job board with a photo.

Safety: A socket that is live with the switch off can shock someone changing a bulb. Tell the customer not to change bulbs on that fixture until it is fixed, and fix it today if you can.

E3. Light stays off

Work Part A or Part B for the switch. If the switch tests good and the fixture has power (Part A, Test A3), go to Part F.

E4. Light is dim

1. If the light is on a dimmer, set the dimmer to full. If it is still dim, bypass the dimmer with a plain switch for a test. A dimmer failing partly on is a common cause.
2. Read voltage at the fixture with the light on (hot to neutral). It should be about 114 to 126 V (Arc Guide, Part 3).
3. If the voltage is low at the fixture but normal at the panel, there is voltage drop on the circuit. A loose connection in a box between the panel and the light is the most likely cause (Arc Guide, Symptom 5, Step 4). Work it with R2.2's voltage drop test and R2.3's mid-pointing.
4. If several lights in the house are dim, and others are bright, stop. That is the lost-neutral pattern. Go to R2.5 now.
5. If the voltage at the fixture is normal and the light is still dim, it is the lamp or fixture. Try a known-good lamp, then go to Part F.

Part F: Fixture Faults: Lamp, Lamp Holder, Splice, Driver

Work every dead or flickering fixture in this order. Each step is quicker and more likely than the next.

Picture coming: LED fixture failure tree, one page, top to bottom. Box 1: "Try a known-good lamp." If it works, stop: lamp. Box 2: "Check socket center tab and contacts (power off)." If fixed, stop: socket. Box 3: "120 V at fixture supply splice, switch on?" No: go to Part A/B, switch or feed. Yes: Box 4: "Integrated LED or LV transformer? Read driver/transformer output against label." No output: driver or transformer failed. Output present, LEDs dark: LED board or module. A side box at the top: "Recessed can cycles on and off: thermal protector. Check lamp wattage and IC rating."

F1. Lamp

1. Turn the switch off and let the lamp cool.
2. Re-seat the lamp. A loose lamp is a common cause of flicker (Arc Guide, Symptom 5, Step 2).
3. Try a known-good lamp of the right base and type.

F2. Edison screw socket

Kuhlman says the most common socket problem is the center tab pushed down by years of bulb changes. The bulb stops making good contact, carbon builds up, and the light stops working. You can see black carbon on the tab and on the bulb's base (p. 48-49).

1. Turn the breaker off and prove the socket dead with your meter (black probe on ground, red probe on the shell and the center tab).
2. Look at the center tab with a flashlight.
3. If it is pushed flat, lift it slightly with a small insulated screwdriver. Kuhlman uses the tip of a non-contact tester to pull the tab out, and stresses the power must be off (p. 49).
4. If there is carbon, clean it off the tab and the bulb base with fine sandpaper or a contact cleaning tool (Kuhlman, p. 48-49).
5. If the socket is cracked, burned, or the tab breaks, replace the socket or the fixture.

F3. Recessed light that goes off and on by itself

Recessed lights have a thermal protector that shuts the light off when the housing gets too hot, then turns it back on when it cools. That causes cycling every few minutes (Kuhlman, p. 48; Arc Guide, Symptom 5, Step 3).

1. Read the label inside the housing. Write down the maximum lamp wattage and whether it is IC (rated for insulation contact) or non-IC.
2. Check the lamp wattage. A lamp over the label maximum causes cycling.
3. Look in the attic if you can get to it. NEC 410.116(B) says insulation shall not be installed above a recessed fixture or within 3 in. of its enclosure, wiring compartment, driver, or transformer unless the fixture is Type IC. Kuhlman warns that homeowners often push insulation back around non-IC cans after an electrician pulled it away (p. 48).
4. The fix is the right lamp wattage, pulling insulation back 3 in. from a non-IC can, or replacing the can or trim with an IC-rated LED unit. Write any insulation problem on the job board as a safety finding.

F4. Low-voltage lights (MR16 cans, puck lights, tape light)

Kuhlman notes that low-voltage recessed cans with MR16 bulbs have sockets that wear out from bulb changes, because they hold the bulb by pressure (p. 48). He also notes that many low-voltage transformers have a reset for short circuits, and that some LED tape lights need the correct polarity (p. 49).

1. Try a known-good lamp.
2. Find the transformer or driver. Read its label for input voltage, output voltage, and whether the output is AC or DC.
3. With the light switched on, read the transformer's input: AC volts, hot to neutral, should be about 120 V.
4. Read the output with the meter set to match the label (AC volts for most magnetic transformers, DC volts for most LED drivers). It should be close to the label (for example, 12 V or 24 V).
5. No output with good input: check for a reset button and press it. If there is no reset or it trips again, look for a short on the low-voltage wiring, then replace the transformer. Kuhlman notes transformers in outdoor lighting are often shorted and ruined (p. 49).
6. Output good, lights dark: check polarity on DC lights (red to +, black to –, per the product), and check the socket or connector.

F5. Integrated LED fixtures (no replaceable bulb)

Many flush mounts, wafer lights, and recessed retrofit trims have the LEDs built in. The parts are the driver and the LED board. This is the same method commercial Module 2.3 uses for a 277 V fixture, at 120 V. See the commercial LIGHTING masterclass for driver types.

1. Confirm 120 V at the fixture's supply splice with the switch on (Part A, Test A3). If there is no voltage, the problem is the switch or feed.
2. Turn the breaker off. Open the fixture to reach the driver. Read the driver's label: input voltage, output voltage range, output current, and whether the output is constant current or constant voltage.
3. Disconnect the driver's output from the LED board if the connector allows, or leave it connected and read across its terminals.
4. Turn the breaker on. Read the driver input (AC volts): about 120 V.
5. Read the driver output (DC volts) with the LED board connected. It should be inside the label's output voltage range.
6. Input good and output 0 V: the driver has failed. Replace the driver with one that matches the label (same output current and voltage range, same dimming type), or replace the fixture. Many low-cost fixtures cost less to replace than to repair; write both options for the office.
7. Output inside the range and LEDs dark: the LED board has failed, or the connector is bad. Check the connector. Replace the board or fixture.

8. If the fixture flickers and the driver output swings, try it on a plain switch to rule out the dimmer before you blame the driver.

Safety: A constant-current driver's output voltage can rise to its maximum with no LED board connected. Do not touch its output leads with the power on.

F6. Loose splice in the fixture box

1. Turn the breaker off and prove dead.
 2. Drop the canopy and look at every splice: incoming hot, neutral, ground, and any wires passing through to other lights.
 3. Tug each conductor in each wire connector. If any wire pulls out or the connector spins loose, remake the splice.
 4. Look for darkened or brittle insulation. Kuhlman shows a light box where too-hot bulbs cooked the wire insulation until it cracked when touched (p. 124). If the insulation crumbles, the conductors need to be cut back to good insulation, or the fixture moved to a new box with new cable, and the lamp wattage brought within the fixture label. That is a scope for the office if it needs wall or ceiling work.
 5. In old houses, the feed often comes into the light box and branches from there (Kuhlman, p. 78). A loose splice in a light box can kill other outlets and lights downstream. If other things on the circuit are dead, this may be the spot.
-

Worked Examples

Example 1: "The hall light only works from upstairs if the downstairs switch is down"

Intake. A handyman replaced the downstairs three-way last month because it was cracked. Since then, the downstairs switch acts like an on/off switch only some of the time, and the upstairs switch only works when the downstairs switch is down.

Five checks (R2.1). Breaker on, no GFCI involved, receptacle voltage 121 V, no overload, no flicker anywhere.

Test B1. At the downstairs switch with the meter on AC volts and the black probe on the ground: the common reads 0 V in one position and 120 V in the other. The traveler screw on the top left reads 120 V in both positions. That traveler screw has the always-hot wire on it. At the upstairs switch, the travelers read 120 V and 0 V only when the downstairs switch is down.

Diagnosis. The handyman put the incoming hot on a traveler screw and a traveler on the common, which is the Arc Guide's warning about mixing up the common when replacing a three-way (Job 3).

Fix. Breaker off, prove dead. Move the always-hot wire (the black from the 14/2 that comes from the panel) to the dark common screw. Move the black traveler from the common to the empty

traveler screw. Torque to the switch package value. Power on and test all four combinations; the light changes every time.

Document. Photo of the wiring before and after, the readings, "three-way common and traveler swapped at downstairs switch." No other findings.

Example 2: "My new LED cans flicker when I dim them"

Intake. The customer replaced six old 65 W incandescent can lamps with 9 W dimmable LED lamps. Now the lights flicker at low settings and won't go fully dim. The dimmer is the original rotary dimmer.

Read the dimmer. It is a 600 W incandescent-only rotary dimmer, no LED rating, no trim adjustment. Load: $6 \times 9 \text{ W} = 54 \text{ W LED}$.

Diagnosis. The dimmer is not made for LEDs, and has no low-end trim. Kuhlman's fix for this exact call is the correct LED dimmer (p. 22).

Fix. Breaker off, prove dead. Install an LED-rated dimmer listed by the lamp's maker (check the lamp package or the maker's website). Torque terminals. Power on. Set the low-end trim so the lights stay steady at the lowest setting and start from off at that setting. Test full range.

Document. Old dimmer model, new dimmer model, lamp model and count, how the trim was set.

If the customer had also complained about a hot dimmer before the LED change, the math would have been $6 \times 65 \text{ W} = 390 \text{ W}$ on a 600 W dimmer, which is within its rating. Kuhlman's 780 W example ($12 \text{ cans} \times 65 \text{ W}$) is what an overloaded 600 W dimmer looks like (p. 23).

Example 3: "The smart switch I bought doesn't work"

Intake. The customer bought a smart dimmer that needs a neutral. They took the old switch out, saw two wires, and stopped. The light now does not work.

Test. Breaker off, prove dead. The box has one 14/2 cable: a black and a white, plus a bare ground. No other cable enters the box. Breaker on, meter on AC volts: white to ground reads 120 V, black to ground reads 0 V with the white and black not connected. The white is the always-hot coming from the light box; this is a switch loop. There is no neutral here.

Options. The smart dimmer the customer bought cannot be installed here as designed. Do not put its neutral on the ground. Options for the office: (1) the same brand's no-neutral model, if the maker lists it for the customer's lamp type and wattage; (2) run a new 14/3 from the light to the switch to bring a neutral down, which needs wall and ceiling access.

Make it work today. Re-install a standard switch (or the customer's old one if it is good). Mark the white with black tape at both ends (200.8(C)(1)). Here the white is the supply to the switch, which is the only way a re-identified white is allowed in a switch loop. Torque, ground the switch, test.

Document. "Switch loop, no neutral at switch box. Customer's smart dimmer needs neutral. Options written for office." Photos of the box and the dimmer's instructions page.

Example 4: "Kitchen flush mount light died"

Intake. A 4-year-old integrated LED flush mount stopped working. The switch also controls a second fixture, which works.

Test A2. The switch reads correctly (120 V on both screws with the switch on). Since the second fixture on the same switch works, the switch and its feed are good.

Test A3 at the dead fixture. 120 V hot to neutral at the supply splice. Power reaches the fixture.

Test F5. Breaker off, open the fixture. Driver label: input 120 V AC, output 24–38 V DC, 300 mA, constant current. Breaker on: input reads 120 V; output reads 0 V DC with the board connected. The driver has failed.

Fix. The office prices two options: a matching driver (same 300 mA output and voltage range), or a new fixture. The customer chose the new fixture, which the office scheduled.

Document. Driver label photo, readings.

Common Mistakes

1. **Replacing a three-way without marking the common.** The new switch then works from one location only. Tape the common wire before you take it off (Arc Guide, Job 3).
2. **Guessing at a three-way by swapping wires until it works.** Each swap with power on is a risk, and you can end up with the hot on a traveler and a light that "works" in a confusing way. Read the voltages or map with the twist-and-beep test.
3. **Splicing neutrals together in two switch boxes.** This makes a parallel neutral (Kuhlman, p. 20) and causes AFCI and GFCI trips.
4. **Using the bare ground as a neutral for a smart switch.** It is not allowed for normal operation (406.50) and it puts current where it does not belong.
5. **Putting a light dimmer on a ceiling fan.** It can overheat the motor (Arc Guide, Symptom 8). Use a control listed for fans (406.46(D)).
6. **Ignoring broken tabs on ganged dimmers.** Each broken tab cuts the rating (Kuhlman, p. 23).
7. **Blaming the dimmer when the lamp is not dimmable.** Read the lamp package first.
8. **Not setting the low-end trim.** An LED dimmer with the trim at the factory setting can flicker or drop out at the bottom of the range.
9. **Working a light socket with the power on.** Lifting a center tab on a live socket can short the tab to the shell. Breaker off first.

10. **Missing the switched neutral.** If the socket is live with the switch off, the switch is in the neutral. That is a shock hazard and must be fixed.
 11. **Pushing insulation back over a non-IC can.** 410.116(B) requires 3 in. clearance unless the can is Type IC.
 12. **Chasing a dimmer when the whole house flickers.** Whole-house or multi-room flicker is a service or neutral problem (R2.5), not a dimmer problem.
-

Field Exercise

Setup. The journeyman uses the training wall with a working three-way circuit (two three-way switches, 14/3 between them, 14/2 to a lamp holder), a single-gang box with a smart dimmer and no neutral, and an integrated LED flush mount on its own switch.

Part 1: Find and fix a swapped traveler and common. 1. Out of your sight, the journeyman turns off the breaker, swaps a traveler and the common on one of the three-ways, and turns the breaker back on. 2. You work the light from both switches and describe the symptom in one sentence. 3. With the circuit on, take Test B1 readings at both switches. Write every reading in a table: switch, screw, handle position, voltage. 4. From the readings only, say which switch is miswired and which two wires are swapped. The journeyman tells you whether you are right before you touch any wire. 5. Turn the breaker off, prove dead, fix it, and test all four handle combinations. 6. Pass standard: correct diagnosis from readings on the first try, no wires moved with power on, and live-dead-live done before touching the screws.

Part 2: Smart dimmer with no neutral. 1. Install the no-neutral-required smart dimmer from the kit in the switch-loop box per its instructions, with a single 5 W LED lamp on the lamp holder. 2. Turn it on and off and dim it. Write down what the lamp does with the dimmer off (glow, blink, flicker) and at low settings. 3. Now replace the single 5 W lamp with three 9 W lamps. Write down what changed. 4. Explain to the journeyman, in two or three sentences, why the lamp misbehaved with the low load and no neutral, and what two fixes you would write up for the office. 5. Show where you would land the neutral if one were in the box, and say out loud why you will not use the ground.

Part 3: Dead LED flush mount. 1. The journeyman disables the fixture in one of three ways without telling you: the lamp board connector unplugged, the driver input lead disconnected, or the switch leg opened at the switch. 2. Work it in order: switch readings (Part A, Test A2), fixture supply reading (Test A3), driver input and output readings (F5). 3. Name the fault from your readings: feed, driver, or LED board/connector. 4. Pass standard: correct fault named from readings, with the readings written down in order.

Write-up. For each part, write a job board card with the complaint, readings, cause, fix, and how you verified it (R2.1, Part F).

NEC 2026 Cross-References

Section	What it says	How it applies here
406.30(A) (2023: 404.2(A))	Three-way and four-way switches shall switch only the ungrounded conductors	The travelers and commons are hots. The neutral never goes through a switch.
406.30(B) (2023: 404.2(B))	Switches shall not disconnect the grounded conductor (with limited exceptions)	A switch wired into the neutral is a violation and a shock hazard (Part E2)
406.30(C) (2023: 404.2(C))	The grounded conductor shall be installed at switch locations controlling lighting in bathrooms, hallways, stairways, and habitable rooms or occupiable spaces, with listed exceptions; exception for replacement or retrofit switches where a neutral can't be extended without removing finish materials	Why new work has a neutral at the switch and old switch loops do not; when a no-neutral smart device is allowed
406.40(B) (2023: 404.9(B))	Snap switches, dimmers, and control switches shall be connected to an equipment grounding conductor	Ground every switch you install
406.46 (2023: 404.14)	Switches shall be marked with their ratings and used within them; motor loads not over 80 percent of an ac general-use snap switch's ampere rating (406.46(A)(4))	Match the switch to the load
406.46(D) (2023: 404.14(E))	General-use dimmers and electronic control switches shall control only permanently connected loads such as incandescent luminaires, unless listed for other loads, and shall not exceed their rating	No light dimmer on a fan motor or a receptacle unless listed for it
406.50 (2023: 404.22)	Electronic control switches shall not introduce current on the equipment grounding conductor in normal operation, except listed retrofit devices under the 406.30(C) exception	Do not use the ground as a neutral
406.10(3)	Push-in terminals only on branch circuits of 15 A or less with 14 AWG solid copper (new in 2026)	No backstabs on 20 A or 12 AWG circuits
200.8(C)(1) (2023: 200.7(C)(1))	A white conductor in a cable may be re-identified as ungrounded by tape or paint at each termination and where visible; in switch loops it may only be the supply to the switch, not the return to the outlet	Tape the white in a switch loop; check that a white in a switch loop is the supply, not the switched leg
110.14(D)	Terminal torque to the value on the equipment or instructions	Every device you install
410.16	Luminaires in clothes closets: allowed types (enclosed LED or incandescent, fluorescent) and minimum clearances to the storage space (12 in. for surface enclosed incandescent or LED, 6 in. for surface fluorescent and for recessed)	When a closet light is the call, check the fixture type and clearance

Section	What it says	How it applies here
410.116(B)	Insulation not above or within 3 in. of a recessed luminaire's enclosure, wiring compartment, driver, or transformer unless Type IC	Recessed cans that cycle on and off
210.70(A)	Required lighting outlets in dwellings, controlled by a wall switch or listed wall-mounted control near the room entrance; stairway switch rules for six or more risers; 210.70(A)(4) limits dimmers on required stairway lighting unless they reach full brightness from each control	When a customer wants a dimmer on stairway lights, the control must reach full brightness at each location
314.27(B)	Boxes that are the sole support of a ceiling fan must be listed and marked for it, with weight marking over 35 lb and a 70 lb limit	Fan wobble or a fan on a plain light box

End-of-Chapter Checklist

Every switch or lighting call - [] Ran the R2.1 intake and five safety checks. - [] Found every switch that controls the light and wrote down what each one does. - [] Tried a known-good lamp before testing anything else. - [] Used live-dead-live before touching any screw or wire.

Single-pole - [] Read both switch screws to ground, OFF and ON. - [] Read hot-to-neutral and hot-to-ground at the light with the switch ON. - [] Used continuity on the switch leg with power off when the voltage tests were not clear.

Three-way and four-way - [] Found the constant hot with Test B1 readings. - [] Mapped the travelers with the twist-and-beep test when readings were not clear. - [] Tested each switch on continuity with power off. - [] Put the feed and the light wire on the commons, travelers on traveler screws. - [] Checked for parallel neutrals in two-gang switch boxes. - [] Tested every combination of every switch.

Dimmers - [] Read the dimmer model, rating, LED rating, tabs, and neutral. - [] Read the lamps: dimmable, watts each, how many. - [] Compared the load to the dimmer rating and minimum load. - [] Set the low-end trim. - [] Confirmed no light dimmer on a fan motor. - [] For smart devices: confirmed a neutral or a model listed for no-neutral use with this load; never used the ground as a neutral.

Fixtures - [] Checked the socket center tab with power off. - [] Checked the recessed can label (max watts, IC or non-IC) and the insulation clearance. - [] Read low-voltage transformer or LED driver input and output against the label. - [] Tugged every splice in the fixture box.

Close out - [] Switched neutral or other safety findings written up with photos. - [] Job board card complete: complaint, readings, cause, fix, verification. - [] Options for the office written without prices.

Sources

- Jesse Kuhlman, Residential Electrical Troubleshooting (2019). Pages cited: 13 (single-pole switches, backstabs, upside-down switches), 14 (three-way travelers and common, rule for spotting travelers, dead-end three-way), 15–20 (three-way layouts, feed at the light, 14/2 as travelers, parallel neutral mistake), 21 (four-way switches), 22 (two-pole switches, dimmer types, LED dimmer complaints), 23 (dimmer wattage, 780 W example, tab derating), 26 (warm dimmers), 48 (recessed lights, thermal cutouts, MR16 sockets, insulation clearance, Edison sockets), 49 (center tab repair, low-voltage transformers, polarity), 50 (LED buzzing, trim swap story), 75 (customer self-repairs), 78 (older homes with feeds at the light), 124 (photo of insulation cooked by too-hot bulbs). All paraphrased. No photos reproduced.
 - Arc Workforce, Residential Electrical Field Guide. Symptom 5 (flicker), Symptom 7 (switch not working), Symptom 8 (dimmer issues), Part 2 (switches), Part 3 (voltage targets), Jobs 3 and 9.
 - YES Electric commercial course, Module 2.3 (three-way exercise, fixture diagnosis) and LIGHTING masterclass (drivers).
 - NFPA 70, National Electrical Code, 2026 edition, sections listed above.
-

Videos to watch

These videos are made by other electricians and companies, not YES Electric. Watch each one after you read the section it goes with. Where a video does something differently from this module, the caution line says so. Follow this module and your journeyman, not the video. Click a title to open it on YouTube.

Section	Video
Part B Three-way switch faults	Troubleshooting 3-Way Switches: Why Does My 3-Way Switch Only Work Sometimes? Electrician U • 8:59 Electrician U troubleshoots a three-way that only works from one end: breaker off, pull the device slowly so nothing changes, and find a traveler landed on the common screw by reading cable sizes and colors. Caution: He identifies travelers partly by wire color and gauge; the module's Test B1/B2 meter method is the reliable way.
Part C Four-way switch faults	How To Fix a 4-Way Switch System Sparky Channel • 16:27 Sparky Channel checks that each box has the right switch type, checks terminals for loose back-wired screws, then separates the wires to find the line with power on and maps travelers with continuity. Caution: Uses an NCV to find the line wire with the wires capped in Wago lever nuts; confirm with a meter as in Test B1. Description is mostly affiliate links.
Part D, D2 Flicker or buzz when dimmed (dimmer and lamp compatibility)	How to Troubleshoot a Dimmer Switch Ask This Old House This Old House • 6:05 This Old House checks a dimmer on low-voltage track lights: confirms transformer type (electronic vs magnetic) matches the dimmer, then fixes the flicker by swapping non-dimmable LED lamps for dimmable ones. Caution: Low-voltage track case; the same method applies to line-voltage LED cans.
Part D, D2 and D4 Flicker, strobing, glow when off; neutral and low-end trim	LED Dimmer Strobing? The Real Fix for Flickering LED Lights (Not Your Wiring!)#LEDStrobing #LED Building Code Geek • 6:54 Explains why two-wire dimmers leak current through LED drivers, how to use the manufacturer's compatibility tool, raise the low-end trim, or switch to a neutral-wire dimmer. Caution: Talking head with slides; his own house.
Part D, D6 Smart dimmer or smart switch will not work right	Smart Switch Neutral Wire Wiring Mistake Remote Electrician • 6:23 Shows the common smart-switch mistake: pulling one neutral out of the splice to feed the switch breaks the neutral for the rest of the circuit; the fix is a pigtail into the existing splice, and each switch must use its own circuit's neutral. Caution: Demonstrated on a loose bundle of wires, not in a wall box.

Part F, F6 Loose splice in the fixture box

[How to Troubleshoot and Repair Lighting Problems](#)

Sparky Channel • 6:00

A light stays dead with new bulbs; the switch tests good, so the fixture comes down and the splices are three wires in undersized wire nuts with no ground, which are remade.

Caution: He measures 118 V at the fixture leads with the breaker on and the fixture down; keep the conductors apart and hands clear while live. Uses Wago lever nuts; YES uses whatever connector is listed for the wire count.