

Reading Wiring Diagrams & Schematics

YES Electric • Arc Workforce Academy HVAC Apprenticeship

Draft 1 (October 2026). This lesson is under review. Videos are made by other companies, not YES Electric; follow this lesson and your journeyman where they differ. Boxes marked "Shop photo coming" will get real photos from our shop in a later version.

Unit 3 • Electrical for HVAC I • Appendix A Competency 6 (applied) — the literacy lesson
Class time: ~4 hrs (1 video + 3 diagram table work)

1. What you'll be able to do

- Tell the two diagram dialects apart and use each for its job: **connection (pictorial) diagrams** — where wires physically land — vs **ladder (schematic) diagrams** — how the logic flows.
- **Find your way into any manufacturer diagram:** legend first, then power sources, then rails, then the rung you care about.
- Trace one circuit through a REAL furnace/condenser diagram and translate it to a ladder rung on paper.
- Use the diagram BEFORE the meter: predict what voltage belongs at each point, then verify — the discipline that makes Unit 6 diagnosis fast.
- Read the standard symbols: switches (NO/NC, pressure, temp, float), coils, contacts, loads, grounds, plugs/terminals.

The diagram is the unit's autobiography. Techs who won't read it diagnose by parts-cannon; techs who read it walk to the right component.

2. Tools & materials

- REAL diagram set (the binder): Carrier straight-cool condenser, Goodman 80% furnace, Rheem heat pump AHU, a packaged unit — laminated, one per team
- The shop units' own door-panel diagrams
- Highlighters (3 colors: line voltage, 24 V, the circuit being traced)
- Symbol legend cards (ours, laminated)

3. Watch first

Order	Video	Channel	Length	Why
1	How to Read AC Schematics and Diagrams Basics	HVAC School	19:53	The two dialects, properly introduced
2	Reading HVAC Electrical Wiring Diagrams for Troubleshooting	AC Service Tech	17:49	Diagram → meter → verdict
3	Straight Cool AC Schematic (Carrier)	HVAC School	8:29	A real one, walked through
4	Wiring Diagram Tracing — Older Rheem Condenser	HVAC School	13:01	Tracing on ugly reality
5	How to Read a Heat Pump Wiring Diagram — Schematic & Connection	AC Service Tech	14:48	Preview of Unit 8's diagrams

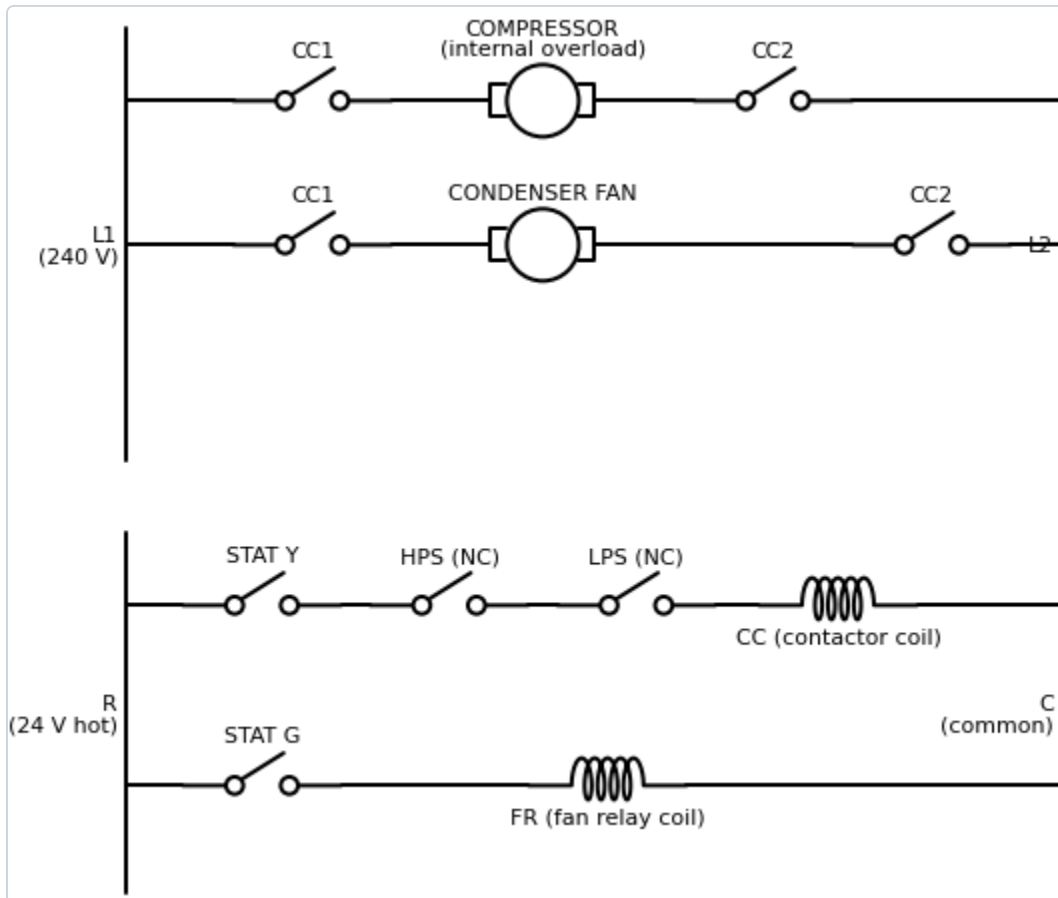
4. The idea

Two dialects, one truth

	Connection (pictorial)	Ladder (schematic)
Shows	Components where they physically sit, wires as they physically run, wire COLORS	Pure logic: rails + rungs, one circuit per line
Best for	"Which terminal does the brown wire land on?" — installs, replacements	"Why isn't the fan running?" — diagnosis
Looks like	A drawing of the box's guts	Lesson 3.3's ladders
On the unit	Usually both printed on the same door sticker	—

Most manufacturer stickers print both, sharing one legend. **Replacement work reads the pictorial; troubleshooting reads the ladder.** Translating between them is today's core skill.

Our reference ladder (code-drawn, correct by construction)



Read it aloud, rung by rung, the way you'll narrate at the unit: - **Rung 1 (240 V):** L1 → contactor contacts CC1 → compressor (with its internal overload) → CC2 → L2. The muscle. - **Rung 2 (240 V):** L1 → CC1 → condenser fan motor → CC2 → L2. Fan rides the same contacts. - **Rung 3 (24 V):** R → stat Y → high-pressure switch (NC) → low-pressure switch (NC) → contactor coil CC → C. The brain rung that closes Rungs 1-2. - **Rung 4 (24 V):** R → stat G → fan relay coil → C; relay's contacts start the indoor blower (drawn on its own line-voltage rung).

Every cooling no-run you'll ever diagnose is a break SOMEWHERE on rungs 3/4 (brain) or 1/2 (muscle). The ladder turns "it's dead" into an address.

How to enter any manufacturer diagram (the 5-step entry)

1. **Legend first.** Two minutes with the symbol table beats twenty minutes of squinting. Every brand abbreviates differently (CC, C, CONT all = contactor).
2. **Find the power sources.** Mark L1/L2 entry and the transformer. Highlight line voltage one color, 24 V another. The diagram now has geography.
3. **Find the rails.** R and C (or 24V/COM). Everything between them is a rung.
4. **Pick your circuit and trace it** — finger or highlighter, source → switches → load → return. Say it aloud.

5. **Predict, then measure.** Before probes: "across this closed pressure switch I expect ~0; across the coil I expect 24." The diagram makes the meter surgical.

Symbols you must own

NO/NC contacts (and the device flavors: thermal limit, pressure, float, sail), coils (round = relay/contacter coil), loads (motors M-in-circle, heaters as resistor zigzag, lamps), the dashed line (mechanical link — one armature moving multiple contacts, 3.6's DPST), terminals/plugs (where diagrams hand off between boards and field wiring — and where diagrams most often "lie" because field wiring changed), chassis ground. The legend card covers the long tail.

When the diagram and the unit disagree

Thirty-year-old units carry three generations of repairs. Wire colors will have been improvised (3.1's rule); components substituted (a universal fan relay where a fan center was). **The diagram describes the design; the meter describes the reality.** When they disagree, trust the meter, then UPDATE the diagram — pencil corrections on the door sticker are professional courtesy to the next tech (often future-you).

5. Table & bench procedure

1. **Legend scavenger:** each team's diagram — find and mark: both power sources, transformer, rails, every safety, every load. Three-color highlight. Teams swap and check.
2. **Translate pictorial → ladder:** from the Goodman furnace pictorial, draw the W (heat call) circuit as a ladder rung on paper. Compare to the printed schematic side. Where did the pictorial hide the logic?
3. **Trace-aloud relay:** each student traces one assigned circuit aloud (Y, G, W, defrost on the HP diagram) — graded on naming every device crossed and its expected state.
4. **Predict-then-measure (shop unit):** pick the Y circuit on OUR condenser's real diagram; write the predicted voltage at 5 points; energize (instructor); measure all 5. Score predictions.
5. **The liar's diagram:** instructor's rigged unit has one field modification vs its sticker (a substituted relay). Find where reality forked from paper — and pencil the correction like a professional.

Checkout: hand the student an unfamiliar manufacturer diagram: 5-step entry narrated, one circuit traced aloud flawlessly, one translation to ladder, one predict-then-measure round (4 of 5 predictions correct).

6. Field gotchas

- **The door sticker is faded/torn/painted?** Model number + manufacturer site or app gets you the PDF in two minutes. No diagram, no guesswork — download it.

- **"I don't need the diagram for a cap swap"** — true until the previous tech moved HERM to a single cap + jury-rigged fan wiring. Pictorials take 90 seconds; comebacks take 90 minutes.
- **Dashed mechanical links are the trap question** of every diagram test: two contact sets, one coil — energizing one rung moves contacts in ANOTHER rung. Miss the link and circuits seem haunted.
- **Plug/terminal handoffs**: a circuit that "disappears" usually went through a molex to another board page. Follow the terminal NUMBER, not the line.
- **Heat pump diagrams double everything** (O/B, defrost board contacts in multiple rungs) — that's Unit 8; today's skills are exactly what makes those readable.

7. Competency link

- Completes the **Comp 6** literacy arc (measure 3.2 + circuits 3.3 + diagrams here).
- The entry ritual + predict-then-measure = the method of every Unit 6/7/8 diagnostic lesson. Comp 20 leans on this lesson hard.

8. Check yourself

1. Pictorial vs ladder — what does each show, and which do you grab for a no-cool diagnosis?
 2. The 5-step entry, in order.
 3. On the reference ladder: a cooling call does nothing, but you measure 24 V across the LOW-pressure switch. What did you just learn? (It's open — and it's the address.)
 4. What does a dashed line between contact sets mean?
 5. Where do diagrams most often disagree with reality, and which wins?
 6. Why does the fan relay COIL live on a 24 V rung while its CONTACTS live on a line-voltage rung?
 7. Trace rung 3 aloud from memory.
 8. Your prediction said ~0 across a closed limit; the meter says 24. Translate.
 9. What do you do for the next tech when you find a field modification?
 10. A circuit vanishes into "PL2-4" on the diagram. What's happening and how do you follow it?
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