Heater Driver v4 — 24-Step Bring-Up & Test Checklist

12 V / 100 W (8.33 A) low-side heater driver · rev 4.0 (all through-hole) · 2026-10-17 · Board S/N: _____ · Tester: _____ · Date: _____

Safety: 8+ A circuits get hot and arc. Use a bench supply with current limit for steps 6–12, eye protection for steps 18–22, and keep the 15 A ATM fuse fitted for every powered test after step 5.

A. Visual & unpowered checks (fuse F1 removed)

#	Check	Expected	Pass
1	Inspect solder joints (power pins J1, J2, F1, Q1, RS1 especially). Check polarity: C1 (+ = square pad), D1 / TVS1 / ZD1 / D2 bands, LEDs (flat = K), U1/U2/U3 pin-1 notch, Q1 metal tab facing the board edge (body toward J2).	No bridges, all polarities match silkscreen / assembly drawing	
2	Ohmmeter J1 +12V to J1 GND (both directions).	> 1 kΩ after C1 charges; no dead short	
3	Diode test J2 HEAT− (red) to J2 HEAT+ (black) — i.e. across D1.	0.15–0.35 V forward; open in reverse	
4	Isolation: J3 PWM− and PWM+ to board GND (J1 GND). Optional 500 V insulation tester.	> 10 MΩ (open). Isolated side must not touch board GND.	
5	Shunt RS1 (OAR-3 strap): 4-wire measurement between the two small Kelvin copper squares next to its legs. NTC TH1 at room temperature.	RS1 10 mΩ ± 1 % (plain DMM: < 0.1 Ω) · TH1 ≈ 10 kΩ at 25 °C	

B. Power-up, no load (fit 15 A ATM fuse; bench supply 12.0 V, limit 100 mA)

#	Check	Expected	Pass
6	Supply current with J3 open, J2 open.	< 20 mA (typ. 3–8 mA)	
7	LEDs after power-up.	D3 RED off (no false latch at power-on), D4 GREEN off	
8	DC voltages vs GND: VREF (U3 pin 5), TRIP_N (U3 pin 6), LATCH_P (U3 pin 7), FAULT (U3 pin 1), TEMP (U3 pin 11), TREF (U3 pin 10).	VREF 119 mV ± 4 mV · TRIP_N 6.0 V · LATCH_P 4.0 V · FAULT < 0.3 V · TEMP ≈ 6 V at 25 °C · TREF 1.19 V	
9	Driver input DRV_IN (U1 pin 2) and Q1 gate-source with J3 open.	Both ≈ 0 V (fail-safe OFF)	

C. Isolated input & gate drive

#	Check	Expected	Pass
10	Apply 3.3 V DC to PWM+ (PWM− to the MCU/source ground, not board GND). Measure across R1, DRV_IN and Q1 Vgs.	V(R1) ≈ 2.1 V (6.4 mA) · DRV_IN 8–10 V · Vgs 11.5–12 V · repeat at 5 V: V(R1) ≈ 3.8 V	
11	Remove the input.	Vgs back to 0 V in < 1 ms	
12	Reverse the input (−5 V on PWM+).	No damage, D2 clamps, Vgs stays 0 V	

D. Load tests (heater or 1.44 Ω / ≥150 W dummy load; supply 12 V, ≥ 12 A capable)

#	Check	Expected	Pass
13	PWM 100 Hz, 50 % from MCU.	D4 GREEN follows PWM; average current ≈ 4.2 A	
14	100 % ON. Measure current, V(RS1 Kelvin pads), Q1 Vds.	8.3 A ± 5 % · 83 mV · Vds < 0.03 V (IRFB7430, 1.3 mΩ)	
15	Thermal soak 15 min at 100 %, 25 °C ambient (IR thermometer).	Q1 tab < 45 °C · RS1 strap < 90 °C (0.7 W in a 3 W part) · board at TH1 < 60 °C · J1/J2 < 50 °C · F1 < 60 °C · D3 stays OFF	

16	Scope Q1 gate at 1 kHz PWM.	Rise/fall < 1 µs; peak ≤ 15 V (ZD1 clamp)	
17	Scope Q1 drain (HEAT−) at turn-off.	Overshoot < 25 V (D1 / TVS1 clamp)	

E. Protection (eye protection on)

#	Check	Expected	Pass
18	Overcurrent: add 2.2 Ω in parallel with the 1.44 Ω load (≈ 13.8 A) and switch ON.	Trips: D3 RED on, gate off, current 0 within < 20 µs	
19	Keep PWM running, remove the extra load.	Stays latched OFF (D3 on) — no auto-restart	
20	Press RESET (SW1) briefly.	D3 off, normal operation resumes	
21	Re-apply the overload, then press and HOLD RESET for ~2 s.	Only short current pulses (avg < 5 A), no sustained overcurrent; on release D3 latches on again	
22	Over-temperature: heater running at 50 % PWM, warm TH1 with a hot-air gun / hair dryer (keep it off the plastic parts). Then let it cool and press RESET.	At ≈ 84 °C on TH1: D3 RED on, heater OFF and stays off. RESET while still hot does nothing; after cooling RESET restores operation.	
23	Power-cycle while latched.	After power-on, D3 is off (latch resets at power-up)	
24	Final: 15 A ATM fuse fitted, terminals torqued (0.5–0.6 N·m), label S/N, optional conformal coat (mask J1–J3, F1, SW1).	Ready for service	

(Optional extra: dead short across J2 through a rated switch — trips in ~10 µs, fuse intact.) Trip threshold is ratiometric with the supply: 11.9 A at 12.0 V, 13.6 A at 13.8 V, 14.3 A at 14.4 V. Heater current scales the same way, so the ~43 % margin is preserved. Heaters with a high cold-start inrush (halogen or PTC types) may trip; resistive NiCr / cartridge heaters are fine.