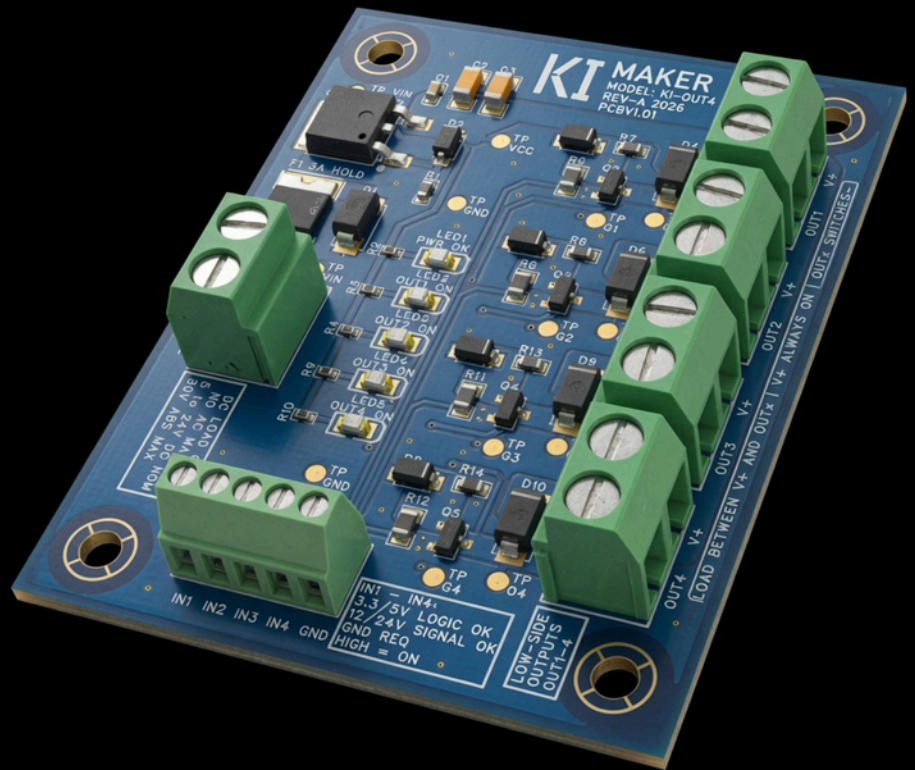


OUT-4

Owner's Manual

Protected 4-Channel Low-Side DC Output Driver

For Arduino, ESP32, Raspberry Pi, STM32, CNC controllers, PLC-style DC signals, and maker automation projects.



5-24 VDC NOMINAL

30 VDC ABSOLUTE MAX

DC LOADS ONLY

NO AC MAINS | LOAD BETWEEN V+ AND OUTx | OUTx SWITCHES LOW SIDE

READ THIS FIRST

Before wiring or applying power

WARNING - LOW VOLTAGE DC MODULE ONLY

The KI Maker OUT-4 is a bare low-voltage DC electronics module. Use it only for DC load switching. Mount it on insulated standoffs, keep it away from conductive surfaces, and remove power before wiring or changing connections.

Five rules before power-up

- Use only a DC supply on CN1. Recommended use is 5-24 VDC nominal. Never exceed 30 VDC absolute maximum.
- Never connect AC mains anywhere on the board.
- Wire each load between V+ and OUTx. OUTx is the switched low-side connection.
- Always connect controller GND to the OUT-4 GND reference.
- IN1-IN4 are logic/control inputs. HIGH turns the commanded output ON.

NOT A CERTIFIED SAFETY DEVICE

This board is not for medical, life-safety, automotive safety, emergency-stop, mains-control, or other fail-safe applications.

DC ONLY

Do not use AC mains

30 V MAX

Absolute limit

COMMON GND

Required for inputs

LOAD PATH

V+ to OUTx

HIGH = ON

Input command

POWER OFF

Wire before power

Welcome to the KI Maker Family!

Congratulations on acquiring the KI Maker OUT-4 Protected Output Driver Board. This manual is your guide to setting up, wiring, testing, and safely using the board to switch real-world low-voltage DC loads from Arduino, ESP32, Raspberry Pi, STM32, CNC, and PLC-style control signals.

This manual is written to be practical: clear wiring rules, honest ratings, realistic warnings, and includes test points you can actually measure.



Inside this manual

Getting Started
First safe power-up

Feature Overview
What the board does

Safety Instructions
Avoid misuse

Troubleshooting
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Ratings and revision

Support
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KI MAKER PROMISE
Clear wiring, honest ratings, and maker-friendly documentation. If a rating is not finalized, the manual says so instead of overstating it.

Quick Start: Read This Before Wiring

This section is the short version for first-time users. It does not replace the rest of the manual. Use it to prevent the most common output-driver wiring mistakes before applying power.

WARNING - POWER OFF BEFORE WIRING

Always remove input power before wiring loads, moving controller connections, changing supply wiring, or attaching probes to uncertain nodes.

Recommended first test

- Place the board on an insulated surface or standoffs.
- Connect a current-limited DC bench supply to CN1 with correct polarity.
- Leave all external loads disconnected.
- Verify PWR OK turns on.
- Connect controller GND to CN2 GND.
- Apply one input signal at a time and verify the matching OUT LED.
- Add one small load at a time and re-check voltage and temperature.

Before you continue

DC supply only

No AC input

No AC mains

Never connect line voltage, anywhere

Common GND required

Your Controller and board

Load = V+ to OUTx

Correct path

HIGH = ON

Input behavior

Start with one load

Check temperature

Product Overview

The KI Maker OUT-4 Rev-A is a compact low-voltage DC output driver board intended to let low-power control electronics switch real-world DC loads safely and cleanly. It is designed for maker projects, small control panels, benchtop systems, enclosure accessories, CNC add-ons, 3D printer modifications, and educational builds.

The board uses four low-side N-channel MOSFET output channels. Each load connects between V+ and its matching OUT+ terminal. When the matching input is driven HIGH, the MOSFET switches OUTx to ground and the load turns on.

Primary functions

- Accepts a DC load supply through CN1.
- Provides a fused load-side V+ rail.
- Switches four independent low-side outputs: OUT1, OUT2, OUT3, and OUT4.
- Accepts IN1-IN4 control signals from Arduino, ESP32, Raspberry Pi, STM32, CNC controllers, or PLC-style DC outputs.
- Supports 3.3 V and 5 V logic use, with protected input conditioning for accidental 12/24 V style signals.
- Provides a PWR OK LED and one output status LED per channel.
- Includes paired V+/OUT terminal blocks; this helps make the onboard fly back path easier to use correctly with inductive loads.

Protection features

- Board-level reverse-polarity MOSFET protection on the input side.
- Input PPTC resettable fuse, marked F1 3A HOLD.
- Input TVS surge clamp.
- Per-channel Schottky flyback diodes for common inductive DC loads.
- Gate resistors, pull-downs, and 12 V gate clamp zeners.

Typical Users and Boundaries

Typical users

- Makers building 5V / 12 V or 24 V accessory systems.
- Arduino, ESP32, Raspberry Pi, and STM32 users driving loads.
- CNC and 3D printer users adding fans, lights, relays, solenoids, or pumps.
- Technicians evaluating low-voltage DC control wiring.
- Educators demonstrating MOSFET low-side switching.

Not intended for

- AC mains or line-voltage wiring anywhere on the board.
- Certified safety, emergency-stop, medical, life-support, or automotive safety systems.
- Isolated relay-contact behavior.
- Switching loads above the tested voltage/current/thermal rating.
- Use without an enclosure where conductive debris, fingers, or tools can contact the board.

What This Board Does / Does Not Do

Does	Does Not
Lets small control signals switch real 5-24 VDC loads.	Does not generate 12 V or 24 V power by itself.
Keeps wiring cleaner than loose MOSFET modules or breadboard jumpers.	Does not switch the positive side of the load; it switches the negative/low side.
Provides four matching channels for outputs OUT1-OUT4.	Does not isolate the controller from the load supply.
Makes each channel easy to test using LEDs and test pads.	Does not make any load safe automatically. Verify voltage, current, polarity, and thermal limits.

Specifications

These values describe the Rev-A prototype documentation state. Final continuous-current ratings must be set only after thermal/current validation.

Category	Item	Specification / status
Electrical	Load supply input	5-24 VDC nominal, 30 VDC absolute maximum
Electrical	Output type	Four low-side N-channel MOSFET switched outputs
Electrical	Logic inputs	IN1-IN4, 3.3 V / 5 V logic compatible, HIGH = ON
Electrical	12/24 V input tolerance	Protected input conditioning for accidental 12/24 V style sourcing
Protection	Input reverse polarity	Board-level P-MOSFET reverse-polarity protection
Protection	Input fuse	F1 resettable PPTC, 3 A hold
Protection	Surge clamp	Input TVS diode on supply side
Protection	Output flyback	SS34 per-channel flyback diodes on CN3-CN6 output pairs
Protection	Gate protection	Gate resistors, pull-downs, and 12 V zener clamps
Mechanical	Mounting	Four M3 mounting holes, insulated standoffs recommended
Environmental	Use condition	Indoor/prototype/maker electronics, protect from conductive debris
Current / PWM	Current rating	Pending thermal validation - do not publish final current yet
Current / PWM	PWM note	Use conservative low-frequency switching only until thermal testing is complete. Verify MOSFET temperature during 3.3 V drive tests.

CURRENT RATING STATUS

Do not add a continuous current rating until prototype thermal testing confirms MOSFET, connector, fuse, copper, enclosure, airflow, and duty-cycle limits.

Low-Side Switching Explained

Low-side switching means the load positive side connects to V+, while the board switches the load negative side at OUTx. This is simple, efficient, and easy to test with maker control electronics.



IMPORTANT WIRING RULE

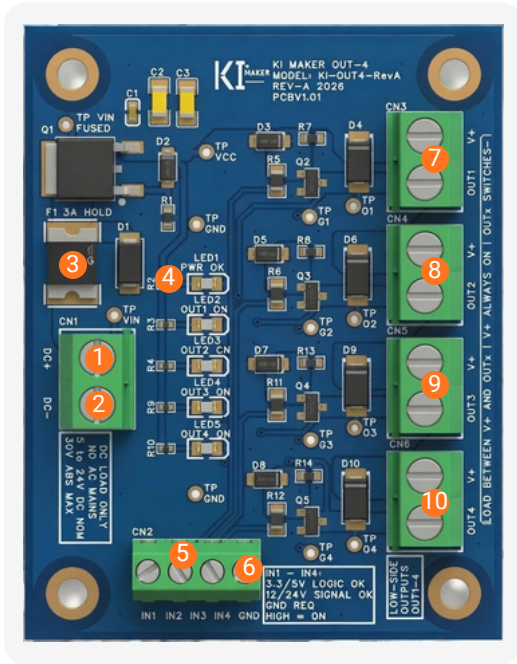
The load is wired between V+ and OUTx. Do not wire the load between OUTx and GND. V+ may be present at the load connector whenever the board is powered.

Why the ground connection matters

The input signal must be measured relative to the board ground. If the controller ground is not connected to CN2 GND, the OUT-4 may not see a valid HIGH/LOW input state.



Connector Map and Board Labels



#	Label	Function	Wiring note
1	CN1 DC+	Load supply positive	5-24 VDC nominal, 30 V max
2	CN1 DC-	Supply negative / GND	Connect to supply negative
3	F1	Resettable input fuse	3 A hold PPTC
4	LED1 PWR OK	Power indicator	On when fused supply is present
5	CN2 IN1-IN4	Logic/control inputs	HIGH turns matching output ON
6	CN2 GND	Logic reference	Must connect to controller GND
7	CN3	V+ and OUT1	Load between V+ and OUT1
8	CN4	V+ and OUT2	Load between V+ and OUT2
9	CN5	V+ and OUT3	Load between V+ and OUT3
10	CN6	V+ and OUT4	Load between V+ and OUT4
-	D4/D6/D9/D10	Flyback diodes	Clamp common inductive spikes
-	TPs	VIN, VCC, GND, G1-G4, O1-O4	Troubleshooting points

BOARD SILKSCREEN REMINDER

The PCB marks NO AC MAINS, DC LOAD ONLY, and LOAD BETWEEN V+ AND OUTx. Treat those markings as wiring rules, not decoration.

Connector Pinout Table

Use this table when wiring the board. Connector names match the PCB silkscreen.

Connector	Pin / label	Net / function	User connection guidance
CN1	DC+	VIN input	Connect to DC supply positive. 5-24 VDC nominal, 30 V absolute
CN1	DC-	GND input	max. Connect to DC supply negative.
CN2	IN1	Channel 1 input	Controller GPIO/control output. HIGH turns OUT1 ON.
CN2	IN2	Channel 2 input	Controller GPIO/control output. HIGH turns OUT2 ON.
CN2	IN3	Channel 3 input	Controller GPIO/control output. HIGH turns OUT3 ON.
CN2	IN4	Channel 4 input	Controller GPIO/control output. HIGH turns OUT4 ON.
CN2	GND	Logic reference	Must connect to controller ground.
CN3	V+	Ch.1 load positive	Connect load positive side.
CN3	OUT1	Ch.1 switched low side	Connect load negative side.
CN4	V+	Ch.2 load positive	Connect load positive side.
CN4	OUT2	Ch.2 switched low side	Connect load negative side.
CN5	V+	Ch.3 load positive	Connect load positive side.
CN5	OUT3	Ch.3 switched low side	Connect load negative side.
CN6	V+	Ch.4 load positive	Connect load positive side.
CN6	OUT4	Ch.4 switched low side	Connect load negative side.

CONNECTOR WIRING RULE

Load positive goes to V+. Load negative goes to OUTx. Do not wire the load between OUTx and GND.

LEDs and Indicators

Indicator	Meaning	Normal behavior
LED1 PWR OK	Fused supply present	ON when CN1 is powered correctly and F1 is not tripped.
LED2 OUT1 ON	Channel 1 active	ON when IN1 commands OUT1.
LED3 OUT2 ON	Channel 2 active	ON when IN2 commands OUT2.
LED4 OUT3 ON	Channel 3 active	ON when IN3 commands OUT3.
LED5 OUT4 ON	Channel 4 active	ON when IN4 commands OUT4.

Test Points

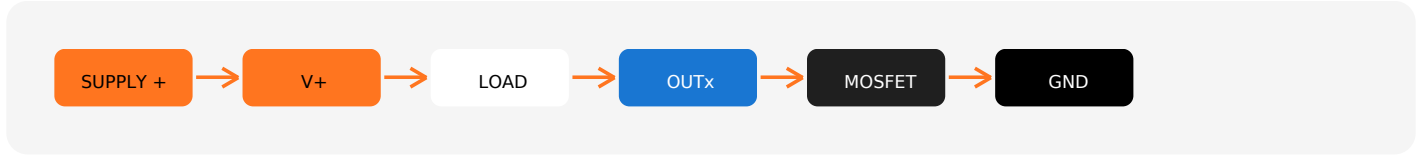
Test point	Use
TP VIN	Raw input voltage from CN1.
TP VIN FUSED	Voltage after F1 PPTC fuse.
TP VCC	Protected/fused load-side rail.
TP GND	Ground reference for measurements.
TP G1-G4	MOSFET gate drive nodes.
TP O1-O4	Switched output nodes.
TP IN1-IN4	Input command nodes when available on board/revision.

METER RULE

Measure voltage between the target test point and TP GND. Start with a current-limited supply and no load installed.

Example Wiring

All examples use the same low-side switching pattern: load positive to V+, load negative to OUTx, and controller ground to CN2 GND.



LED STRIP

LED + -> V+, LED - -> OUT1
 Controller pin -> IN1

DC FAN

Fan + -> V+, Fan - -> OUT2
 GPIO/control -> IN2

RELAY / SOLENOID

Coil + -> V+, Coil - -> OUT3
 Check inductive rating

PUMP / MOTOR

Motor + -> V+, Motor - -> OUT4
 Watch stall current

INDUCTIVE LOADS

Relay coils, solenoids, motors, pumps, and valves can produce voltage spikes. The paired V+/OUT terminal layout helps keep the onboard flyback path straightforward, but you must still verify current, polarity, and duty cycle.

Troubleshooting

Issue	What to check first
No PWR OK LED	Check CN1 polarity, supply voltage, current limit, TP VIN, TP VIN FUSED, and F1 state.
Channel does not turn on	Check controller GND to CN2 GND, input voltage at INx, OUTx LED, and load wiring between V+ and OUTx.
Fuse trips / board hot	Check overload, shorted load, motor stall current, supply voltage, total current, and enclosure airflow.
Inductive kick / odd behavior	Check load type, flyback path, wiring length, supply stability, and whether the load needs external suppression.
Input miswiring	If 12/24 V was accidentally applied, inspect input behavior, gate voltage, and channel status before connecting a load.
Load always on	Check if load negative is tied directly to GND, input stuck HIGH, or MOSFET damage.
Controller resets	Check shared supply noise, insufficient supply current, ground reference, and inductive load spikes.

Troubleshooting order

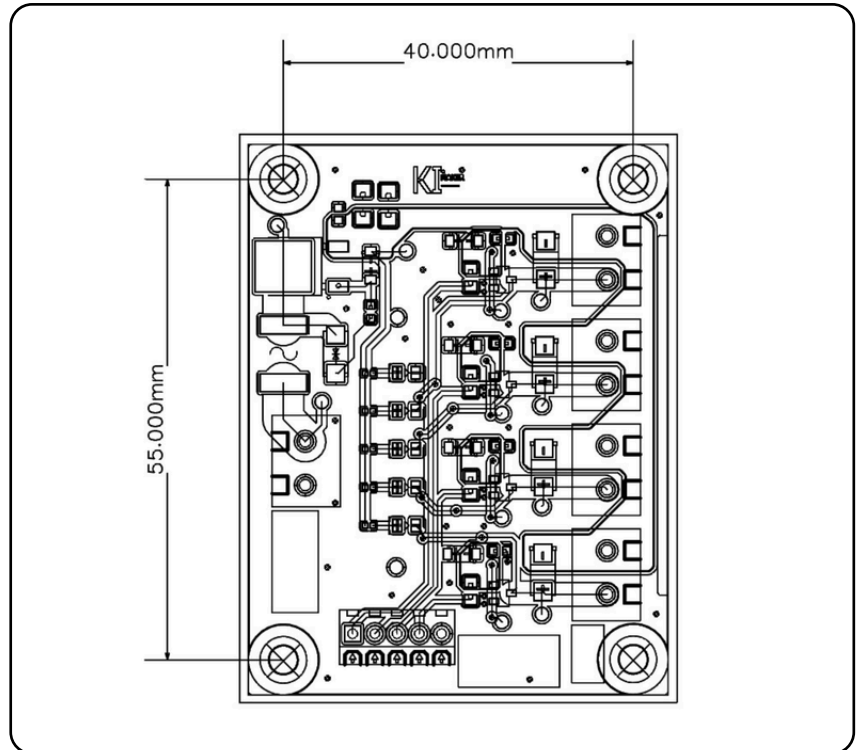
- Power off first, then visually inspect wiring.
- Power with no load and confirm PWR OK.
- Measure TP VIN, TP VIN FUSED, and TP GND.
- Command one input at a time and confirm the matching OUT LED.
- Connect one small load and check temperature before adding more loads.

Mechanical and Board Dimensions

Use the mechanical drawing for enclosure planning and standoff placement. Verify against the final fabrication drawing before ordering drilled panels or machined enclosures.

Dimensions

- Total board size: 50.00 mm x 65.00 mm.
- Mounting-hole spacing: 40.00 mm horizontal center-to-center.
- Mounting-hole spacing: 55.00 mm vertical center-to-center.
- Mounting hardware: M3 standoffs recommended.
- Mounting method: insulated standoffs only; do not mount directly to conductive metal.
- Board orientation: keep terminals accessible and allow room for screwdriver access.



ENCLOSURE PLANNING NOTE

The image shows the mounting-hole center spacing, not a full enclosure cutout template. Keep clearance around screw terminals, wire bend radius, standoff heads, and any cover or lid.

Mounting guidance

- Use the four M3 mounting holes with insulated standoffs.
- Keep wiring strain off the screw terminals.
- Use an enclosure for public, child-accessible, dusty, or conductive-debris environments.
- Check board temperature during first load testing and after enclosure installation.

Revision History and Support

Revision history

Item	Value
Product	KI Maker OUT-4 Protected Output Driver Board
Model	KI-OUT4-RevA
Board Revision	Rev-A
PCB Version	PCBV1.01
Manual Revision	v1.0 Draft
Manual Date	06/01/2026
Manual status	Prototypedocumentation; final current ratings pending thermal/current testing.

When asking for support, include

<p>Wiring photo ShowCN1/CN2/load</p>	<p>Supply voltage Measure at TP VIN</p>	<p>Load details Typeandcurrent</p>
<p>LED behavior PWROKandOUT LEDs</p>	<p>Test pad readings VIN, VCC, OUTx</p>	<p>Controller type Arduino/ESP32/etc.</p>

SUPPORT CHECKLIST

Include clear photos of your wiring, supply voltage, load type, controller type, LED behavior, and voltage readings at the relevant test pads. This helps identify wiring and load issues faster.

LOW-VOLTAGE DC ONLY | NOT FOR AC MAINS | OBSERVE POLARITY | VERIFY LOAD CURRENT