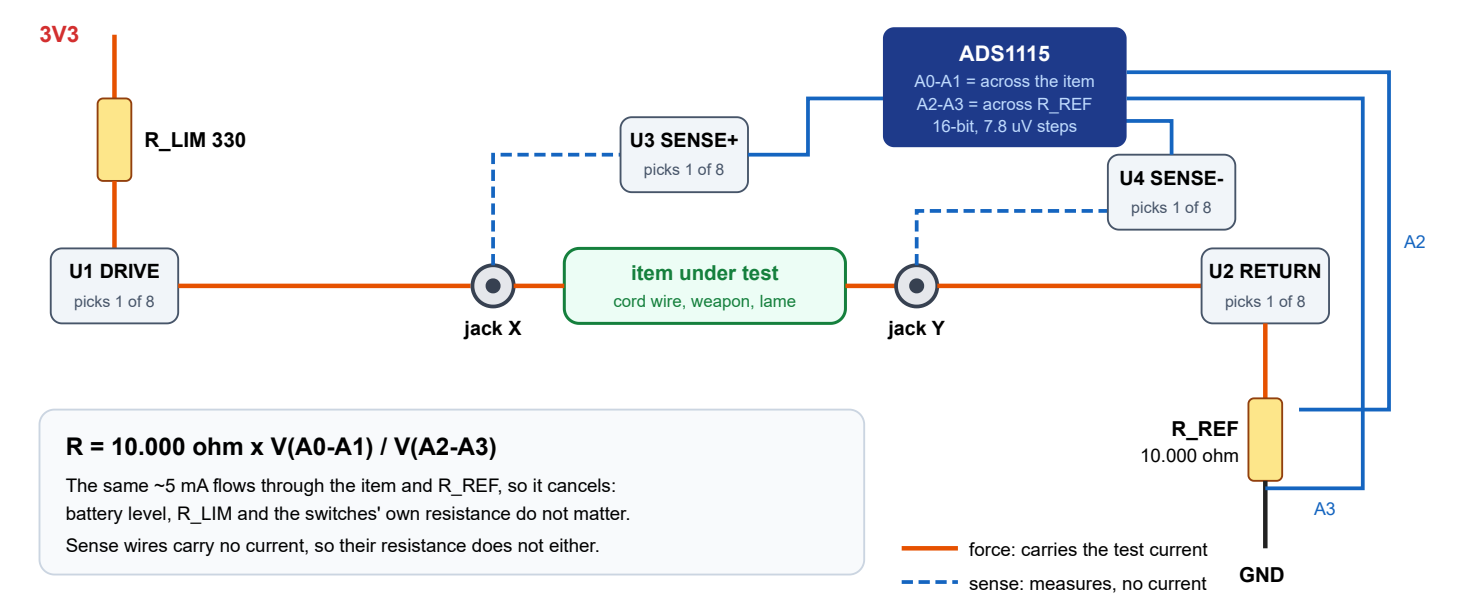


How one measurement works



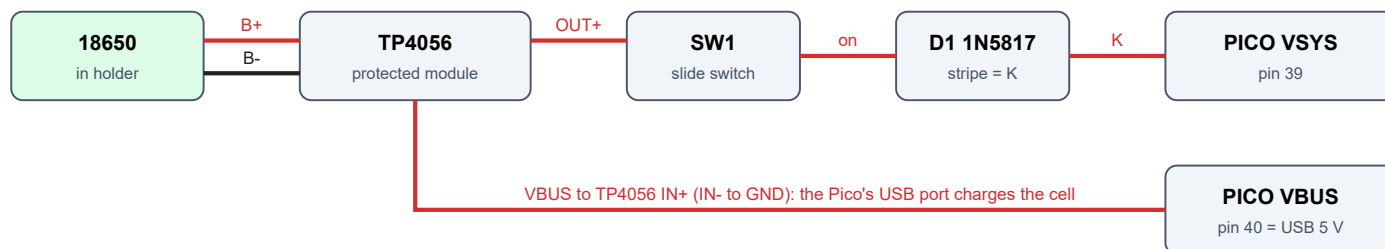
The Pico picks two terminals, X and Y, by setting two 3-bit addresses. Four 8-channel switch chips do the rest:

Chip	Job	Address	Enable
U1	DRIVE: connects the 330 ohm feed to terminal X	X bus (GP10-12)	GP16, low = current on
U2	RETURN: connects terminal Y to R_REF and ground	Y bus (GP13-15)	always on
U3	SENSE+: connects terminal X to ADC input A0	X bus	always on
U4	SENSE-: connects terminal Y to ADC input A1	Y bus	always on

For each reading the firmware takes four conversions: across the item and across R_REF with the current on, then both again with it off, which removes the converter's own offset. Above about 40 ohm it switches to a wider range; with no measurable current (over about 1 Mohm) it reports OPEN.

Why two wires per jack. The FORCE wire carries the 5 mA; the SENSE wire carries none, so its resistance and the switch chips' resistance (about 100 ohm each!) never reach the reading. Joining them at the jack lug is what makes 0.001 ohm accuracy possible from parts this cheap.

Power



The diode stops USB power flowing back into the cell through VSYS. With USB plugged in the tester runs and charges even with SW1 off.
Take power only from the TP4056 OUT pads so its over-discharge and short protection stays in circuit.

Terminal channels (same on all four chips)

Channel	Chip pin	Terminal
ch0	13	J1-A
ch1	14	J1-B
ch2	15	J1-C
ch3	12	J2-A
ch4	1	J2-B
ch5	5	J2-C
ch6	2	CLIP
ch7	4	PROBE

CD74HC4051 pins: 16 VCC (3V3), 8 GND, 7 VEE (to GND), 6 /E (enable, low = on), 11 S0, 10 S1, 9 S2, 3 COM. A 100 nF capacitor sits straight across pins 16 and 8 of each chip.

Pico connections

Pin	Name	Net	What it does
3	GND	REF_BOT	Ground star at R_REF
6	GP4	SDA	I2C data to ADC and screen
7	GP5	SCL	I2C clock to ADC and screen
14	GP10	XS0	X address bit 0 (U1, U3)
15	GP11	XS1	X address bit 1
16	GP12	XS2	X address bit 2
17	GP13	YS0	Y address bit 0 (U2, U4)
19	GP14	YS1	Y address bit 1
20	GP15	YS2	Y address bit 2
21	GP16	DRV_EN	Test current on/off (U1 /E)
22	GP17	LED_R	Red light (FAIL)
24	GP18	LED_Y	Yellow light (CHECK)
25	GP19	LED_G	Green light (PASS)
26	GP20	BTN	Mode button
27	GP21	BUZ	Piezo tones
31	GP26	REF_TOP_P	Break detector (FLEX)
33	AGND	AGND	Analog ground to the star
36	3V3	3V3	3.3 V for all the logic
38	GND	GND	Ground
39	VSYS	VSYS	Battery in, via D1
40	VBUS	VBUS	USB 5 V out to the charger

ADS1115 module: VDD to 3V3, GND and ADDR to ground (address 0x48), SCL/SDA shared with the OLED (address 0x3C), A0 SENSE+ (U3 COM), A1 SENSE- (U4 COM), A2 and A3 on the two legs of R_REF. ALRT is not used.

Lights, sound, button

Each LED runs from its own Pico pin through a 150 ohm resistor (about 8 mA, the pins are set to 12 mA drive); the three cathodes share one ground wire. The piezo is passive: the Pico plays tones on GP21, so pass, fail, tick and break each sound different. The one button is tap = start over, hold = sound on / off. There are no modes: the firmware scans the terminals about eight times a second and decides what is plugged in (Doc 33).

Build A's lamps worked without any code. This one needs firmware, but you never have to compile it: Doc 34 has a ready-made file you drag onto the Pico.