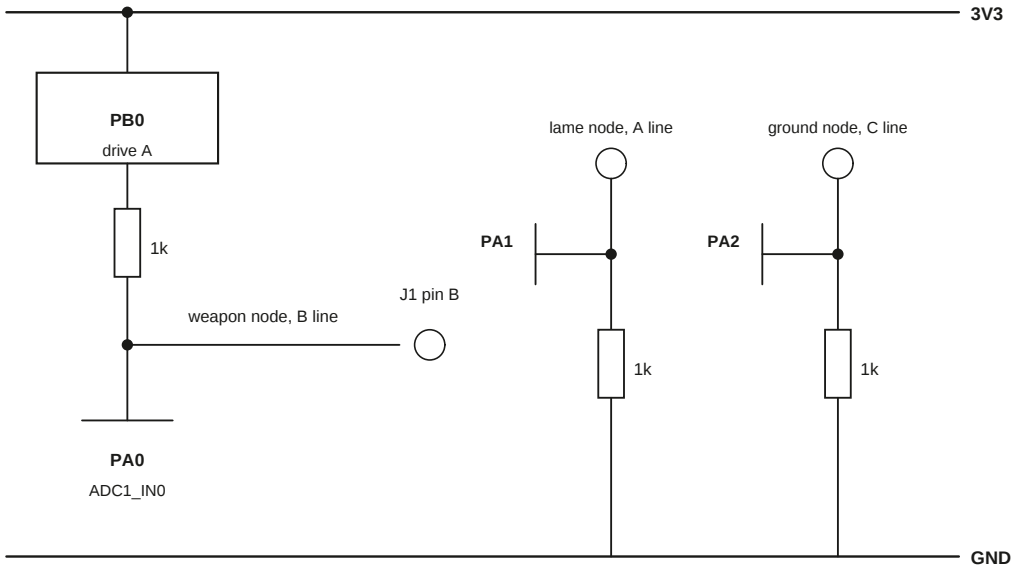


Front end, one channel of seven

Every fencing line gets one 1 k resistor. The five sense lines are pulled permanently to ground. The two weapon lines are pulled from a GPIO instead of from the rail, which is the change that makes blade-to-blade contact visible.



How a touch is recognised

A weapon line pulled to 3V3 through 1 k, joined to a sense line pulled to ground through 1 k, sits at half rail. Both pins read about 2048 at the same instant. Nothing else in the system produces that pattern: an untouched weapon reads 4095 and an untouched sense line reads near zero.

The box therefore knows not just that contact happened but what was touched, because it can see which two nodes moved together. Contact resistance on a damp blade moves both readings the same way, which is why the mid band is wide.

Two phase drive

Phase	PB0 drive A	PB1 drive B	What is measurable
A	HIGH, pull up	LOW, pull down	Everything fencer A's blade touches, including fencer B's blade
B	LOW, pull down	HIGH, pull up	The mirror image

Without this, both weapon lines sit at the same rail and blade-to-blade contact is invisible. That is why no hobby box implements sabre whip-over. Alternating the drive costs two GPIO pins and nothing else.

Three weapon fencing scoring box	Schematic
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Complete connection list

Net	MCU pin	ADC ch	Resistor
Fencer A weapon, B line	PA0	IN0	1k to PB0
Fencer A lame, A line	PA1	IN1	1k to GND
Fencer A ground, C line	PA2	IN2	1k to GND
Fencer B weapon, B line	PA3	IN3	1k to PB1
Fencer B lame, A line	PA4	IN4	1k to GND
Fencer B ground, C line	PA5	IN5	1k to GND
Piste	PA6	IN6	1k to GND
Drive A	PB0	-	-
Drive B	PB1	-	-

Indicators and controls

Function	Pin	Part	Series R
On target A, green	PB12	5 mm LED	220R
Off target A, white	PB13	5 mm LED	220R
Off target B, white	PB14	5 mm LED	220R
On target B, red	PB15	5 mm LED	220R
Fault A	PA8	5 mm LED	220R
Fault B	PA9	5 mm LED	220R
Mode foil / epee / sabre	PB3 / PB4 / PB5	5 mm LED	220R each
Buzzer	PB10	Active piezo	-
Mode button	PB6	Momentary NO	internal pull-up
Reset button	PB7	Momentary NO	internal pull-up
Heartbeat	PC13	on-board LED	-

Avoid PA13 and PA14, they are the SWD debug pins, and PB2, which is BOOT1. Analog pins on the F401 are not 5 V tolerant, so nothing on the fencing side may ever be driven above 3.3 V.

Bill of materials

Three weapon fencing scoring box	Schematic
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Qty	Part	Note
1	WeAct Black Pill, STM32F401CCU6	Buy two, they are cheap
1	ST-Link V2 clone	Backup to USB DFU
7	3-pin fencing socket, or 4 mm banana jacks	6 fencer + 1 piste terminal
1	Binding post or 4 mm terminal	Piste ground
7	1 k resistor, 1 percent	The sense network. Match these
9	220 R resistor	LED limiting
2	5 mm LED, white	Off target
1	5 mm LED, green	On target A
1	5 mm LED, red	On target B
5	5 mm LED, assorted	3 mode, 2 fault
1	Active piezo buzzer	5 V or 3.3 V type
2	Momentary pushbutton, panel	Mode, reset
1	Perfboard, 0.1 inch	
1	Heavy alligator clip lead	Piste ground
-	22 AWG stranded wire	

For the test rig, add an Arduino Nano, an eight channel USB logic analyzer, and seven 2.2 k resistors. Those three items are what let you verify the timings instead of trusting them.