WET LAB BOX · PARTS

Boat 1 · A18 · v10.5 · plastic IP67, about 12 x 8 x 5 in, beside the wet lab

A



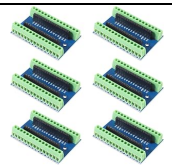
Box, TICONN IP67, about 12 x 8 x 5 in, with plate
The Oct 3 TICONN if it is this big, else buy one
1 · check size

B



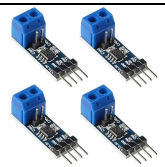
NUCLEO-G431KB
The node's brain. Solder links as shipped
1 · have (Ken, DigiKey)

C



Nano screw carrier (AITRIP)
Nucleo plugs in; every pin on a screw
1 · have

D



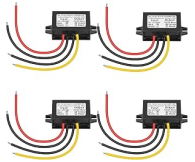
CAN board SN65HVD230
House bus. 120 ohm off (not a bus end)
1 · have

E



CAN surge part, Taidacent RS-12V/2S
On the rail. Ground to 0 V
1 · have

F



24 to 5 V converter, Klnuoxj
Potted. 5 V for the Nucleo and pressure sensor
1 · check shelf

G



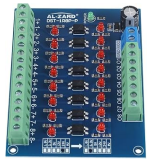
24 V converter, XWST, 10 A
9 to 36 V in, steady 24 V out
1 · have

H



Relay board, HiLetgo 24 V, 8 ch
Ch 1 to 6 used, all normally open
1 · check shelf

I



Opto board, Fafeicy, 8 ch
24 V inputs. IN1 to IN5 used
1 · have

J



DIN fuse holders
5 x 20 mm, on the rail
5 · have

K



Slow-blow fuses 5 x 20 mm
F1 5 A, F2 2 A, F3 2 A, F4 1 A, F5 1 A
5 · have (kit)

L



DIN screw terminal blocks
38 blocks, bridge bars, 2 end stops
38 · count the kits

M



DIN rail, 35 mm
About 11 in, along the bottom
1 · have

N



Diodes 1N5408
One across each pump. Stripe to +
3 · have

O



Surge diode 1.5KE33CA
Across the 24 V bus and 0 V
1 · have

P



Resistors 10k, 18k, 4.7k x2
Under the carrier's screws
4 · have

Q

4-wire lead, black plug each end

Plug lead for the CAN board, RLECS 4-pin
On the 4 pins, zip-tied. Far plug cut off
1 · have

R



Glands: 3 split (PG25, 4 ports)
Altelix 4-port: 2 on the shelf; a 3rd from the 5-pack if one is left. No vent
3 · have 2, check 3rd

S



CAN drop: Micro-C cord, cut, and a tee
Its own tee on the house bus
1 · check shelf

T



DO sensor's FTDI cable (RS-485)
From the USB hub box. Bare end in here
1 · have

U



SBE 45's FTDI cable (RS-232, 0 V)
From the USB hub box. Bare end in here
1 · have

W

two shielded cables, butt splices

Cables C1, C2, and splices
C1: 4/18 shielded (pumps).
C2: 22/12 shielded (valves).
Glue-lined butt splices
1 · have

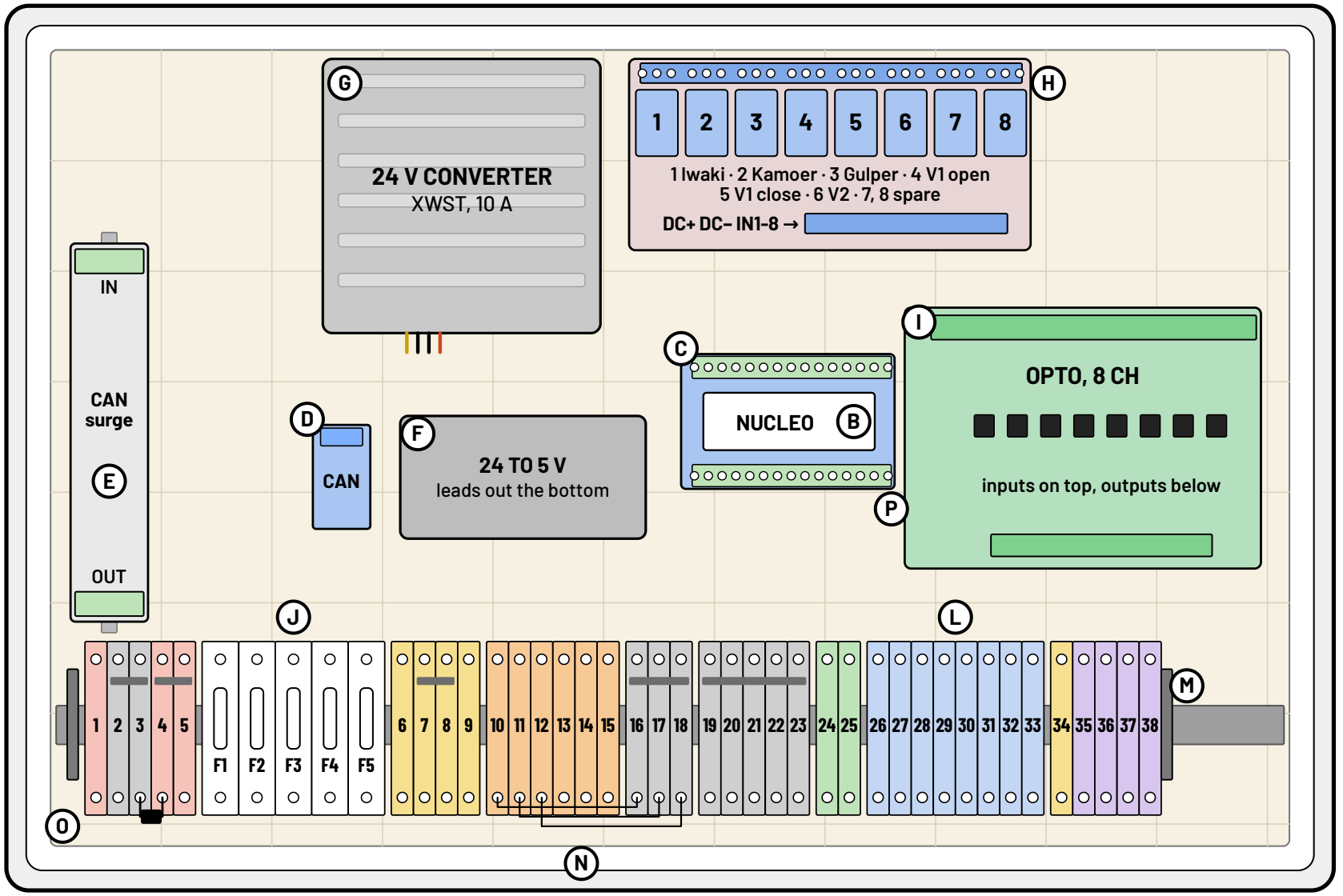
V

wire, ferrules, heat shrink

Wire and ferrules
22 AWG inside; 18 AWG where marked. Singles on hand. Double ferrules
1 · have (kits)

WET LAB BOX · LAYOUT

lid off, looking in · about to scale, 1 grid square = 1 in · as built, from Mike's photo of Nov 6



RAIL BLOCKS

- **E** — CAN surge, own rail
- **1** — 24 V in
- **2-3** — 0 V
- **4-5** — 24 V bus
- **F1-F5** — fuses
- **6-9** — fused feeds
- **10-15** — to pumps, valves
- **16-23** — 0 V, two bars, linked
- **24, 25** — 5 V, 3.3 V
- **26-28** — pressure, I2C
- **29-33** — flow, valves
- **34** — F4 feed
- **35-38** — DO, SBE 45 data

Gray bar = bridged
Letters = page 1

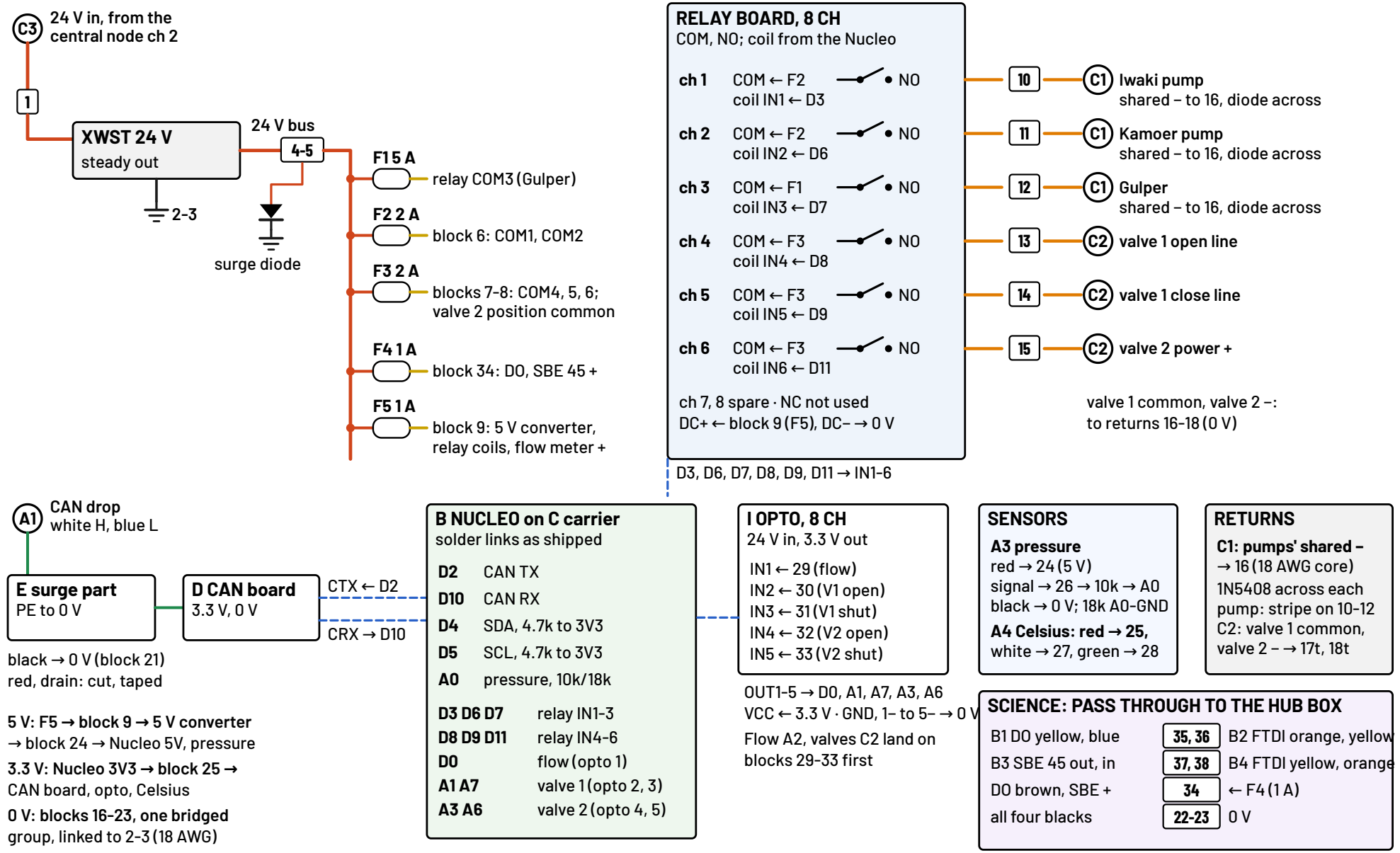
Bottom wall below:
3 split glands, PG25
hole from the thread,
its thread (about 1-1/2 in)
4 ports, round cables
0.15 to 0.30 in



inches from the left end of the box

WET LAB BOX · WIRING

how it connects · numbers in boxes = rail blocks, circles = glands (A, B = split gland ports) · not to scale



24 V · fused 24 V · to the loads · 0 V · CAN · signal · science data · dashed = logic from the Nucleo

WET LAB BOX · EVERY WIRE

rail blocks numbered left to right as on page 2

RAIL, LEFT PART: POWER

b = bottom screw (gland side), t = top screw. Two wires on one screw share a double ferrule.

Block	Job	Wires
E	CAN surge part, on its own rail	IN 1: gland A1 white. IN 2: gland A1 blue. OUT 1, OUT 2: to the CAN board H, L. PE: to block 2
1	24 V in	b: C3 red (16/2 cable). t: XWST red in (its own lead)
2-3	0 V (bridged)	2b: C3 black (16/2 cable), surge part PE (on its own rail). 2t: XWST black in (its own lead). 3b: surge diode. 3t: spare
4-5	24 V bus (bridged)	4t: XWST yellow out (its own lead), to F5. 4b: surge diode. 5t: to F1 (18 AWG), to F2. 5b: to F3, to F4
F1 5 A	Gulper	t: from 5t (18 AWG). b: relay COM3 (18 AWG)
F2 2 A	pumps	t: from 5t. b: to 6
F3 2 A	valves	t: from 5b. b: to 7
F4 1 A	DO, SBE 45	t: from 5b. b: to 34
F5 1 A	node	t: from 4t. b: to 9
6	F2 feed	b: from F2. t: relay COM1, COM2
7-8	F3 feed (bridged)	7b: from F3. 7t: COM4, COM5. 8t: COM6. 8b: C2 purple, valve 2 position common
9	F5 feed	b: from F5, gland A2 flow red. t: KInuoxj red in, relay DC+
10	Iwaki +	t: relay NO1. b: C1 white (Iwaki +), diode stripe
11	Kamoer +	t: NO2. b: C1 green (Kamoer +), diode stripe
12	Gulper +	t: NO3 (18 AWG). b: C1 red (Gulper +), diode stripe
13	valve 1 open	t: NO4. b: C2 red
14	valve 1 close	t: NO5. b: C2 orange
15	valve 2 +	t: NO6. b: C2 brown
16-18	0 V, pump and valve returns (bridged)	16b: C1 black (pumps –), diode. 17b: diode. 18b: diode. 16t: spare. 17t: C2 black (valve 1 common), XWST black out (its own lead). 18t: C2 gray (valve 2 –), link to 19b (joins the two 0 V groups)

WIRE AND ENDS

Inside wires 22 AWG; 18 AWG where marked (the main 24 V path, up to 10 A). Both on hand as single wires. Ferrule on every stranded end. Label both ends. Drip loop on every cable.

RAIL, RIGHT PART: SIGNALS

Block	Job	Wires
19-23	0 V (bridged)	19b: link from 18t. 19t: KInuoxj black in and out. 20t: relay DC–, opto GND. 20b: gland A2 black, gland A3 black. 21t: opto 1– (1– to 5– joined), Nucleo GND. 21b: gland A4 black, gland A1 black. 22t: CAN board GND. 22b: gland B1 black, gland B3 ground. 23b: gland B2 black, gland B4 black. 23t: shields of C1 and C2 (box end only)
24	5 V	t: KInuoxj yellow out, Nucleo 5V. b: gland A3 red
25	3.3 V	t: Nucleo 3V3, opto VCC. b: gland A4 red, CAN board 3V3
26	pressure	b: gland A3 signal. t: 10k to Nucleo A0
27	SDA	b: gland A4 white. t: Nucleo D4
28	SCL	b: gland A4 green. t: Nucleo D5
29	flow pulses	b: gland A2 yellow. t: opto IN1
30	valve 1 open	b: C2 yellow. t: opto IN2
31	valve 1 shut	b: C2 green. t: opto IN3
32	valve 2 open	b: C2 blue. t: opto IN4
33	valve 2 shut	b: C2 white. t: opto IN5
34	F4 feed	t: from F4. b: gland B1 brown, gland B3 power +
35	DO A	b: gland B1 yellow. t: gland B2 orange
36	DO B	b: gland B1 blue. t: gland B2 yellow
37	SBE 45 out	b: gland B3 data out. t: gland B4 yellow (RXD)
38	SBE 45 in	b: gland B3 data in. t: gland B4 orange (TXD)

BEFORE WIRING

Nucleo: solder links as shipped; A2, A4, A5 never used. CAN board: 120 ohm off (this box is not a bus end). Keep its 4 pins: push lead 0 on, zip-tie it lengthwise over plug and board, dab of glue; cut the far plug off and land the wires as the table says. Relay board: set the trigger jumper, glue it. Read each part's wire colors off its label. F1 5 A is a guess: read the Gulper's label. Cables C1, C2: glue-lined butt splices outside, staggered, labelled. Split ports: one round cable each, 0.15-0.30 in.

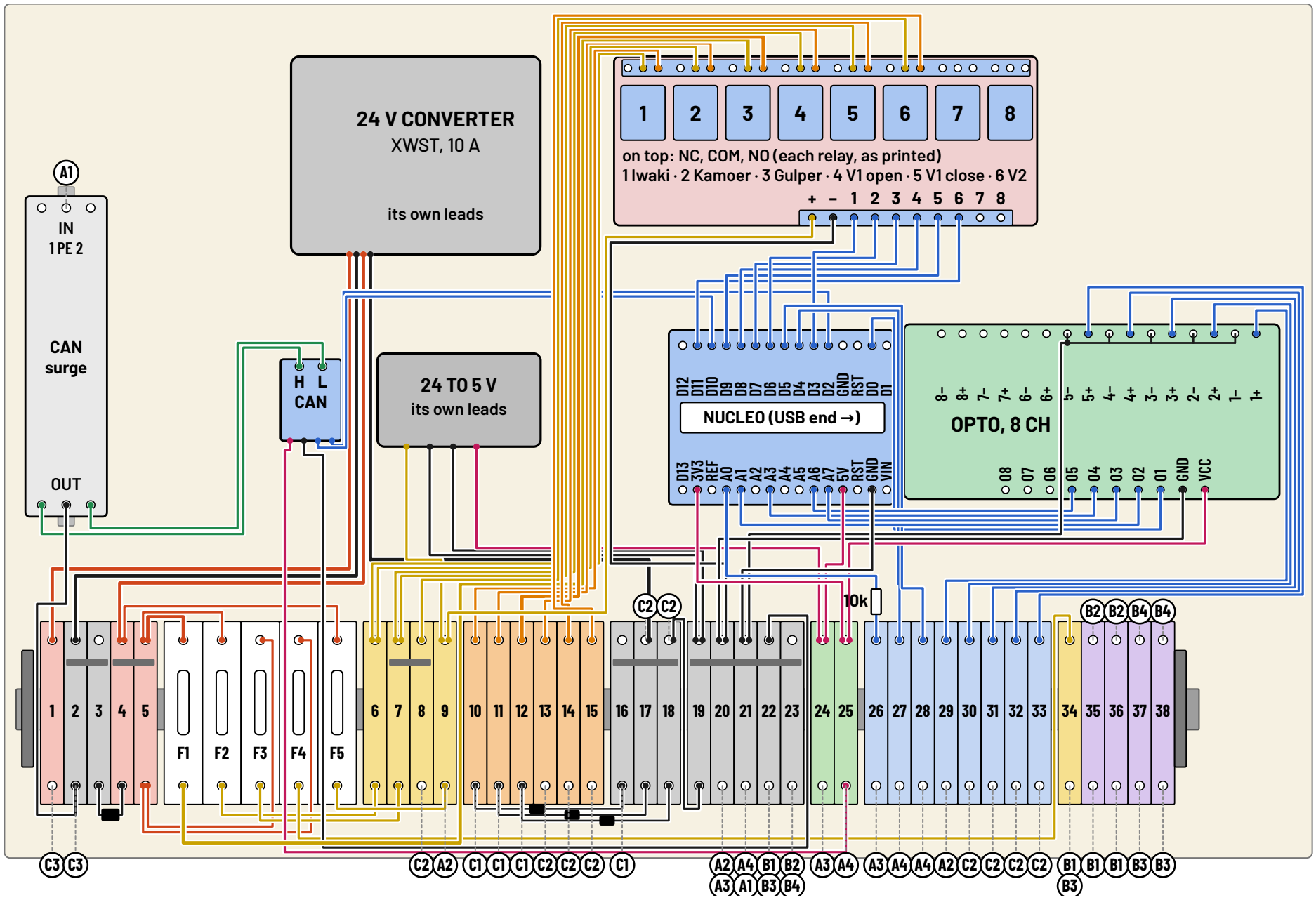
OFF THE RAIL

Part	Wires
Relay board H	DC+ 9t, DC– 20t. IN1-6 ← Nucleo D3, D6, D7, D8, D9, D11. COM1, 2 ← 6t; COM3 ← F1; COM4, 5 ← 7t; COM6 ← 8t. NO1-6 → 10t-15t. Set the trigger jumper, glue it
Nucleo B on carrier C	5V ← 24t. GND → 21t. 3V3 → 25t. D2 → CAN CTX, D10 ← CRX. D4 ← 27t, D5 ← 28t, each with a 4.7k to 3V3. A0: 10k from 26t, 18k to GND. D0, A1, A7, A3, A6 ← opto OUT1-5
Opto I	1+ to 5+ ← 29t-33t. 1– to 5– joined by short jumpers, one wire → 21t. VCC ← 25t. GND → 20t
XWST G	Its own leads go straight to the rail, no added wire: red in ← 1t. black in → 2t. black out → 17t. yellow out → 4t
KInuoxj F	red in ← 9t. black in, out → 19t. yellow 5 V → 24t
CAN board D	CANH, CANL ← surge OUT 1, 2. 3V3 ← 25b. GND → 22t

CABLES IN, BY GLAND

Gland	Cable	Cores
C1	pumps: 4/18 shielded (split C)	white 10b, green 11b, red 12b, black 16b, shield 23t
C3	24 V feed, 16/2	red → 1b, black → 2b
C2	valves: 22/12 shielded	purple 8b, red 13b, orange 14b, brown 15b, black 17t, gray 18t, yellow 30b, green 31b, blue 32b, white 33b, shield 23t
A1	CAN drop (split A)	white, blue → E IN. black → 21b. red, drain: cut, taped
A2	flow meter	red 9b, black 20b, yellow 29b
A3	pressure	red 24b, black 20b, signal 26b
A4	Celsius	red 25b, black 21b, white 27b, green 28b
B1	DO sensor (split B)	brown 34b, black 22b, yellow 35b, blue 36b
B2	DO FTDI	orange 35t, yellow 36t, black 23b. Rest cut, taped
B3	SBE 45	power 34b, ground 22b, out 37b, in 38b
B4	SBE FTDI	yellow 37t, orange 38t, black 23b. Rest cut, taped

WET LAB BOX · WIRES ON THE LAYOUT

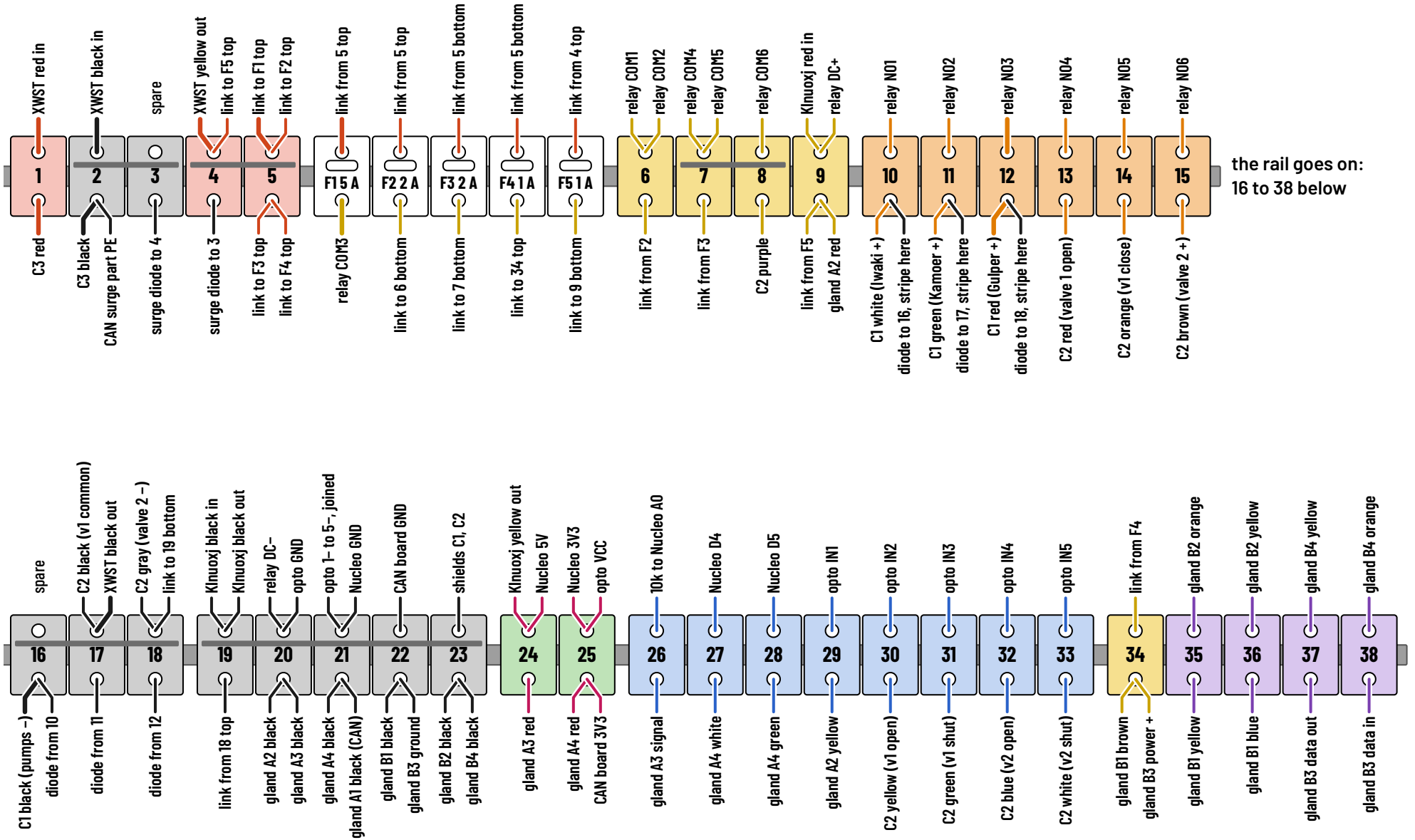


24 V · fused 24 V · to the loads · 0 V · 5 V, 3.3 V · CAN · signal

Thick line = 18 AWG. Circle = the gland whose cable lands on that screw. Where lines cross, the one on top has a white edge; crossing lines never join. Under the carrier's screws: 10k in the A0 wire, 4.7k D4 to 3V3, 4.7k D5 to 3V3, 18k A0 to GND. Board screws are drawn where the wires fit; go by each board's own labels.

WET LAB BOX · DIN RAIL CLOSE-UP

every screw and what lands on it · top screw faces the parts, bottom screw faces the glands

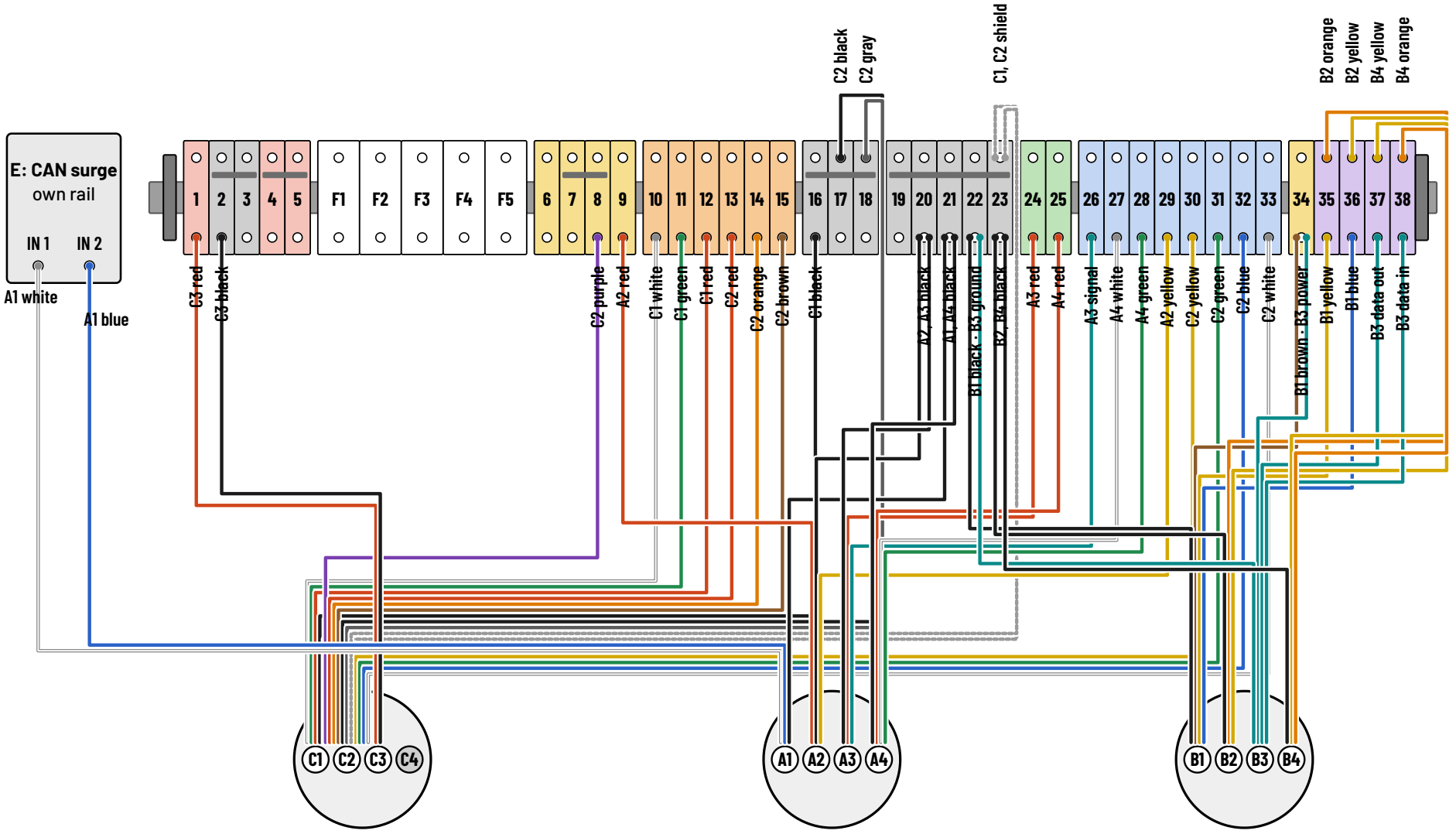


24 V · fused 24 V · to the loads · 0 V · 5 V, 3.3 V · signal · science data

Thick line = 18 AWG (gland 1: its 16/2 cable); thin = 22 AWG. Gray bar = bridged. The CAN surge part sits on its own short rail.

WET LAB BOX · CABLES IN

each wire from its gland to its screw · no inside wiring · labels: gland port and wire color



C: C1 pumps, C2 valves, C3 24 V, C4 plugged

A: A1 CAN, A2 flow, A3 pressure, A4 Celsius

B: B1 DO, B2 its FTDI, B3 SBE 45, B4 its FTDI

Each wire's color, screw and job: page 8

red · black · yellow · white · blue · green · brown · orange · gray · purple · not known

Dashed = shield. Labels above the rail are top screws.

WET LAB BOX · EVERY CABLE WIRE

gland, wire color, screw, and what it carries

Gland	Cable	Wire	Lands on	What it carries
C1	pumps, 4/18 shielded	white	block 10 bottom	Iwaki pump +
		green	block 11 bottom	Kamoer pump +
		red	block 12 bottom	Gulper +
		black	block 16 bottom	all 3 pumps –
		shield	block 23 top	shield, this end only
C2	valves, 22/12 shielded	purple	block 8 bottom	valve 2 position common (24 V)
		red	block 13 bottom	valve 1 open
		orange	block 14 bottom	valve 1 close
		brown	block 15 bottom	valve 2 power +
		black	block 17 top	valve 1 common
		gray	block 18 top	valve 2 power –
		yellow	block 30 bottom	valve 1 position open
		green	block 31 bottom	valve 1 position shut
		blue	block 32 bottom	valve 2 position open
		white	block 33 bottom	valve 2 position shut
		shield	block 23 top	shield, this end only
		pink, beige: spare, taped		
C3	24 V feed, 16/2	red	block 1 bottom	24 V in, from central node ch 2
		black	block 2 bottom	0 V
A1	CAN drop	white	CAN surge IN 1	CAN H
		blue	CAN surge IN 2	CAN L
		black	block 21 bottom	0 V
		red, drain: cut, taped		
A2	flow meter	red	block 9 bottom	24 V (F5)
		black	block 20 bottom	0 V
		yellow	block 29 bottom	pulses
A3	pressure sensor	red	block 24 bottom	5 V
		black	block 20 bottom	0 V
		signal	block 26 bottom	reading, 0.5-4.5 V
A4	Celsius probe	red	block 25 bottom	3.3 V
		black	block 21 bottom	0 V
		white	block 27 bottom	SDA
		green	block 28 bottom	SCL
B1	DO sensor	brown	block 34 bottom	24 V (F4)
		black	block 22 bottom	0 V
		yellow	block 35 bottom	RS-485 A
		blue	block 36 bottom	RS-485 B
B2	DO's FTDI cable	orange	block 35 top	RS-485 A
		yellow	block 36 top	RS-485 B
		black	block 23 bottom	0 V
		red, brown, green: cut, taped		
B3	SBE 45	power	block 34 bottom	24 V (F4)
		ground	block 22 bottom	0 V
		data out	block 37 bottom	RS-232 out
		data in	block 38 bottom	RS-232 in
B4	SBE 45's FTDI cable	yellow	block 37 top	RXD
		orange	block 38 top	TXD
		black	block 23 bottom	0 V
		red, brown, green: cut, taped		
C4	plugged			

Every incoming wire lands on a rail screw, except the CAN drop's white and blue, which go on the CAN surge part. Glands: A, B and C are Altelix PG25 4-port split glands (1-1/2 in hole), one cable per port, 0.15 to 0.30 in. The 24 V feed's oval 16/2 seals in port C3 (Mike, Nov 7). Pumps and valves: their own leads join cables C1 and C2 outside the box with glue-lined butt splices, staggered, each core labelled. The 4/18 and 22/12 colors here are Claude's pick; if your cables' colors differ, swap them and keep the same screws. Pressure sensor, SBE 45: read their wire colors off the labels.