Wiring Guide

Two power rails. One computer. This guide shows what connects to what, and in what order.

MABEL · 59 DOF mobile bimanual platform · Jetson Thor compute

PRIMARY RAIL
24 V
Compute, both arms, neck yaw, lift

SECONDARY RAIL
12 V
Base, hands, boards, neck servos

LINKS TO THOR
7
Ports in use, carrying 15 devices

What is in here

Pages 2 and 3 are power. Pages 4 and 5 are data. Page 6 is the order to power everything up.

Read both diagrams left to right. The box on the left is the source. Everything to the right of it is fed by it.

What the colours mean

24 V · 12 V · USB · Slot · Unused

Colour shows the rail, not the part. Orange is 24 V. Teal is 12 V. A dashed grey box is wired but not used in the standard build.

What is not in here

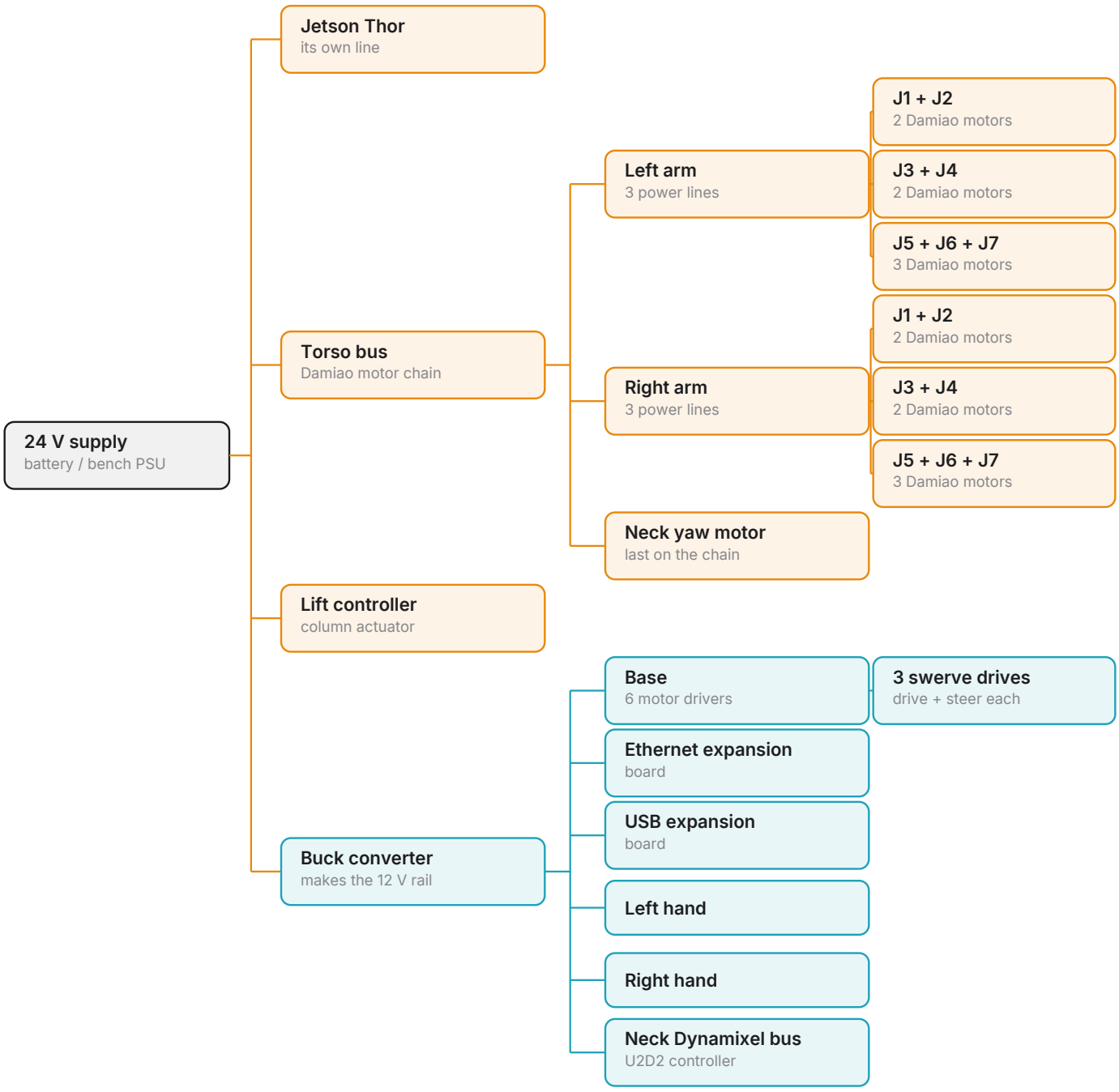
CAN and serial signal wiring. Those share the same looms but need their own document.

Fuse ratings and wire gauge. Measure the stall current on your own build first.

Power

One supply. Four branches leave it. One of them makes the 12 V rail.

24 V · 12 V



Each arm gets three power lines, one per group of joints. If a connector works loose, you lose one group instead of the whole arm. The neck yaw motor is a Damiao motor, so it sits at the end of the same 24 V chain. The other two neck joints are Dynamixels and run on 12 V.

What each line feeds

Every load, and where it taps in.

LOAD	RAIL	TAPS FROM	NOTES
24 V — straight from the supply			
Jetson Thor	24 V	Supply	Its own line. Motor spikes must not reach it.
Torso bus	24 V	Supply	Feeds both arms and the neck yaw motor.
Arms — J1 + J2	24 V	Torso bus	Shoulder pair. One line per arm.
Arms — J3 + J4	24 V	Torso bus	Mid-arm pair. One line per arm.
Arms — J5 + J6 + J7	24 V	Torso bus	Forearm and wrist. One line per arm.
Neck yaw motor	24 V	Torso bus	Last stop on the chain.
Lift controller	24 V	Supply	Its own line. Biggest current spike on the robot.
Buck converter	24 V in	Supply	Makes the 12 V rail.
12 V — from the buck converter			
Base motor drivers	12 V	Buck converter	Six drivers. Two per swerve module.
Ethernet expansion board	12 V	Buck converter	Also carries both Teensies.
USB expansion board	12 V	Buck converter	Ten devices. Never run it bus-powered.
Left hand	12 V	Buck converter	Power only. Data goes over USB.
Right hand	12 V	Buck converter	Power only. Data goes over USB.
Neck Dynamixel bus	12 V	Buck converter	12 V on the servo bus. The U2D2 is powered over USB.

Two rules

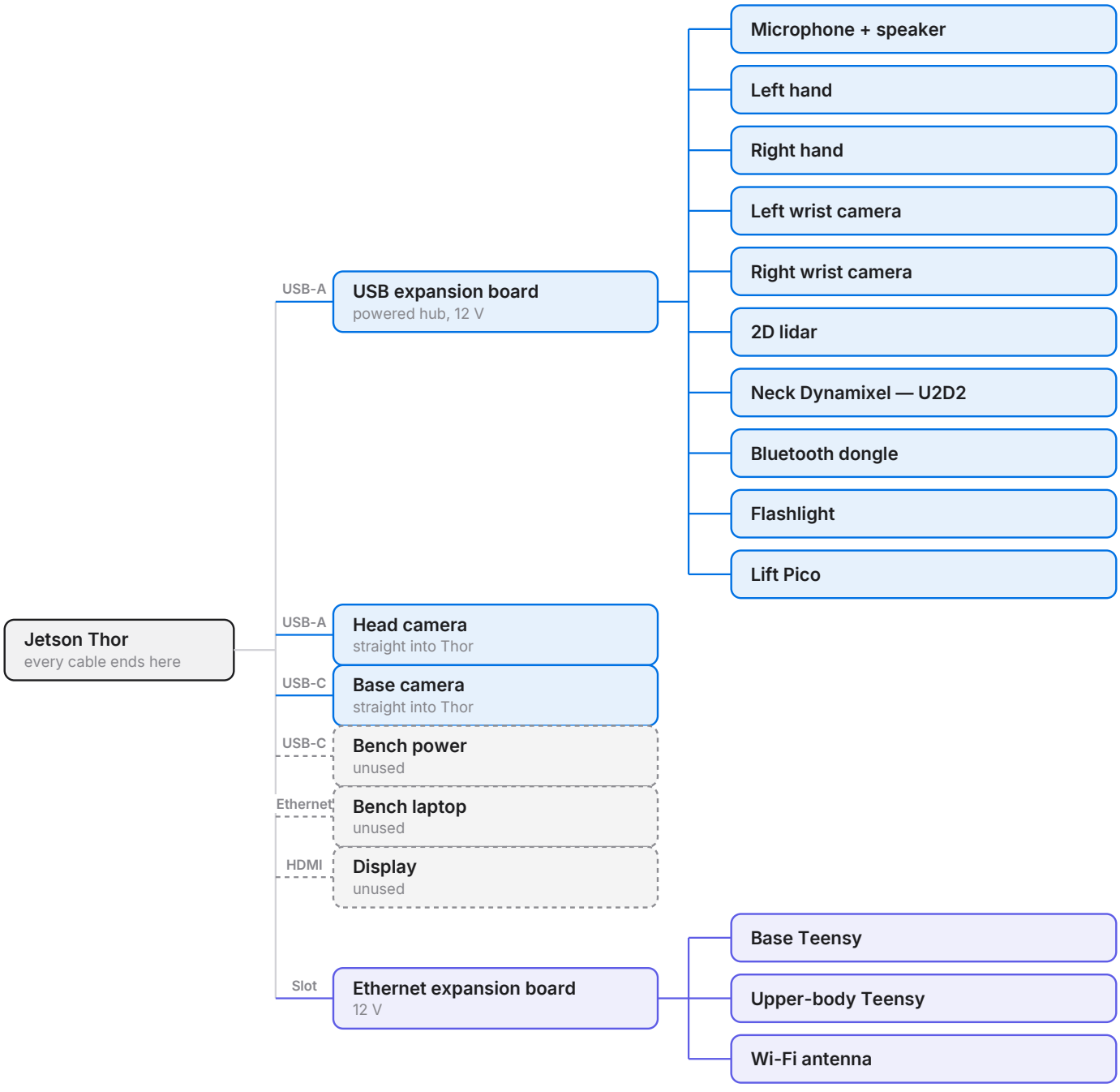
Never share a run back to the supply.
Thor, the lift controller and the torso bus each get their own pair. A few extra metres of cable removes a whole class of fault that is hard to find later.

The buck converter is a single point of failure.
Everything on 12 V depends on it. If the hands, the base and the USB tree all go dark at once, check it first.

Data

Every cable ends at Thor. Seven links leave it.

USB · Slot · Unused



The port name sits on each line. The head and base cameras go straight into Thor because they need the bandwidth. Everything on the hub is either slow or a single wrist stream. Dashed grey links are wired but not used.

Where each cable goes

Find the port, find the device.

PORT	GOES TO	NOTES
On Thor		
USB-A — port 1	USB expansion board	The hub, and the ten devices on it.
USB-A — port 2	Head camera	Direct, to keep it off the hub.
USB-C — port 1	Base camera	Needs USB 3. Keep it off the hub.
USB-C — port 2	Bench power	Unused. Spare input if you run Thor on the bench.
Ethernet	Bench laptop	Unused. For testing one subsystem at a time.
HDMI	Display	Unused. For bring-up and recovery.
Expansion slot	Ethernet expansion board	Both Teensies and the antenna.
On the USB expansion board		
Audio	Microphone + speaker	Mic and speaker on one device.
Hands	Left hand, right hand	Data only. Power comes from 12 V.
Wrist cameras	Left, right	The two biggest streams on the hub.
Lidar	2D lidar	Serial over USB.
Neck servos	U2D2 controller	Signal path to the Dynamixels.
Bluetooth	Mouse dongle	Operator input during bring-up.
Flashlight	Flashlight	Lights the scene for the wrist cameras.
Lift	Lift Pico	Serial link to the lift board.
On the Ethernet expansion board		
Base Teensy	Base	Runs the swerve drives.
Upper-body Teensy	Torso, arms, neck	Runs the upper body.
Wi-Fi antenna	Network	Teleoperation and logging.

Label both ends of every cable before you power up.
Ten black cables into one hub all look the same. Bind the cameras and the lidar to udev rules by serial number, because the port order changes on every reboot.

Power it up in this order

Work outward from the supply. Check each level before you add the next.

1. **Start with nothing connected**

   Turn on the 24 V supply. Leave Thor, the torso bus, the lift controller and the buck converter unplugged. Check the voltage at the terminals.

2. **Add Thor and the lift controller**

   These are the two dedicated 24 V lines. Let Thor boot all the way. If the supply sags now, it will sag worse later.

3. **Add the buck converter, with nothing on it**

   Check for 12 V at its output before you plug anything into it.

4. **Add the arms, one line at a time**

   J1 + J2, then J3 + J4, then J5 + J6 + J7. Left arm first. Each group should hold position before you add the next one. The neck yaw motor goes last.

5. **Add the base**

   Six drivers, three swerve modules. Keep the wheels off the ground until the control loop is working.

6. **Add the USB hub**

   Start with the lift Pico and the audio device. Check they appear. Then add the hands, the lidar and the U2D2. Wrist cameras last.

7. **Add the head and base cameras**

   Straight into Thor, not the hub. If a camera appears but will not stream, the problem is bandwidth.

8. **Add the expansion slot**

   Check that both Teensies and the antenna appear before you hand over to the autonomy stack.

If something is dead

WHAT YOU SEE	WHAT TO CHECK
Hands, base and USB tree, all at once	The buck converter.
One group of joints on one arm	The connector on that line.
Every Damiao motor, neck yaw included	The torso bus.
One USB device, after a reboot	Port order, not wiring.