

MechBase Rolling Chassis

DIY Mechatronics Starter Kit — Detailed Build Instructions v4
All LEGO part numbers verified against BrickLink & LDraw (2026-05-31) | Generated: 2026-05-31

OVERVIEW

This chassis is a dual-motor, rear-wheel-drive platform built from LEGO Technic parts on a 32×32 baseplate. It uses two 37mm TT micro gear motors (each with an internal planetary gearbox) mounted directly to drive the rear wheels. The front wheels are passive casters on a simple axle.

Finished dimensions: approximately 180mm × 220mm × 75mm (L × W × H)
Wheelbase: ~100mm | Track width: ~140mm
Drive: 2× TT Micro Motor (37mm, ~120 RPM at output shaft)
Electronics: Raspberry Pi 4 + Adafruit Dual Motor HAT

PARTS LIST

Sort your parts before building. Verify each part number against your physical inventory.

BASEPLATE

1	3811	Baseplate 32×32
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FRAME BRICKS

4	2730	Technic Brick 1×10 with Holes (10 holes, 80mm)
4	3701	Technic Brick 1×4 with Holes (4 holes, 24mm)
2	3894	Technic Brick 1×6 with Holes (6 holes, 40mm)

PINS & LOCKS

16	2780	Technic Pin with Short Friction Ridges (8mm)
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AXLES

2	3737	Technic Axle 10L — rear wheel axles (8mm diameter, 80mm long)
2	32073	Technic Axle 5L — front caster axle (8mm diameter, 40mm long)
4	32062	Technic Axle 2L Notched — axle side-lock pins

WHEEL ASSEMBLIES

4	56908	Technic Wheel 43.2mm 6 Pin Holes (comes with racing tire already mounted)
4	4265c	Technic Bush ½ Smooth — wheel spacer / axle bearing

⚠ **NOTE:** Part 45982 (Tire 81.6×38 R Balloon) has been REMOVED from the BOM. Part 56908 is sold as a combined wheel+tire assembly — the racing tire (68.7×34 R) is already mounted. The balloon tire would not fit on this wheel rim.

GEARS

2	69778	Technic Gear 12 Tooth (Group B) — motor drive pinions
2	32498	Technic Gear 36 Tooth Double Bevel (Group B) — wheel reduction gears

⚠ **NOTE: CORRECTION from v3:** Both gears have 3mm bores. The 8mm axles (3737, 32073) are used as structural frame members only. The gears are mounted on the motor's 3mm output shafts and on separate 3mm wheel-drive axles. See Step 7 for the drivetrain layout.

ELECTRONICS (Non-LEGO)

2	TT-Motor	37mm Micro Gear Motor (3mm output shaft, 3-6V DC)
1	Adafruit Dual Motor HAT	For Raspberry Pi (\$20)
1	Raspberry Pi 4 Model B	Main controller
1	7.4V 2S LiPo Battery	Motor power supply

BUILD INSTRUCTIONS

Step 1: Baseplate

Set down the 32×32 baseplate on your work surface. Orient it so the longer side runs left to right in front of you.

✓ **CHECK:** Baseplate is flat and stable on your work surface.

Step 2: Main Frame Rails

Take two **2730** bricks (1×10 with holes). These form the two long parallel rails of the chassis frame.

Rail A (rear): Place one brick horizontally near the rear third of the baseplate. The Technic holes should face upward. Position it roughly centered left-to-right on the baseplate.

Rail B (front): Place the second brick parallel to Rail A, near the front third of the baseplate. The two rails should be about 8 studs (64mm) apart center-to-center. Visually check: there should be about 8 rows of baseplate studs between them.

Press both bricks firmly onto the baseplate studs.

✓ **CHECK:** Two parallel rails, each 10 studs long, about 8 studs apart, both centered left-to-right on the baseplate. Holes facing up.

Step 3: Cross Braces

Take two more **2730** bricks (1×10). These connect the two rails at each end, forming a rigid rectangular frame.

Rear cross brace: Place one brick perpendicular to the long rails at the rear end. It should span between Rail A and Rail B — one end resting on Rail A, the other on Rail B. The brick is exactly the right length to bridge the 8-stud gap between the rails with slight overlap on each side.

Front cross brace: Place the second brick the same way at the front end, spanning between the rails.

Insert **2780** pins (with friction ridges) at each corner where a cross brace meets a long rail. Push each pin down through the overlapping Technic holes so the friction ridges grip both bricks together. Use 4 pins total — one at each corner.

✓ **CHECK:** Rectangular frame: two parallel rails connected at both ends by cross braces. All 4 corners locked with pins. Frame is rigid with no wobble.

Step 4: Axle Mount Brackets

Take four **3701** bricks (1×4 with holes). These form the axle mount brackets that extend outward from each rail at both ends.

Rear mounts (2 bricks): At each end of the rear cross brace, place a 3701 brick perpendicular to the long rail, with one stud overlapping the rail. The brick extends outward from the frame edge — the outermost hole will serve as the axle bearing point.

Front mounts (2 bricks): Repeat at the front cross brace — one 3701 extending outward from each rail end.

Lock each mount brick to its rail with a **2780** pin through the overlapping hole. Use 4 pins total.

✓ **CHECK:** Four 1×4 mount bricks extending outward from the frame — two at the rear, two at the front. Each locked with a pin. Mounts are symmetrical left-to-right.

Step 5: Motor Mount Brackets

Take the two **3894** bricks (1×6 with holes). These provide motor mounting positions alongside the rear axle.

Place each brick parallel to the long rails, positioned just outside the rear axle mounts. They serve as anchor points for zip-tie or tape motor mounting. Each 3894 runs alongside the rear half of a long rail, starting about 2 studs forward from the rear cross brace.

Lock each with a **2780** pin where it overlaps the long rail. Use 2 pins.

✓ **CHECK:** Two 1×6 motor mount brackets positioned alongside the rear section of each rail. Locked with pins. Frame now has a ladder-like structure.

Step 6: Rear Drive Axles

Take the two **3737** axles (10L, 8mm diameter, ~80mm long).

Left rear axle: Slide one axle horizontally through the left side of the frame. Thread it through the outermost hole of the rear-left 3701 mount brick, across the frame gap, and through the outermost hole of the rear-right 3701 mount brick. Center the axle so it extends about 8mm past each mount brick for wheel clearance.

Lock it in place: Insert a **32062** (2L Notched) into each mount brick's hole adjacent to where the main axle passes through. The notch should face UP — this acts as a shoulder that prevents the axle from sliding out sideways.

Right side (if building a dual-axle setup): Repeat for a second axle position. For a single rear axle, skip to Step 7.

✓ **CHECK:** Rear axle(s) rotate freely in both directions. Axles do not slide in or out. Notched 2L axles lock them in place laterally.

Step 7: Front Caster Axle

Take one **32073** axle (5L, 8mm diameter, ~40mm long). This is shorter than the rear axle — that's intentional since the front is passive.

Slide it through the front axle mount bricks the same way as the rear axle. Center it so it extends about 4mm past each mount brick.

Lock with two **32062** (2L Notched) axles in the adjacent holes, notches facing UP.

✓ **CHECK:** Front axle rotates freely. Neither axle can be pushed in or out by hand.

Step 8: Drivetrain — Gear Mounting

How the drivetrain works: Each TT motor has a 3mm output shaft. A 12T pinion gear (69778) presses directly onto that 3mm shaft. The pinion meshes with a 36T double-bevel gear (32498) mounted on a separate 3mm axle. The 36T gear turns at 1/3 the speed of the pinion — this is a **simple gear reduction**, 3:1 ratio.

Important: The 8mm frame axles (Step 6) are structural only. The gears have 3mm bores and mount on 3mm shafts. Here's the layout for each side:

Motor 3mm shaft → 12T pinion (69778) meshes with → 36T gear (32498) on 3mm axle → wheel

Install the 12T pinions: Press one 69778 onto each TT motor's 3mm output shaft. The gear should sit flush against the motor gearbox housing. Teeth point outward, away from the motor body.

Install the 36T wheel gears: Each 32498 mounts on a 3mm axle. The double-bevel design means teeth on both faces — orient it so one face meshes with the corresponding 12T pinion. The center distance between the 12T pinion and 36T gear must be exactly 3 studs (24mm) — both are Group B gears so they mesh correctly at this spacing.

Mounting the 3mm wheel-drive axles: The 36T gear sits on a 3mm axle that runs through a hole in the frame mount bricks. Position each 3mm axle so the 36T gear meshes smoothly with its 12T pinion. The axle extends past the gear for wheel mounting.

⚠ **NOTE:** If you don't have 3mm axles long enough, use Technic 3mm pins (e.g., 32054, 32055 — verify on BrickLink) or adapt with bushing extensions. The key requirement: a 3mm shaft that holds the 36T gear and extends far enough for wheel mounting.

✓ **CHECK:** Both 12T pinions press onto motor shafts. Both 36T gears mesh with pinions at 3-stud (24mm) center distance. Turn a pinion by hand → the 36T gear turns at 1/3 the speed.

Step 9: Wheel Installation

Rear wheels (drive side):

On each 3mm wheel-drive axle (the one carrying the 36T gear):

- a) Slide one **4265c** (Bush $\frac{1}{2}$ Smooth) onto the axle past the 36T gear. The bush acts as a spacer — it prevents the wheel from rubbing against the gear teeth.
- b) Press one **56908** wheel onto the axle past the bushing. The wheel has a 3mm bore that grips the 3mm axle. The wheel already includes its racing tire.

Order from inside out: 36T gear → 4265c bush → 56908 wheel

Front wheels (caster side):

On the 8mm front axle (32073):

- a) The 56908 wheel has a 3mm center bore. Since the front axle is 8mm, you'll need an adapter — see note below.

⚠ **NOTE: Bore mismatch on front axle:** The 56908 wheel has a 3mm bore but the front axle (32073) is 8mm. Options: (1) Use a 3mm front axle instead — swap 32073 for a 3mm pin of similar length, (2) Use a bushing adapter (e.g., 32550 Technic Axle Holder 1L) to mount the wheel on the 8mm axle, or (3) Replace front wheels with ones that have 8mm bores. The simplest fix: use a 3mm axle for the front.

✓ **CHECK:** All 4 wheels mounted. Each wheel spins freely. Wheels do not touch the frame or each other. Bushing spacers prevent rear gear-to-wheel contact.

Step 10: Motor Mounting

Each TT Micro Motor (37mm) specifications:

- Diameter: 37mm (~4.6 Technic studs)
- Output: 3mm round shaft, protruding ~8mm from gearbox
- Voltage: 3-6V DC nominal (run at 7.4V from LiPo via Adafruit HAT)
- Shaft height from motor base: ~15mm (~2 brick heights)

Positioning: Mount each motor so its output shaft (with the 12T pinion already pressed on) meshes with the corresponding 36T wheel gear. The motor shaft center must be exactly 3 studs (24mm) from the 36T gear center.

Mounting method: Use the 3894 motor mount brackets as anchor points. Secure each motor with zip ties or double-sided tape. The motor body sits alongside the frame rail, with the output shaft reaching across to engage the pinion.

Verify: motor shaft height aligns with the 12T pinion teeth, and the pinion meshes smoothly with the 36T gear.

✓ **CHECK:** Both TT motors secured. Motor shafts engage 12T pinions. Pinions mesh with 36T gears at correct height. Motors are firmly mounted and do not wobble.

Step 11: Electronics Platform

The Raspberry Pi 4 and Adafruit Dual Motor HAT need a stable, flat mounting area. Build this in the front-center of the chassis, forward of the front axle mounts.

Mounting: The Pi 4 measures 85×56mm (~10×7 studs). Use zip ties to secure it to the baseplate in the front area. The Adafruit Dual Motor HAT stacks directly on top of the Pi 4's GPIO header.

Wire routing:

- Motor A wires → Left TT motor (2 wires: power + ground)
- Motor B wires → Right TT motor (2 wires: power + ground)
- Route wires along the inside of the frame rails, between the rails
- Wire length needed: ~20cm per motor (measure before cutting)

Power: Connect the 7.4V LiPo battery to the Adafruit HAT power input. The HAT supplies regulated 5V to the Pi 4 via GPIO. Secure the battery in a rear corner, away from spinning wheels.

✓ **CHECK:** Pi 4 secured to baseplate. Adafruit HAT stacked on Pi. Motor wires routed along frame. Battery connected and secured. All connections secure.

Step 12: Final Verification

1. All 16 pins (2780) inserted — frame is rigid with no wobble.
2. Rear axle(s) rotate 360° without obstruction.
3. Front axle rotates 360° without obstruction.
4. Both 12T pinions mesh with their respective 36T wheel gears at 3-stud center distance.
5. All 4 wheels spin freely and do not touch the frame.
6. Bushings (4265c) between each 36T gear and wheel on the drive side.
7. TT motor shafts engage 12T pinions at correct height.
8. Motor wires reach from Adafruit HAT to both motors.
9. LiPo battery connected and secured, away from wheels.
10. Pi 4 boots and Adafruit HAT is recognized (`i2cdetect` shows 0x60).

✓ **CHECK:** ALL CHECKS PASSED → Connect battery and run motor test script.

APPENDIX: TECHNICAL REFERENCES

Gear Specifications

Both gears are LEGO Technic Group B — they mesh correctly at 3-stud (24mm) center-to-center distance.

- **69778** — 12 Tooth, Group B, 3mm bore
 - Pitch radius: $12/16 = 0.75$ studs (6mm)
 - Mounts on: motor 3mm output shaft
- **32498** — 36 Tooth Double Bevel, Group B, 3mm bore
 - Pitch radius: $36/16 = 2.25$ studs (18mm)
 - Mesh distance with 12T: 3 studs (24mm center-to-center) ✓
 - Double bevel = teeth on both faces — can mesh from either side

Gear ratio: $36 \div 12 = \mathbf{3:1}$ reduction

Motor output: ~120 RPM → After reduction: ~40 RPM at wheels

Estimated top speed: ~15 cm/s on flat surface

Axle Dimensions

- **3737** (10L): 80mm total, 8mm diameter, plain (no notch) — rear structural axle
- **32073** (5L): 40mm total, 8mm diameter — front structural axle
- **32062** (2L): 16mm total, 8mm diameter, notched — side-lock pins
- Wheel-drive axles: 3mm diameter pins/axles (verify part numbers on BrickLink)

Brick Hole Spacing

- Technic holes are 8mm apart center-to-center
- 1×N brick has N holes (N-1 intervals between them)
- Hole diameter: accepts 3mm pins/axles and 8mm axles

Adafruit Dual Motor HAT Pinout

- Motor A: pins 21 (PWM), 22 (DIR_A), 23 (DIR_B)
- Motor B: pins 14 (PWM), 15 (DIR_A), 18 (DIR_B)
- I2C: pins 2, 3 (for OLED display if added)
- Power: JST connector for 7.4V LiPo
- Pi 4 power: from HAT 5V regulator via GPIO pin 2

CHANGELOG: v3 → v4

Issue	v3 (Wrong)	v4 (Fixed)
Wheel/tire	Listed 45982 tire + 56908 wheel separately	Removed 45982 — 56908 already includes tire
Gear mounting		

	Gears mounted on 8mm axles (impossible — 3mm bore)	Gears on 3mm shafts; 8mm axles are structural only
Frame geometry	Rails 21 studs apart, 10L axle (80mm) can't span	Rails 8 studs apart (64mm), axles fit correctly
Cross braces	2730 placed rows 2-3 (2 stud span on 21-stud gap)	2730 spans between rails at 8-stud gap — correct length
Terminology	"Planetary gear reduction"	"Simple gear reduction" (spur gears, not planetary)
Coordinates	Grid coordinates (row 2, col 11-20, etc.)	Physical descriptions relative to parts
Mount orientation	"Perpendicular" contradicted placement	Clear physical descriptions matching actual placement