

MechBase Rolling Chassis

DIY Mechatronics Starter Kit

Detailed Build Instructions v3

All parts verified against BrickLink (2026-05-31)

OVERVIEW

This chassis is a dual-motor, rear-wheel-drive platform built entirely from LEGO Technic parts on a 32x32 baseplate. It uses two 37mm TT micro gear motors with 3:1 planetary gear reduction (12T pinion -> 36T double-bevel gear per wheel). The Raspberry Pi 4 and Adafruit Dual Motor HAT are mounted on a raised electronics platform at the front.

Finished dimensions: approximately 180mm x 220mm x 75mm (L x W x H)

Wheelbase: ~110mm | Track width: ~130mm

Drive: 2x TT Micro Motor (37mm, ~120 RPM output after gearing)

For LeoCAD v23.03+ and physical Technic parts

Generated: 2026-05-31

PARTS LIST

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

BASEPLATE

1x 3811 Baseplate 32 x 32 studs

FRAME BRICKS

4x 2730 Technic Brick 1 x 10 with Holes (10 holes)
4x 3701 Technic Brick 1 x 4 with Holes (4 holes)
2x 3894 Technic Brick 1 x 6 with Holes (6 holes)

PINS & COUPLERS

16x 2780 Technic Pin with Short Friction Ridges

AXLES

2x 3737 Technic Axle 10L (10 lengths, plain, no notch)
4x 32062 Technic Axle 2L Notched
2x 32073 Technic Axle 5L

GEARS

2x 69778 Technic Gear 12 Tooth (Group B) - Pinions
2x 32498 Technic Gear 36 Tooth Double Bevel (Group B) - Wheel gears

WHEEL ASSEMBLIES

4x 4265c Technic Bush 1/2 Smooth (spacer)
4x 45982 Tire 81.6 x 38 R Balloon
4x 56908 Technic Wheel 43.2mm 6 Pin Holes

ELECTRONICS (Non-LEGO)

2x TT-Motor 37mm Micro Gear Motor (3mm output shaft)
1x Adafruit Dual Motor HAT for Raspberry Pi
1x LiPo 7.4V 2S LiPo Battery
1x Raspberry Pi 4 Model B

STEP 1: BASEPLATE PREPARATION

S1

1.1 - Place the Baseplate

Set down the 3811 baseplate (32 x 32 studs) on your work surface. Orient it so the longer side runs left-to-right in front of you. The baseplate has a grid of studs spaced at 8mm intervals.

(Baseplate reference: stud (0,0) = bottom-left corner, (31,31) = top-right corner)
(All positions below use (column, row) where column runs left-to-right (0-31) and row runs front-to-back (0-31))

[CHECK] Baseplate is flat on work surface, 32 studs wide x 32 studs deep

STEP 2: MAIN FRAME RAILS

S2

2.1 - Install Rear Long Rail (Rail A)

Take one 2730 brick (1 x 10 with holes). Place it horizontally along row 2 of the baseplate, starting at column 11. The brick spans 10 studs (columns 11 through 20). The Technic holes face upward - these are critical for pin and axle insertion.

(Rail A: 2730 at row 2, columns 11-20)

(Orientation: holes facing up, long axis along column direction)

2.2 - Install Front Long Rail (Rail B)

Take a second 2730 brick. Place it parallel to Rail A at row 23, also starting at column 11. This creates a track width of 21 studs ($21 \times 8\text{mm} = 168\text{mm}$ center-to-center between the two rails).

(Rail B: 2730 at row 23, columns 11-20)

(Track width: 21 studs = 168mm)

2.3 - Install Rear Cross Brace

Take a second 2730 brick. Place it vertically (perpendicular to the long rails), along column 11, spanning from row 2 to row 3 (overlapping Rail A and extending forward). This forms the rear corner of your rectangular frame.

(Rear cross brace: 2730 at column 11, rows 2-3 (overlaps Rail A))

2.4 - Install Front Cross Brace

Take the fourth 2730 brick. Place it along column 20, spanning from row 2 to row 3 (overlapping Rail B). This forms the front corner of your frame.

(Front cross brace: 2730 at column 20, rows 2-3 (overlaps Rail B))

2.5 - Lock Frame with Pins

Insert 2780 pins (with friction ridges) at each intersection where the cross braces meet the long rails. Push pins down firmly through the Technic holes so the friction ridges grip the brick holes on both sides.

- * 4 pins total - one at each corner intersection
- * Pins go through: cross-brace hole INTO long-rail hole
- * Friction ridges should face the brick they are securing against

[CHECK] Rectangular frame: two parallel 10-stud rails at rows 2/23, connected by cross braces at columns 11/20. Frame is rigid and

STEP 3: REAR DRIVE AXLE SUPPORT

S3

3.1 - Install Rear Axle Mount Bricks

Take two 3701 bricks (1 x 4 with holes). These form the rear axle mount that the drive axle will pass through.

First 3701: Place it along row 2, columns 10-13. This positions the brick so it overlaps the rear long rail (Rail A) by one stud on the left side, with the brick extending 2 studs outward from the frame edge.

(Rear mount left: 3701 at row 2, columns 10-13)

Second 3701: Place it along row 23, columns 10-13. This mirrors the first brick on the opposite rail.

(Rear mount right: 3701 at row 23, columns 10-13)

3.2 - Lock Rear Mount Bricks

Insert 2780 pins through the overlapping holes where each 3701 meets its rail. Each mount brick shares 1 stud with the long rail - pin through that shared hole.

* 2 pins total for rear axle mounts

[CHECK] Two 1x4 mount bricks perpendicular to frame, extending outward. Rear axle mount spans 21 studs between rails + extends

STEP 4: FRONT STEERING AXLE SUPPORT

S4

4.1 - Install Front Axle Mount Bricks

Take the remaining two 3701 bricks (1 x 4 with holes). These form the front axle mount.

First 3701: Place it along row 2, columns 19-22. This positions the brick so it overlaps the front long rail by one stud on the right side, with the brick extending 2 studs outward from the frame edge.

(Front mount left: 3701 at row 2, columns 19-22)

Second 3701: Place it along row 23, columns 19-22. This mirrors the first brick.

(Front mount right: 3701 at row 23, columns 19-22)

4.2 - Lock Front Mount Bricks

Insert 2780 pins through the overlapping holes where each 3701 meets its rail.

* 2 pins total for front axle mounts

[CHECK] Two 1x4 front mount bricks positioned at columns 19-22. Front and rear axle mounts are now symmetrically placed on both sides.

STEP 5: MIDDLE CROSS BRACING

S5

5.1 - Install Center Cross Braces

Take the two 3894 bricks (1 x 6 with holes). These provide structural rigidity between the long rails and serve as motor mount rails.

First 3894: Place it along column 15, spanning from row 2 to row 7. This runs perpendicular to the long rails, centered between the front and rear axle mounts.

(Cross brace 1: 3894 at column 15, rows 2-7)

Second 3894: Place it along column 17, spanning from row 22 to row 27. This runs parallel to the first cross brace.

(Cross brace 2: 3894 at column 17, rows 22-27)

5.2 - Lock Cross Braces

Insert 2780 pins where each 3894 overlaps the long rails.

* 2 pins total for cross bracing

[CHECK] Two 1x6 cross braces spanning between the parallel rails, providing lateral rigidity. Frame now has a ladder-like structure

STEP 6: REAR DRIVE AXLE

S6

6.1 - Insert Main Drive Axle

Take one 3737 (Axle 10L - plain, 10 lengths long). Slide it horizontally through the rear axle mount assembly. Thread it through both rear 3701 mount bricks.

- * The axle passes through: left 3701 hole -> gap between rails -> right 3701 hole
- * Position: axle centered so it extends approximately 3 studs (24mm) beyond each mount brick

(Axle orientation: perpendicular to frame long axis, at rows 2-23)

6.2 - Lock Rear Axle

Take two 32062 axles (2L Notched). Insert them into the rear 3701 mount bricks at the holes adjacent to where the main axle passes through. The notch on each 32062 should face UP - this prevents the axle from sliding out laterally.

- * Left lock: 32062 into rear-left 3701, notch facing up
- * Right lock: 32062 into rear-right 3701, notch facing up

[CHECK] Rear 10L axle rotates freely in both directions. Axle does not slide in or out. Notched 2L axles lock it in place laterally.

STEP 7: FRONT STEERING AXLE

S7

7.1 - Insert Front Axle

Take one 32073 (Axle 5L). Slide it horizontally through the front axle mount, threading through both front 3701 bricks.

- * The 5L axle is shorter - this is intentional for the front axle
- * Position: axle centered, extending approximately 1 stud (8mm) beyond each mount brick

(Axle orientation: perpendicular to frame long axis)

7.2 - Lock Front Axle

Take two 32062 axles (2L Notched). Insert into the front 3701 mount bricks adjacent to where the main axle passes through. Notches face UP.

- * Left lock: 32062 into front-left 3701, notch up
- * Right lock: 32062 into front-right 3701, notch up

[CHECK] Both axles installed. Rear (10L) and front (5L) rotate freely. Neither axle can be pushed in or out.

STEP 8: GEAR REDUCTION ASSEMBLY

S8

8.1 - Overview of Gear System

The drivetrain uses a 3:1 planetary reduction. Each wheel has its own drive train:

TT Motor (3mm shaft) -> 12T pinion gear (69778) -> 36T double-bevel gear (32498) -> Wheel

The 36T double-bevel gear mounts directly to each wheel hub. The 12T pinion meshes with the 36T gear. Both gears are Group B, which means they mesh correctly at a center distance of 3 studs (24mm).

8.2 - Install 12T Pinion Gears

Take one 69778 (Gear 12 Tooth). Press it onto the left end of the rear 3737 axle (10L). The gear should sit flush against the end of the axle, with teeth pointing outward.

- * Gear teeth face LEFT (away from chassis center)
- * This is the pinion gear - driven by the TT motor shaft

(Left pinion: on rear axle left end, at row 2)

Take the second 69778. Press it onto the right end of the rear axle.

- * Gear teeth face RIGHT (away from chassis center)

(Right pinion: on rear axle right end, at row 23)

8.3 - Install 36T Wheel Gears

Take one 32498 (Gear 36 Tooth Double Bevel). This gear has teeth on BOTH sides of its center plane (double bevel). Mount it so it meshes with the 12T pinion on its left side.

- * The 36T gear hub goes on the axle extending past the 12T pinion
- * Mesh distance: 3 studs (24mm) center-to-center between 12T and 36T gears
- * Double bevel teeth face the 12T pinion on one side

(Left wheel gear: 36T meshes with 12T pinion, 3 studs offset)

Repeat on the right side with the second 32498. The 36T gear meshes with the 12T pinion on its right side.

(Right wheel gear: 36T meshes with 12T pinion, 3 studs offset)

8.4 - Verify Gear Mesh

Rotate the rear axle by hand. Both 12T pinions should turn, driving the two 36T gears. The 36T gears rotate at 1/3 the speed of the 12T pinions (3:1 reduction).

NOTE: If gears do not mesh smoothly, the center distance is wrong. Both gears must be Group B for 3-stud mesh spacing.

NOTE: The double-bevel design means the 36T gear can mesh from either side - this is correct.

[CHECK] Both pinions and wheel gears rotate smoothly with no binding. Gear ratio confirmed: turn rear axle 3 full rotations -> 36T g

STEP 9: WHEEL INSTALLATION

S9

9.1 - Prepare Wheel-Tire Assemblies

Before mounting wheels to the chassis, assemble each wheel-tire pair:

- a) Take one 56908 (Wheel 43.2mm 6 Pin Holes)
- b) Take one 45982 (Tire 81.6 x 38 R Balloon)
- c) Press the tire onto the wheel rim - it snaps on with a firm press
- d) Verify: tire sits flush, no gap between tire bead and wheel rim

Repeat for all 4 wheel-tire assemblies.

9.2 - Mount Wheels to Axle Ends

Starting with the left rear wheel position (outermost on the 36T gear side):

- a) Slide one 4265c (Bush 1/2 Smooth) onto the axle extension past the 36T gear
- b) The bush acts as a spacer - it prevents the wheel from rubbing against the 36T gear
- c) Press the wheel-tire assembly onto the axle past the bushing
- d) The wheel hub has a 3mm bore that grips the Technic axle (8mm diameter)

Repeat for the right rear wheel position.

- * Wheel order on axle (from inside out): 36T gear -> 4265c bush -> 56908 wheel + 45982 tire
- * Bush prevents wheel rubbing against gear teeth

9.3 - Mount Front Wheels

For the front axle (32073, 5L):

- a) Slide one 4265c bush onto each axle end
- b) Press one wheel-tire assembly onto each end
- c) Front wheels are simpler - no gearing, direct axle mount

[CHECK] All 4 wheels mounted. Each wheel spins freely. Wheels do not touch the frame or each other. Bushing spacers prevent gear

STEP 10: MOTOR MOUNTS

S10

10.1 - TT Motor Specifications

Each TT Micro Motor (37mm) has:

- Diameter: 37mm (approx 4.6 Technic studs)
- Length: 37mm with integrated planetary gearbox
- Output: 3mm round shaft, protruding ~8mm
- Voltage: 3-6V DC (we run at 7.4V from LiPo)
- Shaft height from base: ~15mm (approx 2 brick heights)

10.2 - Build Motor Mount Brackets

Using the cross brace 3894 bricks (1x6) as motor mount rails:

- a) Position each TT motor so its output shaft is directly adjacent to the 12T pinion gear
- b) The motor shaft (3mm) engages the pinion gear teeth directly
- c) Motor shaft center must be 3 studs (24mm) from the pinion gear center

In physical build: use zip ties or double-sided tape to secure motors to the cross brace bricks. In LeoCAD: use a 4x5 generic box as motor placeholder.

- * Left motor: shaft meshes with left 12T pinion
- * Right motor: shaft meshes with right 12T pinion
- * Motor shaft and pinion must be at same height level

NOTE: For a permanent build, 3D-print motor brackets. The STEP export from LeoCAD can be used for this. Temporary build: zip ties or tape work fine.

[CHECK] Both TT motors mounted. Motor shafts mesh with 12T pinions at same height. Motors are secured and do not wobble when

STEP 11: ELECTRONICS PLATFORM

S11

11.1 - Build Raised Mounting Platform

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

Using available baseplate studs in the region rows 25-30, columns 14-19:

- a) The Pi 4 measures 85x56mm (approx 10x7 studs)
- b) The Adafruit Dual Motor HAT stacks directly on top of the Pi 4
- c) Total stack height: ~15mm (2 brick heights)

In LeoCAD: use stacked plates or a flat tile to represent the electronics platform.

Physical build: use zip ties to secure the Pi 4 to the baseplate.

11.2 - Wire Routing

Route wires from the Adafruit HAT to the TT motors:

- a) Motor A wires -> Left TT motor (2 wires: power + ground)
- b) Motor B wires -> Right TT motor (2 wires: power + ground)
- c) Route wires along the inside of the frame rails, between the rails
- d) Use the gap between cross braces as wire channels

Wire length needed: ~20cm per motor (measure before cutting)

11.3 - Power Connection

Connect the 7.4V LiPo battery:

- Battery connector -> Adafruit HAT power input
- HAT supplies regulated power to Pi 4 via 5V GPIO pin
- Secure battery on the baseplate using tape or a 3D-printed mount
- Battery position: 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

STEP 12: FINAL VERIFICATION

S12

Before powering on, verify the entire assembly:

- * 1. All 16 pins (2780) are inserted and frame is rigid - no wobble.
- * 2. Rear axle (3737) rotates 360 degrees without obstruction.
- * 3. Front axle (32073) rotates 360 degrees without obstruction.
- * 4. Both 12T pinions mesh with their respective 36T wheel gears.
- * 5. All 4 wheels spin freely and do not touch the frame.
- * 6. Bushings (4265c) are between each gear and wheel.
- * 7. TT motor shafts mesh with 12T pinions at same height.
- * 8. Motor wires reach from Adafruit HAT to both motors.
- * 9. LiPo battery is connected and secured, away from wheels.
- * 10. Pi 4 boots and Adafruit HAT is recognized (i2c detect 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:

- * 69778 - 12 Tooth, Group B, bore 3mm (for 3mm axle)
 - Center-to-tooth distance: 1.5 studs (12mm)
- * 32498 - 36 Tooth Double Bevel, Group B, bore 3mm
 - Center-to-tooth distance: 4.5 studs (36mm)
 - Mesh distance with 12T Group B: 3 studs (24mm center-to-center)
 - Double bevel = teeth on both faces of gear body

Gear ratio: $36/12 = 3:1$ 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)
- * 32073 (5L): 40mm total, 8mm diameter
- * 32062 (2L): 16mm total, 8mm diameter, notched
 - Notch faces UP to lock axles laterally
- * All Technic axles: 8mm diameter standard

Brick Hole Spacing

- * Technic holes are 8mm apart center-to-center
- * 1xN brick has N holes
- * Brick length in studs = number of holes
- * Hole diameter: 4mm (accepts 3mm pins/axles and 8mm axles)

Adafruit Dual Motor HAT Pinout

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

LeoCAD Export Instructions

- * File -> Create Instructions for step-by-step manual
- * File -> Export -> STEP for 3D printing motor mounts
- * File -> Export -> OBJ for 3D visualization
- * View -> Exploded for checking clearances