

# Motor Mount and Wheel Kit (#27971)

Includes two 36-position Quadrature Encoder Kits (#29321)

The Parallax Motor Mount and Wheel Kit is a complete mechanical drive system for sturdy and robust mid-sized mobile robots. It's comprised of two independent drive assemblies that are mirror images of each other. Each assembly contains a right angle, worm-drive gear motor, axle and ball bearing assembly, six-inch pneumatic tire, and an integrated encoder system that provides feedback to the microcontroller or processor of your choice.

Although this kit is designed for direct compatibility with our Robot Base Kit (#28977), it can be easily adapted to a custom platform of your choice or design using the pre-drilled, pre-tapped holes in the precision machined 6061 aluminum mounting blocks.



## Features

### Drive system

- Powerful worm-drive DC gear-motors mount on precision machined 6061 aluminum hardware
- Conveniently located pre-tapped holes for easy mounting
- Rugged pneumatic tires well-suited for indoor and outdoor terrain
- Powerful and strong, yet light weight

### Encoders

- 36-position Quadrature Encoders provide up to 144 pulses per revolution
- Dual-signal out-of-phase outputs indicate direction, pulse widths indicate speed, and number of pulses indicates distance traveled
- Small form-factor and low voltage/current operation are easy to integrate with your robotic system

## Key Specifications

### Drive system

- DC motor nominal operating voltage: 12.0 VDC
- No load current: 1.50 Amps (approx.)
- 3.15 lbs. per drive assembly (two included in this kit)
- Approx. 150 RPM @ 12.0 VDC, 1.50 A, no load

### Encoders

- Power requirements: 2.5 VDC @ 3.5 mA, 3.0 VDC @ 5.0 mA, 11.6 ma @ 5.5 VDC max.
- Communication: two-channel high/low pulse output
- Dimensions: 2.0 x 1.1 x .25 in (5.1 x 2.7 x 0.6 cm)
- Operating temperature: 32 to 158 °F (0 to 70 °C)

## Product Change Notice

The original Motor Mount and Wheel Kit contained Position Controller Kits (#27906). The current version of the kit includes 36-position Quadrature Encoder Kits. The 36-position Quadrature Encoder Kit is NOT an electrical drop-in replacement for the Position Controller Kits. *The communication protocols and electrical connections are substantially different.* Microcontroller code written for one system would not be compatible for the other. For information about the Position Controller Kits search 27906 at [www.parallax.com](http://www.parallax.com).

## Bill of Materials

Part #	Description	Quantity
27958	Motor, 12 VDC (left)	1
27959	Motor, 12 VDC (right)	1
29321	36-position Quadrature Encoder Kit	2
34010	Motor Bearing Block – 6061 Aluminum	2
34015	Wheel, main rim – 6061 Aluminum	2
34016	Wheel, rim ring – 6061 Aluminum	2
34021	Axle, 6061 Aluminum	2
700-00100	1/8 x 1" Roll Pin	2
710-00015	1/4" – 20 x 0.5 Flat Head Screw	12
710-00105	1/4" – 20 x .625 Button Cap Screw	2
710-00110	M4 x 50 mm Socket Cap Screw	6
713-00012	3/8" – OD, #8-ID x 1" Aluminum Spacer	6
721-00004	Inner Tube, 6" x 1-1/4" Pneumatic, with valve stem cap	2
721-00006	Knobby Tire, 6" x 1-1/4" Rubber	2
724-00001	0.5" ID x 1.125" OD Ball Bearing	2

## Mechanical Assembly

This section details assembling one motor, motor mount, and encoder. Two sets are included in your kit. You will need the following tools:

- Screwdrivers: #1 Phillips and flathead
- Hex Keys: 3 mm and 5/32"
- Small wooden mallet or hammer
- Wood block
- Tire pump, preferably manual

**Step 1:** Remove any debris from the internal fins on the encoder disk (a toothpick, fingernail or tiny screwdriver works well). Then slide the disk onto the axle as far as it will go. It should be a tight fit as you push it on, as the internal fins of the disk conform and compress to the axle.



**Step 2:** Insert the axle assembly into the Bearing Block. This will be a very close tolerance fit. Take care to properly align the bearing with the block while maintaining a gentle pressure. Very gentle tapping with a wooden mallet can be used if required. This close-tolerance fit is by design.



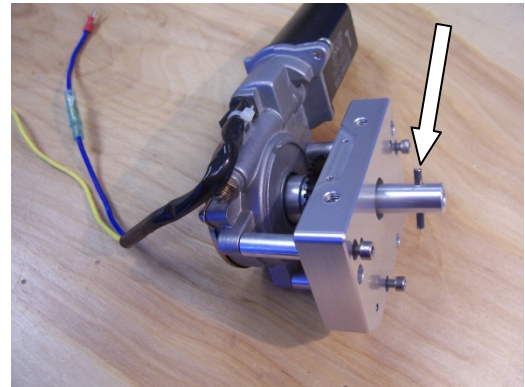
**Step 3:** Insert the motor shaft into the large diameter end of the drive axle.



**Step 4:** Insert the three M4 x 50 mm socket-cap screws into the counter-sunk holes as shown. Slide three 1" long standoffs onto the screws and then line up the screws to the motor screw holes and tighten with a 5/32" Allen wrench.



**Step 5:** Insert the drive pin into the hole in the axle. You may want to place the axle against a wooden block as you gently drive the pin half-way through the axle. The pin should be a very tight fit, and it should be centered in the axle as shown here. Tighten the (3) socket-cap screws.



**Step 6:** Do not over-inflate the inner tube—it will only take a little bit of air—it's safest to use a hand-held bicycle pump. Inflate the inner tube just enough to eliminate any wrinkles or folds in the rubber. Then, insert the tube into the tire cavity, as shown.





**Step 7:** Align the main hub with the tube's valve stem, as shown.

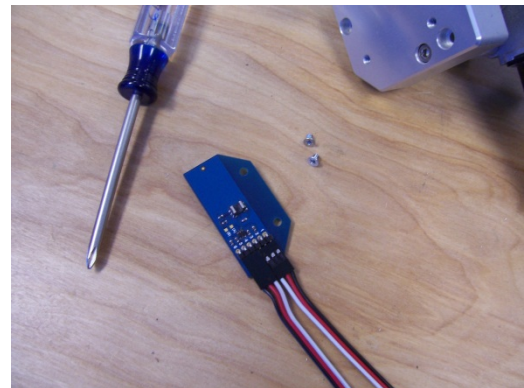


**Step 8:** Sandwich the two rims together, and secure with (6) #4-40 x 1/2" Flat Head Philips screws.

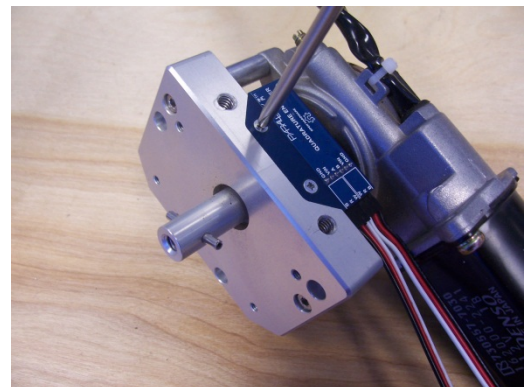
You can assemble the wheel with the valve stem either on the inside or outside of the robot. On the outside, it's more convenient to re-fill, if necessary. On the inside, it gives a cleaner, more streamlined look. This picture shows the valve stem oriented towards the inside of the Motor Mount assembly (indicated by the drive pin slot on the hub).



**Step 9:** Attach two cables to each of the Quadrature Encoder boards, as shown. Note the polarity and orientation of the cables; the two white wires should be adjacent to each other.



**Step 10:** Attach the Quadrature Encoder board to the Bearing Block as shown, using (2) 3/16 x 4-40 Flat Head Philips screws. Be sure that the Encoder Disc is centered within the Encoder sensor's slot.



**Step 11:** Secure the wheel to the axle with a 1/4"-20 x 5/8" button-cap screw.



**Step 12:** Attach the Encoder PCB using two # 4-40 x 1/8" flat head Philips screws, as shown.

Be careful to align the Disc with the Encoder's slotted sensor.



**Step 13:** Gently spin the wheel assembly, and watch how the encoder disk spins in relation to the encoder's slot. Adjust the disc such that it spins freely within the confines of the Encoder's slot.

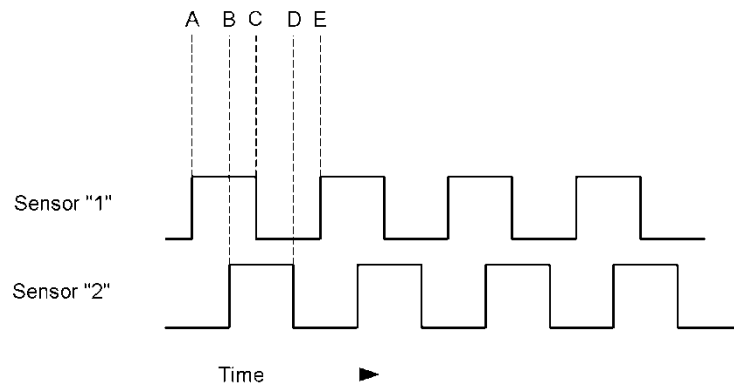


## 36-position Quadrature Encoder Operation

The 36-position Quadrature Encoders provide a convenient means to reliably track the position and speed of each wheel at all times. With the (included) Encoder disks, each Encoder assembly has a basic resolution of 36 positions per rotation. However, because there are two sensors in each assembly, this results in a potential resolution of 144 positions per full tire rotation. This translates to a linear resolution of approximately 0.13 inches of travel per drive assembly, using the stock six-inch tires. Actual resolution will be limited by the amount of backlash in each of the gear motor assemblies, which is approximately +/- .175 lineal inches.

The 36 Position Quadrature Encoder Kit employs a dual-slotted sensor mounted on a printed circuit board (PCB). This module contains a single infrared light source on one side of its slot, and two separate sensors embedded into the opposite side of the slot.

When the encoder disk rotates and swings through the slot, each individual fin on the disk blocks one sensor first, and then the other, from the light source. The first blocked sensor transitions from low to high, and then, as the encoder disk continues to rotate, the second sensor is blocked and it too transitions from low to high. These two signals overlap each other, as shown in the diagram below.



In the diagram, notice that after sensor 1 goes high (A), sensor 2 then goes high (B) as the encoder continues to rotate. Then, as the encoder continues to spin, sensor 1 goes low (C), and then sensor 2 follows (D). Because sensor 1 went high before sensor 2 (A-B), this indicates that the encoder disk is rotating in one direction (in the case of a robot, either forward or reverse). If sensor 2 went high before sensor 1, then the disk is rotating in the opposite direction.

By interpreting these two signals, the following can be determined:

- Whether or not the device is moving (by detecting transitions on either sensor).
- The direction in which the device is moving (by detecting which sensor transition occurs first).
- The speed at which the device is moving. By measuring the widths of each pulse, or by measuring the frequency of the pulses).
- The total distance traveled (by counting the number of pulses from either sensor).

The Quadrature Encoders are compatible with most any microcontroller. Keep in mind that the Encoders provide pure, real-time data; there is no processing delay on the Encoder board itself. The Encoder delivers two high-speed output channels (through the white wires) to the circuit (or microcontroller) of your choice.

## Revision History

Version 2.0: Revised to reflect the product changes in the Product Change Notice, page 1.

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