

Penguin Robot Kit

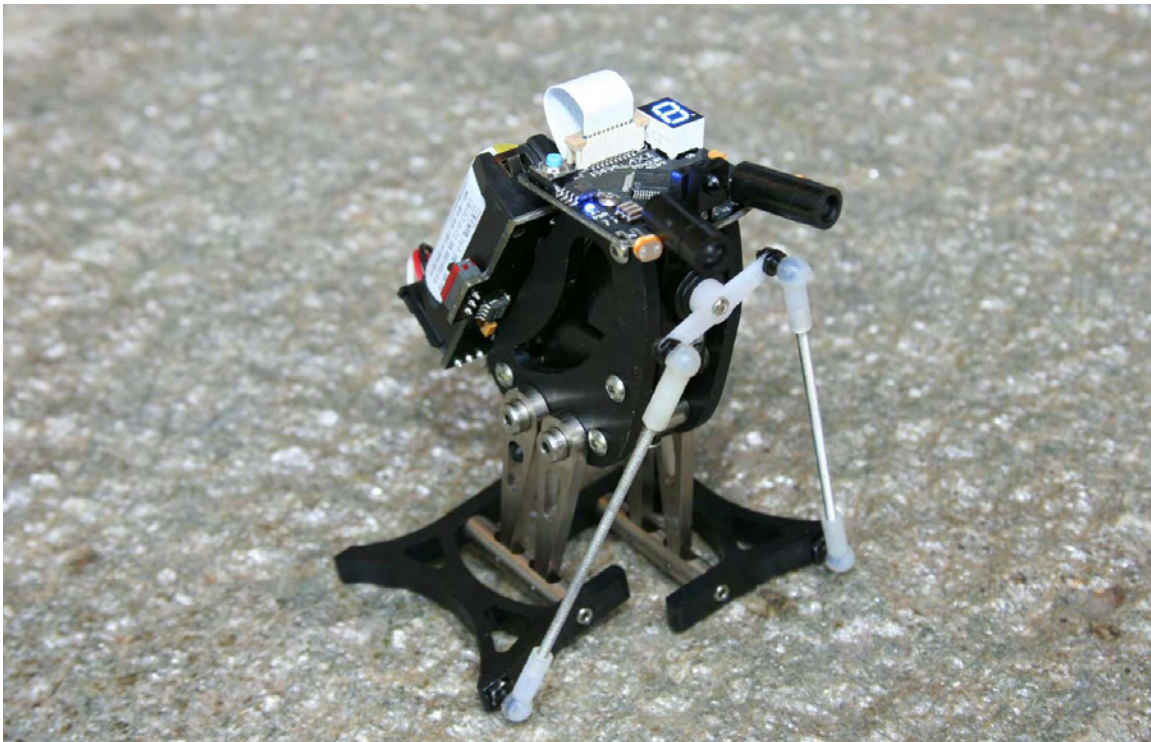
(Red #27313)

(Blue #27314)

(Clear #27315)

(Black #27316)

The Penguin Robot is a precision-machined 4" tall biped. The Penguin walks forward with a tilt-stride action and turns by sweeping both feet on the ground in opposite directions. Individual movement segments are linked together for this robot to walk. This basic biped design functions best in the Penguin's small scale. The Penguin mechanics have a close-tolerance fit and are designed to provide precise electronic control.



The Penguin's microcontroller is an embedded BASIC Stamp2px24 module, the fastest and most powerful BASIC Stamp microcontroller model in the Parallax lineup. The Penguin requires three hours to assemble, after which it is a PBASIC programming challenge to exploit all of the robot's capabilities.

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1.0 INTRODUCTION

1.1. AUDIENCE

The Penguin isn't a beginner's robot. The Penguin is a small desktop robot, not intended for long-distance adventuring. The Penguin's electronics are fully assembled and wired to an assortment of I/O devices. Additionally, it has a fairly complex programming process which is more difficult to understand than a two-wheeled robot. For example, Penguin's walking steps must be linked and the compass sensor must be calibrated. For these reasons we recommend this robot for the hobby robotics enthusiast or collector who has an extended interest in PBASIC programming.

1.2. FEATURES

- BS2px24 module chipset
- CNC-machined 6061 aluminum parts available in four color schemes
- (2) micro servos
- Hitachi HM55B Digital Compass sensor
- Blue seven-segment LED for feedback
- (2) photoresistors
- (2) infrared emitters and one detector
- Piezospeaker in body, underneath battery pack
- Power switch located adjacent to battery pack
- FTDI 232RL mini USB programming port
- (2) CR123 batteries for 6V power supply
- Blue power indicator LED
- expansion I/O port, Vss and Vdd header for Ping))) distance sensor or RF modules

1.3. SYSTEM AND SOFTWARE REQUIREMENTS:

- PC running Windows XP/Vista, with an available USB port
- BASIC Stamp Editor Software v 2.3 or higher - download from www.parallax.com/downloads.
- USB VCP Drivers - these can be installed automatically via the BASIC Stamp Editor v2.3 installer, or you may download the latest version separately from link on www.parallax.com home page.
- Penguin Test and Sample Programs - test programs are included in this document; all programs listed may be downloaded as .bpx files from Penguin product page at www.parallax.com.

1.4. BILL OF MATERIALS

Part #	Description	Quantity
Penguin Body Kit		
720-27313	Red Anodized Penguin	1
720-27314	Blue Anodized Penguin	1
720-27315	Clear Anodized Penguin	1
720-27316	Black Anodized Penguin	1
Each of the above includes:		
--	Body panels	2
--	Leg pairs attached to ankle	2
--	Feet	2
--	4-40 5/8" long standoffs, with machined flat space	4
Penguin Hardware Package		
720-00013	Stride linkage	1
720-00015	2-56 threaded rod 2.5" long	2
710-00013	4-40 1/8" long, 0.149" diameter stainless steel shoulder screw	4
710-00010	4-40 1/8" long, 1/8" diameter stainless steel shoulder screw	4
710-00011	4-40 1/4" button socket cap stainless steel screw	12
710-00012	2-56 1/4" button socket cap stainless steel screw	2
710-00014	2-56 1/4" flathead stainless steel screws	4
725-00016	2-56 ball links for 2-56 threaded rod	2
725-00062	1/16" hex key	1
725-00063	0.05" hex key	1
725-00064	5/64" hex key	1
725-00067	1.5 mm hex key	1
725-00018	1/16" ball links for 2-56 threaded rod	2
Electronics		
555-27313	Penguin BS2px printed circuit board	1
Each of the above includes:		
--	BS2px24 circuit board	1
--	Flat white ribbon cable to connect the boards	1
--	Power pack board	1
Miscellaneous		
700-00064	Parallax dual-head screwdriver	1
752-00003	CR123 Batteries	2
805-00010	USB A to Mini B programming cable	1
900-00014	Grand Wing Naro standard servo	2
700-00063	Drill bit, #55	1

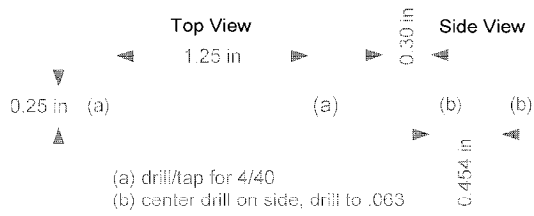


Missing parts? Your Penguin experience should be nothing short of complete success and satisfaction. If you encounter a missing part contact us immediately and we'll put it in the mail for you. The best way to do this is by e-mail to sales@parallax.com, or you can call us at (888) 512-1024.

1.5. BODY KIT MECHANICAL DRAWINGS

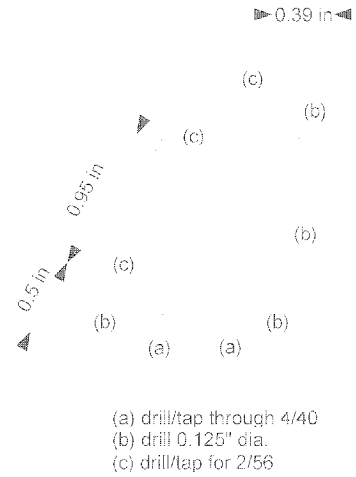
Axle

Material: aluminum 1.25" length standoff, 0.25" diameter with 4/40 threads (McMaster 93330A461)



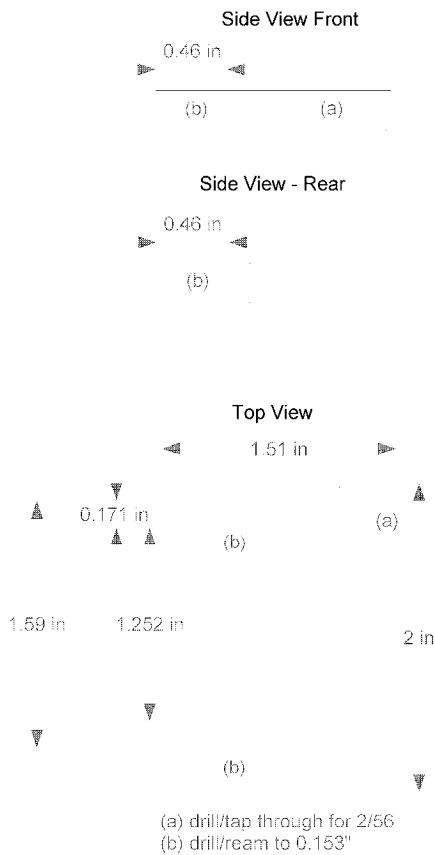
Body Panel

Material: brushed aluminum 6061 0.125" (+0.005 -0.000")



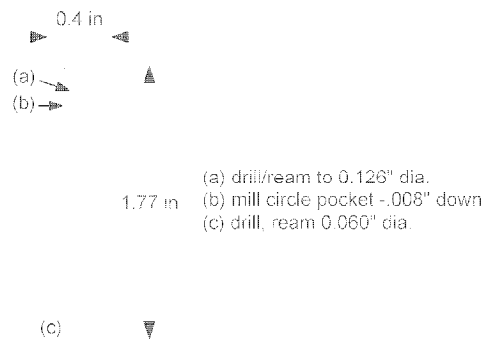
Foot

Material: brushed aluminum 6061 0.25" (+.005" -0.000")



Leg

Material: brushed aluminum 6061 0.125" (+0.000" -0.002")



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2.0 ASSEMBLY

2.1. TOOLS REQUIRED

The Penguin kit includes a portion of the tools required to build the robot (the hex keys, drill bit, and screwdriver). You will need to provide these additional tools to finish assembly, which are not included in the kit:

- Small pliers
- Ruler or calipers
- Handheld drill, small drill press, or a vise
- Small adjustable crescent wrench (or 3/16" socket)
- Safety glasses



Safety first! Taking basic safety precautions is absolutely necessary when building a Penguin. The assembly process includes several steps where you will be exposed to danger. You will be using a sharp drill bit to enlarge a tiny hole, and tiny pieces may fly. You will be pressing ball joints together, where a small slip can puncture your skin. These dangers are minimized by wearing safety glasses and using the right tools for the job.

2.2. ASSEMBLY INSTRUCTIONS

Step 1: Attach standoffs to servos

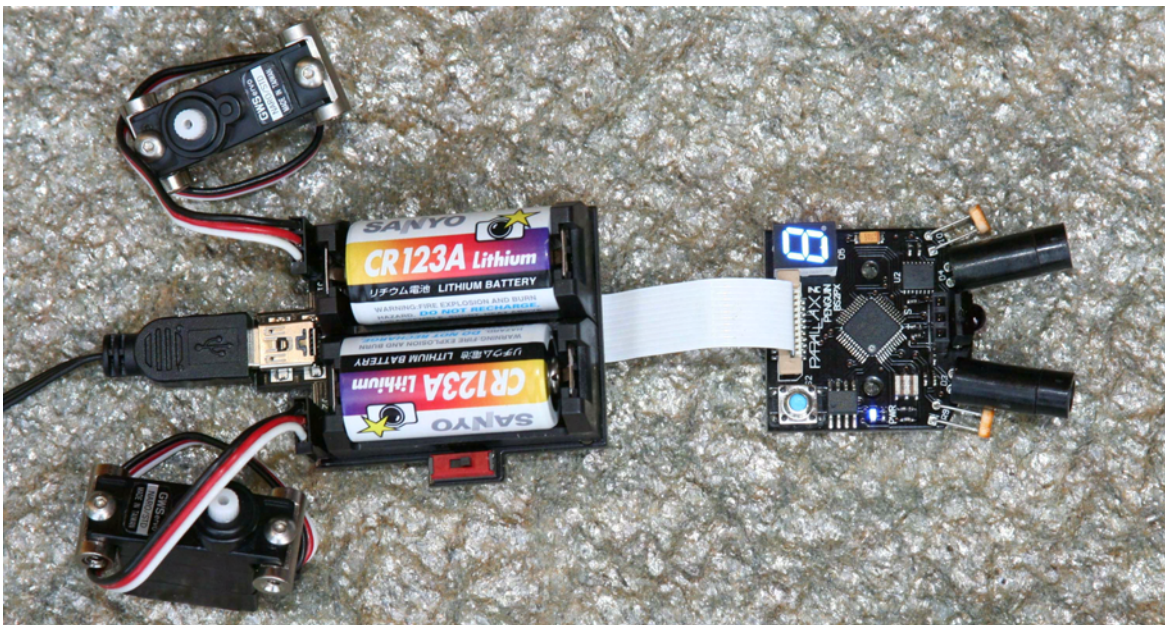
Connect (4) of the 4-40 1/4" button socket cap stainless steel screws to the middle of the 5/8" 4-40 standoffs. The standoffs have a machined flat space in the middle against which the servo tab will be seated when the screw is tightened. Press the standoffs against the servo body when tightening the screws. This will ensure proper spacing when the servos are mounted in the Penguin body panels.



Step 2: Center the servos using the BASIC Stamp Editor

This step centers the servos, so that further mechanical tuning will be minimized once the Penguin is assembled. It also ensures that you won't need to take the Penguin apart once you start programming it. The servos need to be centered with a 1.5 ms pulse, following the directions below:

- Connect the Penguin boards together using the flat ribbon cable. The blue-tipped side of the cable faces away from both boards (blue side is facing down in this photo).
- Insert two (2) CR123A batteries into the power pack. A line drawing on the inside of the battery holder shows how the batteries are oriented.
- Plug two servos into the bottom of the power pack, being careful to orient them correctly. From the perspective of this photo, the servo's white leads are on the bottom, or the right side of each servo connector as viewed behind the Penguin.
- Download and install the BASIC Stamp Editor and FTDI USB VCP drivers software if you have not done so already.
- Plug the mini USB cable into the power pack.
- Plug the other end of the USB cable into your PC.
- Turn on power to the board (red switch).
- Open the BASIC Stamp Windows Editor and run the Penguin Servo Centering.bpx program.
- The servos are now centered. Disconnect the servos first, and then remove the batteries and USB cable from the power pack board.



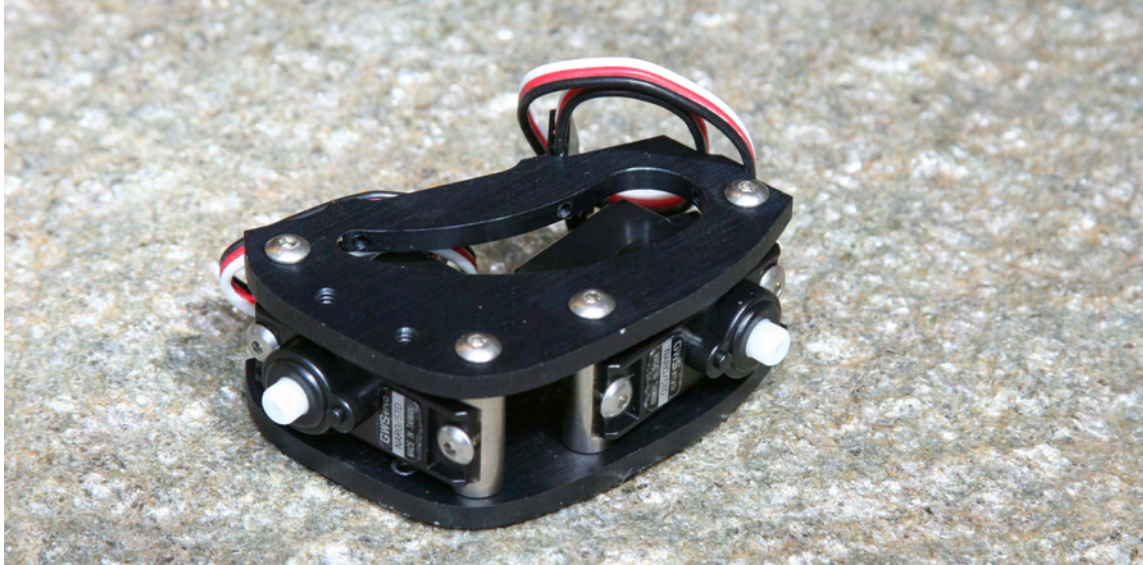
```
' Parallax Penguin Robot
' Penguin-CenterServos.bpx
' {$STAMP BS2px}
' {$PBASIC 2.5}

Center      CON      1875      ' Centered servo pulse
StrideServo PIN      6
TiltServo   PIN      7

DO
  PULSOUT StrideServo, Center      ' Center stride servo (J1)
  PULSOUT TiltServo,   Center      ' Center tilt servo (J2)
  PAUSE 15
LOOP
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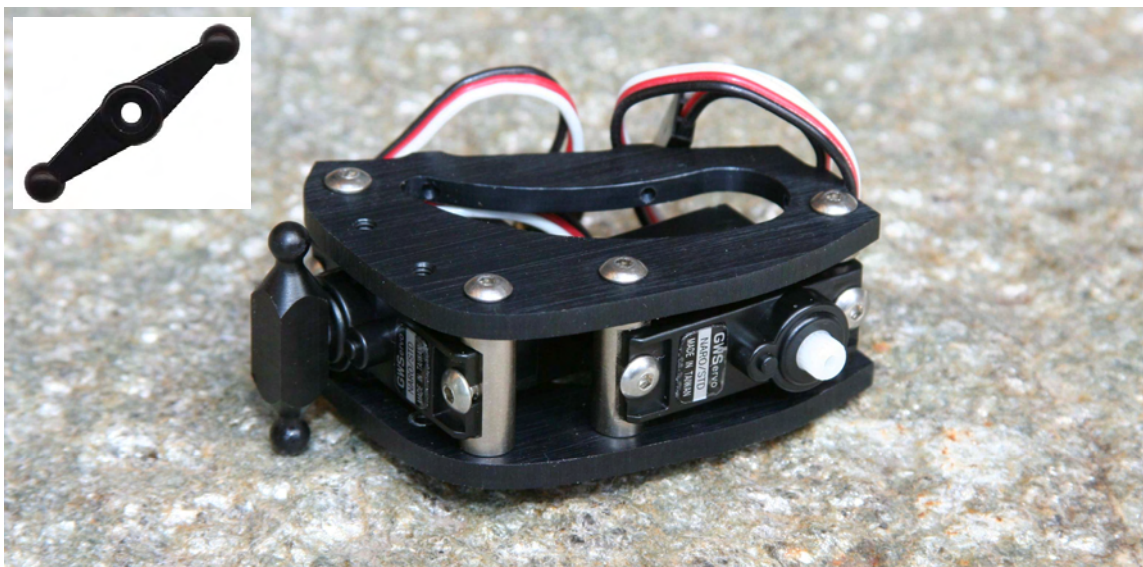
Step 3: Assemble the Penguin body

Install the servos into the Penguin body using (8) 4-40 1/4" long button socket cap stainless steel screws and the 1/16" hex key. The picture shows how the servo splines are oriented: the stride (bottom) servo spline is near the rear of the Penguin; the tilt (top) servo spline is near the top of the Penguin. Tighten the screws.



Step 4: Install stride linkage on the stride servo

Locate the small black plastic stride linkage with two ball-shaped ends. (This part has changed: the style shown on the left is included in your kit. The previous style is shown in all the photographs.) The stride linkage has a recess in the reverse shape of the servo spline. Press it onto the servo so that it is as close to cross-wise to the Penguin body as possible; it may not be perfectly perpendicular because the spline is toothed. For fine-tuning, this can be corrected with calibration-in-software using sample code available for free download from the Penguin product page. Secure the stride linkage to the spline with the servo screw.



Step 5: Attach legs and ankles to body

The Penguin's legs and ankles come pre-assembled since they required a specialized tool to properly insert small dowel pins through the round ankle. Each Penguin has a pair of left and right legs. Also notice that there's a round machined recess with a diameter slightly larger than the shoulder screw head on each pair of legs. The recess faces out towards the shoulder screw, and the shortest part of the ankle faces forward. Shoulder screws have a 1/8" diameter smooth stainless steel surface upon which the legs will rock back and forth.

To install the leg assemblies on the Penguin, use the (4) 4-40 1/8" long shoulder screws and the 5/64" hex key. The ball-shaped ends of the stride linkage fit within the matching oval cutout in the rear legs.

The legs should move freely when assembled, and you will hear the stride servo's gears moving at the same time. If it takes force to move the legs you have one of two problems: either the metal parts have bound, or the screws are too tight into the body panels. Tighten everything enough to remove "slop" but not so tight that parts are unable to move freely.

