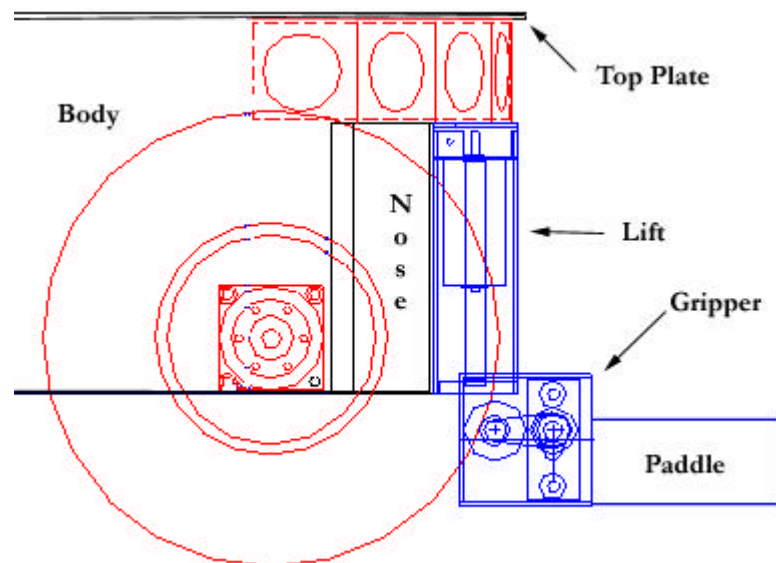


Pioneer

Mobile Robots

with Pioneer Server Operating System Software



Pioneer 2 Gripper Manual

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Introduction

Congratulations on your purchase and welcome to the rapidly growing community of researchers, developers, and enthusiasts of the Pioneer Mobile Robot.

This *Pioneer 2 Gripper Manual* provides the general and technical details you will need to install and operate your new P2 Gripper in your Pioneer 2 Mobile Robot.

We also encourage you to use these companion resources that come with your Pioneer:

- ✓ Pioneer 2 Operation Manual
- ✓ Saphira, Ayllu and PAI Software Manuals
- ✓ Pioneer Registration & Account Sheet
- ✓ Personal Account for the <http://robots.activmedia.com> Internet server
- ✓ Pioneer- and Saphira-users@activmedia.com support newsgroups

P2 Gripper Package

Our experienced robotics manufacturing staff put your Pioneer 2 Gripper through a “burn-in” period and carefully tested it before we shipped the hardware and software to you. Our care extends beyond: Besides the companion resources listed above that bring the whole community of Pioneer to you, we warranty the Gripper against mechanical and electronic parts and labor defects for 90 days. All of these precautions ensure that you have many years to enjoy your new accessories for the Pioneer 2 Mobile Robot.

Even though we’ve made every effort to make your package complete, please check the components once again after you unpack it from the shipping crate.

Package Components

- ✓ Pioneer 2 Gripper complete with mounting hardware and cabling
- ✓ Pioneer 2 Gripper Manual

User Supplied Components

- ✓ Pioneer 2 Mobile Robot
- ✓ Set of hex wrenches that accompanied your original robot
- ✓ Small, flat-bladed screwdriver

Basic Pioneer 2 Platform

Pioneers are small, intelligent mobile robots originally developed by Kurt Konolige of SRI International and now available exclusively through ActivMedia ROBOTICS. The basic Pioneer 2 Mobile Robot platform contains all of the components for sensing and navigation in a real-world environment, including battery power, drive motors and wheels, position encoders, and range-finding ultrasonic sonar transducers—all managed via an onboard Siemens C166-based microcontroller board (Figure 1-1).

The Pioneer 2 DX and CE models are two-wheel, differential drive mobile robots intended for indoor, albeit less-than-ideal surface operation (wheel-chair accessible areas, for example). The Pioneer 2-AT is a four-wheel drive, differential skid-steering version of the Pioneer 2 intended for outdoor, all-terrain (AT) operation. Otherwise, the platforms are nearly identical and share accessories, including the P2 Gripper.

All Pioneers come with onboard robotics server software (Pioneer 2 Operating System) and an open API for client software control of the robot’s systems and accessories. Users access the onboard servers from their client workstation connected wirelessly, or via a piggyback laptop or integrated onboard PC through an RS232 serial communication port.

The P2 Gripper

The Pioneer 2 Gripper is a manipulation accessory that attaches to the Pioneer 2 DX, CE, or AT’s Nose.

Mechanically, the P2 Gripper is a simple, yet powerful 2-degrees of freedom robotic manipulator. Independent segments—the Gripper itself and its Lift mechanism—each are driven by a reversible-DC motor (Figure 1-2). Embedded limit switches act to sense the Gripper and Lift positions. And the Gripper’s paddles each contain grip sensors and IR breakbeams both front and rear to sense objects and their positions within its grasp.

Introduction

As part of the Pioneer 2 Operating System (P2OS), onboard software servers interface with the Gripper and Lift electronics and sensors to fully manage their operations. Accordingly, the client software developer need only issue a single, simple command to actuate fundamental manipulation operations.

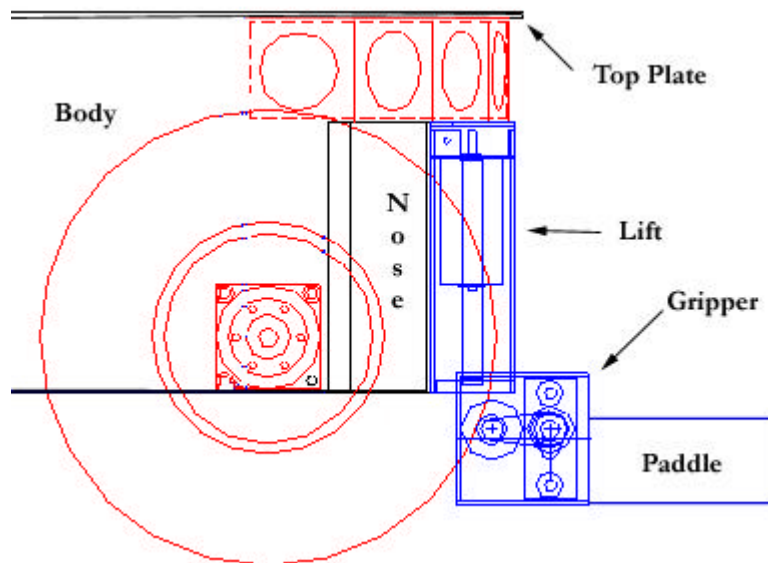


Figure 1. Pioneer 2 AT with P2 Gripper attached.

General vs User I/O

The original version of the P2 Gripper was attached to and controlled from the robot's onboard User-I/O port. The current version attaches to and uses the shared bus of General-I/O port on the microcontroller for control, freeing User-I/O for other applications. The latter configuration comes at a cost: You lose some direct controls and the software for controlling the P2 Gripper is significantly different between the two versions. See Chapter 3, *P2 Gripper Operation and Programming*, for details.

All P2 Grippers are convertible: They may use either the General I/O or User I/O for control. The differences are the connection cable and the control software. The General I/O-based version has cable-inline conversion electronics. Use a 20-pin pass-through ribbon cable to connect the P2 Gripper directly to User I/O. There is a kit available to convert a User I/O-based P2 Gripper into one that attaches to the General I/O port.

P2 Gripper Specifications

In its fully down and open state, the two 3cm (1.5 inch) tall by 9.5cm (3.5 inch) deep P2 Gripper paddles, each with 2mm soft-foam pads on the inside, are 21.5cm (8.4 inches) apart and ride 2.4cm (1.2 inches) off the floor with the Pioneer 2 DX/CE or just 1cm (0.25 inches) off the floor with the AT. The paddles extend out from the Pioneer 2's main body 11cm (5 inches) beyond the Console edge.

The P2 Gripper paddles, close together horizontally until they grasp an object or close on themselves. The grasping pressure is under software control, and varies between 200g (0.5 lbs.) and 2kg (5 lbs.). Under independent control and drive, the Gripper's Lift mechanism reaches to the floor, rises 9cm (4 inches), and can lift objects weighing up to 2kg (5 lbs.).

Required Components

The P2 Gripper will fit and operate on any Pioneer 2 DX, CE, or AT Mobile Robot and work with all versions of client software. The only caveat is P2OS: You need version 1.D or later and its related utilities to operate your new accessory and its various I/O ports and connections.

If the P2 Gripper came attached to your new robot, you should already have the necessary software. Otherwise, use the disk that comes with the Gripper, or a version that supports your computing platform as downloaded from our support website (see *Additional Resources* below).

If still in doubt, please contact pioneer-support@activmedia.com for help in updating your robot's server software.

Additional Resources

Every Pioneer customer gets three additional and valuable resources: a private account on ActivMedia ROBOTICS' Internet server for downloading Pioneer software, updates, and manuals; access to private Pioneer and Saphira robotics newsgroups; and e-mail access to the Pioneer support team.

Pioneer Web Software Archive

We have a World Wide Web server connected continuously to the Internet where customers may obtain Pioneer software and support materials. Point your favorite Web browser to:

<http://robots.ActivMedia.com>

Some access areas are restricted to licensed customers, including Pioneer owners. To gain restricted access, use the username and password that are written on the Pioneer ***Registration and Account Sheet*** that accompanied your robot.

Pioneer and Saphira Newsgroups

ActivMedia ROBOTICS also maintains a special e-mail-based newsgroup for Pioneer owners and Saphira programmers to share ideas, software, and questions. We strongly encourage you to sign up. For details, send E-mail:

To: **pioneer-users-request@ActivMedia.com**

From: <***your return email address goes here***>

Subject: <choose one commands:>

help (returns instructions)

lists (returns list of newsgroups)

subscribe

unsubscribe

Our SmartList-based listserver will respond automatically. Once subscribed, send your email comments, suggestions, and questions intended for the worldwide community of Pioneer users:

To: **pioneer-users@ActivMedia.com**

From: <***your return email address goes here***>

Subject: <***something of interest to all members of pioneer-users***>

Access to the pioneer-users newlist is limited to subscribers, so your address is safe from spam. However, the list currently is unmoderated, so please confine your comments and inquiries to that concerning Pioneer operation and programming.

Support

Have a problem? Can't find the answer in this or any of the accompanying manuals? Know a way that we might improve Pioneer? Share your thoughts and questions directly with us:

pioneer-support@ActivMedia.com

Your message goes to our team of Pioneer developers who will help you directly or point you to where you may find help. Because this is a support option, not a general-interest newsgroup like pioneer-users described above, we must reserve the option to reply only to questions about bugs or problems with Pioneer and its accessories.

Installation

Please read through this chapter carefully before you attempt to attach the P2 Gripper to your Pioneer 2 Mobile Robot. If for any reason you do not wish to perform the work yourself, contact *ActivMedia* ROBOTICS and make arrangements to have the assembly installed at the factory.

On the other hand, skip this chapter altogether if your Pioneer 2 Mobile Robot came with the Gripper already attached.

The newest P2 Gripper requires P2OS version 1.D or later.
Contact pioneer-support@ActivMedia.com if you need to update P2OS.

Step 1: Remove Power

Switch MAIN power off. On the DX and AT models, for extra safety, you might reach in through the back door and remove the automotive spade-type fuse from its socket on top of the battery box.

Step 2: Remove Nose

The P2 Gripper attaches to your Pioneer 2's Nose. Use the hex wrenches that come with your robot to remove the two 3mm button-head screws that fasten it to the underside of the sonar ring and to the underside of the Body. If you do not have an onboard PC, simply loosen and remove the Nose.

If you have an onboard PC, swing the unfastened Nose towards the left side of the robot, and carefully unplug the following cables, noting the orientation of each connector:

- ✓ Fan
- ✓ Speaker
- ✓ Hard-Disk Drive

Once removed from the robot, remove the plastic plug that covers the rectangular gripper cable-access hole in the front face of the Nose.

Step 3: Remove Top Plate.

DX and CE Models: Using the hex wrenches that came with your robot, remove the six 3mm flat-head screws that attach the top plate of the Pioneer 2 to the sides of its Body. They are the three rear-most screws on each side. Do not remove the screws that attach the microcontroller board and the front sonar ring to the top plate (Figure 3).

Also remove the eight 4mm screws from the two wheel struts and remove the struts from the wheel axles.

P2 AT Model: Remove the sixteen 3mm flat-head screws that attach the top plate to the Body. All of the screws are to the rear of the robot, along the sides and around the Accessory door (Figure 5). Do not remove the screws at the front of the robot or around the Console.

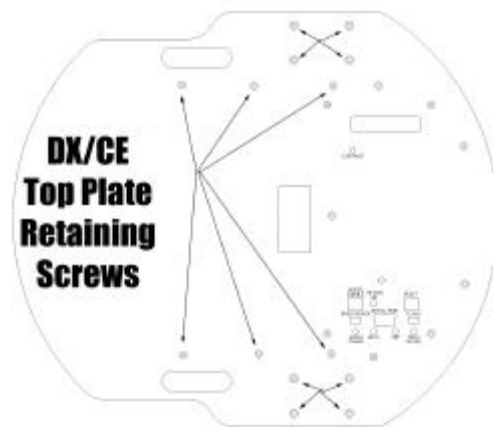


Figure 2. DX and CE top plate retaining screws

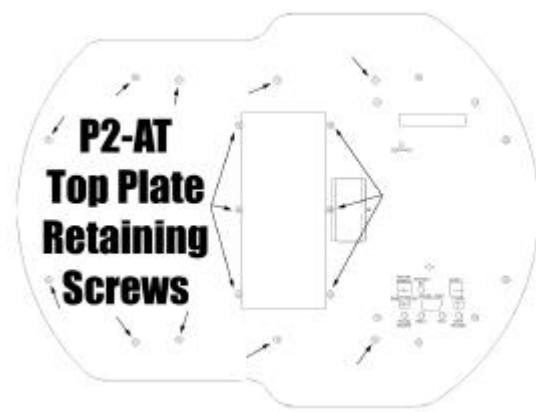


Figure 4. AT top plate retaining screws

All Models: Lift the top plate a few centimeters from the robot's body and carefully unplug the following cables after noting their position on the robot (Figure 6):

- ✓ 10-wire twisted-pair flat-cable from the rear sonar ring (if present)
- ✓ All of the cables attached to the rear of the microcontroller board, including the 20-wire ribbon cable and any 10-wire ribbon cable(s) to the serial port(s).

Lift the top plate free from the robot and set it aside.

Step 4: Install Gripper Power and Control Cables

At the rear of the robot, on top of the box that holds the batteries, locate the main Power Out screw terminals. Loosen those screws and add the spade terminal ends of the Gripper Power cable to that connector; black wire to similar black wire GND, and yellow wire to yellow wire Vpp (12 VDC).

Route the Gripper Power cable forward to the front of the robot.

Insert the 34-wire Gripper Control cable into the General I/O connector on the back of the Pioneer 2 microcontroller that is still attached to the Top Plate.¹

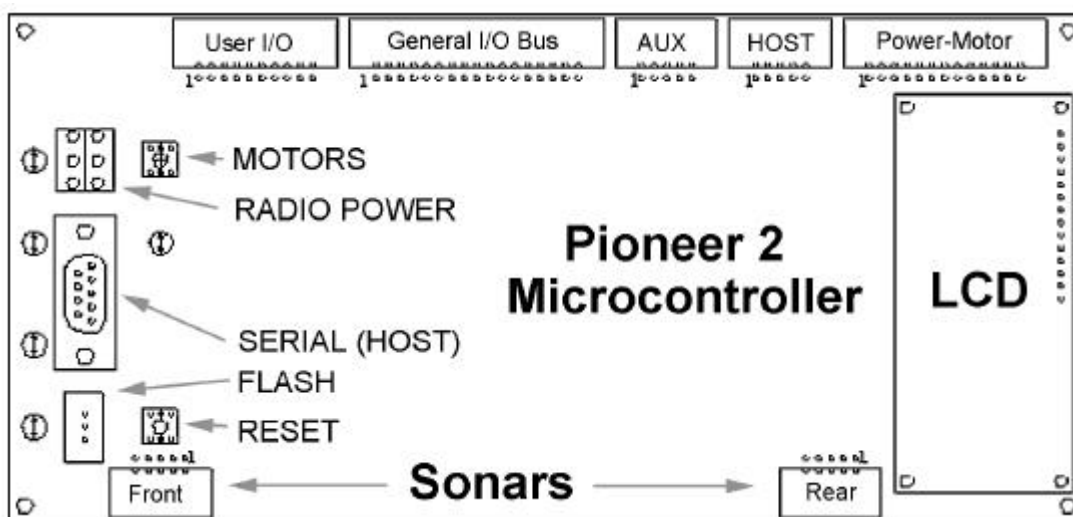


Figure 7. Pioneer 2 microcontroller ports and connectors

Step 5: Remount the Top Plate and Nose

Reverse the process in Steps 2 and 3. Hold the Top Plate a few centimeters above the Pioneer 2 Body and reattach the 10-wire rear sonar cable (if present) to the rear sonar controller and each of the previously unplugged cables to the rear of the microcontroller. Make sure that you insert the “host” serial cable into the HOST port, and the AUX serial connector (if present) to the AUX port. You can damage the microcontroller and an attached accessory if you get things backwards.

Align the 3mm mounting holes and reattach the Top Plate to the Body with the 3mm hex screws. And reattach the wheel struts on the DX and CE models with the 4mm screws.

Draw the Gripper Power and Control cables through the access portal you uncovered in Step 2, and reattach the computer cable connectors and Nose hardware to the front of the Pioneer 2.

CAREFUL! Re-attaching the hard-disk drive cable incorrectly will permanently damage both the drive and the onboard PC.

¹ The control cable for User I/O-based version of the P2 Gripper attaches to the 20-conductor User I/O port. Of course, install that cable if you want to use that version of the P2 Gripper.

Step 6: Attach the Gripper

Locate the Gripper power cable and plug it into the 2-pin latching connector on the P2 Gripper control board. Find it at the rear of the P2 Gripper's Lift mechanism.

Plug the 20-line P2 Gripper control cable into the 20-pin header on the P2 Gripper Control board.

Place the P2 Gripper Assembly flush against the Nose of your robot, aligning the pilot pins through their respective guide holes. Now secure the P2 Gripper with the four 3mm button-head screws supplied with the assembly.

That's it. Time to switch on your Pioneer 2's MAIN Power and sniff for blue smoke. If sparks don't fly and smoke is absent, it's time to enable the Gripper servers.

Step 7: Enabling the Gripper in P2OS

If you have the newer P2 Gripper which control cable attaches to the General I/O port on the P2 microcontroller, you must use P2OS version 1.D or later. These later versions contain servers for both the newest and previous (User I/O-based) versions of the P2 Gripper.

If your robot's P2OS pre-dates version 1.D:

Do not start up your robot until you are ready to install the software; you could damage its motors. Please download and install the latest P2OS version according to the README instructions that come with the software. Briefly, either double-click the Win32 self-extracting icon `p2osV_r.EXE` ("V" and "r" are the Version and revision numbers, respectively; `p2os1_D`, for example) or `uncompress/untar` the `p2osV_r.tgz` Linux version that is on the disk that accompanied your P2 Gripper or a distribution that you have downloaded from the <http://robot.activmedia.com> support website. In either case, the extracted archive creates a `p2os` directory containing the necessary download and configuration utilities, as well as the new P2OS image file.

Tether your computer's serial port with the one on Pioneer's Console unless you are performing the P2OS download from an onboard integrated PC. If you use a tether, you may have to disconnect any other device that plugs into the HOST serial port.

Power up and *immediately* place your Pioneer's microcontroller into BOOT mode by holding down the white MOTORS button, pressing and releasing the red RESET button, then after about 5 seconds, releasing the MOTORS button.

Execute the `p2os/p2osdl(.exe)` program (`p2osdl p2os1_D.hex`, for example) to download the new servers, then RESET Pioneer 2.

Now that your robot has P2OS version 1.D or later installed:²

P2 Gripper on General I/O:

Use the `p2oscf(.exe)` program that accompanied your P2OS distribution to reset the **HasGripper** parameter to 2 (> **hasgripper 2**) to enable the P2 Gripper servers and support software for the newest P2 Gripper which is controlled through the General I/O port. You may also examine and set the `JoyVelMax` and `JoyRVelMax` values that control the translational and rotational speeds for the manual Joystick drive (see the *Pioneer 2 Operational Manual* for details). Save the parameters to your robot's FLASH, if not also to a current configuration file that you store on disk.

P2 Gripper on User I/O:

Use the `p2oscf(.exe)` program that accompanied your P2OS distribution to reset the **HasGripper** parameter to 1 (> **hasgripper 1**) to enable the P2 Gripper servers and support software for the older P2 Gripper which is connected to the User I/O port on the Pioneer 2 Microcontroller. Set the `JoyVelMax` and `JoyRVelMax` values to 0—the older P2 Gripper and manual joystick drive share ports and are

² Details for operation of the P2OS utility programs are given in the Pioneer 2 Operations Manual.

incompatible (see the *Pioneer 2 Operational Manual* for details.) Save the parameters to your robot's FLASH, if not also to a current configuration file that you store on disk.

CAUTION!

If you attach the P2 Gripper to User I/O,
disable the manual joystick by setting JoyVelMax and JoyRVelMax to 0.
Otherwise, your robot may drive away on you.

Step 7: Test the Assembly

Time to test your new P2 Gripper. Run its self-test, which is described in detail in the next chapter.

P2 Gripper Operation and Programming

The Pioneer 2 Gripper comes fully integrated with the Pioneer 2's systems and software. All versions of Pioneer 2's operating servers, P2OS, contain support for state-based software control routines that manage the P2 Gripper functions for you. When attached through User I/O port, P2OS gives you direct control of the P2 Gripper functions.

In turn, these P2OS servers are supported in all versions of Pioneer 2-related client software that support P2OS, including Saphira and Ayllu. We supply simple Saphira-based examples for programming the P2 Gripper in this manual. Please consult the various Pioneer-related Operation and Software Manuals for more details about P2OS, Saphira, Ayllu, PAI, and P-LOGO.

P2 Gripper Self Test

P2OS comes with test routines for all of the main functions of the robot. This section describes the P2 Gripper's self-test. Consult the *Pioneer 2 Operation Manual* for a detailed description of the location and operation of the various Console function buttons and switches and for how to test the drive, I/O, and sonar subsystems.

Do not perform Pioneer 2 Mobile Robot self-tests on a tabletop.

The P2 Gripper self-test is the last in the series of Pioneer 2 self-tests, just after the Analog tests. And it happens in lieu of the User PWM self-test described in the *Pioneer 2 Operations Manual* if you have properly configured your robot to recognize the P2 Gripper accessory (HasGripper; see Chapter 2).

The Gripper self-test simply exercises the mechanism, first lowering and opening the paddles. Then, after a short delay, the Gripper closes (perhaps on an object you have placed inside), and rises to the top of its Lift.

Press the white MOTORS button to end the Analog #5 test and start the P2 Gripper self-test. Press the white MOTORS button or the red RESET button on the Console to prematurely halt the test. Otherwise, it will run to completion and return the robot to its client-connect wait state.

Gripper on General I/O Port

The newest P2 Gripper's drives and sensors are attached electronically to the General I/O port on the Pioneer 2 microcontroller. See Appendix B for port specifications. When the P2 Gripper is attached to the General I/O port's shared bus, there are no direct P2OS commands for control of the individual I/O lines or, consequently, the individual functions of the Gripper. Rather, you must control the P2 Gripper through its P2OS servers.

Electronics and Control Software Differ Significantly
when the P2 Gripper is attached to the User versus the General I/O port.

Gripper on User I/O Port

Table 3-1 summarizes the P2 Gripper to User I/O port connections.

When connected to the User I/O port, you may directly control the various P2 Gripper functions and read its sensors using native P2OS commands that manage the User I/O digital input and output ports. For example, to lift the P2 Gripper you may set the appropriate control output bits on the digital I/O ports with the P2OS DIGOUT command number 30. This can be dangerous, however. Left unattended and running, you could damage the P2 Gripper's drive electronics.

Table 3-1. P2 Gripper Connections on User I/O

Pin	Label	Description	When high	when low
Digital Outputs				
1	OD0	Gripper enable	Off	On
3	OD1	Gripper direction	Open	Close
5	OD2	Lift enable	Off	On
7	OD3	Lift direction	Up	Down
Digital Inputs				
2	ID0	Paddles open limit	Between	Tully open
4	ID1	Lift limit	Between	Top or bottom
6	ID2	Outer breakbeam	Obstructed	Clear
8	ID3	Inner breakbeam	Obstructed	Clear
9	ID4	Left paddle contact	Clear	Grasping
11	ID5	Right paddle contact	Clear	Grasping

DIGIN Readings

When it is attached to the User I/O port, you may examine the states of the various switches on the P2 Gripper with the DIGIN self-test. See the *Pioneer 2 Operations Manual* for details. Table 3-2 summarizes the bits.

Table 3-2. DIGIN self-test bits associated with the P2 Gripper on User I/O

DIGIN:	X	X	1	1	0	0	1	1
Grip switch	-	-	Right Paddle	Left Paddle	Inner Breakbeam	Outer Breakbeam	Lift Limit	Grip Limit
When 1	-	-	open	open	obstructed	obstructed	open	open
When 0	-	-	closed	closed	clear	clear	closed	closed

P2 Gripper Servers

For safety and convenience, use the set of P2 Gripper servers that come with P2OS version 1.D or later to manage the accessory. These servers automatically drive the P2 Gripper so to achieve some fundamental state, such as up or down, open or closed. When used by client software, P2OS' Gripper servers monitor and report its progress towards and achievement (or lack) of a state, saving you coding time and effort. And the servers include a timeout feature to protect against unfortunate stalls or hang-ups.

P2OS GRIPPER and P2 Gripper Commands

Table 3-3 summarizes the P2 Gripper's P2OS-based command set. From the client, issue the P2OS GRIPPER command (number 33), followed by its required unsigned integer argument which is the Gripper command number.

The P2 Gripper's commands are, for the most part, self-explanatory. For example, to make the P2 Gripper close its paddles, issue the following Saphira/Colbert command, for example:

```
sfRobotComInt( 33 , 2 ) ;
```

Table 3-3. P2OS Gripper Command Set

P2OS Command	Argument (Gripper Command or Value)	Label	Action
33	1	GRIPopen	Open Gripper paddles
	2	GRIPclose	Close Gripper paddles; grasp pressure regulated by command #16
	3	GRIPstop	Stop Gripper paddles
	4	LIFTup	Raise Lift
	5	LIFTdown	Lower Lift
	6	LIFTstop	Stop Lift
	7	GRIPstore	Simultaneously closes paddles and raises Lift. For storage; not for grasping/carrying an object
	8	GRIPdeploy	Simultaneously lowers Lift and opens paddles. Not useful for object drops, but for getting ready to grasp an object.
	15	GRIPhalt	Halts both Gripper paddles and Lift
	16	GRIPpress	Sets gripper grasping pressure; <i>must</i> follow immediately with P2OS command 36 and grasp time value.
	17	LIFTcarry	Intermediate Lift position; <i>must</i> follow immediately with P2OS command 36 and carry_time value
36	1-100	grasp_time	Time delay in 20 millisecond increments after Gripper paddles first grasp an object and before they stop moving. Regulates grasp pressure.
	\pm 1-255	carry_time	Time in 20 millisecond increments to raise (+) or lower (-) the Gripper lift; allows for a “carry” position

GRIPPERVAL Gripper Values

In some cases, the Gripper command requires an operating value. Use another P2OS command to set that operating value: Immediately follow the P2OS GRIPPER command (33) that contains the P2 Gripper server command with the new P2OS GRIPPERVAL command (36) and make its integer argument the preceding Gripper command's operating value.

Grasping Pressure

To set how hard the P2 Gripper paddles will grasp an object, set a *grasp_time* delay, in 20 millisecond increments, for when the paddle contacts trigger (about 0.2kgs pressure) to when the Gripper motor stops. The default is 10 (200 milliseconds) which provides a grasping pressure of around 0.5kgs. Incrementally, the grasping pressure is roughly 0.5kgs per 200 milliseconds, to a maximum grasping pressure of around 2kgs (grasp_time of 2 seconds).

For example, to very lightly grasp an object:

```
sfRobotComInt(33,1); /* Open the paddles */
.... place object between paddles
sfRobotComInt(33,16); /* GRIPpress */
sfRobotComInt(36,1); /* Grasp lightly -- about 0.5 lbs. pressure) */
sfRobotComInt(33,2); /* Close the paddles to that pressure */
```

LIFTCarry

The LIFTcarry command and required *carry_time* operating parameter lets you use the P2 Gripper to lift or lower an object some distance between the top and bottom of the Gripper's limits. The *grip_carry* distance is time-based, since there are no travel-encoders attached. Accordingly, the actual Lift distance

will be imprecise, depending on load, battery voltage, and a variety of other factors. Under no-load and otherwise normal conditions, assume approximately two centimeters per second of travel.

For example, to lower the Lift approximately three centimeters,

```
sfRobotComInt(33,17); /* Carry command
sfRobotComInt(36,-75); /* Travel 1.5 sec = roughly 3cm */
```

P2 Gripper States and Status

Salient P2 Gripper information gets included in the standard Server Information Packet (SIP) that P2OS regularly sends to a connected client. Appendix A contains the standard SIP details.

Included in the standard P2OS SIP is a P2 Gripper state byte, comprising the most-significant-byte portion of the User I/O Timer portion of the SIP. It is the P2 server's best guess of current Gripper status. Note the differences in that state byte when the P2 Gripper is attached to the General I/O (HasGripper = 2; Table 3-4) versus User I/O (HasGripper = 1; Table 3-5) port on the P2 microcontroller.

Table 3-4. Gripper State Byte when onGeneral I/O

Bit	Meaning when CLEAR (0)	Meaning when SET (1)
0	Paddles fully open ¹	Paddles between or closed
1	Lift fully up or down	Lift between
2	Outer breakbeam clear	Outer breakbeam obstructed
3	Inner breakbeam clear	Inner breakbeam obstructed
4	Left paddle grasping	Left paddle free
5	Right paddle grasping	Right paddle free
6	Lift idle	Lift moving
7	Gripper idle	Gripper moving

When the P2 Gripper is connected to and controlled through the User I/O port, the diginput and digoutput bytes of the SIP reflect the actual states of the digital input and output ports, respectively, that interface with the Gripper electronics. Accordingly, their values are more reliable than the Gripper state byte. Refer to Table 3-2 for digital input and output values and connections with the Gripper electronics.

Table 3-4. Gripper State Byte when on User I/O

	Bit	Meaning when SET (1)
G	0	Paddles open ¹
R	1	Paddles close ¹
I	2	Paddles moving
P	3	Gripper error
L	4	Lift up ¹
I	5	Lift down ¹
F	6	Lift moving
T	7	Lift error

¹ If both set or clear, position is unknown.

Saphira Convenience Functions

For convenience, we supply Saphira 6.x software plugins that package the various P2OS-based P2 Gripper commands, states, and variables into a collection of functions. Choose the plugin that fits your P2 Gripper's attached control port: The original, generic p2grip or the newer p2grip_genio version.

Gripper Operation and Programming

To use them, simply load the respective dynamic link library *p2grip.so* or *p2grip_genio.so* for Linux/Unix or *p2grip.dll* or *p2grip_genio.dll* for WIN32 into a Saphira 6.x running Colbert. Type “help p2grip” in the Colbert interaction window to review the list of implemented functions.

Also, when installed, the source and makefiles (MSVC++ v6.x project files or gcc for Linux) get placed in the devices directory of your Saphira distribution. Freely examine and modify these C-languaged based documents.

Maintenance & Repair

The Pioneer 2 Gripper is built to last a lifetime and requires little maintenance.

Drive Lubrication

An occasional drop or two of oil on the guide rails is a very good idea. Place some thin, household oil on a Q-Tip or similar applicator, and rub along the rails. Then start up the Pioneer to exercise the Gripper and spread the lubricant.

Factory Repairs

If you are having *hardware* problems with your Pioneer and, after reading this manual, you are satisfied that it needs repair, here's who to contact:

pioneer-support@ActivMedia.com
(603) 924-2184 fax

In the body of your E-mail or fax message, give your Pioneer 2's serial number, so we can look up its configuration, and describe the problem in as much detail as possible. Also include your name, e-mail and mail addresses, as well as phone and fax numbers, and when and how we can best contact you (we will assume e-mail is the best manner, unless otherwise notified).

We will try and resolve the problem through communication. If the robot must be returned to the factory for repair, obtain a shipping and repair authorization code and shipping details from us first. We are not responsible for shipping damage or loss.

Appendix A

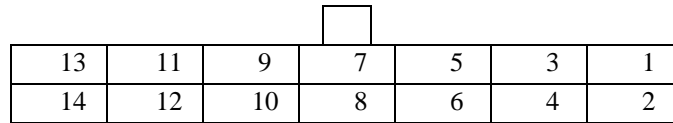
P2OS Standard Server Information Packet

Name	Data Type	Description
Header	integer	Exactly 0xFA, 0xFB
Byte Count	byte	Number of data bytes + 2; must be less than 201 (0xC9)
Status	byte = 0x3S; where S =	Motors status
	sfSTATUSNOPOWER (0)	Motors power off
	sfSTATUSSTOPPED (1)	Motors stopped
	sfSTATUSMOVING (2)	Robot moving
Xpos	unsigned integer (15 ls-bits)	Wheel-encoder integrated coordinates; platform-dependent units; multiply by
Ypos	unsigned integer (15 ls-bits)	<i>DistConvFactor</i> in the parameter file to convert to millimeters
Th pos	signed integer	Orientation in platform-dependent units—multiply by <i>AngleConvFactor</i> for degrees.
L vel	signed integer	Wheel velocities (respective Left and Right) in platform-dependent units—
R vel	signed integer	Multiply by <i>VelConvFactor</i> to convert to millimeters per second
Battery	byte	Battery charge in tenths of volts
Bumpers	integer	Motor stall indicators; left = msb
Control	signed integer	Setpoint of the server's angular position servo—multiply by <i>AngleConvFactor</i> for degrees
PTU	unsigned integer	Pulse width of selected servo #1
Compass	byte	Compass heading in 2-degree units
Sonar readings	byte	Number of new sonar readings included in information packet; readings follow:
Sonar number	byte	Sonar number
Sonar range	unsigned integer	Sonar reading—multiply by <i>RangeConvFactor</i> for mm
	...rest of the sonar readings...	
<i>User I/O</i>		
Timer	unsigned int	MSB = P2 Gripper status; LSB = currently selected analog port number 1-5 (default is 5)
Analog	byte	User analog input reading (0-255) on selected port #1-5
Diginput	byte	Digital input port values
Digoutput	byte	Digital output ports
Checksum	signed integer	Checksum

Appendix B

Pioneer 2 User and General I/O Ports

Note that all the internal connectors on the Pioneer 2 Microcontroller (IDC sockets) are numbered odd pins on top and even pins on the bottom, from right to left, relative to the key (Figure B-1):



13	11	9	7	5	3	1
14	12	10	8	6	4	2

Figure B-1. Common IDC connector pinouts

Consult the Pioneer 2 Operation Manual for details.

Table B-1. User I/O Expansion Port

Pin #	Label	Use		Pin #	Label	Use
1	P2_12	OD0 or PWM #1		2	P3_0	ID0
3	P2_13	OD1 or PWM #2		4	P3_1	ID1
5	P2_14	OD2 or PWM #3		6	P3_2	ID2
7	P2_15	OD3 or PWM #4		8	P3_3	ID3
9	P5_4	ID4 or A/D #1		10	P3_4	OD4
11	P5_5	ID5 or A/D #2		12	P3_5	OD5
13	P5_6	ID6 or A/D #3		14	P3_6	OD6
15	P5_7	ID7 or A/D #4		16	P3_7	OD7
17	P5_9	A/D #0/5		18	Vcc	<100ma
19	Vpp	<100ma		20	Gnd	

Table B-2. General I/O Bus Connections

Pin #	Label		Pin #	Label
1	P3_0		2	D0
3	P3_1		4	D1
5	P3_2		6	D2
7	P3_3		8	D3
9	P3_4		10	D4
11	P3_5		12	D5
13	P3_6		14	D6
15	P3_7		16	D7
17	WR		18	CS2 (Gripper)
19	Vpp		20	CS3 (Bumpers & Added Sonars)
21	P2_12		22	CS4
23	P2_13		24	CS5
25	P2_14		26	A0
27	P2_15		28	A1
29	P5_9		30	Vcc
31	Gnd		32	RD#
33	Gnd		34	Vcc

Warranty & Liabilities

Your Pioneer Mobile Robot and its accessories are fully warranted against defective parts or assembly for one year after it is shipped from the factory. This warranty explicitly *does not include* damage from shipping or from abuse or inappropriate operation, such as if the robot is allowed to tumble or fall off a ledge, or if it is overloaded with heavy objects.

The developers, marketers, and manufacturers of Pioneer shall bear no liabilities for operation and use of the robot or any accompanying software except that covered by the warranty and period. The developers, marketers, or manufacturers shall not be held responsible for any injury to persons or property involving the Pioneer Mobile Robot in any way. They shall bear no responsibilities or liabilities for any operation or application of the robot, or for support of any of those activities. And under no circumstances will the developers, marketers, or manufacturers of Pioneer take responsibility for or support any special or custom modification to Pioneer.



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