



Goodrich ISR Systems

Piccolo Servo Gimbal Integration Guide

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Piccolo Servo Gimbal Integration Guide Change Log:

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- Section 3.2: Added a table with a complete list of I/O lines and corresponding servos for Piccolo Autopilots.

1 Introduction

Cloud Cap Technology offers high performance stabilized camera gimbals that are substantially smaller, lighter, and lower cost than many other gimbals on the market today.

Cloud Cap Technology’s line of stabilized camera gimbals integrated seamlessly with the Piccolo autopilot offering the potential to provide high performance/high value solutions.

Piccolo autopilots are designed to interface with a wide range of gimbals. This document covers how to setup and configure a non-stabilized, servo based gimbal—other than a Cloud Cap Technology gimbal—to the Piccolo autopilot using the pan and tilt servo connections available on the Piccolo autopilot. The Piccolo can stabilize the gimbal and it will respond to the Cloud Cap TASE gimbal protocol just as if it were a connected TASE gimbal. Please see the *Piccolo External Interface* document for detailed interface information.

1.1 Gimbal UI

You may purchase a license to use the Cloud Cap Gimbal User Interface (UI) with your gimbal. Gimbal UI can provide many of the same features for servo gimbals that it provides for CCT TASE gimbals. This can even include optional ground based video tracking and stabilization (requires additional plug-in license(s)).

If you are using the Gimbal UI to control the gimbal, see the *Gimbal Integration Guide* for complete information for installing the software, video card and drivers.

2 Connections

You may connect the pan and tilt servos to any free Piccolo I/O line. In addition, if you are using a Sony block camera in your gimbal, you may connect an available Piccolo serial port to the camera in order to control functions like zoom. See the *Signal Descriptions* section in the *External Interface* document for more information.

Note: If you have a servo based gimbal retract mechanism you may also configure a servo line for this function.

Gimbal Signal:	Connects To:
Pan and Tilt Servo Power	Any SERVO_VOUT
Pan and Tilt Servo Ground	Any SERVO GND
Sony Camera 232 TX and RX	Any Piccolo Serial Port
Sony Camera 232 RTN	Any GND

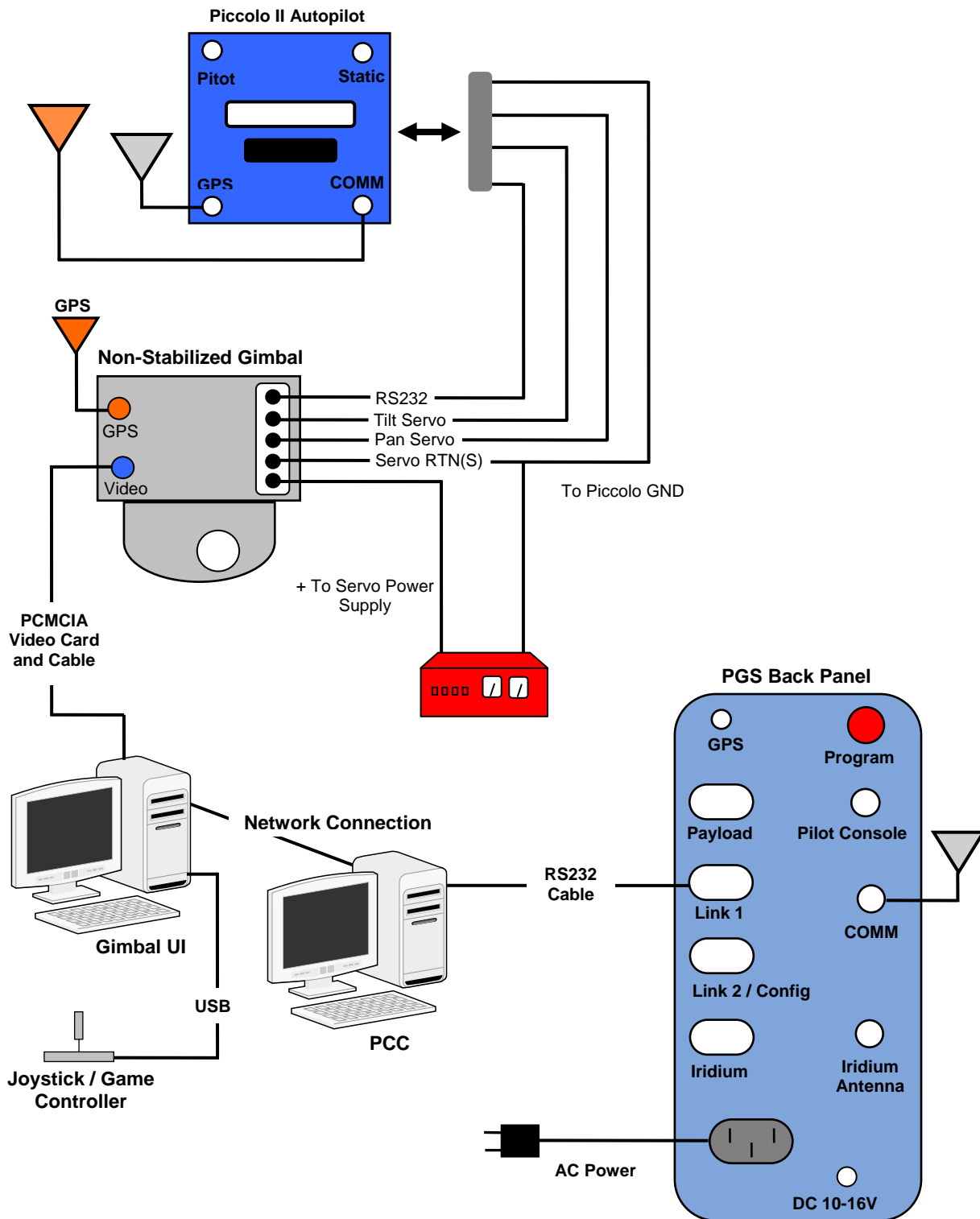


Figure 1 - Gimbal and Piccolo Integration Diagram

3 Configuring the Pan and Tilt Servos in PCC

To configure the Pan and Tilt servos to operate the gimbal they must be configured in the **Payload I/O Settings** window and **Surface Calibration** windows in the PCC. The configuration windows are located under **Window » Preflight Windows » Advanced Windows**.

The **Payload I/O Settings** window provides the user the ability to control and reconfigure the I/O lines on the main external connector (39 pin for Piccolo LT, 51 pin for he Piccolo SL, 44-pin Piccolo Plus and Piccolo II). The Piccolo II has additional I/O lines on the 25-pin microdot connector.

The **Surface Calibration** window is a large active aircraft window. It is used to configure the autopilot and adapt it to the airframe. The controller software generates control surface outputs that must be translated into pulse width signals to be sent to the servo actuators. The **Surface Calibration** window allows the user to configure the calibration between control position and pulse width. It also specifies the control function of each of the actuator I/O lines.

3.1 Selecting the I/O Lines and Servos

To correctly configure and calibrate the Pan and Tilt servos to control the gimbal, you must first choose two open I/O lines in the Payload I/O Settings window and then select the **Pan** and **Tilt** servos.

In **Figure 2** we are using **I/O 8** and **I/O 9** lines to configure the **Pan** and **Tilt** servo to operate the gimbal for a Piccolo II autopilot. They can be selected from the pull down menus under **Mode**. Also make sure **Param1** and **Param2** are set to 0 for each channel. Click the **Send All** button to send this information to the autopilot.

Note: You may also configure an I/O line to control a servo based retract mechanism.

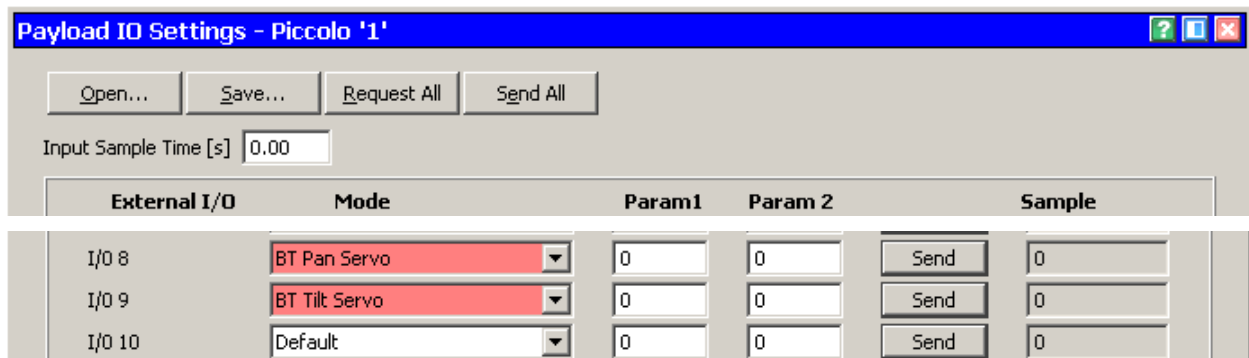


Figure 2 - Payload I/O Settings Window

The next step is to select the appropriate control surface outputs in the **Surface Calibration** window that corresponds to the external I/O lines that you selected to control the **Pan** and **Tilt** servos. For this example refer to the *Piccolo II Microdot Pin-out Connector* table found in the *Piccolo External Interface* document.

3.2 Calibrating the Servo

As you can see in this table from the Piccolo External Interface Guide, the I/O Lines that were selected in the **Payload I/O Settings** window correspond with Servo 13 and 14 respectively in the **Surface Calibration** window.

Pin	Index	Name	Type	Level	Function
21	12	SERVO_12_PWM	I/O	5V	TPU_B8 / GPIO3
19	13	SERVO_13_PWM	I/O	5V	TPU_B9 / GPIO4



It is important that the I/O lines correspond with the correct servo that is being calibrated in the **Surface Calibration** window. See **Table 1** for a complete list of I/O lines and corresponding servos for all Piccolo Autopilots.

Table 1 - I/O Lines and Corresponding Servos

Piccolo, Piccolo Plus, Piccolo II External Interface Connector					
I/O #	Servo #	Pin #	I/O #	Servo #	Pin #
0	5	39	6	11	20
1	6	38	7	0	44
2	7	37	8	1	43
3	8	36	9	2	42
4	9	35	10	3	41
5	10	5	11	4	40
Piccolo II Micro-D Connector					
I/O #	Servo #	Pin #	I/O #	Servo #	Pin #
12	12	21	14	14	17
13	13	19	15	15	15
Piccolo LT External Interface Connector					
I/O #	Servo #	Pin #	I/O #	Servo #	Pin #
0	0	19	4	4	34
1	1	16	5	6	4
2	2	13	6	5	22
3	3	37			
Piccolo SL External Interface Connector					
I/O #	Servo #	Pin #	I/O #	Servo #	Pin #
0	0	21	7	7	27
1	1	22	8	8	44
2	2	23	9	9	26
3	3	24	10	10	16
4	4	25	11	11	13
5	6	30	12	12	45
6	5	47			

The **Surface Calibration** window only displays the pulse width-to-angle calibration for one surface at a time. The surface displayed is chosen with the radio buttons shown on the left side of the window.

1. In the **Surface Calibration** window (**Figure 3**) under **Surface**, select the surface number you want to calibrate.
2. Enter the calibration parameters in the table for that surface. In this example select # 13 and enter the parameters for that surface in fields 1 through 9.
3. Select “no actuator” from the **Actuator Type**: drop down box.
4. Press **Send Table**. Repeat the same process for surface #14.

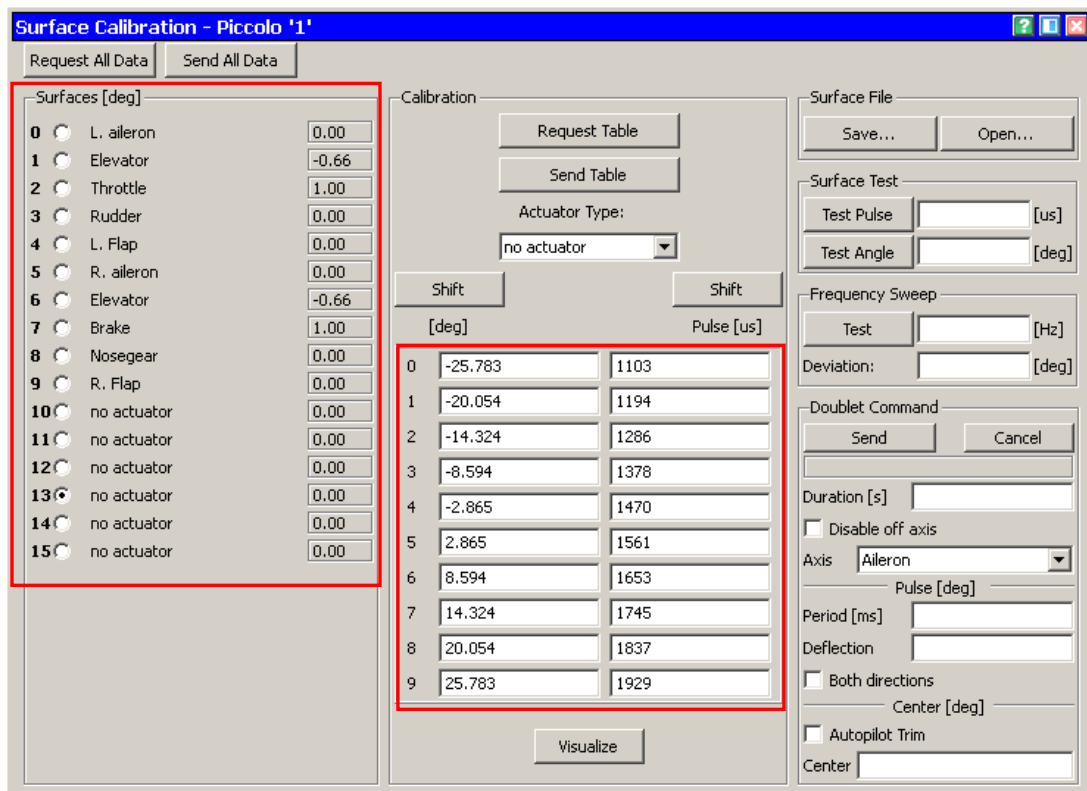


Figure 3 - Surface Calibration Window

For a servo gimbal, the position, direction of travel and amount of travel depend on the actuator to gimbal axis linkage design. In order to account for variations in the linkage the autopilot outputs are translated to actuator signals via calibration data. The calibration data account for sign convention, neutral position, travel limits, and any non-linearities in the surface motion.

Each channel has its own calibration data. The data relates the actuator pulse width in microseconds to the gimbal position. The gimbal position data are given in ascending order, and the pulse widths are in ascending or descending order.

Although the pulse width column shown is regularly spaced, this is not required. Note the pulse width values of 1103 and 1929 in **Figure 3**. These correspond to $\pm 100\%$ pulse width as measured from a Futaba pilot console. You should find the minimum and maximum pulse widths appropriate to your gimbal.

3.2.1 Retraction Servo

If you have a servo based gimbal retract mechanism you may also configure a servo line for this function. Set an open I/O line in the **Payload IO Setting** window to the **BT Retract Servo** function. **Param1** and **Param2** are the servo pulse widths in nanoseconds for the retracted and deployed states, respectively (typically approximately 1000000 to 2000000 ns).

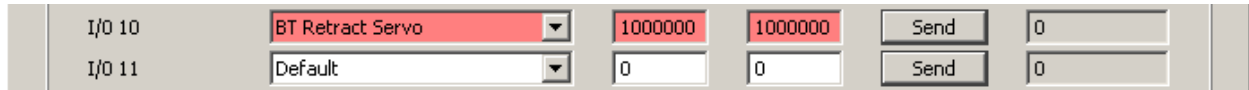


Figure 4 - Retraction Servo

3.3 Testing the Calibration Parameters

In order to determine the calibration numbers, it is helpful to be able to set the pulse width being sent to any given channel. This can be done with the **Surface Test** feature located in the upper right of the **Surface Calibration** window. To use the feature, the autopilot must be on (i.e. not in manual control) and it must be in pre launch mode. Enter in a desired pulse width and press the **Test Pulse** button. The requested pulse width will be sent out the selected channel for 60 seconds. While the pulse is being sent you can measure the actual surface deflection. By doing this for each desired pulse width the surface calibration table can be built up. The inverse function of commanding the surface to deflect a certain angle is also available, using the **Test Angle** button.

3.4 Control Surface Curve

Once you have sent the table, click the **visualize** button. The PCC will graph the control surface curve for you.

Your control surfaces should have a smooth calibration curve. If the curve isn't smooth, either something is wrong with the servo or the calibration wasn't performed correctly. The following is an example of the expected linear curve, and a curve that will result in poor performance.

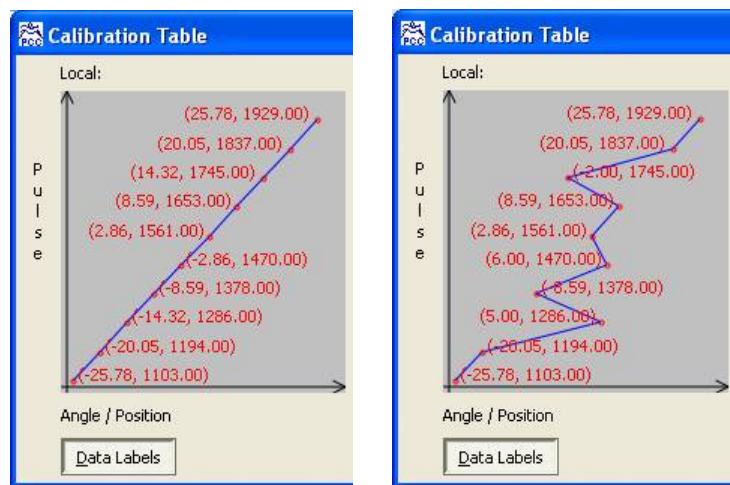


Figure 5 - Surface Calibration Curve

3.5 Piccolo and Piccolo Ground Station Configuration

Before the Gimbal is added to the system, the Piccolo Command Center should be running on the PC, and the Piccolo and ground station should be communicating. Configure the Piccolo autopilot, Piccolo Ground Station, and PC for HIL operation as outlined in the *Piccolo HIL Setup Guide*. The setup guide is available at www.cloudcaptech.com.

3.6 Gimbal Configuration

1. Power down the system.
2. Set up and connect a gimbal as shown in **Figure 1**. The Piccolo Command Center and the Gimbal UI should be installed on the same PC.
3. Power up the system.
4. Start the Piccolo Command Center. The Piccolo and Ground Station should be communicating.
5. Double check the **Payload Com Settings** window and make sure that you do NOT have a serial port set to **Gimbal protocol**, as this would configure the Piccolo to use a TASE gimbal rather than a servo gimbal.
6. If you want to configure a Sony block camera connected to a Piccolo serial port, go to **Window** and open the **Payload Com Settings** window (**Figure 6**). For the com port connected to the Sony camera, select Baud Rate 9600 and Protocol Sony Camera.
7. Click **Send All** to write the information to the Piccolo.

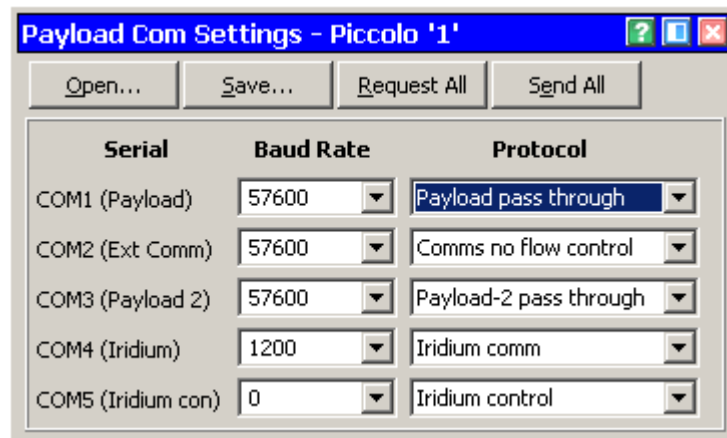


Figure 6 - Payload Com Settings Window

8. Open the Gimbal UI. On the **Communication Dialog** start page, select **Serial Direct**.
9. Under **Serial Port Settings** select the proper COM port on the PC that the gimbal is connected to. Select a Baud Rate of 57600.
10. Click **OK**. The Gimbal UI window opens and displays a real-time video of where the camera is pointing. The gimbal is now under PC control.

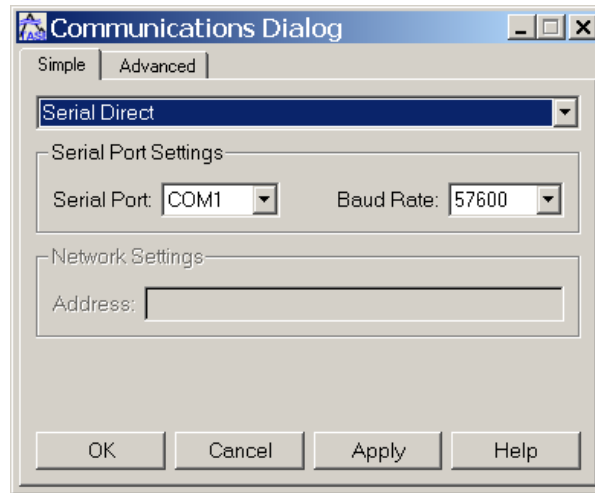


Figure 7 - Gimbal Communications Window

11. From the **Display** menu, open the **Gimbal Telemetry** window (**Figure 8**). You should be able to move “gimbal angles” with your joystick. (If that data doesn't change in response to the joystick after the gimbal is set up, check the joystick settings in Gimbal UI).

Sign convention for gimbal angles:

- **Pan:** negative is left, positive is right
- **Tilt:** negative is below the horizon, positive is above the horizon

You should ideally plot the calibration data with Excel and pick the 10 points (angle vs. servo pulse in microseconds) over the entire range that best fit your calibration data.



Figure 8 - Gimbal Telemetry Window

12. Refer to the **HELP** menu for information on how to operate Gimbal UI.