Servo Tester 2

User Manual

by

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1 Introduction

1.1 What is the Servo Tester 2?

The Servo Tester 2 is hardware and software that, basically, makes a pulse width signal between 1 and 2 ms. This is the signal used to control common R/C servos. There are numerous servo tester construction articles on the Internet. This one has some advanced features, not usually found on servo testers.

Feature list:

- Generates two separate signals for driving two servos.
- Sweep mode for stress testing servos.
- Input for reading a servo signal (from a receiver).
- Receiver signal quality analysis.
- Very high resolution at both input and outputs. 0.1µs (which equals 10,000 steps between 1 and 2 ms).
- Voltage and current readout. How much current does your servos actually consume? How much does your receiver pack drop under load?
- Simple user control. Access all features with just a single rotary knob with integrated push button.
- 2 x 16 character LCD.
- Optical tachometer.
- RS-232 connection. Write your own program (PC or whatever), that can control every feature of the tester. **Future enhancement. RS-232 firmware not written yet.**

1.2 License

The Servo Tester 2 hardware and software is free for **non-profit** use only. You may copy, build and use it as much as you like, as long as you don't make any money out of it. You are allowed to build some for your friends, as long as you only charge them for the parts used, not the time spent to build it.

But please bear in mind that I've spent a great many hours making this servo tester. I am curious by nature, and would very much like to hear how and where my creation is being used. So if you build one, please send me a mail with a few words. See contact details in chapter 4.

1.3 Acknowledgments

I would very much like to thank Warren Brayshaw for his great help in beta testing the software. You have provided lots of feedback and good ideas throughout the development of this tester. I thank you.

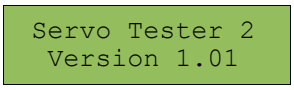
Also, I'd like to thank everyone from www.rcgroups.com that came with ideas and suggestions when I was planning the design of this tester.

2 Using the Servo Tester 2

2.1 The first power up

The tester is to be powered from an external supply through one of the servo connection connectors. Use a 4 or 5 cell receiver battery pack, or an ESC with built-in BEC. Actually the Servo Tester 2 internal circuitry can use any voltage from 3 to 18 V if it's built after the original schematics, but this same voltage will be applied to the servos and they probably won't be happy with much more than 6 Volt. Some newer high-speed servos is built to withstand higher supply voltages

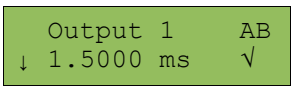
As soon as power has been applied, a welcome screen is displayed:



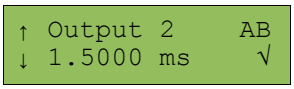
This screen will be displayed for 4 seconds, or until the rotary knob is used.

2.2 Navigating the menus

After the initial 4 seconds, the first menu will appear:



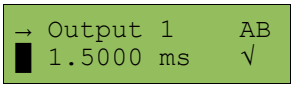
Now the tester is ready for use. By turning the knob one click clockwise, you'll move to the next menu:



Further turning the knob clockwise will take you through the remaining menus. Turn the knob counter-clockwise to move back up again. If the knob behaves opposite of this, you can either re-solder it, swapping the A and B signals from the encoder, or you can navigate to the Setup menu and reverse the direction there. See chapter 3.9.8.

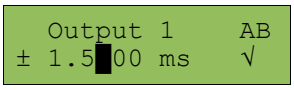
2.3 Making changes within a menu

Once you have found the menu you wish to enter, press down on the knob. This will take you into the selected menu. We'll use the Output 1 menu as an example.



The up/down arrows change to left and right arrows. This indicates that turning the knob won't take you up or down the menus anymore, but rather back and forth within the selected menu. Furthermore, there is a flashing cursor in the lower left corner. This cursor can be moved back and forth with the knob. Placing it to the leftmost position (where it is to begin with) will take you back to the menu selection when you push the knob.

By rotating the knob clockwise, the cursor will move over each digit in the pulse width. By pushing the knob, you can change the value of the displayed pulse width.

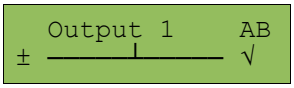


The left/right arrows now change to a ± symbol, indicating that you are now in edit mode. By turning the knob, you'll increase or decrease the value where the cursor is positioned. One click will in- or decrease the digit by one, but turning the knob faster will progressively speed up the changes. This way you can make precise changes by turning slow, and make big adjustments in no time by turning fast. This progressive behavior can be disabled in the Setup menu (chapter 3.9.2) if so desired.

When done, just push the knob to get out of edit mode.

Usually the middle digit is a good place to adjust the pulse widths from. It is sufficiently precise for most uses, but still allow you to get from one end to the other with just a single, fast twist. The two last digits are usually only used for high precision tasks.

Another way to edit the pulse width, is through “analogue mode”. Here the servo position is displayed with a vertical row of pixels, moving back and forth on a long line. Select the digit you wish to alter, then press and hold down the knob for about a second. The display then changes to analogue mode.



Turning the knob does exactly the same as in normal editing mode, only the pulse width is replaced with the analogue graphic. To exit, press the knob (no need to hold it down).

2.4 Selecting what to send to the servos

Despite the first two menus are called “Output 1” and “Output 2”, these values aren't necessarily sent to the servos. The actual servo outputs are called Out A and B, not 1 and 2. When using the servo tester for the first time, it will be set up to send Output 1 to servo A and Output 2 to B, but this can be changed at any time.

To the rightmost of every menu that has a pulse width that can be used with a servo, there are the two letters “AB”. If there is a check mark beneath one (or both) of these letters, the pulse width from this menu is currently being sent to the corresponding output. If you want to output a pulse width to a servo, move the cursor below the A or B, and press the knob. A check mark will appear, and the signal will be sent to the selected servo. The selection (together with all other settings) will be retained during power off, if you have enabled the Autosave option. See chapter 3.9.1.

If you select an output, where there already is a mark, the output will go back to the previous selected menu. This way, if you select an output by mistake, just push the knob once more, and everything is back to the way it was. The information of which outputs were previously used, is not retained when power is removed.

2.5 Multi-page menus

Some menus have more than one screen. By moving the cursor to the right, more screens may appear. Move the cursor to the left to get back. For a quick overview of all menu pages, please see the separate document menu_overview.pdf available at the Servo Tester 2 homepage:

www.ejberg.dk/servotst2/

Remember, to exit a menu, always turn the knob counter-clockwise as far as you can, and then press the knob once.

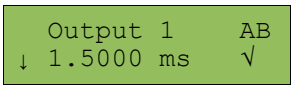
2.6 Low battery warning

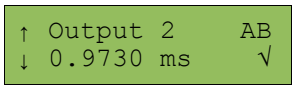
When the battery is running low, a **B** will start to flash in the upper left of the display. The recommended low battery limit is 1.10V per cell (4.40V for a standard 4 cell receiver pack). The voltage threshold for the warning can be adjusted in the setup menu. See chapter 3.9.9.

3 The menus

This chapter describes the use of all the menus in Servo Tester 2. How to navigate and edit the menus will only be described if they differ from what has already been said in the previous chapter.

3.1 Output 1 and Output 2

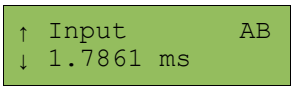




These two menus can make a static servo signal, that will stay the same until the user changes it. This is the most common use for a servo tester: To generate a servo signal that is user controllable. The pulse width can't go beyond the safety limits (default 0.9000 and 2.1000 ms) in order to prevent damage to the connected servos.

The safety limits are configurable in the Setup menu. See chapter 3.9.11.

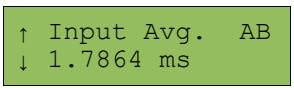
3.2 Input



The Input menu displays the pulse width currently present on the input connector. If no valid servo signal is present, the display will show 0.0000 ms.

Please note that the measured input signal can be sent to the outputs as well.

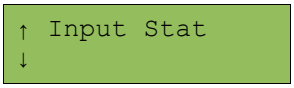
3.3 Input Avg.



As the Input menu displays the input signal in real time, it can be a quite hard to get a stable reading. This menu displays the average input value from the last 32 pulses.

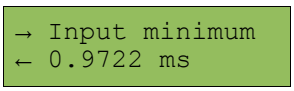
It is possible to send this averaged value to the outputs, although I don't really see the point in doing so.

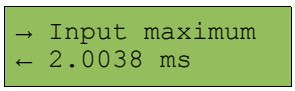
3.4 Input Stat



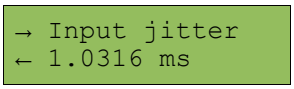
This is a multi-page menu, that displays various statistical values about the input. Furthermore this menu doesn't have a cursor as there is nothing to edit in this menu. Turn the knob to select which page to see. Turn it all the way to the left to exit the menu.

The first two screens are the minimum and maximum valid pulse widths seen on the input.



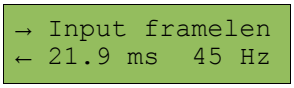


The next screen is the measured jitter (maximum-minimum).



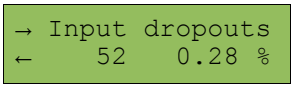
This can be used to measure the accuracy of a transmitter/receiver system. Send a steady signal with your transmitter, and connect the receiver to the Servo Tester input. Push the knob to reset the measurements, and watch the jitter.

The next screen show the measured frame length, i.e. how fast the transmitter/receiver update the servos. *This is a new feature introduced in version 1.01*



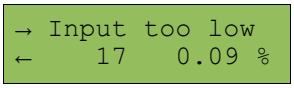
Some newer transmitter/receivers are capable of updating some or all of the servo outputs at a faster rate than in the old days, especially after the introduction of 2.4 GHz systems. The frame length is displayed both as time in ms, and as frequency (updates per second).

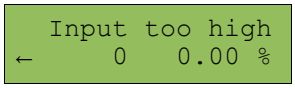
The next screen is the measured dropouts.



Servo pulses are sent at regular intervals, usually every 20 ms. A dropout is one or more consecutive missing pulses in this stream. The Servo Tester 2 automatically adjusts to the pulse interval of your radio system. In the displayed example, there has been 52 missing pulses, which equals 0.28% of the total amount of received pulses.

Similarly, pulses that are shorter or longer than the usual pulse widths used for servos, are recorded. The limits used are the safety limits configurable in the Setup menu.

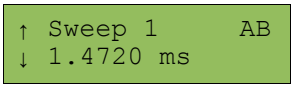


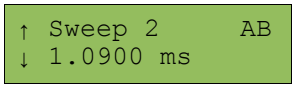


These three last screens are particular useful for determining a radio systems performance while making a range check of the transmitter.

By pressing the knob at any but the leftmost screen, all of the input statistics are reset.

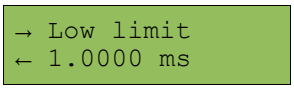
3.5 Sweep 1 and Sweep 2

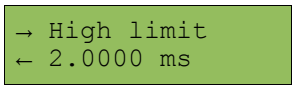




These two menus are used for generating a variable signal (one for each menu). This can make a servo move back and forth between two definable endpoints. On the first screen is the generated signal displayed, and the outputs can be selected.

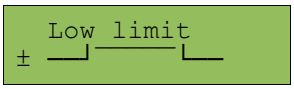
The next two screens are used for setting the lower and upper end to the motion.





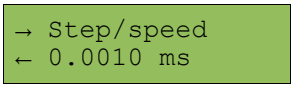
You can't set the low limit higher than the high limit, and vice versa. Also, you can't go beyond the safety limits that are configurable in the Setup menu.

Using the analogue mode (see chapter 2.3) in these two menus, shows a special form of analogue graph. Now there isn't a single vertical line, but rather two edges:



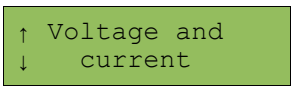
The entire length represents the time between the two safety limits. The first edge is the position for the sweep low limit, and the second edge is the high limit. The space between the two edges is the “area” where the sweep will run.

At the last screen, the speed can be set.

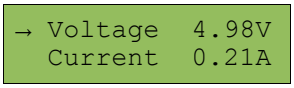


The speed is how much the pulse width will change for each single pulse generated. The Servo Tester 2 generates a servo pulse every 19.6608 ms.

3.6 Voltage and current

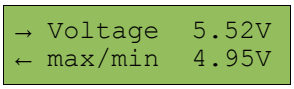


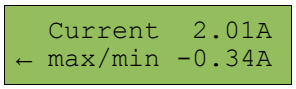
When entering this menu, you can see the input voltage (the receiver battery or ESC) and the current consumption at Output B.



If your Servo Tester 2 is made like the original design, the current at Output B can be both positive and negative. Positive current is going out of the tester. So if you connect the battery to Output B, the current displayed will be negative. The setup menu permits you to select the current polarity and perform voltage and current calibrations.

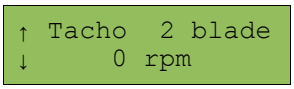
The next two screens display the highest and lowest values measured.





Pushing the knob at one of the max/min screens will reset the max/min values.

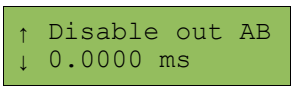
3.7 Tachometer



The tachometer hasn't really anything to do with a servo tester, but it is quite handy to have at hand whenever it is needed. It can be adjusted to measure 2, 3 and 4 bladed props.

NOTE: The hardware for the tachometer isn't finished yet, so it doesn't work.

3.8 Disable output



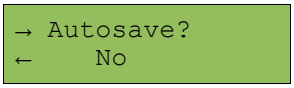
This menu can be used to disable the servo pulses completely. The only option in this menu, is to select the output(s) to be disabled.

3.9 Setup



In the setup menu, a lot of the tester's behavior can be adjusted. This chapter will go through the setup options one by one.

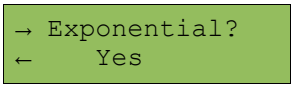
3.9.1 Autosave



When enabled, every change to the tester will be saved and remembered during power off. This includes things like the output settings and pulse widths in output and sweep menus.

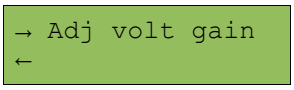
When disabled, all changes are lost when the power is removed. This includes changes made in the setup menu.

3.9.2 Exponential

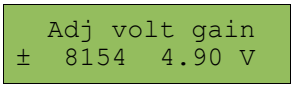


This option enables or disables the speed accelerated pulse width edit mode. See chapter 2.3 for a detailed explanation.

3.9.3 Adjust voltage gain

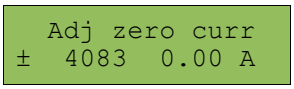


This menu is used to calibrate the voltage measurement. First, connect a known voltage to the Input or Output A connector, not Output B. Then enter this calibration menu.



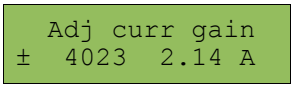
The first number is the calibration factor. Turn the knob until the displayed voltage is equal to the voltage applied. Note that these adjustment screens use speed accelerated input, even if that has been disabled in the previous setting.

3.9.4 Adjust zero current



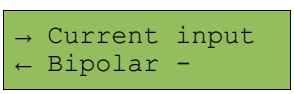
This menu adjusts the zero point for current measurements. This is only meaningful if the current measuring type is bidirectional. See chapter 3.9.6 for further explanation. Adjust for zero current with no load at Output B.

3.9.5 Adjust current gain



Like the voltage gain, this menu adjusts the current gain. First, make sure that you have completed the zero current adjustment in the previous menu. Then load the Output B connector with a known current. Using a relatively high current will improve accuracy. 2-3 A is fine. Now adjust the display to match.

3.9.6 Current measurement input type



This setting is used to configure the software to the hardware used to measure currents. Each time you push the knob, the value will cycle between the three possible settings: Unipolar, Bipolar + and Bipolar -.

If the tester is built after the original design, the measured current can be both positive and negative. The setting should then be Bipolar. Which direction that will be positive can be set with the two types of Bipolar (+ or -).

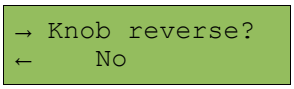
If you have made a more simple current measuring circuit, where zero current equals 0 volt at the A/D input, you should select Unipolar.

3.9.7 Backlight time



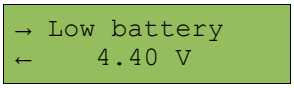
Here you can set the time the LCD backlight should remain on after you last used the tester, provided you have used a LCD with LED backlight. The options are: 10, 20, 30, 40, 50 or 60 seconds, or always on or off.

3.9.8 Knob reverse



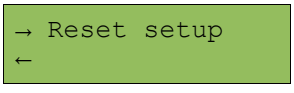
This option is used for reversing the direction of the rotary encoder, if it is going in the opposite direction than described in this manual.

3.9.9 Battery cell count

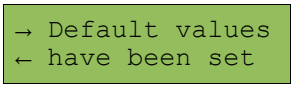


Here you can setup the threshold for the low battery warning. See chapter 2.6 for further explanation.

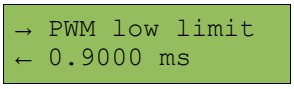
3.9.10 Reset setup

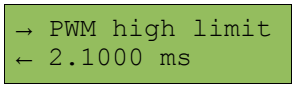


If you wish to bring the tester back to its default setup, use this menu. To reset the tester, push *and hold down* the knob. When the tester has been reset, the following screen is displayed:



3.9.11 PWM low and high limit





The last two settings are the safety limits for the servo tester. No servo signal generated by the tester can go outside these limits. In addition, these limits also defines the valid input signal limits. Do not adjust these values unless you know *exactly* what you are doing. Setting these limits too wide can permanently damage servos.

4 Contacts

If you have any suggestions, comments or bug reports, you can contact me through my homepage:

http://www.ejberg.dk/

I no longer provide my e-mail address in this manual, as spammers found it in the previous version, even if it was hidden deep down in a pdf document.