

Monochord Assembly Instructions

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Abstract

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1 Introduction

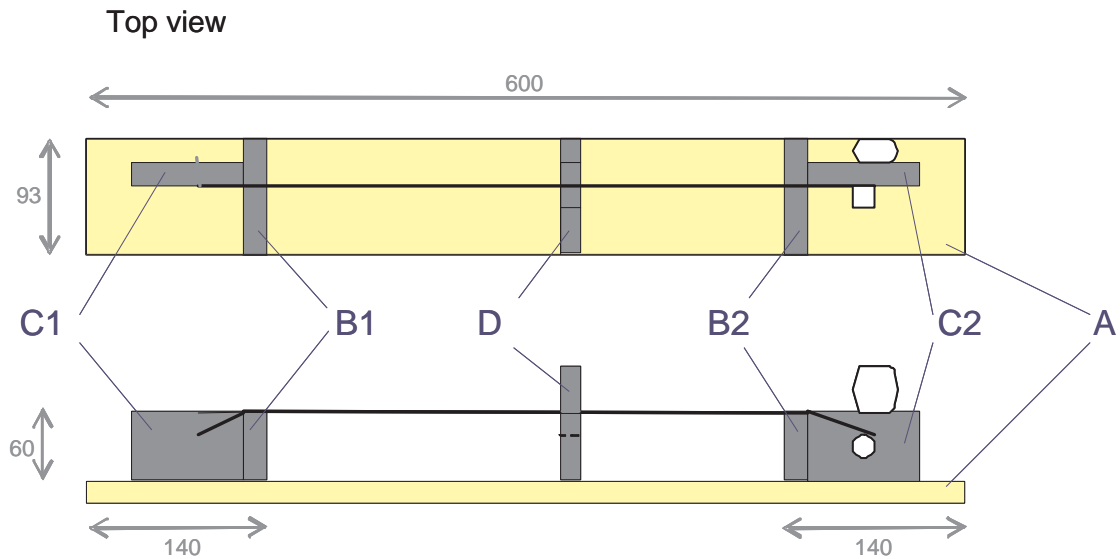


Figure 1:

2 Parts List

1. One plank 93 mm wide and 20 mm thick from which is sawn, Bottom plate, 600 mm long (A),
2 transverse supports 93 60 mm (B1, B2),
2 longitudinal supports 100 60 mm (C1, C2),
Magnet support 93 100 mm high (D).
and with a cutout 14 mm wide and 55 mm deep
2. In the magnet support, two magnets stick to two bolts M640 mm.
3. Violin steel G string (196 Hz).
4. A tuning screw (tuning peg) for guitar.
5. 2 nuts for guitar (the part, at the top of the fingerboard, over which the string runs through a groove).

Optional optical sensors (typically less than \$10 each):

- OPB815 W with 9.5 mm gap (Optek)
- ELITR8102 with 3 mm gap (Everlight)
- ELITR8402 with 6 mm gap (Everlight)

Suppliers:

- *In Sweden:* Elfa. Suitable magnets are part number 37-522-68.
- *In the U.S.*

3 Parts Description

3.1 Longitudinal support C1 (where the string is anchored)

1. 100 mm long, 20 mm thick and 60 mm high.
2. A hole of 2 mm diameter, 7 mm from the upper edge and 25 mm from one end, through which to pass and anchor the string.

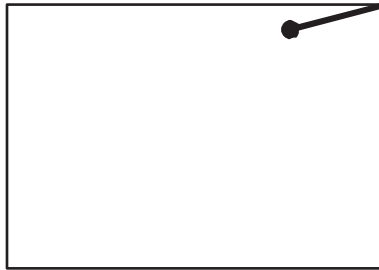


Figure 2:

3.2 Longitudinal support C2 (for the tuning screw)

1. 100 mm long, 20 mm thick and 60 mm high.
2. A hole for the axle of the tuning screw, 20 mm below the top edge and 40 mm from the end. Modify for the chosen screw if necessary.

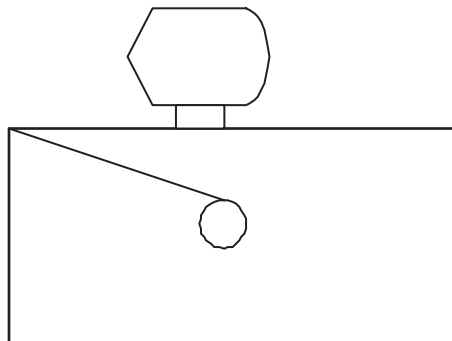


Figure 3:

3.3 Transverse supports B1 and B2 (boundary condition for the string)

- 93 mm long, 20 mm thick, and 60 mm high.
- Make a recess for the guitar nut along the 60mm top edge, 3 mm wide and 8 mm high. Modify for the chosen nut if necessary.

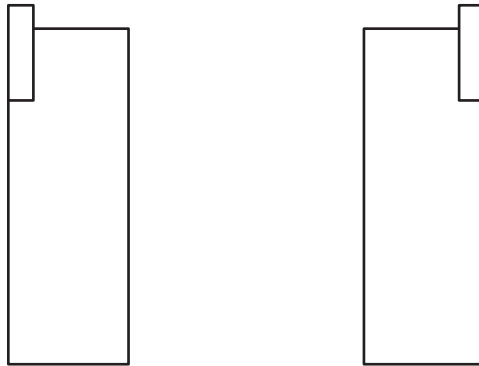
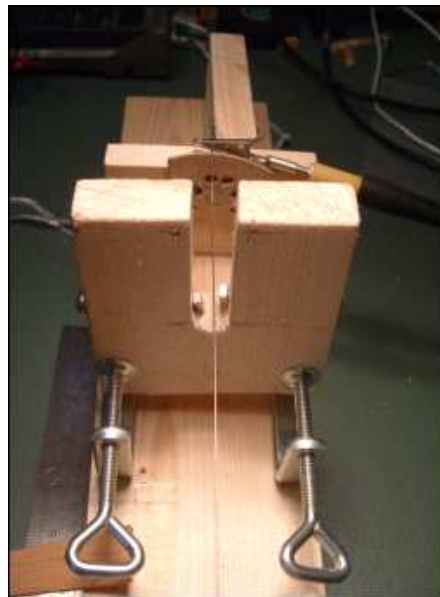
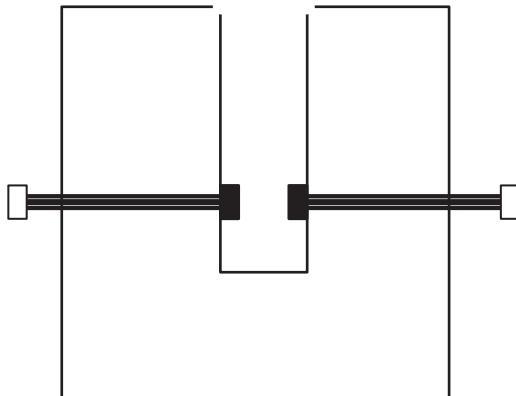


Figure 4:

3.4 Magnet holder D



1. 93 wide, 100 mm high.
2. A recess from the upper edge 55 mm tall and 14 mm wide.

3. On both sides a 5.5 mm hole, 55 mm from the upper edge, into which 40 mm M6 bolts are screwed in. The tip of each bolt needs to be filed flat.
4. Two rectangular neodymium magnets (853 mm) are held in place magnetically to
5. the bolt tips.

For a horizontal magnetic field, the Magnet Holder is held vertically by two small clamps (see photographs). It can easily be moved along the string, and can also be rotated 90 degrees for a vertical magnetic field.

4 Assembly

1. Acquire a plank of solid wood 93 mm wide by 20 mm thick of about 2 metres length.
2. Cut off the 600 mm long bottom plate (A)
3. Cut off two blocks 93 mm long (transverse supports B1, B2)
4. Cut off two blocks 100 mm long (longitudinal supports C1, C2).
5. Cut the blocks to 60 mm width
6. Make a recess 3 mm wide and 8 mm deep along one upper edge of the transverse supports B (see below).
7. In C1, drill a 2 mm hole through which to pass and fasten the string.
8. In C2, drill holes as necessary for the chosen tuning screw
9. Transverse supports B1 and B2 are glued with the recesses away from each other and with their inner faces 140 mm from the ends of bottom plate A.
10. Fit the guitar nuts into the recesses in B1 and B2. Secure the nuts snugly with plumber's putty or epoxy.
11. C1 and C2 are glued so as to support B1 and B2 respectively.

5 Magnetic Pickup Amplifier

The signal levels are low. Using a 9V battery supply reduces possible problems with hum and earth loops. The output signal is proportional to the string velocity.

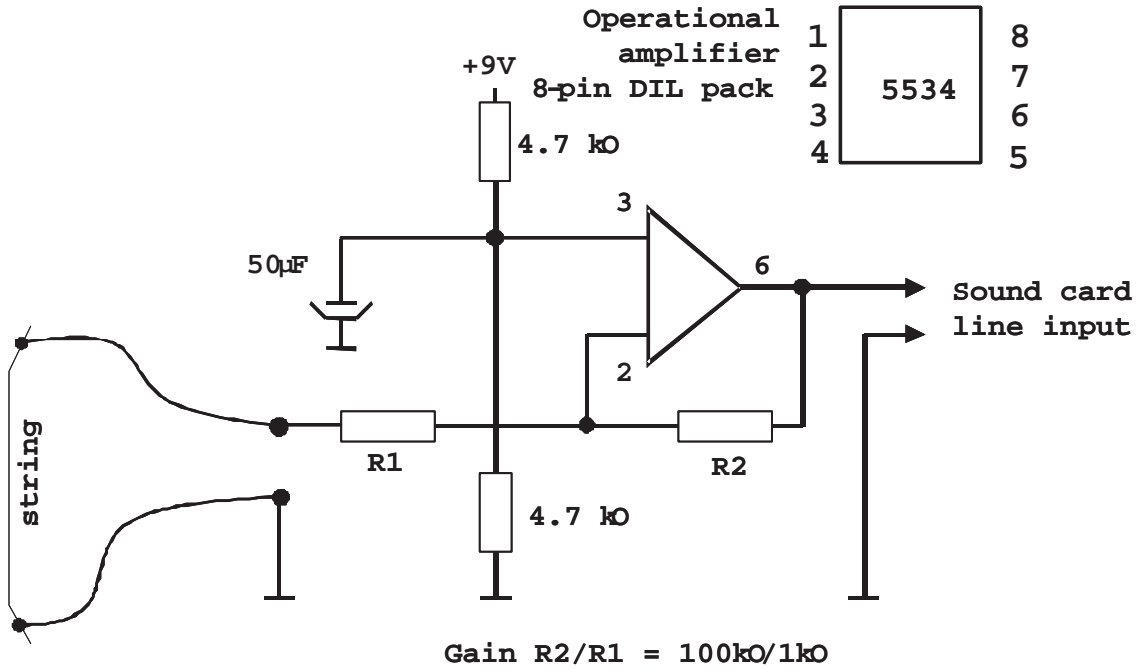


Figure 5:

6 Optical Transducers

Each transducer is a LED/phototransistor pair that are mounted facing each other, in what is henceforth called a "fork." The fork must be carefully positioned such that the string at rest partially obstructs the light passing from LED to the phototransistor. The string does not need to be an electrical conductor. Optical transducers measure the string's displacement. With two of them mounted at right angles, both horizontal and vertical deflection can be measured. Optical transducers are best mounted near one end of the string.

6.1 Mounting

1. Make a small wooden block that can be clamped onto support B1.
2. Mount the fork on the small block, such that the light from the LED is shadowed by the string before reaching the phototransistor, see <http://www.speech.kth.se/music/acvigit4/>, chapter 9, Figure 9.14.

6.2 Drive circuit and pickup circuit for optical transducers, O1 and O2

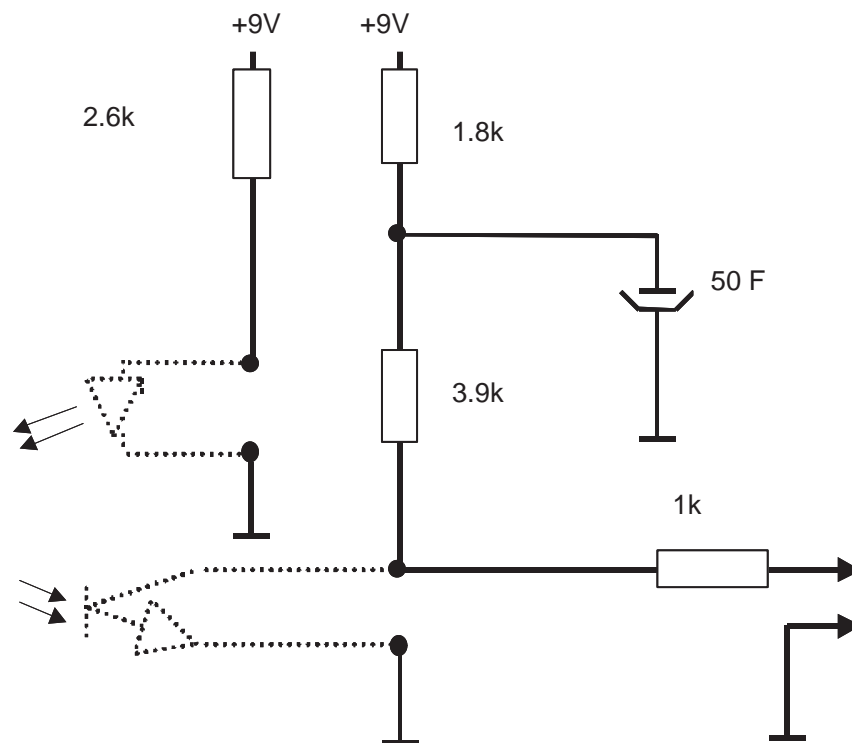


Figure 6:

6.3 Positioning the Optical Sensor

The optical transducer can be correctly positioned using only a voltmeter, measuring the output voltage of the circuit shown above.

Test the fork by measuring the output voltage both for unobstructed light and when the light is blocked by an opaque object. This will give the working range. An example is shown in the table.

Note that stray light in the room will significantly affect the result, MORE INFO TO BE SUPPLIED SOON.

Fork gap	Unblocked [V]	Blocked [V]
9.5 mm	5.63	3.15
6 mm	5.3	3.0
3 mm	5.3	2.9

Table 1:

Select the resting point as the voltage midpoint between the two extremes. Adjust the position of the fork so that the midpoint voltage is reached. Start from the unobstructed position and move the fork slowly.

For example, with a violin G string of .75 mm diameter, we might have: Fork gap 9.5 mm, unblocked 4.8 V, blocked 3.4 V, giving a midpoint voltage of 4.1 V.

The position must be accurate to a few tenths of a millimeter. When acquiring the string vibrations, the oscilloscope and/or sound card should be AC-coupled. Sound cards are almost always AC-coupled.

The optical method requires 10 times higher accuracy for positioning than does the magnetic method. The magnetic velocity signal can be time-integrated to give displacement, which is easier to understand.

6.4 Block Diagram for Two Optical Transducers O1 and O1

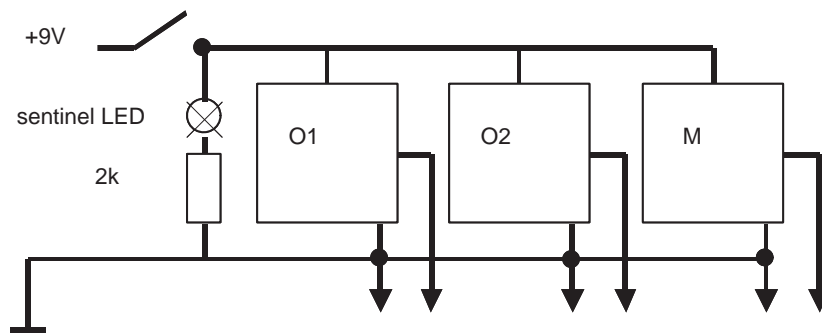


Figure 7:

7 Conclusions