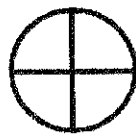
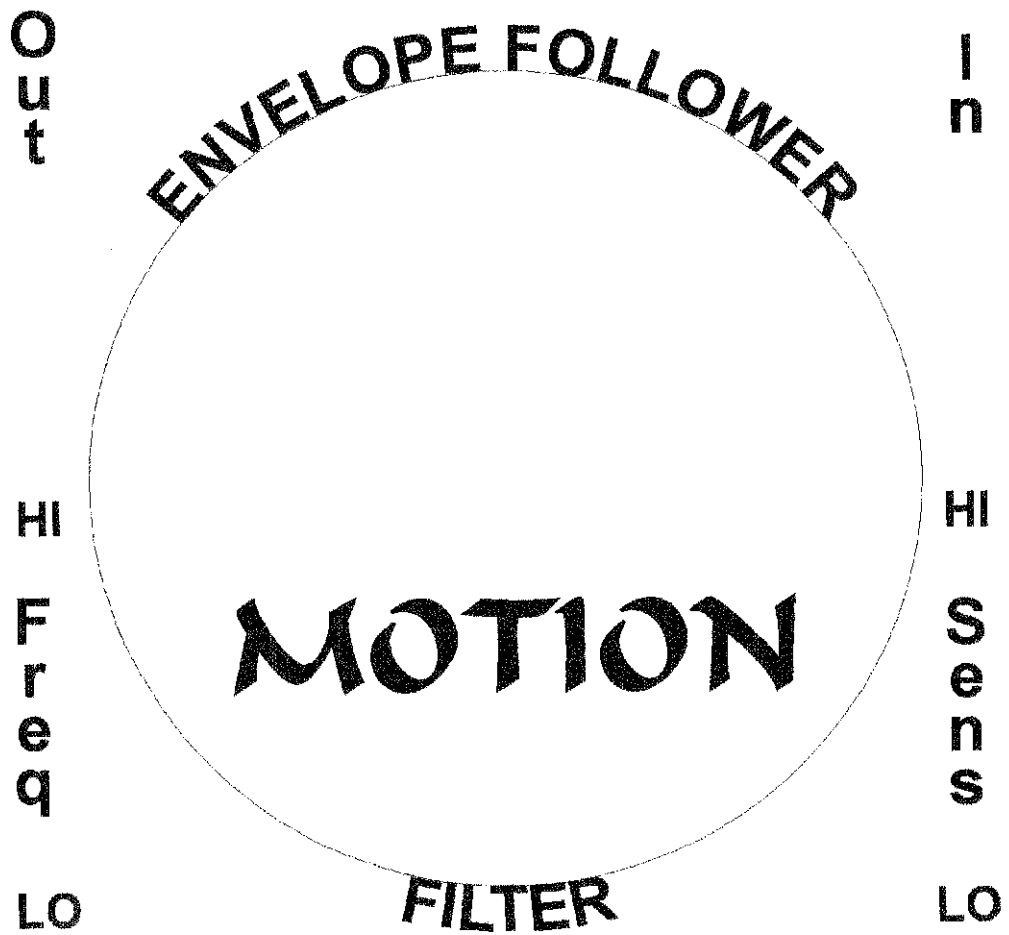


RAIA Motion (envelope follower) **Filter**

Model 5720
Assembly and Using Manual

5720



CANCEL

IMPORTANT - Before beginning assembly of your new kit, check the supplied parts against the following parts list. If parts are missing or damaged contact PAIA Electronics, Inc., phn: (405) 340-6300, email: info@paia.com

5720 Motion Filter Packing List

Qty Value Desc (alternate markings)

All resistors 1/4W. 5%, values in ohms

1 - 10 ohm resistor (brown-black-black)
1 - 100 ohm resistor (brown-black-brown)
1 - 150 ohm resistor (brown-green-brown)
1 - 1K resistor (brown-black-red)
3 - 10K resistor (brown-black-orange)
1 - 47K resistor (yellow-violet-orange)
2 - 100K resistor (brown-black-yellow)
6 - 1 Meg resistor (brown-black-green)
1 - 3.9 Meg resistor (orange-white-green)

Potentiometers:

1 - 500K PC mount trim pot
2 - 500K linear taper potentiometer

Capacitors

1 - 100pF ceramic disk capacitor (100K)
1 - .05uF ceramic disk capacitor (503)
 may be 0.47uF (473)
1 - 1uF polyester capacitor (104)
2 - .01uF polyester capacitor (103)

Electrolytic Capacitors:

5 - 1uF 10v. electrolytic capacitor
1 - 100uF 10v. electrolytic capacitor

Semiconductors:

2 - 1N4148 or 1N914 diode
2 - 1N4001 or 1N4003 diode
1 - 2N4124 transistor
1 - 4136 quad op-amp IC
1 - 4066 quad analog switch IC (in foam)

Misc:

2 - 14 pin IC socket
1 - 9v. battery connector
1 - 1/4 inch open circuit phone jack
1 - 1/4 inch stereo phone jack
1 - push on/off switch
1 - battery holder
1 - 4-1/2 inch piece foam tape
1 - 6 inches bare wire
2 - 15 inches insulated wire
1 - 5720 PC board
2 - knobs

INTRODUCTION

Thank you for buying the PAiA 5720 Motion Filter kit. We realize that you are anxious to get on with the assembly, but before you start, please take the time to read the hints and suggestions that follow.

— BEFORE YOU BEGIN —

Familiarize yourself with this manual. It's not necessary to read the whole thing in detail, but at least go through and look at the illustrations. Get a feel for the parts and how they fit together. It is particularly important to check the parts supplied against the parts list on the facing page. This is a relatively simple kit and it will not take long to assemble. Nevertheless, please do us all a favor - TAKE YOUR TIME. Time invested in careful assembly now will pay great dividends in the time saved trouble-shooting when you're done.

SOLDERING

Successful operation of your kit, as well as its longevity, is probably more dependent on how the components are soldered in place than any other one thing that the assembly involves. There are three key rules to go by, these are as follows:

TYPE OF SOLDER: Use ONLY ROSIN CORE SOLDER. Acid core solder or silver solder / paste flux should never be used to assemble electronic circuitry.

SOLDERING TOOL: Use a soldering iron with a power rating of about 25 watts to 35 watts, and a small pointed tip. Soldering guns are completely unacceptable for soldering solid state components, as the large magnetic fields they generate can easily damage some components. Be sure to keep your soldering iron tip clean. Before soldering a connection, wipe the tip on a damp sponge - This will aid in heat transfer and prolong tip life.

SOLDERING TECHNIQUE: Look at the solder connections on commercially available amps and effects units and try to imitate them as closely as possible. A proper circuit board solder joint has just enough solder to cover the soldering pad and about 1/16" (2mm) of the component lead passing through it.

To solder, hold the tip of the iron against both the wire to be soldered and the circuit board trace (or jack lug, switch lug, or whatever). Hold it there for a second or two to let things heat up, then feed a small amount of solder onto the connection. Do not simply feed the solder onto the tip of the iron and expect it to run down onto the connection. Continue holding the iron against the connection until the solder melts fully and flows freely over the connection. Then remove the iron and let the joint cool. Do not move any of the wires while the solder is cooling; if this happens, re-heat the connection, feeding in a tiny bit more solder.

There are two types of improper connections to watch out for; using too little solder (or too little heat) will result in a connection which will appear to be soldered when actually there is a layer of flux or oxidation insulating the component lead. To cure this, re-heat the connection and flow a small additional amount of solder on the joint. Using too much solder can lead to excess solder flowing between adjacent terminals or traces of a circuit board, causing a short circuit. Unintentional solder bridges of this type can be cleaned off onto the tip of a CLEAN, hot soldering iron while holding the board upside down. Another problem with using too much solder is that it can flow over to an adjacent hole, blocking it with solder.

If this happens, again hold the board upside down and flow solder away from the blocked hole and onto the tip of a clean hot iron. Use a pin to poke through any remaining solder left in the hole.

Finally, avoid using too much heat or leaving the iron on a connection for too long. Excessive heat can damage many types of electronic parts, and in extreme cases can cause the foil conductors to lift from the circuit board.

CIRCUIT BOARD ASSEMBLY

() Prepare the 5720 circuit board for assembly by thoroughly cleaning the conductor side of the board with a clean steel wool pad. Rinse completely with clear water and allow to dry. **DO NOT USE PRE-SOAPED PADS.**
A BRIGHT SHINY BOARD IS MANDATORY FOR SUCCESSFUL SOLDERING!

WIRE JUMPER INSTALLATION

() Using the BARE wire provided, form and install the 6 wire jumpers on the circuit board. Designations for these jumpers are the solid lines broken by a letter "J" printed on the component side of the board and in the parts placement drawing. NOTE the wire supplied can be straightened by pulling it between your pinched thumb and forefinger several times.
MAKE SURE 6 WIRE JUMPERS ARE INSTALLED.

RESISTOR INSTALLATION

Solder each of the fixed resistors in place following the parts placement designators printed on the circuit board and shown in Figure 1. Note that the fixed resistors are non-polarized and may be mounted with either of their leads in either of the holes provided. Insert both leads in the mounting holes and push the resistor FULLY against the board. On the conductor side of the board, bend the leads outward to about a 45 degree angle to help hold the component in place while soldering. **AFTER SOLDERING**, clip off each lead flush with the top of the solder joint.

DESIGNATION	VALUE	COLOR CODE		
		A	B	C
() R1	1 Meg	brown	black	green
() R2	1 Meg	brown	black	green
() R4	10K	brown	black	orange
() R5	3.9 Meg	orange	white	green
() R6	150 ohm	brown	green	brown
() R7	47K	yellow	violet	orange
() R8	1 Meg	brown	black	green
() R10	10 ohm	brown	black	black
() R11	1 Meg	brown	black	green
() R12	1 Meg	brown	black	green
() R13	10K	brown	black	orange
() R14	10K	brown	black	orange
() R15	100K	brown	black	yellow
() R16	100K	brown	black	yellow
() R17	1K	brown	black	red
() R19	1 Meg	brown	black	green
() R20	100 ohm	brown	black	brown

Silver or Gold
(disregard)

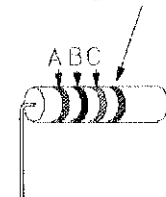
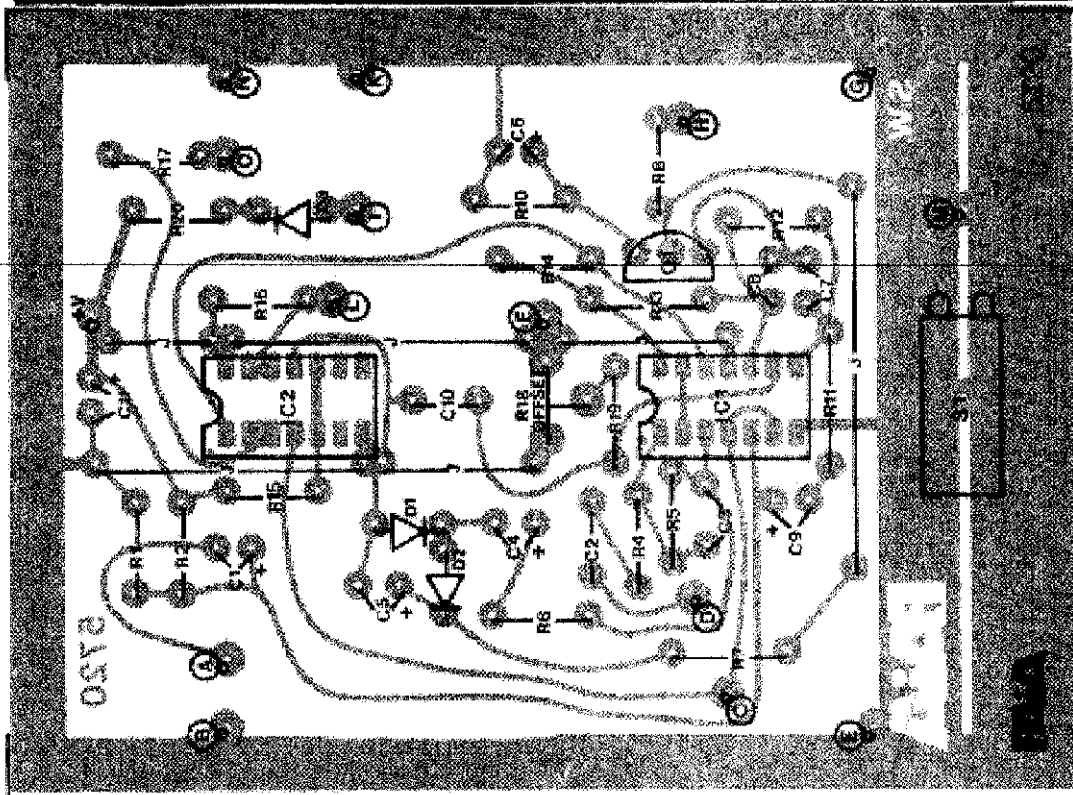
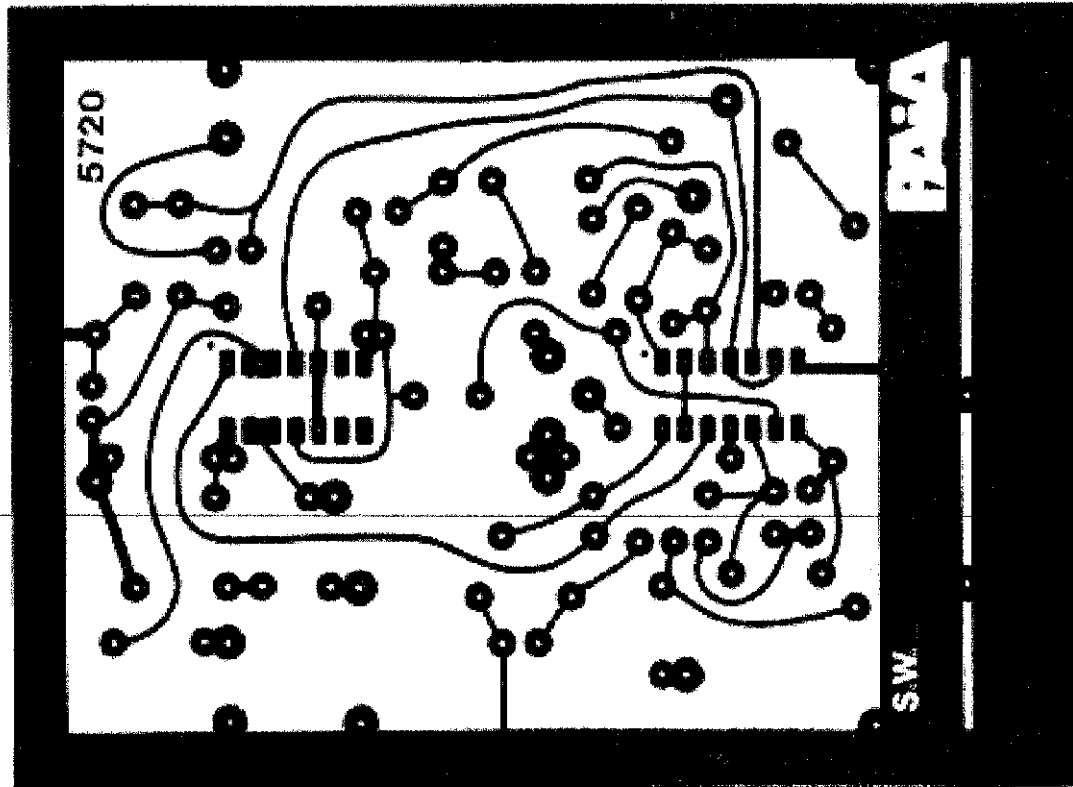


Fig. 1: Printed Circuit and Parts Placement
(Conductor Side)

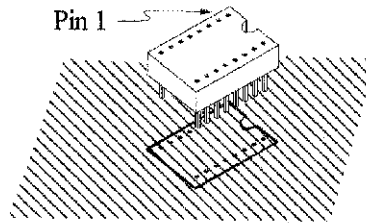


(Component Side)

IC SOCKET INSTALLATION

Install each IC socket by inserting its pins into the holes provided from the COMPONENT side of the circuit board and then soldering each pin to its respective pad on the CONDUCTOR side of the board. BE SURE THE SOCKET IS PRESSED DOWN FIRMLY ON THE BOARD AND THAT ALL THE PINS ARE PROTRUDING THROUGH TO THE CONDUCTOR SIDE. Some sockets may bear orientation markings on one end. While there is no electrical significance to the orientation of the socket, it is good practice to acknowledge these marks and orient the socket accordingly. Normally the marked end will correspond to the semicircle notch at one end of the parts placement designator for each IC.

- () IC socket 1 14 pin
- () IC socket 2 14 pin



CAPACITOR INSTALLATION

Install the polyester capacitors. Like the resistors, these components are non-polarized. The value of the capacitor will be marked on the body of the part. Solder in place and clip the excess leads.

DESIGNATION	VALUE	ALTERNATE MARKING
() C2	.1uF	104
() C7	.01uF	103
() C8	.01uF	103

polyester capacitor



In the same manner, install the ceramic disk capacitors.

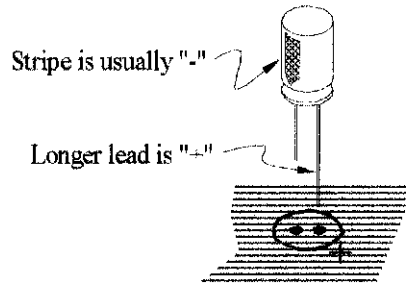
DESIGNATION	VALUE	ALTERNATE MARKINGS
() C3	100pF	100K
() C10	.05uF	503

ceramic disk capacitor



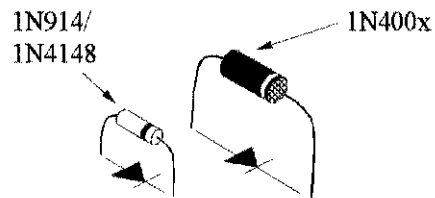
Up to this point, all components have been non-polarized, (i.e. either lead can go into either hole). Electrolytic capacitors are polarized; just like a battery they have a (+) and a (-) end; and like a battery, if installed incorrectly the circuit won't work. The capacitors supplied will have either the (+) or the (-) lead marked on the body of the part. The (+) lead must go through the circuit board hole marked positive (+). In the event the capacitors have their negative (-) lead marked, this lead should go through the unmarked hole on the circuit board. NOTE THAT THE SPECIFIED VOLTAGE RATING IS A MINIMUM RATING. CAPACITORS SUPPLIED WITH CERTAIN KITS MAY HAVE A HIGHER VOLTAGE RATING THAN THAT SPECIFIED.

DESIGNATION	VALUE
() C1	1uF/10V.
() C4	1uF/10V.
() C5	1uF/10V.
() C6	1uF/10V.
() C9	1uF/10V.
() C11	100uF/10V.



Next we will install the diodes. Like all semiconductors, diodes are heat sensitive. To be on the safe side, heat sink each lead of the diode by grasping the lead with a pair of needlenose pliers or a small copper alligator-type clip at a point between the body of the component and the circuit board. Be sure to orient the diode as shown in the drawing.

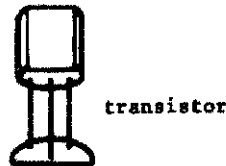
DESIGNATION	TYPE
() D1	1N4148 or 1N914
() D2	1N4148 or 1N914
() D3	1N4001 or 1N4003



Relative diode sizes

Install the transistor. Note that there is a flat side on the transistor case and that there is a corresponding flat on the circuit board parts placement graphics. When viewed from the top, these flats should align. Transistors, like the diodes, are heat sensitive and the same care and heat sinking techniques should be used when installing ed for installing the diodes.

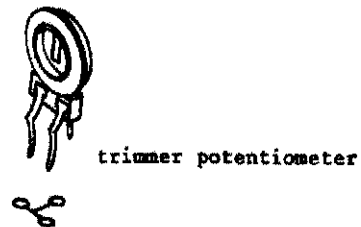
DESIGNATION	VALUE
() Q1	2N4124



transistor

Install the trimmer potentiometer R18.

DESIGNATION	VALUE
() R18	500K



trimmer potentiometer

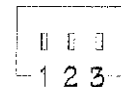
() Install the foot switch S1 by inserting the mounting shaft into the large hole in the circuit board from the component side. Thread one of the large hex nuts onto the shaft of the switch and tighten it securely against the conductor side of the board. Orient as shown if Figure 2. NOTE: Some kits may be supplied with a double pole switch (four lugs). In this event, the pair of lugs at either end of the switch housing can be designated lug 1 and lug 2 (unless otherwise specified). Only two connections will be made to the switch.

POINT TO POINT WIRING

In the following steps the insulated wire provided with this kit will be used to make the connections from the switch, the two control potentiometers and the two plug-in jacks to the circuit board. At each step, prepare the wire by cutting it to the specified length and stripping 1/4 inch (.5 cm) of insulation from each end. "Tin" each end by twisting the strands together and melting just enough solder into the wire to hold the strands together. To be sure you will have sufficient wire for all steps, "rotate" through the strands supplied, at each step cutting from the longest strand available. At each step, solder both ends of the wire.

It is good practice to tin the solder lug on the jacks and controls before soldering the wire to it since the heat required to tin the lug may well be enough to melt the insulation on the stranded wire. Hold the component in a small vise during this operation. If no vise is handy, a pair of needlenose pliers held closed with a rubber band will help. Tin these lugs by holding your soldering iron against them for a few moments to allow the lug to heat completely. When the lug is hot, feed solder to the point where the lug and iron meet. If the solder does not flow out onto the lug, it is an indication that oxidation is interfering with the solder bond. Break down the oxidation by rubbing the soldering iron around while applying firm pressure until the solder adheres smoothly to the lug.

	LENGTH	FROM	TO
()	2-1/2" (6.8 cm)	J1 lug 1	A
()	2" (5.2 cm)	J1 lug 2	B
()	2-1/4" (5.7 cm)	R3 lug 1	C
()	2-1/2" (6.8 cm)	R3 lug 2	D
()	2" (5.2 cm)	R3 lug 3	E
()	3-1/2" (8.8 cm)	R9 lug 3	F
()	2" (5.2 cm)	R9 lug 1	G
()	2-1/4" (5.7 cm)	R9 lug 2	H
()	3-1/2" (8.8 cm)	S1 lug 1	L
()	2" (5.2 cm)	J2 lug 2	N
()	2-1/2" (6.8 cm)	J2 lug 1	O

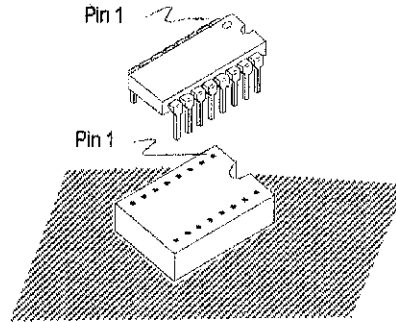


Note: The foot switch (S1) supplied with this kit has three lugs as shown above. The switch is symmetrical, use the center terminal for lug 2 and either of the end terminals as lug 1.

- () Using bare wire, make the connection between point "M" and lug 2 of S1.
- () Locate and install the battery connector. Connect the RED lead to the point on the circuit board marked "+V".
- () Connect the BLACK lead from the battery to J1 lug 3. Solder the connection.

Install the integrated circuits. Align the circular indentation or notch at one end of the case with the semicircular key drawn on the circuit board designators. When pressing the IC into the socket take care that pins do not bend under.

DESIGNATION	TYPE
() IC 1	4136 quad op-amp
() IC 2	4066 quad analog switch



This completes assembly of the 5720 circuit board. We will now install the board, the jacks and controls in the case.

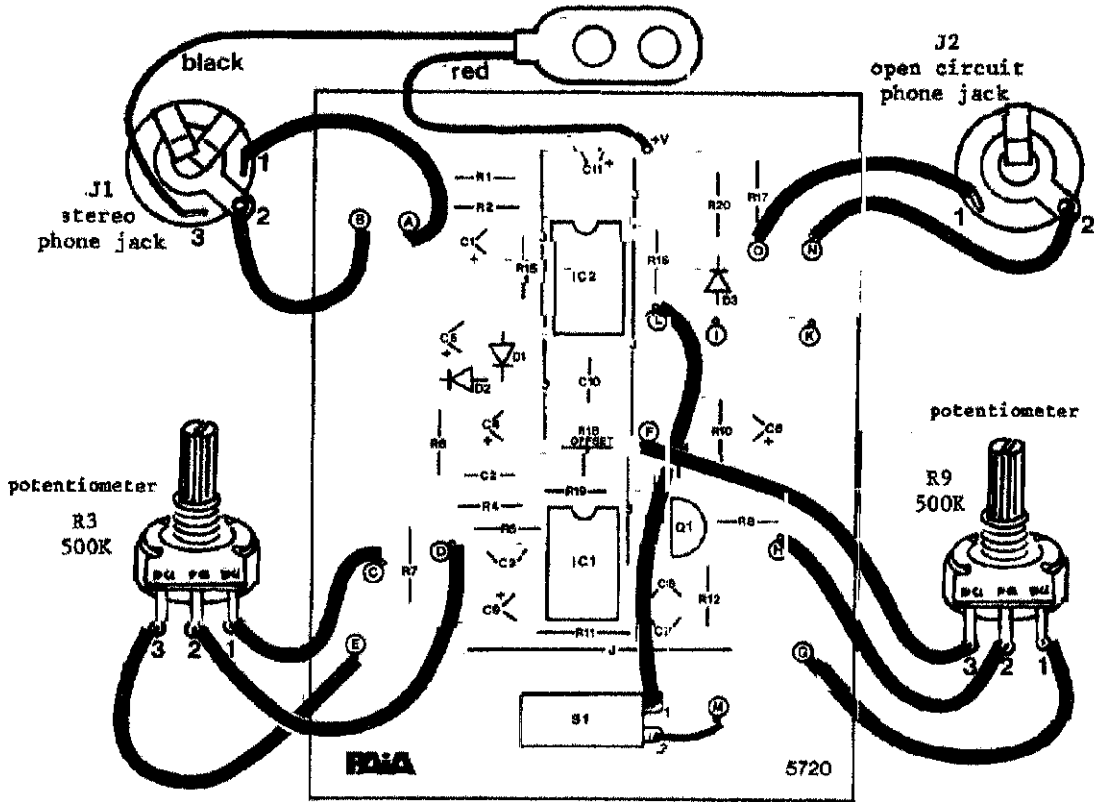


Figure 2: Wiring Diagram

() Locate the foam tape and cut off 1/2" (1.3 cm) from the length provided. DO NOT REMOVE THE PROTECTIVE PAPER FROM THE TAPE.

Of these two pieces of tape, the shorter will be used to attach the battery clip to the case and the longer will be used as an insulator to prevent the unsupported end of the circuit board from touching the case top.

To get a feel for the location of the tape section and the battery clip, trial fit the circuit board by passing the shaft of the stomp switch into the hole while dropping the circuit board in place. Notice that a small space must be allowed between the folded lip of the case and the clip to provide clearance to the case bottom when it is installed.

() Install the longest piece of tape on the inside top of the case as shown in Figure 3. DO NOT PEEL OF THE PAPER BACKING.

() Locate the "U" shaped battery holder and stick the small piece of foam tape to the bottom of it. Remove the protective paper and position it to the inside of the case top as shown in Figure 3.

() Install the extra hex nut on the switch mounting shaft and run it down to about 1/8 inch from the first nut (the one holding the switch on the circuit board).

() Install the circuit board in the case by inserting the shaft of the CANCEL switch up through the hole from the inside of the case. From the outside, thread the knurled finish nut onto the end of the shaft and tighten securely.

In the following steps, when the pots and jacks are installed, one of each of the pair of nuts supplied should be threaded onto its shaft and used as a spacer. Adjust this nut so that as little of the shaft as possible extends beyond the case as possible.

() Install J1 in the hole marked "IN" by inserting the threaded shank of the jack through the hole from the inside and threading the other nut onto it from the outside. Tighten securely.

() In a similar manner, install J2 in the hole marked "OUT".

() In a similar manner, install R3 (with one nut in place) in the hole marked "SENSITIVITY".

() In a similar manner, install R9 in the hole marked "INIT FREQ".

() Locate the four rubber feet and install them on the outside case bottom. Remove the protective paper and stick them into position.

CALIBRATION

We are now ready for testing and calibration. Snap in a fresh 9-volt battery

(alkaline is best) and plug your axe into the MOTION FILTER "IN". Plug the "OUT" into the input of your amp, set the SENSITIVITY control to about 80% and the INITIAL FREQUENCY control to about 25%. Set the volume control on your axe to full up and see if your Motion Filter is working. The effect will be quite obvious, so if you don't seem to be hearing it, try pressing the CANCEL switch and playing again.

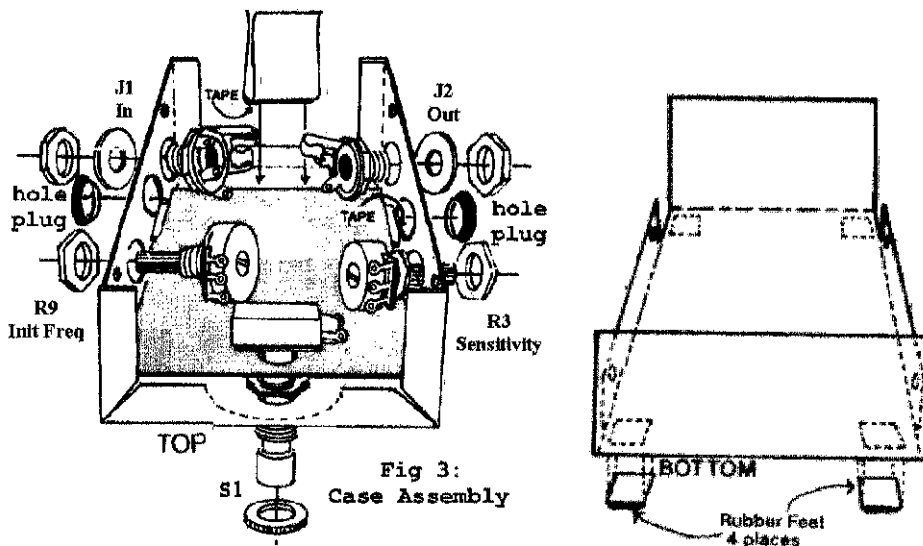
After the MOTION FILTER has been in operation for about 15 minutes, you can set the OFFSET trimmer. The easiest way to do this is to keep pressing the CANCEL switch while listening to the output. There is no need to play into the unit while making this adjustment. Just turn the trimmer in very tiny increments and wait a few seconds between adjustments for things to settle. Keep pressing the CANCEL switch while listening for the popping to go away. The correct setting should be near the center of rotation.

() After the calibrations are complete, install the case bottom by slipping it into position and inserting the four #8 machine screws through the holes in the sides of the case top.

() Install the knobs. Once the knobs are pushed onto their shafts, they will be difficult to remove. Before installing the knobs, set the controls to MIN and align the pointer on the top of the knob so it is in about a 5:00 o'clock position (INIT FREQ); 7 o'clock position (SENSITIVITY). Push the knob firmly into place.

() Install the hole plugs as shown in Figure 3.

REMEMBER THAT THE POWER (battery) TO YOUR MOTION FILTER IS TURNED ON AUTOMATICALLY WHEN A PLUG IS INSERTED INTO THE INPUT (IN) JACK. TO PRESERVE BATTERY LIFE, UNPLUG THE CORD FROM THE INPUT WHEN THE UNIT IS NOT IN USE.



DESIGN ANALYSIS

When an ordinary 1/4 inch phone plug (mono type) is inserted into J1, the ring connector is shorted to ground, connecting the negative side of the battery, supplying power to the MOTION FILTER. The input signal is coupled to the input buffer amplifier by C1. R1 and R2 hold the input of this op-amp at a D.C. level that is half way between the positive supply voltage and ground. The output of IC1a is directly coupled to one of the inputs of IC2 to provide effect by-passing. The same signal is dropped across SENSITIVITY control R3 and is picked off by the wiper and coupled by C2 to the input of op-amp IC1b where it is amplified to a level sufficient to drive the envelope follower circuitry. The gain of this amp is extremely high to provide a wide range of sensitivity.

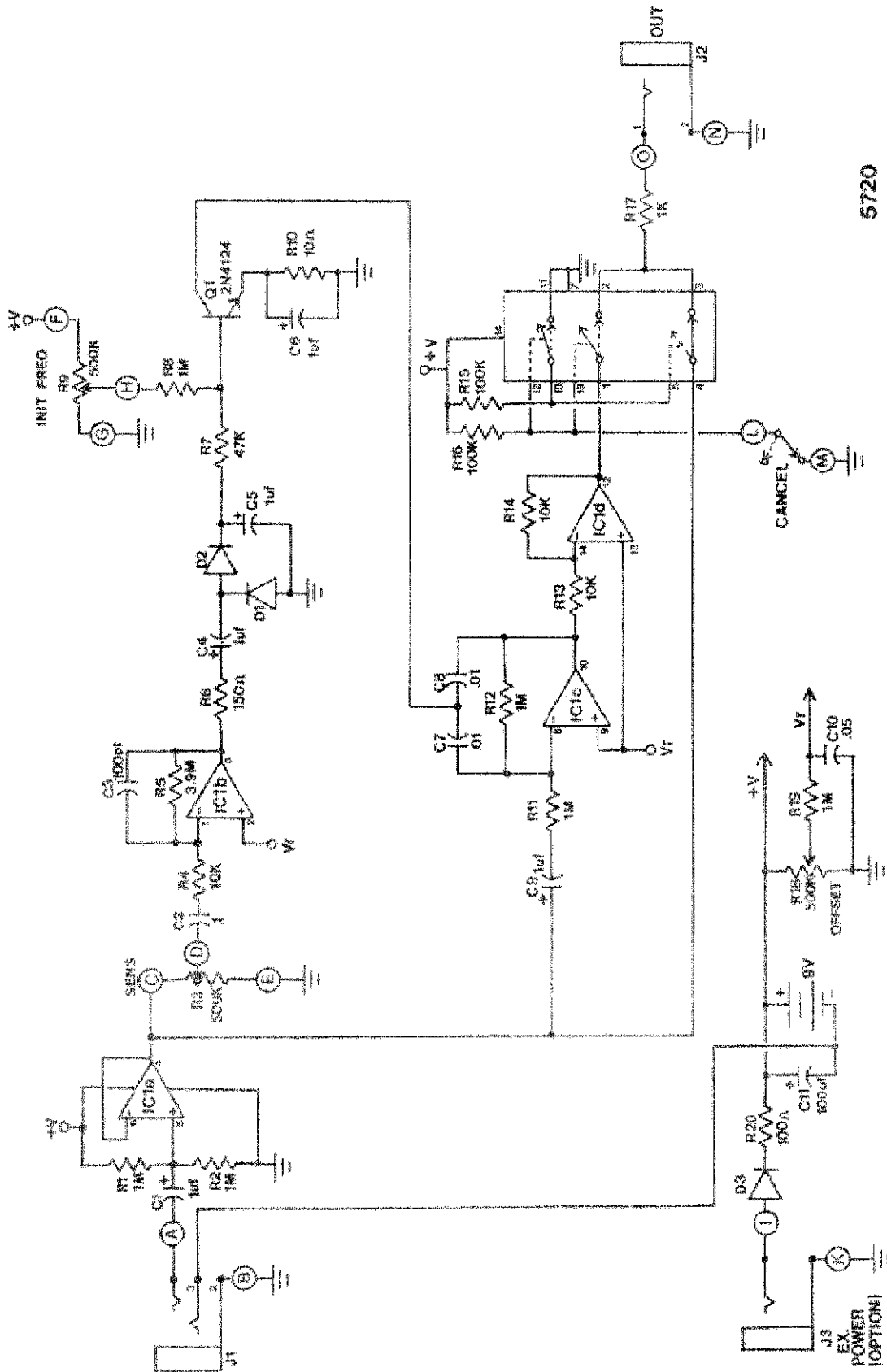
The output of IC1b is coupled through R6 and C4 to the signal rectifier diodes D1 and D2. A D.C. voltage reflecting the peak amplitude of the signal from IC1b is developed across C5. This voltage is used to control Q1 via R7. INITIAL FREQUENCY control R9 provides a second control voltage coupled to the base of Q1 by R8. The emitter of Q1 sees ground through R10 and C6, while the collector is connected to the junction of C7 and C8. This arrangement allows Q1 to manipulate the corner frequency of the filter.

The filter stage comprises C7, C8, R11, R12 and op-amp IC1c. The input signal is coupled from the output buffer amp to the filter input by C9. The output of the filter is then directly coupled to a second inverting amp IC1d. The gain on this op-amp is unity since it's only purpose is to invert the signal from the filter's output a second time so that the final output signal will be in phase with the input signal. This is done to prevent cancellation in the event the unit is to be used in a parallel arrangement.

IC2 is a four channel analog switch. Two of the channels are used to switch between processed and unprocessed output signal. A third channel is used to provide an inversion between the control signals to these two output signal select channels. The fourth channel is not used. When S1 is open the processed signal is selected and when S1 is closed the straight signal is selected. Isolating the mechanical switch in this way yields quiet in/out switching provided there is no D.C. voltage difference between either of the two switching channel inputs.

All of the op-amps with the exception of the input buffer IC1a, have an adjustable reference voltage source connected to the non-inverting inputs. This adjustment allows nulling of input offset voltages at IC1c or IC1d so that the D.C. voltages at the outputs of IC1a and IC1d can be made to match exactly. NOTE: This adjustment should be set after the unit has had at least 15 minutes to "burn in" the first time it is turned on.

External power can be applied through an optimal jack J3, reversed polarity protection diode D3 and R20.



5720

Notes

Notes



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