



Envelope Follower

Model 9753 Assembly and Using Manual

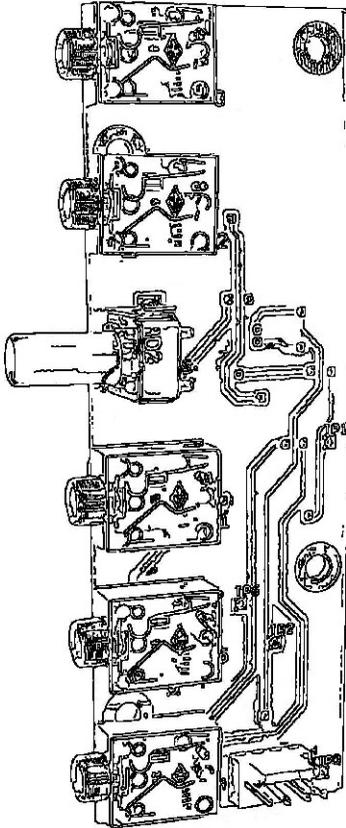
This second-generation 9700-series processing element for modular sound synthesizers is designed to provide great sound and excellent value.

The -11, revisited.

Audio or control signals input to the 9753 module are converted to "envelopes" relative to the amplitude, and triggers, Gate (step) or Pulse. The Envelope output is a CV that follows the dynamics of the input signal. The Gate-trigger occurs for the duration of the input signal. The Pulse-trigger occurs at the onset of the input signal. A Sensitivity control matches the signal source to the envelope and triggering range.

This module is used to interface guitars or microphones (or other pick-ups and sensors) to a modular synthesizer, as sources for triggers and control of waveform dynamics. A thru-connector is provided so that audio from the sensed source can be split or tapped at the module for processing through other modules such as VCFs or VCAs.

This high-performance module is designed to be compatible with most modular synthesizer systems with little or no modification. Most active components are already mounted, making assembly a snap.



ASSEMBLING THE 9753 Envelope Follower

Before beginning assembly, go through the manual. Look at the drawings. Feel the parts. You're naturally eager to plunge right in, but take a few deep breaths first. Check the parts supplied against the packing list at the back of this manual.

*In some cases, notes packed with the parts will be used to call your attention to special situations. **If parts are missing, please notify PAiA at missing@paia.com or by phone at (405) 340-6300, fax (405) 340-6378. A NOTES page is included at the end of this manual.***

Notice that each step in the manual is marked with a checkoff box like this:

| DESIGNATION | DESC. | MARKING |
|-------------|--------|-----------------|
| () R27 | 100ohm | brn-blk-brn-gld |

Checking off each step as you do it may seem silly and ritualistic, but it greatly decreases the chance of omitting a step and also provides some gratification and reward as each step is completed.

Numbered figures are printed in the Illustrations Supplement in the center of this manual. These pages may be removed for easy reference during assembly.

THE CIRCUIT BOARD

The 9753 Envelope Follower is built on a double-sided circuit board. Note the “top” side of the board has the connector and control placement designators. Surface-mounted components are on the “bottom” of the board. Install parts to the top of the board and solder them on the bottom.

TOOLS

You'll need a minimum of tools to assemble the kit – a small pair of diagonal wire cutters, pliers, screwdriver, soldering iron, and solder.

Modern electronic components are small (in case you hadn't noticed) and values marked on the part are often difficult to see. Another handy tool for your bench will be a good magnifying glass. Also use the magnifier to examine each solder joint as it is made to make sure that it doesn't have any of the problems in the SOLDERING section which follows.

SOLDERING

Select a soldering iron with a small tip and a power rating of not more than 35 watts. Soldering guns are completely unacceptable for assembling solid-state equipment because the large magnetic field they generate can damage components.

Use only a high quality electronic solder. Your kit is compatible with lead-free and/or tin-lead flux-core solders made especially for electronic assembly. Plumbing solder will destroy your kit with its acid core. Jewelry solder (silver solder) will destroy your kit with its high working heat. Neither is for electronics work.

A proper solder joint has just enough solder to cover the soldering pad and about 1/16-inch of the lead passing through it.

There are two improper connections to be aware of: Using too little solder will sometimes result in a connection which appears to be soldered when actually there is a thin layer of flux insulating the component lead from the solder bead. This situation can be cured by reheating the joint and applying more solder.

Too much solder may produce a conducting bridge of excess solder between adjacent pads causing a short-circuit. Continued feeding of solder into a hot joint can result in accumulation on the underside of the board and may cause bridges or impede the action of mechanical components. If you see this, position the board above the iron tip and the excess will flow to the tip.

Use care when mounting all components. Never force a component into place.

CONTROLS AND CONNECTORS

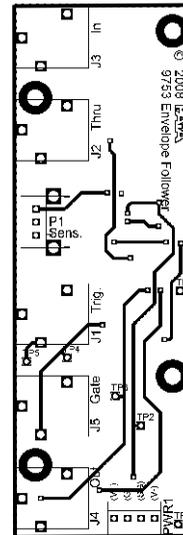
Controls and connectors will be installed on the top side of the board with the placement designators as shown in the illustration to the right.

Miniature phone connectors referenced as “stereo phone jacks” in the manual parts list are specified below with the contact/terminal names, Tip, Ring and Sleeve (TRS) and are labeled on the board and schematic as such.

The potentiometers have tabs extending from their body for stability. They have a snap-fit to the board. Align the tabs and pins with their holes and press them into place. There is no need to bend the tabs or terminals.

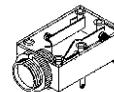
To ensure the best alignment with these parts with the front panel, begin by soldering only one of the multiple terminals associated with each of the following parts as it is installed. Then, if a part is tilted or crooked, it is only a matter of reheating the joint as the part is aligned.

Match the tab of the polarized power connector with the corresponding board marking.

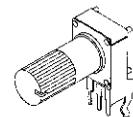


Top of circuit board

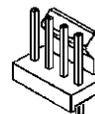
| DESIG. | DESC. | MARKING |
|----------|----------------------------------|---------|
| () J1 | TRS socket | |
| () J2 | TRS socket | |
| () J3 | TRS socket | |
| () J4 | TRS socket | |
| () J5 | TRS socket | |
| () P1 | 50K ohm Potentiometer, linear | B50K |
| () PWR1 | Header | |



TRS connector
“stereo phone jack”



Potentiometer



Header

COMPLETION

The front panel is used for mounting the module in a rack system or cabinet. Complete the module assembly by mounting the 9753 PCB subassembly to the front panel as follows:

Referring to Fig. 1A of the illustration supplement, use the knurled phone jack nuts to secure the subassembly to the front panel. Check for clearance of the potentiometer shafts to ensure they rotate freely. Finger-tighten the phone jack nuts and then use the tips of the diagonal cutters to give them another quarter of a turn or so.

Complete the soldering of all multi-terminal parts. Take care the solder doesn't run through to the opposite side of the board when soldering the mounting tabs. With practice, it is possible to flow solder to cover the opening; otherwise, just flow a bit to secure the tab to the pad ring.

Cut a 3/8" (10mm) long shim sleeve for each pot from the length of polyethylene sleeve provided. Set the shafts fully counter-clockwise, slip the shims over the pot control shafts, put the knob in place with the pointer aligned to about a 7:00 setting, and use a small screwdriver to tighten the set-screw just enough that it grips.

POWERING AND TESTING

Power to the circuit is via a four-circuit, dual-polarity DC power supply. A 9791 power connector cable matches the header for connection with one of the PAiA 977x supplies at 15v or more. Connect the circuit labeled (+) to the positive DC source (V+), the circuit labeled (-) to the negative DC source (V-), the circuit labeled (G) to the power ground (G), and the circuit labeled (SG) to the signal ground (SG). For other supplies without separate signal and power grounds, use two wires to join the two grounds (G and SG) to the one ground (aka GND, 0VDC or common) at the supply.

Before applying power, check again, to be sure the wiring for the two DC polarities and that the polarized 4ckt connectors are as intended (see Fig.1B).

Use two-circuit, Tip-Sleeve (TS or mono), cords for patching in or out of the Envelope Follower when connecting with external devices. Within a 9700-series system, either single conductor (Tip-only), or TS cords may be used. If this seems confusing, remember that a regular mono cable will always work for most home studios. PAiA equipment allows tip-only connections for professional applications where star grounding is required.

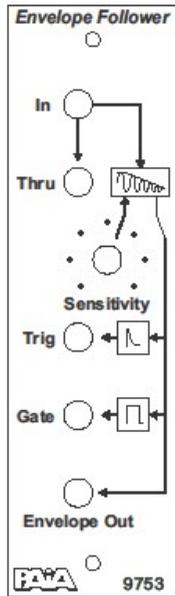
Connect a patch cord to the input and monitor the voltage outputs for positive DC voltage or connect these to a VCO control input so you can hear the effect of the voltage change. With the Sensitivity control fully advanced, simply touching the tip of the free end of the input patch cord should cause the outputs to change. The Envelope Output will rise and hold with the contact to the tip. The Pulse-trigger output, a momentary positive voltage pulse, will make a fast change, and the Gate-trigger will rise to a maximum positive value and hold there for the duration of the input condition. Note it's best if you don't touch the panel or sleeve of a TS cable which would reduce the "hum" from your finger-tip. Of course, the real test is to input a guitar, microphone, or other sensor. The Sensitivity control will then match the Envelope swing to the input dynamics, but also the triggering threshold. Note the pulse-trigger must 'reset' with a return to zero of the input signal -- it won't reoccur if the input is always sensed as being above the triggering threshold.

With guitar or a microphone (or an audio channel) connected, the Pass-thru connector makes the input signal accessible for further processing. The Envelope CV can be patched to a VCF or VCA control voltage input while the Thru signal is patched in as audio input. The VCF output is an envelope driven filter effect, like an auto-wah. The VCA output is a downward expander, working to make quiet parts even quieter. An envelope generator can be started with one or both of the trigger outputs and used to operate as control for the VCF or VCA.

The filter swept with ADSR or AR control gives the processed audio more of a “synthesized” sound. Attack delay effects can be achieved through the VCA for bowed-string or reverse tape effects. ADSR settings can truncate the sound, or instead of operating on the source audio, introduce some other modulation amount via a VCA such as the 9752 S/H output for even more “synthesized” effect,

A piezo sensor connected to the input enables putting a modular system to use as a drum voice similar to the model 5700 The Drum. Use a VCO and/or Noise Source, or some external audio channel as the “tone” -- perhaps add a bit of Balanced Modulation, some VCF for resonance, or not, and a VCA for the percussion as set with ADSR modulation (a bit of LFO and/or reverb might be useful too).

Guitar, Microphone, Piezo Sensor, Audio Channel, etc. These may benefit from preamplification.



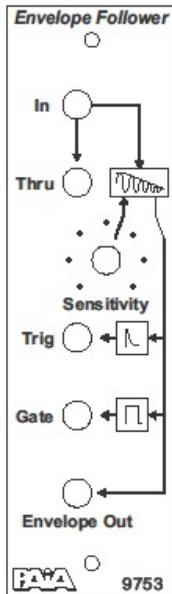
A tap of the signal input to the Envelope Follower for connection as audio input to a VCF or VCA module.

Pulse-trigger output. Active for the instant the sensed audio signal results in a positive envelope output.

Gate-trigger output. Active for the duration the sensed audio signal results in a positive envelope output.

Control Voltage output proportional to the amplitude dynamics of the audio input signal.

Guitar



VCF Input

VCF CV Input

Notes

Mounting holes are provided on the board for custom applications.

DESIGN ANALYSIS

Low-level audio or periodic signal sources applied to the input of the Envelope Follower are boosted by op-amp stage U1C, one section of a quad op-amp. The output from this section drives a precision full-wave rectifier comprised of two more op-amp sections U1D and U1A and diodes D5 and D6 for a positive DC output. This is used as the Envelope Control Voltage output and passed on to a comparator stage for obtaining trigger signals.

U1B compares the voltages on its inputs, and, outputs a positive level when the non-inverting input is most positive with respect to the inverting input. This section is the source for the Gate and Pulse triggers with the Gate output being scaled to a +5V DC range by the R13 and R14 voltage-divider and the Pulse being a differentiated branch of the Gate circuit via capacitor C4. Diodes D7 and D8 provide discharge paths for the capacitance in these circuits.

9753 Test Point Data

| | |
|-----|---------------------|
| TP1 | +12 VDC |
| TP2 | -12 VDC |
| TP3 | 0 VDC |
| TP4 | Gate-Trigger Output |
| TP5 | Envelope CV Output |

9753 Power Requirements

| Voltage | Current |
|---------|---------|
| +15 VDC | 10.2 mA |
| -15VDC | 13.2 mA |

9753 Parts List

Please check the parts against this list. As you locate a part type and verify the quantity (and mounting hardware -- if required) check it off in the space provided.

Because we have introduced surface-mount parts with these kits, we are providing the printed circuit card as a sub-assembly with the surface-mount parts already in place.

Also, we want to make you aware that we are using both linear- and audio-taper potentiometers in some of the modules. They are marked differently so we are asking that you check carefully.

If anything is missing please notify PAiA at missing@paia.com or by phone at (405) 340-6300, fax (405) 340-6378.

| | Quan | Description | Ref Des | Marking |
|-----|------|---|--------------------|---------|
| () | 1 | 9753 PCB Sub-assembly, Envelope Follower | | |
| () | 1 | 9753 Front Panel, Envelope Follower | | |
| () | 1 | 50K ohm Potentiometer, 9 mm Snap-In, Linear | P1 | B50K |
| () | 5 | Phone Jack, Stereo, 3.5mm | J1, J2, J3, J4, J5 | |
| () | 1 | Knob, Set Screw | | |
| () | 1 | Shim, Knob, Polyethylene Sleeve | | |
| () | 1 | Header, Vertical, 1row, 4pin | PWR1 | |
| () | 1 | Cable Assembly, Power, 4-wire | | |
| () | 2 | Screw, Self tap, #4 x 3/8, Pan Head Phillips, Black Oxide | | |

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