

# DO-IT-YOURSELF

## The String Damper

**Designer Paul Williams introduces an easy-to-build project capable of providing the guitarist (or indeed the synth-player) with automatic damped string effects, as well as a range of envelope and gate processing. The String Damper comes housed in a neat footswitch case with easy battery access, and the complete kit of parts is available from E&MM.**

Although damping the sustain of strings presents no physical problem to most guitarists, this neat little unit will not only accomplish effortless damping, but also achieve it more consistently, and over a much wider range, right down to thin 'pops'. The other effect available from the E&MM String Damper – that you will have great difficulty in producing manually – is the slow attack sound that Hank Marvin uses frequently to great effect. This too is adjustable over a wide time range from instantaneous through a 'bowing' sound to an almost painfully slow, gradual build-up.

The very low switching noise inherent in the design coupled with the optional non-latching footpedal operation means that an occasional slow attack or damped note can be 'dropped-in' wherever the musician wishes. This also allows for manual tremolo (amplitude modulation), or volume pumping effects to be easily achieved.

Although originally intended for use with guitars, the String Damper will operate satisfactorily with most key-

boards, giving the synthesist another useful performance control to waggle away at with an unused foot, perhaps in conjunction with last month's Bass Pedal Synth project. . .

Although battery consumption is minimal, a jack socket is provided for the connection of an external mains-operated DC supply. The battery is housed in a recess under the footplate that simply unclips to reveal the battery for quick changing.

### Construction

Most of the components are contained on the PCB, and what little wiring is left should present no problem. Since the standard footswitch unit comes with a jack socket and switch mounted on a PCB, the first job is to remove the PCB assembly from the case and de-solder the switch and socket: the PCB can then be discarded. If you don't have access to a solder pump, then the solder can be removed from the joints using the bared ends of stranded wire applied with the soldering iron tip to the joints.

The assembly of the String Damper

starts by inserting from the track side, and soldering the seven veropins. Next, insert and solder the IC sockets, but leave the ICs out till later. Insert and solder D2-5 and all the resistors, referring to the component overlay for positioning. Note that some of the resistors are mounted vertically.

Mount and solder the capacitors, taking care with the orientation of the electrolytics. The jack sockets and the switch can now be soldered in place, making sure that they are pushed firmly down onto the PCB whilst doing so. Note that the socket removed from the original PCB is JK3. Having completed the PCB assembly, it must be checked carefully for correct assembly and component orientation, and with an eyeglass on the track side for dry joints or bridged tracks. The ICs can then be loaded into their sockets, and again, be careful with orientation.

Now is the time to decide whether you require on-off or momentary operation. If you want momentary operation, then the end of the wire detent which locates into the mechanism of the switch must be

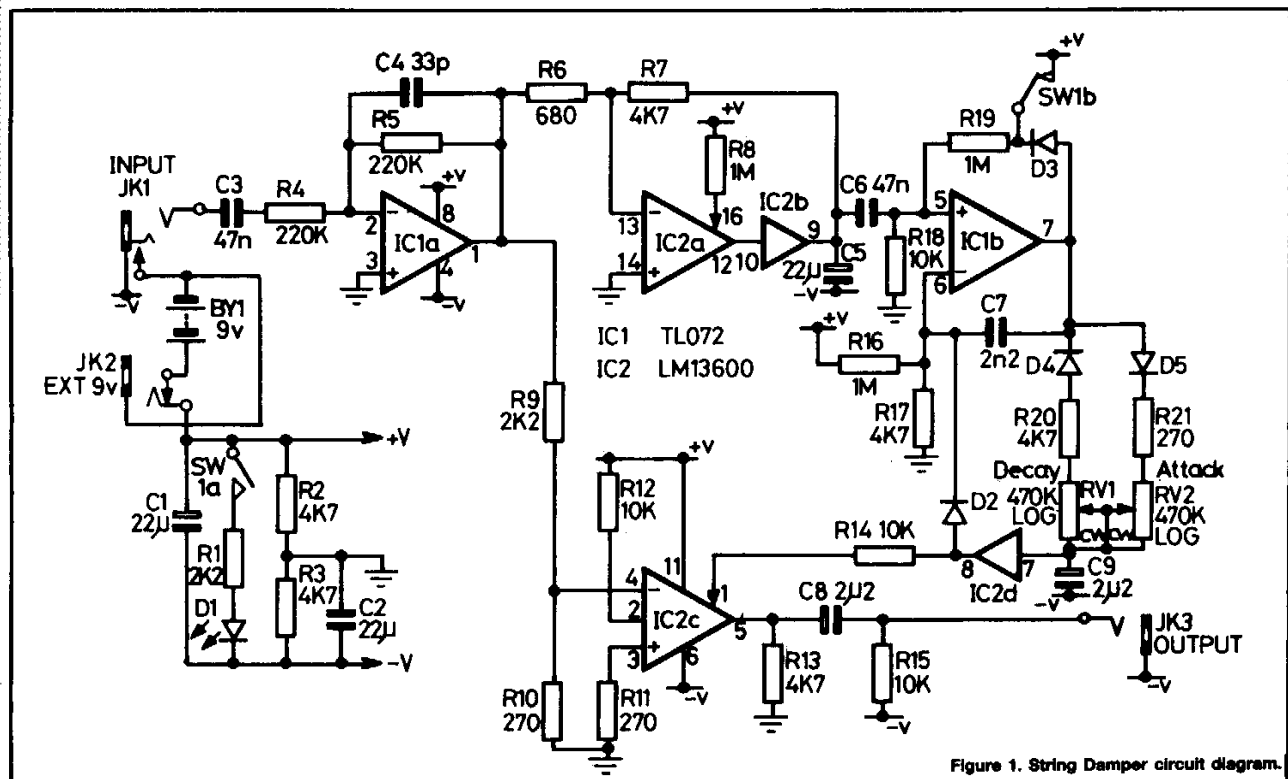


Figure 1. String Damper circuit diagram.

pulled out and allowed to rest on the side of the switch body. The coil spring will retain it in this position, ready for changing to on-off operation if required.

Remove the inner moulding from the footswitch case by withdrawing the two securing screws, and prepare the two mouldings as shown in Figure 2. Thread the free end of the battery connector wires through the small hole in the corner of the battery compartment. Before fitting the LED in place using a clip and collar, solder 100mm-long insulated wires onto the leads and sleeve the joints: identify the anode wire by bending over the free end.

After the pots on the inner moulding panel have been mounted, they can be connected to the PCB assembly veropins using 100mm-long insulated wires, along with the battery clip wires. Now drop the inner moulding back into the main moulding, guiding the LED wires through the hole in the inner moulding, and screw it in place. The LED wires can now be soldered to the PCB assembly, though remember that the bent-over wire is the anode connection. Feed the jack socket bushes into the appropriate case holes and locate the PCB on the inner moulding pillars so that the switch lever drops into the actuator arm.

All that remains now is to screw on the jack nuts (no need to secure the small jack), fit the control knobs, and screw on the base plate. Now pop in a fresh PP3 battery (preferably a mercury type), and away you go!

## Circuit Description

The circuit diagram shown in Figure 1 reveals that the amplitude of the signal is controlled by that old favourite, the LM13600 dual Operational Transconductance Amplifier (OTA). IC1a buffers the input, presenting a high impedance to the guitar and a nice low-output impedance to the following stages. IC2a&b form a precision rectifier, storing the peak value of the input amplitude on C5. C6 and R18 form a simple differentiator whose purpose is to detect when the signal amplitude increases at a high enough rate and by a great enough amount – to indicate that a new note has been played. The bi-stable formed around IC1b is then triggered, its output on pin 7 going positive. This condition is latched for the time being by D3 and R19.

C9 will now charge via D5, R21 and the attack pot, RV2. The voltage on C9 is buffered and followed by IC2d. When the voltage is sufficient to forward bias D2, causing current to flow into R17, the bi-stable IC1b becomes re-set. This signifies the end of the attack period, the length of which is obviously determined by the rate of charge of C9 via RV2. The maximum attack and decay times can both be increased by making the value of C9 larger.

C9 now discharges via D4, R20 and RV1, the decay pot. R14 generates a control current for the OTA IC2c, proportional to the voltage across C9. The output signal is thus equal to the product of the input signal and the voltage across C9. When the footpedal is released, SW1b closes, forcing the bi-stable IC1b to be permanently set, so that the input

signal is allowed to pass through to the output unattenuated. Note that the signal path does not change during switching, so that very little noise is induced when switching in or out.

The input jack JK1 has a make contact which automatically switches the battery on when the guitar plug is inserted into the input jack.

## In Use

Assuming that the unit now works correctly, as it should do if you have followed the assembly instructions carefully and checked all your work thoroughly, once the Damper is connected to a guitar and amplifier you will find that the signal from the guitar is passed to the amplifier unchanged. If you have decided to opt for the on-off mode of operation, ensure that the footswitch is positioned so that the LED is extinguished.

Now with the footswitch operated, and the controls both turned fully anti-clockwise, notes played on your instrument will only be heard as very short 'pops' since the damping is at a maximum. Advancing the decay control will broaden the 'pops' into more recognisable damped strings, up to the point fully clockwise where little damping takes place. Each new note played, regardless of how far the previous note has decayed, will trigger the unit into a new envelope cycle. When

playing chords it is advisable to damp the strings manually to prevent re-triggering during decay.

Advancing the attack control will give each new note a more gentle entrance, up to the fully clockwise position where the attack time will be over one second. With the attack control at 12 o'clock and the decay control fully anti-clockwise, a 'reversed' sound can be obtained, since a slow attack will be followed by an abrupt decay.

With both controls at 11 o'clock, a gentle effect not dissimilar to bowing a violin will be produced. Playing notes in rapid succession without manually damping the previous ones will result in an eerie chord effect, where each new note is accompanied by a short sample of all the notes previously played. With this same setting, it is possible to produce manually-controlled tremolo and volume pumping effects by continuously pressing and releasing the pedal.

If you prefer your effects to be subtle and unobtrusive, then you may wish to introduce an envelope effect just on an occasional note. For instance, to give a note a slow attack only, press the footswitch just before the note and, as soon as the note has reached its loudest, release the pedal. Don't expect to get perfect results first time, since the String Damper is a performance control and as

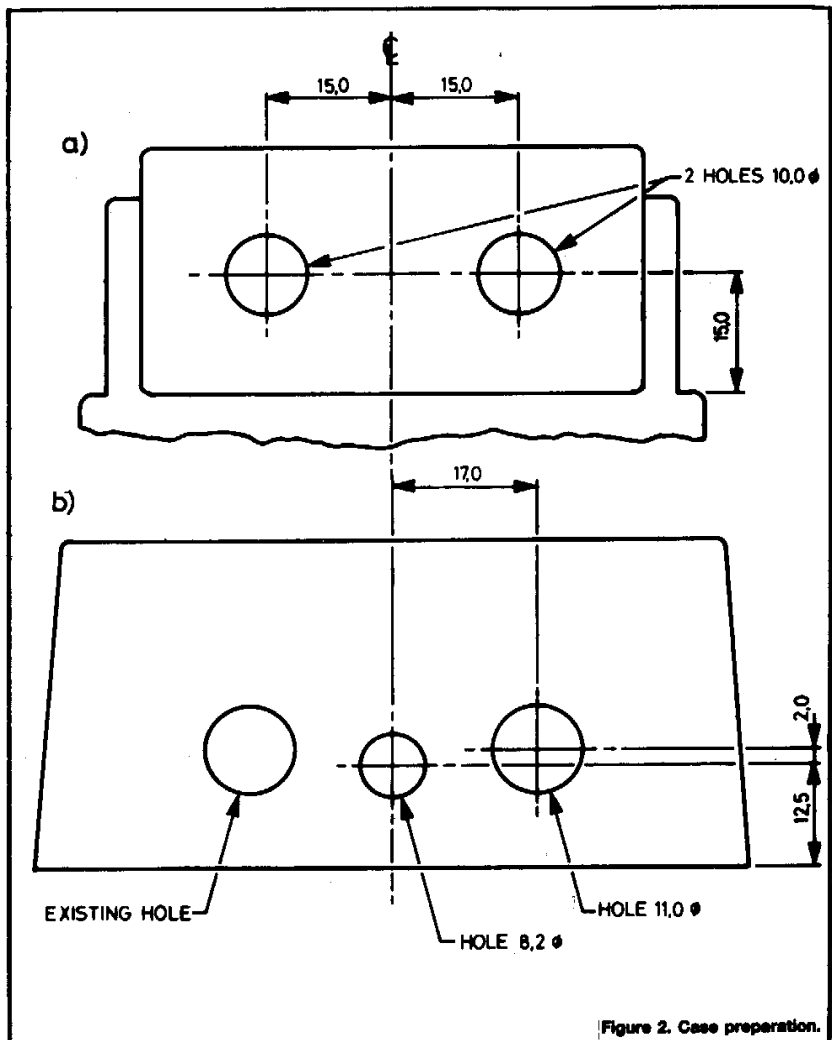


Figure 2. Case preparation.

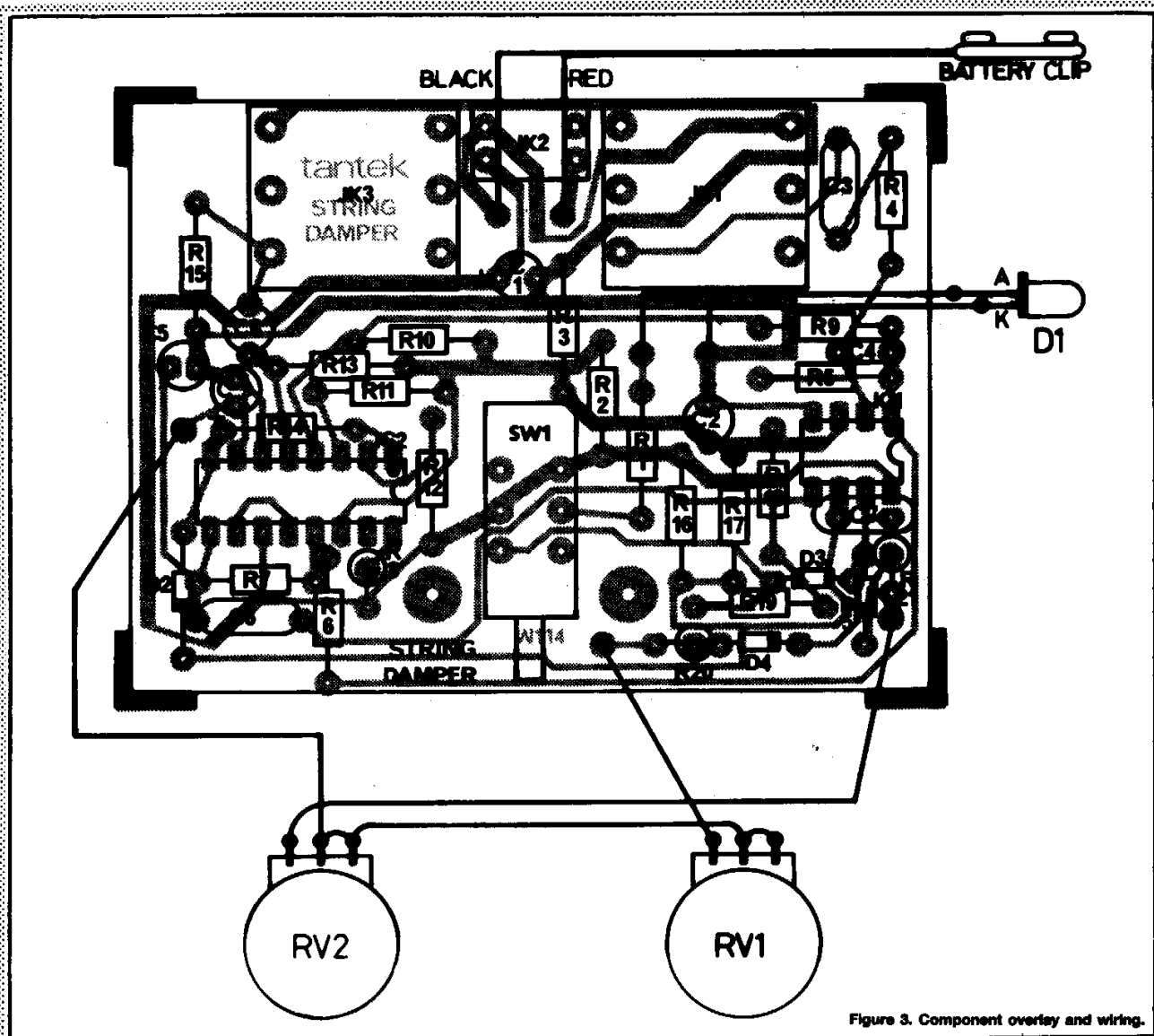


Figure 3. Component overlay and wiring.

such needs practice to achieve artistic results.

If you wish to run the unit from a mains power supply, then this should be of the regulated 9V DC variety. Remember to withdraw the jack plugs after use to preserve the battery life.

As with all new effects, the name of the game is experimentation: the musician prepared to try out new techniques will soon find that he has a whole new spectrum of sounds to draw on.

Paul Williams

E&MM

The String Damper is obtainable as a complete kit of parts from E&MM at the editorial address, price £23.95 including VAT, postage and packing. Cheques/POs should be made payable to Glidecastle Publishing Ltd. Please allow 28 days for delivery.

### Typical Specifications

Frequency response (-3dB)	15Hz to 18kHz
Output noise (open)	-87dBm (A)
Output noise (closed)	-100dBm (A)
Attack time	0.5ms to 1 sec
Decay time	10ms to 1 sec
Battery drain (active)	8mA
Battery drain (standby)	5mA

### Capacitors

C1, 2, 5	22uF 16v radial electrolytic
C3, 6	47nF polyester
C4	33pF ceramic
C7	2n2 ceramic
C8, 9	2u2 50V radial electrolytic

### Miscellaneous

JK1	1/4" PC Jack socket with make contact
JK2	3.5mm PC jack socket
JK3	1/4" PC jacket socket (supplied with case)
SW1	Latchswitch (supplied with case)

### String Damper Parts List

#### Resistors - all 1/4W 5% carbon film

R1, 9	2K2	R8, 16, 19	1M
R2, 3, 7, 13, 17, 20	4K7	R10, 11, 21	270
R4, 5	220K	R12, 14, 15, 18	10K
R6	680	RV1, 2	470K log pot

#### Semiconductors

D1	LED
D2-5	1N4148
IC1	TL072
IC2	LM13600

battery clip (PP3)
LED clip
Footswitch case (Rhino 801)
Knob (2 off)
Knob cap (2 off)
8-3ay DIL socket
16-way DIL socket
PCB
Veropins
Wire