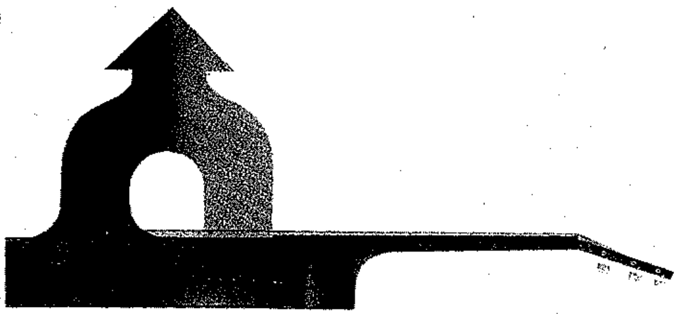
INTRODUCTION

Congratulations on your purchase of the Passac. You are about to discover that you can achieve the true amplified sound of your acoustic guitar, violin, cello, double bass, dobro or mandolin, with the convenience of a contact vibration pickup.

This manual will explain the unit's principles of design and operation, and guide you through the process of tailoring its effect to your particular instrument.



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Part 1. PASSAC PRINCIPLES

You've probably noticed that the body of your instrument is hollow. It has a hollow air chamber, a soundboard and a soundhole through to the hollow body. Without delving too deeply into acoustics, it should be obvious that all these things interact to contribute to the instrument's total acoustic sound. A cursory view of this interaction, however, will help understand why the Passac is important.

When the soundboard picks up the vibration of the string, it moves up and down, compressing and expanding the air in the hollow body. This in turn pushes air in and out of the soundhole — like a kind of piston. The soundboard has a set of ways it wants to vibrate — resonant modes — which depend on things like its weight and stiffness (lower modes) and struts, bracing and curvature (higher modes). The soundhole also has a frequency of vibration which it prefers, i.e. a resonant frequency, which depends on the volume of air in the hollow body and on the diameter (area) of the soundhole.

So you've got vibrations from the soundboard causing vibration in the air within the body causing vibration in the air in the soundhole, each with particular resonances. However, it turns out that the addition of a soundhole resonance shall always cause a gap in the soundboard response. This is very efficient in the acoustic instrument, as where one leaves off, the other takes over, but if you isolate just one element, you're not getting the whole picture of the sound.

Aha! The pattern starts to emerge. If you stick a transducer onto the soundboard to pick up its vibrations, it's going to pick up this vibration only — gap in the frequency response and all. Mics are obviously OK as they respond to the vibrations of the air produced by the whole instrument, but if you want the flexibility and gain before feedback of a contact vibration transducer, somehow you've got to add the soundhole's contribution to what the bug's picked up.

If you could do that, your electrical signal would correspond much more closely to the total sound of the instrument. One solution is to use a mic on the soundhole as well as the bug, but then you're tied to the mic again and your level is again limited by how much level you can get out of the mic before it squeals.

That's where the Passac comes in. As well as being a preamp, it's also a special filter system which adds a particular resonance electronically to the signal coming from the bug, just as the soundhole adds its resonance to the soundboard.

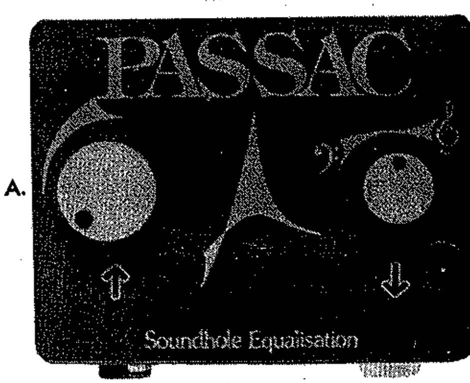
So, the secret of using the Passac with a particular instrument is to find that resonance normally contributed by the soundhole, and set up the unit so that it adds it electronically to the bug signal.

PASSAC CONTROLS

Figure 1. The Passac

A. VOLUME CONTROL.
Adjusts the output level of the Passac to produce the required volume.

A.



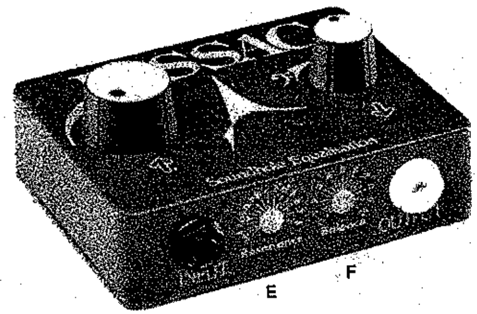
D.

B. Input jack. **C. Output jack.**

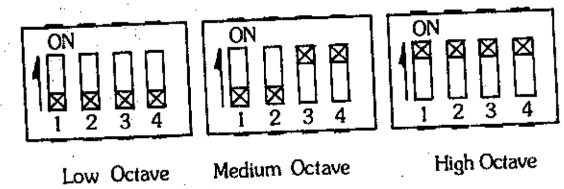
D. EMPHASIS CONTROL. A combination 'tone' control. Centre position gives a flat response; rotation to left (anticlockwise) emphasises lower frequencies, i.e. boosts bass and cuts treble; rotation to right (clockwise) cuts bass and boosts treble (cut and boost each 10dB, pivot point 650 Hz). Used to aid in the tuning of the Passac's RESONANCE (E) for individual instruments. (see Part 3).

E. RESONANCE CONTROL. Screwdriver-adjustable control which, in conjunction with OCTAVE SELECT (G) sets pitch (frequency) of the Passac's filter resonance corresponding to the soundhole resonance of the instrument. Note that screwdriver aligns with calibration marks.

F. BALANCE CONTROL. Screwdriver-adjustable control which effectively sets amount of the 'soundhole' resonance added to the soundboard signal.



G. OCTAVE SELECTION
Under bottom plate



H. BATTERIES 2 × 9v

Part 2. THE SOURCE OF VIBRATION — PICKUP CHOICE AND PLACEMENT

Since the Passac depends on vibrations of the soundboard as the basis for its 'acoustic contouring', the type and placement of pickups is important.

The first thing to note is that, for this purpose, you're interested only in picking up the actual vibrations of the soundboard, so a microphone-type transducer is not ideal; you don't want to pick up vibrations of the air, just of the wood.

Solid mounting is critical, so that all vibrations are transferred directly to the pickup, and you should ensure that the pickup is not riding on a bubble of air, as this would make it prone to feedback without any vibration of the timber itself.

For instruments like the guitar, therefore, where you're attaching the pick-ups directly to the soundboard, a hard epoxy is the best way to go; and for curved-soundboard instruments such as the violin, the pickups should be securely clamped to the bridge as described a little later on.

Pickup type

The water-thin piezo-electric pickups supplied with your Passac act as light-weight sensors of the actual 'bending behaviour' (vibrations) of the soundboards or bridge of your instrument. They supply a very high-level, noise-immune signal which is a true electrical representation of what the wood is doing.

Also, because of their light weight and the fact that they're directly coupled to the source of vibration — i.e. they're not picking up sound from the air at all — the pickups don't feed back; it's the acoustics of the instrument itself which will determine how loud you can go before things start to feedback.

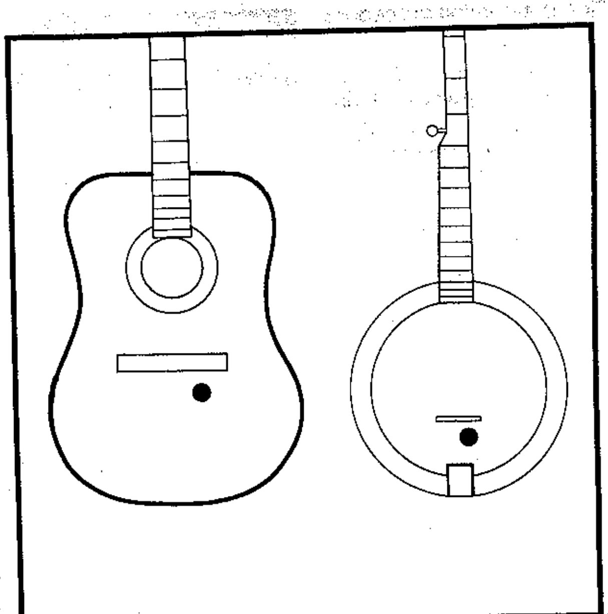
Pickup Mounting

Warning: These pickup mounting procedures are guidelines for professionals only. The installation and associated woodwork should not be attempted by an inexperienced person. The manufacturer does not accept any responsibility for any damage caused as a result of improper transducer mounting.

1. Guitar and banjo

Figure 3 illustrates pickup mounting positions for guitar, banjo and mandolin. These are not arbitrary positions: they are based on the way the soundboard tends to vibrate. If you'd like to know more about why you should place it where suggested, check out Appendix 1.

Figure 3. Pickup placement for guitar and banjo.



Note that care in drilling the hole for the jack in the end block of the instrument is important; you need to make sure the hole is perpendicular to the bottom of the instrument, so start with a small drill bit and work up to the required ½". You'll have more control that way.

2. Violin, cello, double bass

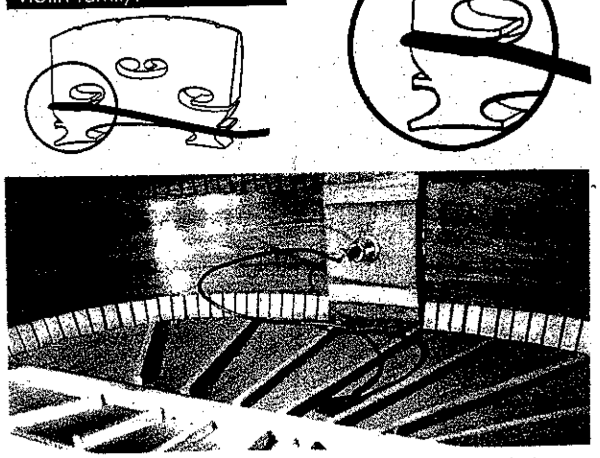
Since the soundboard of these instruments is curved, it is difficult to attach the pickups as described above. However, it turns out that the vibrations in the bridge correspond to those in the soundboard, so the 'classical' instrument pickups are designed to clamp directly to the bridge itself as shown.

Pickup mounting procedure

If you are mounting the pickups yourself, the following diagrams will help.

1. Drill a 7/16" (11mm) hole in the centre of the bottom end of your guitar. Exactly where the strap pin is, or should be. You will find that the socket itself has a strap pin built on.
2. Glue transducer using epoxy to the soundboard as specified, making sure that there are no bubbles between transducer and soundboard.
3. Tie a length of string to the free end of the wire protruding from the transducer. Slip the nut supplied (for socket) onto the string.
4. Thread string through the hole and draw the wire through.

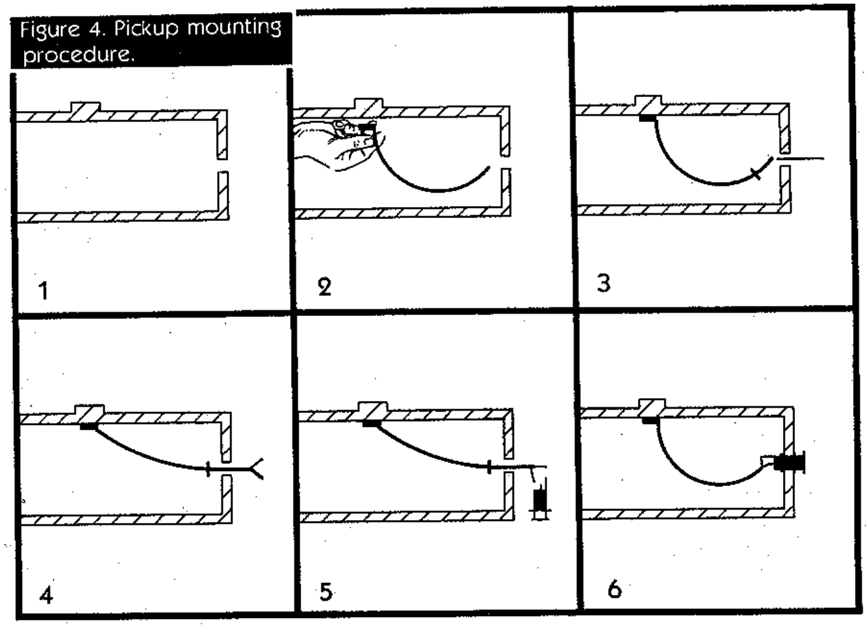
Figure 5. Mounting procedure for the violin family.



5 Solder the wires to the terminals on the socket.

6 Place the socket into hole and tighten nut.

Figure 4. Pickup mounting procedure.



Part 3. TUNING THE PASSAC TO YOUR INSTRUMENT

Remember, the Passac is a filter system which you're going to use to simulate the soundhole resonance missing from the soundboard or bridge signal. So you need to find exactly where that gap in the response is for your particular instrument.

If you were to listen to the soundboard or bridge by itself, you could here this most noticeably as a 'dead' note, a note of a different timbre to its brothers, lacking in warmth and 'bottom end'.

Once you've mounted your pick-up(s), the easiest way to hear this 'dead' note is to use a set of headphones, so you isolate the pickup signal from the sound of the instrument as a whole. Unfortunately, the Passac's output won't drive headphones directly, so find an amp with a headphone socket to plug into. An alternative to using a set of headphones is to use the amplified signal to produce a level much louder than the actual level of the instrument.

OK, here we go:

1.
Remove the base plate and set the OCTAVE SELECT to 'low'. Replace the plate.

2. Plug your transducer (duly attached to the soundboard — see Part 2) — into the Passac input.

3. Plug the Passac output into an amplifier, preferably with a headphone output — see above).

4. Plug a set of headphones into the amplifier and adjust the volume to a comfortable listening level, but make sure you hear more of the headphones than the acoustic instrument.

5. Set the BALANCE control to 0 (no 'soundboard resonance' introduced).

6. Set the RESONANCE fully anti-clockwise. Since the Passac is basically a form of high-pass filter, this will ensure the 'dead' note falls within the pass-band of the unit, i.e. you'll be able to hear it. You'll set this control to the 'resonant' note later on — once you've found it.

7. Play up and down the neck around the area suggested in the accompanying table. You should hear a note which changes in timbre. sounds dull and lifeless, lacking in bottom end. That's the culprit.

8. If you're having difficulty distinguishing the note, turn the EMPHASIS control fully anti-clockwise (towards the bass end), which will emphasise the bottom end of the sound and you should be able to hear more clearly where the bottom end drops out of the note.

9. When you hear the note, remember it.

10. Select the note itself on the RESONANCE control, using a screwdriver. Choose correct Octave.

Table of Recommended Settings

Type of instrument	Octave	Resonance	Balance
double bass	L	HIGH E	5
dreadnought guitar	M	C	4
classical guitar	M	C	4
banjo	M	C#	4
mandolin	H	C#	4
violin	H	C#	4

11. Turn the balance control clockwise until the 'dead' note takes on the same timbre as its lively brothers and your scale is even as you play it.

Note that the Passac's filter introduces the electronic resonance in a very narrow frequency band (see Appendix 3), and if its's not precisely aligned with the acoustic resonance of the soundhole, it won't sound right, even if you seem to have selected the right 'note' on the Resonance control. You may need to fine-tune the Passac's resonance once you've introduced it to the 'bug' sound.

If, as you play up a scale around the area of the dead note you discovered, you still hear a 'weak' note followed by a 'strong' note, then the frequency of the electronic resonance you've selected is a bit higher than the acoustic resonance, and you should turn the RESONANCE control slightly anticlockwise until the sound is even. On the other hand, if you hear a 'strong' note followed by a 'weak' note, your selected resonant frequency is too low, and you need to fine-tune it by turning the RESONANCE control a touch clockwise.

Note also that insufficient 'balance' will cause a 'hollowness' around the resonant frequency, while too much causes 'boominess'.

12. Return the EMPHASIS control to flat and again check that the scale is even in tone. Then use it to tailor the sound to taste if necessary.

SPECIAL EFFECTS

As well as achieving a natural amplified sound for acoustic stringed instruments with soundholes, the Passac can be used for various other effects, both natural and 'unnatural'.

The unique equalisation curves of the unit can be exploited to give a pseudo-resonant feel to any type of input signal: 'acoustic warmth' can be given to synthesisers, electric bass or guitar, drums, even vocals. In this case, the balance control should be run relatively low (less than 4, say) so that there is no overly predominant note, and the resonance control can be set to give the desired frequency range to be enhanced.

The filter may also be used with a high balance setting to give a distinctive resonant 'pitch' to normally muted 'thud' sounds for pseudo-drum effects, as well as to strengthen the natural pitch selectively of instruments such as tom toms. The latter application can give excellent drum separation.

APPENDIX 1. PICKUP PLACEMENT THEORY

In Part 1 of this manual, we mentioned that, due to its physical construction, the soundboard has a particular set of resonant modes, i.e. ways in which it wants to vibrate. Figure (i) shows a typical set for a classical guitar.

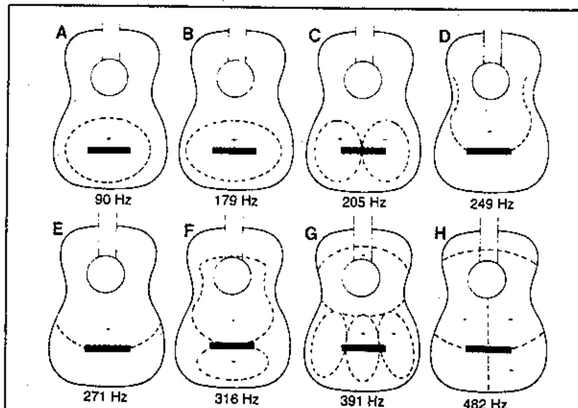


Figure (i) Resonant modes of a classical guitar

You'll note that there is at least one mode which produces a pattern of vibrations which would effectively cancel themselves out in the direction perpendicular to the soundboard (i.e. towards the audience), and if you were to place a single pickup too close to the centre of one area of such complementary vibration, the result wouldn't be a true reflection of the acoustic behaviour of the soundboard for that frequency.

If an instrument is played in a small room then all these radiation modes shall be heard, as if not directly then indirectly their shall be an early reflection of all sound which ever direction they travel. In this situation one should attempt to transduce all of the resonance frequencies of the soundboard.

Generally, analysing the direction the instrument is positioned with respect to the audience will tell you which radiation patterns are important, and you can place the pickups on or off various vibration mode areas accordingly. Remember that the 'nodal' (dotted) lines represent areas which don't vibrate — good places to place a pickup if a certain mode is to be avoided.

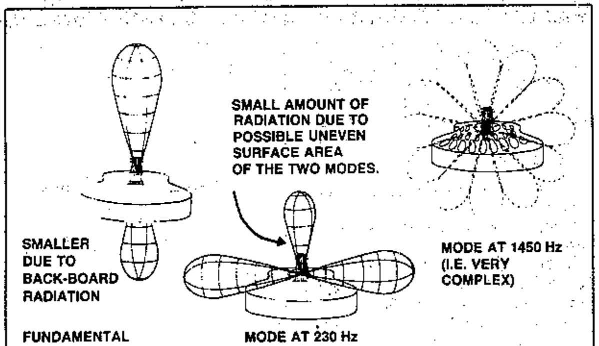


Figure 3. Radiation patterns of some modes of the sound-board.

APPENDIX 2. TECHNICAL DATA

Signal-to-noise ratio at maximum volume — 91 dB relative to 1 V rms.

Total Harmonic Distortion — 0.1% at 1 k Hz.

Input Impedance — 1 meg Ohm

Output Impedance — 1 k Ohm

Current drain — 1 m amp

Power consumption — 18 m watts

APPENDIX 3. PASSAC FILTER CHARACTERISTICS (Gain vs frequency)

These curves illustrate graphically what's going on at the various BALANCE CONTROL settings suggested for various instrument families.

Curve A and its corresponding pitch scale refers to the double bass. Curve B and its corresponding pitch scale refers to the guitar and cello. Curve C and its corresponding pitch scale refers to the banjo, mandolin and violin.

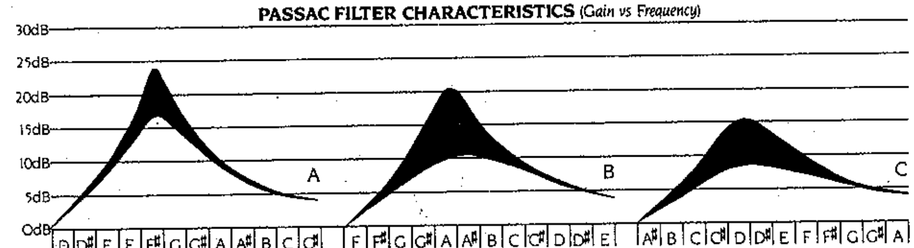
You'll note that for the higher BALANCE CONTROL settings, the curve becomes much 'sharper' a characteristic of the filter designed to reflect the contribution of the soundhole to the sound of that particular instrument. This characteristic also means that the setting of the RESONANCE control becomes more criticial, the higher the BALANCE CONTROL setting.

If you look at Curve A, for example — the double bass curve — you'll see that if you miss the resonance by a mere semi-tone or less, the difference in gain between the peak of the curve (which should be the actual soundhole resonance) and the resonance you've selected, is very marked.

For the lower BALANCE settings on the other hand, the difference is much less.

You can use these curves, in association with Part 3. Tuning the Passac to your instrument, to understand the effects of the settings you select.

PASSAC FILTER CHARACTERISTICS *(Gain vs Frequency)*



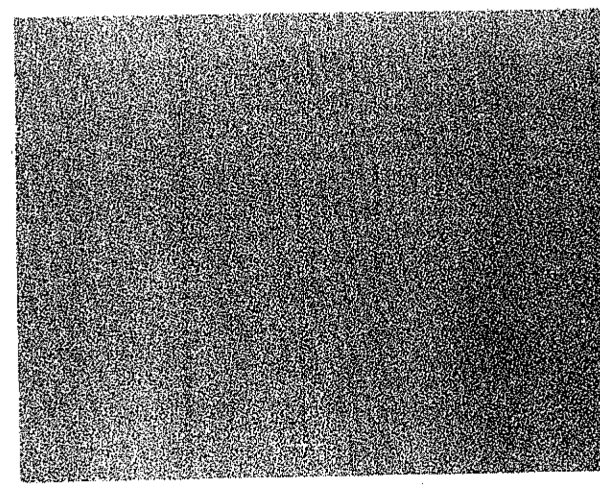
NOTES

PASSAC CORPORATION
347 Beach Rd.
Burlingame
CA 94010
USA

Telephone (415) 343 8335

PASSAC Pty Ltd
2 Shephard St,
Chippendale.
NSW, 2008,
AUSTRALIA

Telephone (02) 212 6415
212 6264



April 1986

Because Passac Corporation is devoted to constant development, specifications and outward appearance may change without notice.