

TAG1

ACOUSTIC

GRAPHIC EQUALISER

TAP1

ACOUSTIC

PREAMP

TAC1

ACOUSTIC

COMPRESSOR

O P E R A T I N G
I N S T R U C T I O N S

TRACE
ACOUSTIC

P E D A L
S E R I E S

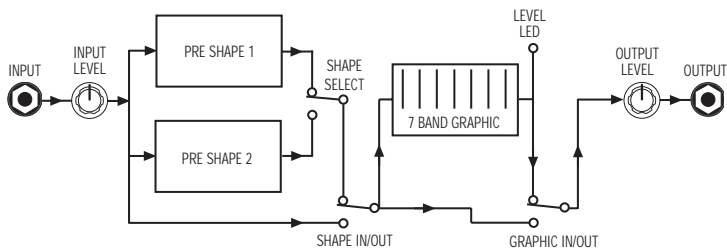
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TAG1 ACOUSTIC GRAPHIC EQUALISER PEDAL

General overview

The TAG1 pedal provides a range of equalisation facilities for acoustic instruments in a convenient effects pedal format. It is more than just a graphic equaliser designed specifically for acoustic instruments as it includes 2 PRE SHAPED equalisations that are ideal for achieving instant and usable sounds. See BLOCK DIAGRAM below:-



The TAG1 pedal can provide a wide range of EQ that is easily and instantly adjustable from a graphic equaliser specifically designed to suit acoustic instruments, provide two preshaped instant sounds, provide any combination of the graphic and preshapes, provide a switchable volume boost, and can function in the effects loop or on the front end of any amplification system.

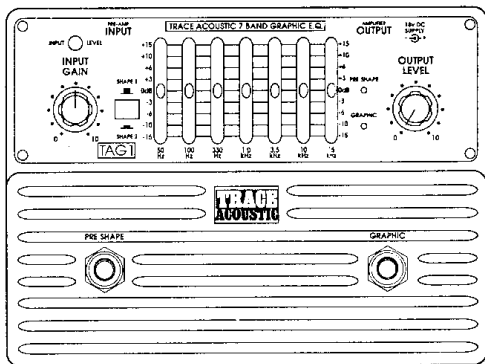
We at TRACE ELLIOT consider that one battery of 9 volts does not give sufficient headroom in the circuitry for the peaks in the signal from your instrument especially with the massive boost and cut available in the equalisation section, so as not to compromise the signal integrity the TAG1 pedal uses two 9 volt batteries to give an internal power supply of 18 volts.

Connections and controls

Power to the unit is supplied from the two internal 9 volt batteries or from the D.C. SUPPLY socket on the back of the unit (this requires a regulated 18 volts mains

adaptor available from TRACE ELLIOT as an optional extra).

Power to the unit is turned on when a jack plug is inserted into the OUTPUT socket.



Two LED's indicate the ACTIVE status of the unit, these are PRE SHAPE and GRAPHIC to indicate when those effects are switched into circuit.

If either of these LED's should start to become dim then it is time to replace the batteries.

Input control

The INPUT to the TAG1 is suitable for connection to the output of an acoustic instrument that has its own inbuilt preamp. If however your signal is coming directly from a PIEZO pickup with no preamplifier then you will need to correctly match the impedance of this signal to the input of the TAG1, this can be done by using a TAP1 acoustic preamp prior to the TAG1 input socket. Failure to correctly match the impedances will result in a loss of instrument tone.

The INPUT control is to allow you to set the input sensitivity of the unit to your instrument, if this is not set to the optimum level level then you will not have full use of the equalisation range available.

With your instrument plugged into the TAG1 and its own level control turned up

full play a few loud notes. Gradually increase the setting of the INPUT control, the INPUT LEVEL LED should start off showing GREEN as you play and eventually turn to RED as the INPUT control is increased. The optimum setting for this control is when the LED shows GREEN for every note played with an occasional flick into the RED on loud peaks.

It will be necessary to readjust this INPUT GAIN control after adjustment of the graphic equaliser to ensure that the signal is not clipping.

Pre shape

Next to the INPUT GAIN control is the switch for selecting PRE SHAPE 1 or 2. The selected PRE SHAPE sound is switched in and out with the footswitch below this marked PRE SHAPE.

The PRE SHAPE facility is like a preset graphic equaliser built into the TAG1 that you can switch in or out to modify the sound of the instrument.

PRE SHAPE 1 is the classic TRACE ACOUSTIC shape as found on the TA35, TA50, TA100 and TA200 amplifiers, it adds a boost at both the low end and the high end of the frequency spectrum as well as a cut at mid frequencies.

PRE SHAPE 2 is a gentler equalisation providing a wider bandwidth boost at low frequencies, less of a mid cut and a slight boost at higher frequencies. This is a less extreme E.Q. than PRE SHAPE 1.

Both these pre shaped sounds may be used with or without the GRAPHIC EQUALISATION section being switched in.

Graphic equaliser

A carefully designed GRAPHIC EQUALISER is a very flexible way of varying the sound of an instrument and if properly used will provide an extremely powerful method of tone shaping for your instrument.

The TAG1 has a 7 band GRAPHIC EQUALISER that can be switched IN or OUT of the signal path from the right hand foot switch. Because of the flexibility and massive BOOST and CUT potential of the GRAPHIC it is important to know how to get the best from it.

It is equally important to know how to avoid the problems that can be associated with its incorrect use, so firstly here is a list of things not to do, and why:-

1. Do not fully boost just one frequency band as this will tend to emphasise a small range of notes producing a PEAKY and not very useful sound.
2. Do not boost or cut all frequencies as this will have the same effect as increasing or decreasing the overall volume level without affecting the tonal characteristics of the sound.
3. Do not use excessive bottom (50Hz) boost on the graphic as this will tend to accentuate any acoustic feedback problems.
4. Do not use excessive top boost; this will tend to add a lot of HISS to the sound (especially with active instruments).

The 7 sliders have been provided to give you full control at a number of frequencies providing a flexible and comprehensive EQ system for the discerning user.

Having got out of the way the things NO TO DO we move on to what can do with the GRAPHIC EQUALISATION section. Basically you can do whatever you like as long as you bear in mind the DON'TS and follow two simple rules, these are:-

1. Try to keep the slider settings balanced around the 0dB line on the graphic.
2. Try to set the sliders in a smooth, gentle curve, as setting adjacent sliders at opposite extremes will give sharp peaks and troughs in the sound, emphasising some notes and killing others.

Switch the graphic IN and experiment with the available sounds.

N.B. Don't forget to re-adjust the INPUT GAIN setting once you have altered the graphic. This is necessary because altering the graphic will change the overall gain and the level indicating circuit monitors the signal at a number of places to ensure that clipping or distortion is not occurring at any stage. Consequently changing the gain will change the reading on the LED and you will have to re-adjust the INPUT GAIN control to compensate.

Output level control

The OUTPUT LEVEL control adjusts the level of signal from the TAG1 pedal, adjust this to suit either the input or the effects return to your amplifier.

Connection within your system

The TAG1 pedal can be used IN LINE on the front end of your amplification system with your instrument plugged directly into the INPUT and its OUTPUT taken to the input of your amplifier, or if you have an effects loop it may be used connected into this loop.

If you are already a TRACE ACOUSTIC user and you are adding the TAG1 pedal to your system then you will find the results will be different between using it on the front end and in the effects loop. The reason for this is that on the front end the TAG1 is working prior to the amplifiers EQ whilst in the effects loop it is actually placed after the amplifiers EQ, you may want to experiment with both methods to discover which you prefer.

Replacing the batteries

When either the RED LED's start to become dim or the INPUT LEVEL LED starts to show an orangy red most of the time then it is time to replace the batteries.

The access to the batteries is through the bottom plate of the unit, by removing the one small screw that secures the battery cover plate in position. Lift the battery body from the outside edge of the unit to remove either battery. Always replace both batteries at the same time.

For maximum life always use higher power type batteries, this should then give you useful working life of approximately 100 hours. Remember to always unplug the unit when not in use to conserve battery life.

An A.C. mains adaptor is available for the TAG1 pedal, this is a special 18v regulated D.C. unit and is available from TRACE ELLIOT as an optional extra. Do not use any other A.C. adaptor to power this pedal.

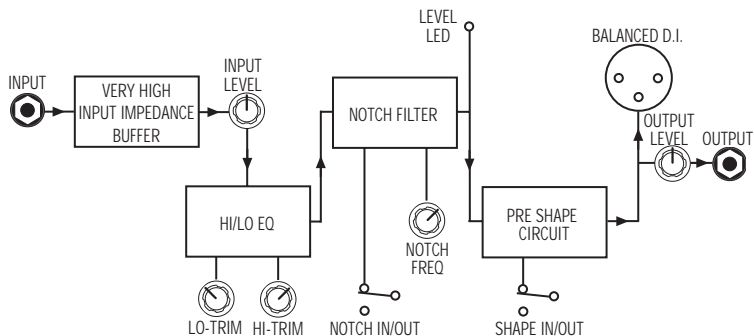
TAG1 pedal - Technical Specifications

<i>INPUT</i>	Impedance 250k Ohms Signal level 600mV nominal, 6v max.
<i>OUTPUT</i>	Impedance 15k Ohms Signal level nominal level 600mV.
<i>SUPPLY</i>	Internal - 18v from 2, 9v batteries (MN1604) Average load - 6.5mA Max. load - 10mA Average life - 75 hours External supply - 18v DC adaptor Centre pin negative.

TAP1 ACOUSTIC PREAMP PEDAL

General overview

The TAP1 pedal is a complete acoustic guitar preamp and balanced D.I. box with suitable equalisation and a notch filter (anti feedback) allowing the acoustic guitarist to achieve a trouble free amplified sound that is perfectly matched to his instrument whether it has just a PIEZO pickup or an inbuilt preamplifier. It provides outputs suitable for connection to an on stage amplification system and for direct connection to a balanced input on a mixing desk for the main front of house P.A. All this is contained in a compact, easily portable, rugged effects pedal format. See BLOCK DIAGRAM below:-

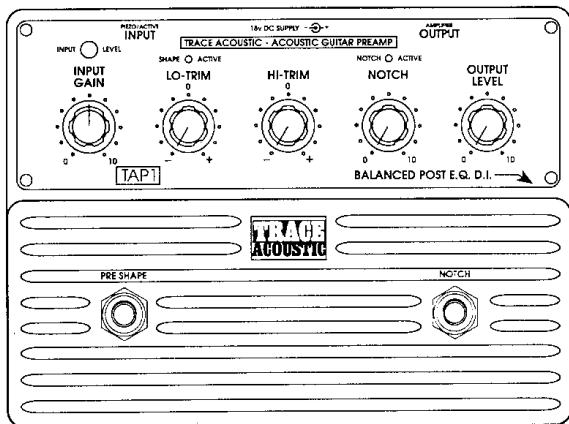


We at TRACE ELLIOT consider that one battery of 9 volts does not give sufficient headroom in the circuitry for the dynamic peaks in the signal from your instrument, so as not to compromise the signal integrity the TAP1 pedal uses two 9 volt batteries to give an internal power supply of 18 volts.

Connections and controls

Power to the unit is supplied from the two internal 9 volt batteries or from the D.C. SUPPLY socket on the back of the unit (this requires a regulated 18 volts mains adaptor available from TRACE ELLIOT as an optional extra).

Power to the unit is turned on when a jack plug is inserted into the INPUT socket.



Two LED's indicate the ACTIVE status of the unit, these are SHAPE ACTIVE and NOTCH ACTIVE to indicate when those effects are switched into circuit.

If either of these LED's should start to become dim then it is time to replace the batteries.

Input socket

The INPUT to the TAP1 is suitable for connection to the output of any acoustic instrument whether it has its own inbuilt preamp or not. If your signal is coming directly from a PIEZO pickup with no preamplifier then it is extremely important to correctly match the impedance of the PIEZO pickup to the input of the

amplification system that you are using, the TAP1 is designed to do this. An amplification system such as the TRACE ACOUSTIC RANGE that is specifically designed for acoustic instruments is the only type of amplification that will correctly match the acoustic instruments. Any other amplifier whether a guitar amplifier, keyboard amplifier or a full P.A. system will not have high enough impedance inputs to correctly match to a PIEZO pickup. Failure to correctly match the impedance will result in a serious loss of instrument tone.

Input gain control

The INPUT GAIN control is to allow you to set the input sensitivity of the unit to your instrument, if this is not set to the optimum level then you will not have full use of the equalisation range or the benefit of the excellent signal to noise ratio available.

With your instrument plugged into the TAP1 and the instrument level control turned up full, play a few loud notes. Gradually increase the setting of the INPUT GAIN control, the INPUT LEVEL LED should start off showing GREEN as you play and eventually turn to RED as the INPUT GAIN control is advanced. The optimum setting for this control is when the LED shows GREEN for every note played with an occasional flick into the RED on loud peaks.

It may be necessary to readjust this INPUT GAIN control after adjustment of the equalisation (HI-TRIM 7 LO-TRIM controls) to ensure that the signal is not clipping.

Lo-trim control

The LO-TRIM control is for adjusting the bass end of the instruments sound. This is a BOOST and CUT type of control i.e. its FLAT (no EQ) position is in its central position with BOOST when the control is turned to the right and CUT when turned to the left.

The range and effect of this control has been tailored to best suit the requirements of an acoustic instrument. In use try not to add too much BOOST as this increases the possibility of feedback from the body of the instrument.

Always start with this control set to its 'O' or FLAT position and get to know the amplified flat sound of your instrument well before starting to add any equalisation.

Hi-trim control

The HI-TRIM control is for adjusting the treble end of the instruments sound. This is a BOOST and CUT type of control i.e. its FLAT (no EQ) position is in its central position with BOOST when the control is turned to the right and CUT when turned to the left.

The range and effect of this control has been tailored to best suit the requirements of an acoustic instrument.

Always start with this control set to its 'O' or FLAT position and get to know the amplified flat sound of your instrument well before starting to add any equalisation.

Preshape

In addition to the HI and LO TRIM equalisation controls there is a PRESHAPE facility built into the TAP1. This may be switched in and out with the left hand foot switch and is in circuit when the SHAPE ACTIVE LED above the LO-TRIM control is lit.

The PRESHAPE facility is like a preset graphic equaliser built into the TAP1 that you can switch in and out to modify the sound of the instrument.

The PRESHAPE is the classic TRACE ACOUSTIC shape as found on the TA35, TA50, TA100 and TA200 amplifiers, it adds a boost at both the low end and the high end of the frequency spectrum as well as a cut at mid frequencies. Its sound is ideal for both finger picking and strumming styles of playing and adds a 'Sparkle' to the amplified sound.

Notch control

The NOTCH is a special type of control that removes a narrow band of frequencies from the audio spectrum. The band of frequencies removed is kept very narrow so as not to unduly effect the sound of the instrument. The NOTCH control adjusts where in the audio range this band of frequencies is placed and within the TAP1 the adjustable range has been optimised for acoustic guitar.

This is an extremely useful device for an acoustic guitar as it allows the natural body resonance of the instrument to be 'Tuned Out' which in turn enables a far higher level of amplification to be achieved before feedback.

The NOTCH may be switched in and out with the right hand foot switch marked NOTCH and is active when the LED above the NOTCH control is lit.

To use the NOTCH facility to its best advantage first of all switch it out of circuit i.e. NOTCH ACTIVE LED is off, turn up the OUTPUT LEVEL control until the instrument starts to feedback (it is very often the 'A' string that goes first), switch the NOTCH in and adjust the NOTCH control until the feedback either goes away or is reduced. This is the optimum position for your instrument.

Feedback is the amplified sound of the guitar getting back to the instrument from the loud speakers and exciting it into resonance. Your position relative to the amplification system will affect the sensitivity of your instrument to feedback. If you have adjusted the NOTCH control to its optimum position to reduce any initial feedback and you are still having trouble then you will either have to change your position relative to the speakers or turn the system down a bit.

Output level control

The OUTPUT LEVEL control adjusts the level of signal from the TAP1 pedal to the output jack on the back of the unit, adjust this to suit the input of your amplifier. This control has no effect on the level from the D.I. output on the side of the unit.

D.I. balanced output

The BALANCED D.I. output is an XLR output intended for direct connection to the low impedance balanced microphone input on a mixing console. The level of output from this is fixed and will be correct if the units INPUT GAIN control has been correctly set as instructed.

This allows for a direct, noise free, matched connection to any mixing console for direct injection into the P.A. or for recording, leaving the jack output with its own OUTPUT LEVEL control for adjusting your on stage monitor volume through a suitable amplifier, a TRACE ACOUSTIC amplifier is obviously best for this application.

The signal from the BALANCED D.I. is post EQ but prior to the TAP1 OUTPUT LEVEL control. In a live situation the TAP1 is possibly all you need with your instrument plugged into its input and the D.I. output plugged into the P.A.

Connection within your system

The TAP1 pedal can be used IN LINE on the front end of your amplification system with your instrument plugged directly into the INPUT and its OUTPUT taken to the input of your amplifier, or if you have other effects units such as the TAC1 or the TAG1 it may be used as a front end preamplifier to perfectly match your instrument to the input of either of these effects units or indeed any other effects unit you may wish to use.

Replacing the batteries

When either the RED LED's start to become dim or the INPUT LEVEL LED starts to show an orangy red most of the time then it is time to replace the batteries.

The access to the batteries is through the bottom plate of the unit, by removing the one small screw that secures the battery cover plate in position. Lift the battery body from the outside edge of the unit to remove either battery. Always replace both batteries at the same time.

For maximum life always use higher power type batteries, this should then give you useful working life of approximately 100 hours. Remember to always unplug the unit when not in use to conserve battery life.

An A.C. mains adaptor is available for the TAP1 pedal, this is a special 18v regulated D.C. unit and is available from TRACE ELLIOT as an optional extra. Do not use any other A.C. adaptor to power this pedal.

TAP1 pedal - technical specifications

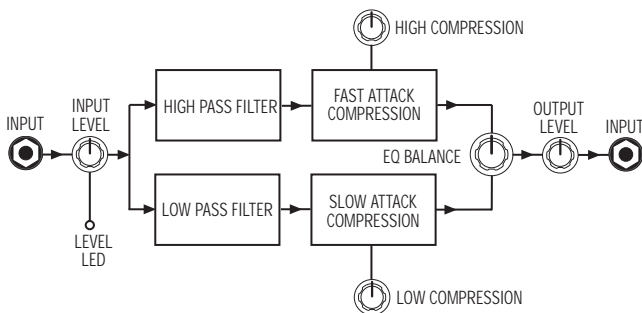
<i>INPUT</i>	Impedance 4 meg Ohms Signal level 150mV to 6v max.
<i>JACK OUTPUT</i>	Impedance 15k Ohms. Signal level Nominal level 600mV.
<i>D.I. BALANCED XLR OUTPUT</i>	Impedance 600 Ohms balanced. Signal level 300mV nominal.
<i>EQUALISATION</i>	LO-TRIM + & - 15dB @ 150Hz acoustically tailored. HI-TRIM + & - 15dB @ 5kHz acoustically tailored.
<i>NOTCH</i>	Range - 60 to 300Hz. Attenuation - 18dB.
<i>SUPPLY</i>	Internal - 18v from 2, 9v batteries (MN1604). Average load - 6.5mA. Max Load - 8mA. Average life - 75 hours. External supply - 18v DC adaptor Centre pin negative.

TAC1 - ACOUSTIC COMPRESSOR PEDAL

General overview

It is important to understand a little of what goes on inside the TAC1 pedal to give you an idea of what is happening to your sound as you adjust the units controls. To help with this a short description follows prior to the actual operating instructions.

The TAC1 DUAL COMPRESSOR is two separate compressors in one unit, each compressor has its parameters set to suit the frequency band that it is dealing with i.e. Fast attack for the High frequencies and Slow attack for the Low frequencies. Two input filters are used to split the signal into its High and Low frequency components, the output from these feed the High and Low compressors. The EQ BALANCE control sets a crossfade between the output of the two compressors and provides an extremely versatile and entirely new form of powerful tone control. See BLOCK DIAGRAM below:-



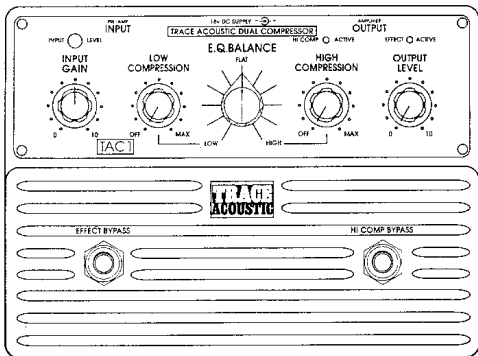
The TAC1 pedal can increase sustain on any note or harmonic, smooth out playing dynamics, add definition to fast runs, provide a switchable volume boost, provide a wide range of EQ's that are easily and instantly adjustable, provide HIGH or LOW compression or any combination of the two and can function in the effects loop or on the front end of any amplification system.

We at TRACE ELLIOT consider that one battery of 9 volts does not give sufficient headroom in the circuitry for the peaks in the signal from your instrument, so as not to compromise the signal integrity the TAC1 pedal uses two 9 volt batteries to give an internal power supply of 18 volts.

Connections and controls

Power to the unit is supplied from the two internal 9 volt batteries or from the DC SUPPLY socket on the back of the unit (this requires a regulated 18 volts mains adaptor available from TRACE ELLIOT as an optional extra).

Power to the unit is turned on when a jack plug is inserted into the INPUT socket.



Two LED's indicate the ACTIVE status of the unit, these are EFFECT ACTIVE above the OUTPUT control to indicate when the effect is switched into circuit, and HI COMP ACTIVE to indicate when the HIGH COMPRESSION is switched into circuit. This second LED will indicate the status of the HIGH COMPRESSION even when the unit is in bypass mode i.e. EFFECT ACTIVE off, to let you know the current condition of the HIGH COMPRESSION prior to switching the overall effect into circuit i.e. EFFECT ACTIVE on.

If either of these LED's should start to become dim then it is time to replace the batteries.

Input & input gain control

The INPUT to the TAC1 is suitable for connection to the output of an acoustic instrument that has its own inbuilt preamp. If however your signal is coming directly from a PIEZO pickup with no preamplifier then you will need to correctly match the impedance of this signal to the input of the TAC1, this can be done by using a TAP1 acoustic preamp prior to the TAC1 input socket. Failure to correctly match the impedances will result in a loss of instrument tone.

The INPUT GAIN control is to allow you to set the input sensitivity of the unit to your instrument, if this is not set to the optimum level then you will not have full use of the compression range available.

With your instrument plugged into the TAC1 and its own level control turned up full play a few loud notes. Gradually increase the setting of the INPUT control, the INPUT LEVEL LED should start off showing GREEN as you play and eventually turn to RED as the INPUT control is increased. The optimum setting for this control is when the LED shows GREEN for every note played with an occasional flick into into the RED on loud peaks.

Compression

The compression within the TAC1 pedal has been split into two entirely separate compressors, one optimised for LOW frequencies and one optimised for HIGH frequencies, but both individually adjustable by the user.

Separate attack and release characteristics are used for the HIGH and LOW compression, fast for the HIGH and medium to slow for the LOW. Fast is needed on the HIGH compression in order to catch initial high frequency transients on striking the string. A slower attack is used on the lower frequencies so as not to distort the shape of bass note.

If the slower attack were to be used on the high frequencies any initial transient would get through unchecked and subsequent transients would disappear as the low bass compression would not have time to recover, i.e. the release is too slow for the high frequencies.

Low compression

The LOW frequency compressor acts upon the low pass signal only.

Applying the compression to the LOW PASS gives a fat bottom end to the sound without losing the upper frequency attack characteristics of the note. It is somewhat of a less processed sounding effect than full range compression but works extremely well in smoothing out bass signal peaks.

You will also find that a degree of LOW compression will add definition to your playing, bringing out the notes within a run without loss of the upper dynamics. As the compression control is advanced and compression is applied to the signal the overall level of volume is compensated for, if this were not done then adding compression would have the effect of reducing the volume of the sound as the

The compression within the TAC1 pedal has been added as a means of creatively modifying your sound and as such becomes part and parcel of the overall sound character that you create, and not merely as an effect.

By turning either compression control to its fully anticlockwise position removes all compression from the sound without significantly altering the overall volume.

High compression

The HIGH frequency compressor acts upon the high pass signal only.

The HIGH COMPRESSION should be used with care as it is directly affecting the attack portion of the sound, this can be used to good effect but moderation should always be exercised when applying the high compression.

As the compression control is advanced and compression is applied to the signal the overall level of volume is compensated for, if this were not done then adding compression would have the effect of reducing the volume of the sound as the available dynamics are reduced.

However in the case of the HIGH compression circuit this means that when no signal is present then additional gain is added at high frequencies. The more the compression control is advanced the more additional gain. This in itself presents no problem as the electronics within the TAC1 produce very little noise. However if you are using an active instrument you may well find that adding high compression adds HISS to the sound, this HISS is coming from the active electronics within your instrument, this can be proved by unplugging the instrument from the TAC1 input socket, and the HISS goes away.

The two compression circuits can be set individually to produce some useful sounds, i.e. with LOW set to about half to tighten up the bottom end of the sound, the HIGH can be varied in conjunction with the EQ BALANCE control to produce a variety of different attacks to the note to suit many different styles of playing.

EQ balance

This is an entirely new concept in terms of a means of EQ adjustment. The signal entering the TAC1 pedal is a full range mono signal, this is then split into two, with one part containing the HIGH PASS (upper frequency) content of the signal and the other part containing the LOW PASS (lower frequency) content of the signal.

Both parts pass through their own separate compression circuitry and then on to the EQ BALANCE control. Here they are re-combined into a single full range signal

once again that contains a mix of the HIGH and LOW frequencies in proportion to the setting of the EQ BALANCE control.

As can be seen from the block diagram, the EQ BALANCE control varies between HIGH and LOW and is FLAT in its centre position.

The action of this control can be envisaged by imagining a pivot point at the centre of the frequency spectrum of your instrument about which the EQ of the instrument can be swung.

Turning the EQ BALANCE control to the right increases the top end and decreases the bottom end, while turning it to the left decreases the top end and increases the bottom end.

The internal filter circuits that feed this control have been designed to allow the HIGH PASS and LOW PASS signals to overlap in frequency so that fully LOW or fully HIGH may be used as individually useful sounds in their own right.

Whether or not you understand its action, you will find the EQ BALANCE control a very easy and flexible way to instantly modify your sound over a wide range.

Output control

The OUTPUT control is to set a balance between the levels when the effect is switched in or out, this can be used in two ways by either adjusting it to give the same overall level but just the addition of compression or EQ when switched in, or to give a level boost when the effect is switched on.

Connection within your system

The TAC1 pedal can be used IN LINE on the front end of your amplification system with your instrument plugged directly into the INPUT and its OUTPUT taken to the input of your amplifier, or if you have an effects loop it may be used connected into this loop.

If you are already a TRACE ACOUSTIC user and you are adding the TAC1 pedal to your system then you will find the results will be different between using the TAC1 pedal on the front end and in the effects loop. The reason for this is that on the front end the TAC1 is working prior to the EQ (Hi and Lo Trim and the graphic) whilst in the effects loop it is actually placed after the EQ, you may want to experiment with both methods to discover which you prefer.

Replacing the batteries

When either of the ACTIVE LED's start to become dim or the INPUT LEVEL LED starts to show an orangy red most of the time then it is time to replace the batteries. The access to the batteries is through the bottom plate of the unit, by removing the one small screw that secures the battery cover plate in position. Lift the battery body from the outside edge of the unit to remove either battery. Always replace both batteries at the same time.

For maximum life always use higher power type batteries, this should then give you useful working life of approximately 75 hours. Remember to always unplug the unit when not in use to conserve battery life.

An A.C. mains adaptor is available for the TAC1 pedal, this is a special 18v regulated D.C. unit and is available from TRACE ELLIOT as an optional extra. Do not use any other A.C. adaptor to power this pedal.

TAC1 - technical specifications

High pass filter section

Filter type	Butterworth
Filter frequency	225Hz
Filter roll off	12dB/octave
Filter damping	1.4

Low pass filter section

Filter type	Butterworth
Filter frequency	900Hz
Filter roll off	12dB/octave
Filter damping	1.4

Composite crossover point of the overlapping High and Low pass filters = 350Hz

High compression

Attack time	1mS
Decay time	70mS
Max comp ratio	8:1

Low compression

Attack time	22mS
Decay time	122mS
Max comp ratio	8:1

Input

Impedance 250k Ohms
Signal level 600mV nominal, 6v max.

Output

Impedance 15k Ohms
Signal level nominal level 600mV

Supply

Internal	18v from 2, 9 v batteries (MN1604)
Average load	6.5mA
Max load	10mA
Average life	75 hours
External supply	18v DC adaptor. Centre pin negative.