Ultimate Passive Control Units

BEYOND THE SIMPLE PASSIVE POTENTIOMETER, TRANSFORMER TECHNOLOGIES CAN SET THE AGENDA FOR HIGH END SYSTEM CONTROL, AS MARTIN COLLOMS EXPLAINS

MARTIN COLLOMS

Technically speaking, the role of a line 'pre-amp' is to link a fixed level source signal (for example from a CD player, phono pre-amp or DAC) to a power amplifier. It should provide good matching at its input and output, by which we mean not to unduly load the source, but also to provide a clean strong signal to the output cable and subsequent power amplifier.

Ideally there should be some gain or amplification between input and output so that quieter sources, such as some tuners, will be rendered loud enough to drive the power amplifier to the required maximum volume level. More significantly, there needs to be adjustable attenuation, aka a volume control, so that any desired loudness may be set.

Finally the ideal pre-amp or controller performs this role while adding no noise or distortion, and no cross coupling between channels. A wide, flat frequency response is a given, while further desirable facilities may include a mono or channels summed function, left/right control of balance, input selection, and the facility to operate in single ended (SE) and balanced modes, both in and out. Balanced working may incur additional expense, and possibly also compromise the build, leading to a potential loss in performance.

Performance essentials can be summarised as transparency, silence and neutrality; its insertion and use should result in a minimal loss in signal quality. This is easily verified by substitution, for example by making a simple fixed loudness attenuator. Two resistors (say a series 30kohm and a shunt 15kohm) may be fitted into the power amp end of an interconnect, calculated for say 10dB of attenuation and giving a fixed, fairly high loudness. The sound quality of such a link will usually be found to be exemplary.

It is fairly easy to make a general purpose active preamp, yet surprisingly difficult to make an excellent one. To some degree the problem is to do with the inherent additive sounds of active electronics and their associated power supplies. So, would it be possible to make a pre-amp – more correctly termed a line control unit – with input switching and volume but without the electronics. Can a viable compromise be reached?

Certainly it can, and at amazingly low cost, down to £100-200, just by using a selected volume control potentiometer, typically 10kohm or 20kohm, in a box. However, optimum operation requires that the signal sources be loud (*eg* 2V or more) and of relatively low impedance (such as 10-100ohms); that the power amplifier be sensitive (say 0.6-1V) and of high input impedance (30-200kohm), while taking care to use relatively short, low capacitance interconnects.

The purpose of these conditions is to help match sources to the overall load (cable included), to provide a good volume range and preserve signal fidelity. Inherently there is a loss of both signal power and ideal matching when using the passive controller method but nevertheless the results can be very good. (*eg* Creek *OBH-22, HIFICRITIC Vol1 No2*).

However, an alternative 'passive' technique exists which optimises signal and load impedances and includes control over volume, even with some gain, with good matching and no loss of power. While there's no direct proof, this method does appear to preserve the dynamics of music replay better. It fixes this known if mild shortfall of 'simple' passives, a deficiency which some costly active pre-amps also successfully address.

This alternative method uses a transformer to change the gain, *ie* stepping up or down an audio signal voltage, which is an AC (alternating current) component, for which inherent matching changes both level and impedance, the two being inextricably associated. While these parameters may be exchanged almost at will, the signal's power is preserved: up to 95% is presented to the power amp load, whereas a passive potentiometer takes as much as 70% for itself. Of course the high input impedance of the power amplifier will not draw much on this available power, but it does benefit from the corresponding low impedance drive, with lowered input noise and a wider bandwidth.

Usually transformers have a fixed input/output ratio, but the windings may also be constructed with multiple taps and connections made to these sections of the winding. Selecting each tap, for example *via* a switch, can provide different ratio or volume settings. If the winding points are carefully calculated, the associated rotary switch may be quite precisely calibrated in decibel steps. Since these are discrete steps, there will be a practical limit to the number steps possible in the construction of a proprietary switch: 24 or 36 is considered usual, except for a few historical custom components such as the 1dB, 59 position switch seen in the Cello components from the 1980s. There are necessary compromises here, and 2dB steps are usually considered acceptable, often giving a control range of 48dB. That's certainly not down to whisper-quiet levels in some systems, but that's the price to be paid for the potential subjective performance gain.

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Townshend Glastonbury Pre -1

TOWNSHEND'S LUXURY PASSIVE SYSTEM CONTROL UNIT
UNIQUELY USES AUTOTRANSFORMER TECHNOLOGY

By Martin Colloms

A bulky unit that measures 49x12x38cm (WxHxD) and weighs 11kg, Townshend's £8,999 *Glastonbury Pre-1* control unit is a substantial and unashamedly high end control unit finished in satin silver anodised aluminium alloy. It has nicely weighted controls and the useful if perhaps surprising provision of remote control *via* an elegant metal handset.
Our sample was an early production example of the standard single-ended model. Although it had some XLR connections which internally revert to single-ended connection, a future version will add the six transformers needed to provide true balanced inputs and outputs. (The sound quality of this alternative balanced variation will need further verification.) While the 24-step attenuator has mostly 2dB resolution, the remote control offers 1dB interpolation plus 10dB of gain when required. That means a 59dB control range in total, plus mono operation and mute. Input selection and volume may operated from the front panel without the remote power supply; other features require the remote handset and its power supply connection.
The input impedance here is dependent upon both the gain setting and the load impedance of the chosen power amplifier. For example, with a power amplifier having a 50kohm input impedance, and the volume set to a typical -10dB (0.33), the loading on the source is only 450kohm, which will maximise its potential.
The *Glastonbury Pre-1* has six RCA phono socket input pairs, two of which are paralleled by two XLR input pairs. Two pairs of outputs are supplied from both XLR and phono pairs. At its heart is a pair of 27-tap air-gapped autotransformers with 'Deep Cryogenic Treated' (DCT) wire and 80% Nickel Mu-metal micro-laminations. Many styles and lamination geometries were prototyped. (The balanced *Pre-2* version, has eight additional 1:1 DCT-wound transformers). Each transformer has 400m of the proprietary DCT copper wire (preferred to silver in tests) while the rated input impedance is 130mH plus 200pF.

Sound Quality

I first heard this sample down at PM's, *via* a Naim *NAP500* /Bowers & Wilkins *800 Diamond*/Rega *Valve Isis* system, and was mighty keen to take it home. Back at base and set up, there was clearly no doubt at all about its exceptional musical ability. Ironically, rather than representing a specific 'improvement' in sound quality on the part of the *Glastonbury Pre-1*, this is more of an aspersion on the vast majority of control units, which are nothing like as truthful as this, to put it mildly. On my comparative scale, this control unit, as supplied in single-ended form, reached an exemplary 195 points for overall sound quality.

To be truthful I found it difficult to lay a finger on its aural performance. Bass lines seemed deeper, more visceral and tactile, more dynamic, and more expressively detailed than usual. The mid was very neutral, highly transparent and well focused, with very natural high level sounds and most revealing and detailed low level sounds. The high treble was very slightly distant, a really small effect, but remained of excellent quality. Complex material was rendered with impressive differentiation and separation, with very natural and believable……

instrumental tone colours. It clearly had very good rhythm, and sounded most uncontrived, non electronic, almost perfectly natural if I can put it that way. Stereo image width, focus and depth were all exemplary. (Note: when comparing results, this test was for single-ended mode from the MSB *Platinum Signature* source to the Krell *Evo402E* power amp.)

Serendipitously I was able to assess the effect of the DC-lift capacitor 'double blind', as it had become engaged by accident. I worried that something in my system had come adrift, and hunted for the cause. Subjectively, this showed a significant loss in rhythm, clarity and focus, with a weaker, more boomy bass. (The measured effect was really quite small.) The DC-lifted score was about 155 marks, which is still very good, but when I tracked down and removed the cause, aural sanity was immediately restored. (The loss is not entirely the fault of the selected Hovland film capacitor used, since there is also that known low frequency interaction with the transformer input inductance to consider.)

Lab report

Most results are so perfect as to not be worth relating, but here are a few highlights. Even the DC-lift mode only perturbs the response by 0.25dB at 20Hz, -1dB at 10Hz. Deliberately invoking a touch of core saturation at low frequencies (20Hz), 1V input gave 0.05% distortion, while by 50Hz it was at very low -95dB (0.0015%), and still achieved -84dB at 10V input. For the -10dB setting the midband distortion at 2V was typically -98dB. I left the plug-top switch-mode power supply disconnected for the review, since my sample had some hum leakage; the recommended supply is a low noise linear design, available to order.) DC-coupled for a higher than usual 150ohm source and 100kohm load, the response at -10dB volume setting was effectively flat to 5Hz (just -0.015dB at 10Hz), but there was some roll-off at high frequencies: -1dB by 12kHz, -2.2dB by 20kHz. With a lower 20ohm source it was essentially flat to 20kHz (+0.15dB), and then rose to a moderate peak of +15dB way up-band at 75kHz. With a typical source its behaviour will therefore be pretty uniform. With the DC-lift 'on', the slight measurable change was +0.5dB at 20Hz, which is technically insignificant. Channel balance was excellent, typically +/- 0.05dB, and the attenuation settings were typically accurate to 0.1dB.

Conclusions

Travelling a difficult design path, Max Townshend has painstakingly exploited auto-transformer technology to deliver a most truthful and non-invasive passive line controller, combining expertise in transformer design, materials technology and advanced conductors. A fully balanced version will also be available.

This is one of the most accurate and neutral line controllers made, and at present defines the state of the control art. Townshend Audio should try to complete the production process rapidly and get these delightful devices to the market.

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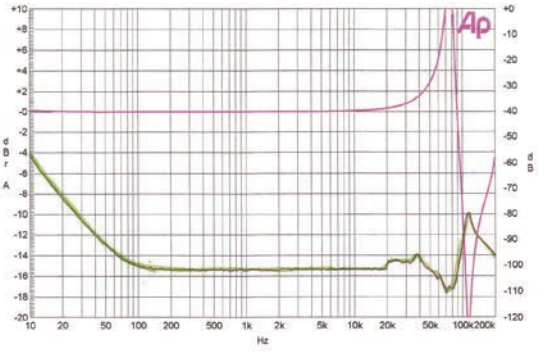
Glastonbury frequency response 2V yellow and distortion [green] 20ohm source -10dB set



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