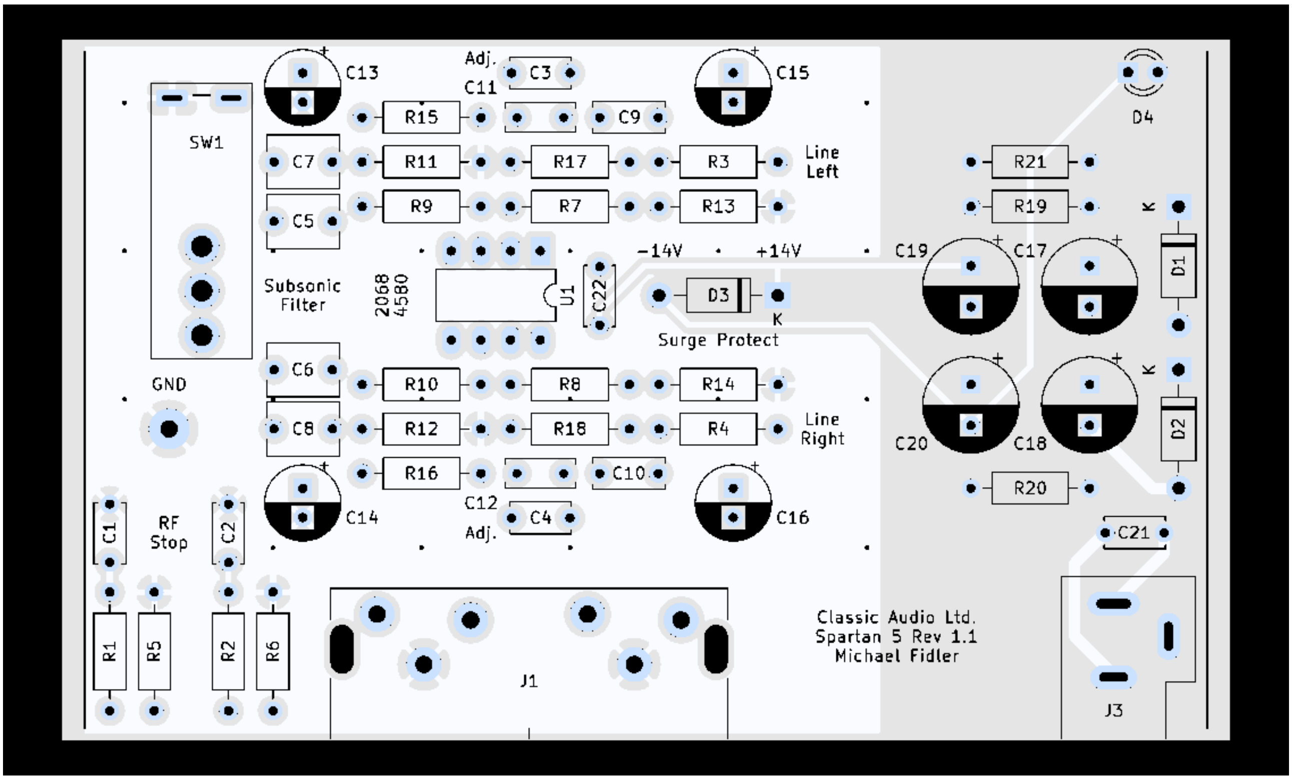

SPARTAN 5

High-efficiency all-linear moving magnet phonostage

User Guide

Technical Specification

RIAA Accuracy	±0.25dB, 45Hz to 22kHz
Channel balance	±0.25dB, 45Hz to 22kHz
Signal to noise ratio (220Hz-22kHz flat)	76dB, at output ref 5mV cartridge load
THD (10kΩ line load)	<0.0015%, 45Hz to 22kHz, 8.5V RMS output
Maximum output (5kΩ line load)	>8.5V RMS, 22Hz to 50kHz
Maximum input at 1kHz	84mV RMS
Maximum input at 10kHz	420mV RMS
Overload margin, ref 5mV	24dB
Gain at 1kHz (nominal gain)	40dB, 100x
Output impedance	100Ω
Input impedance	48kΩ
Subsonic filter	20Hz, 2nd order, for -13dB at 10Hz
Dimensions (W*H*D)	110*46*90mm
Power consumption (no signal)	<500mW

Introduction

Thank you for your vote of confidence in buying the Spartan 5 phonostage. A completely original design that I first came up with in January 2022, as a means of delivering strong RIAA accuracy, and second order subsonic filter from a single amplifier stage, it is *high-efficiency* in many ways. To my knowledge, this is the first commercial product to implement a second order subsonic filter with a maximally flat response as part of the input coupling network.

The input filters contain hand-selected polypropylene capacitors to maintain as flat an in-band response as possible while also rejecting subsonic content by more than a factor of four in the troublesome 10Hz region. The 100V rated RIAA equalisation film capacitors are also chosen by hand to reproduce the replay characteristic of vinyl records within a quarter of a decibel, for lower colouration in the critical mid-band where hearing is most sensitive.

Originally I didn't believe that it would be possible to design a single amplifier phonostage with the features I considered to be essential for high quality playback; at least not while obtaining good performance. After a breadboarding session on a dull afternoon revealed very promising signs, fastidious and exhaustive component selection has yielded quite an excellent specification that represents a very real improvement over integrated and conventional external phonostages.

Great care was taken in deciding on the NJM2068 op-amp. Commonly found in professional audio equipment where low noise operation is paramount, it's a near perfect match for the noise characteristics of moving magnet cartridges. Though not well suited to multi-stage phono designs, as it doesn't like driving heavy inter-stage loads, it works beautifully in the Spartan 5 where it only needs to drive the RIAA network and line output. Careful adjustment of the RIAA network impedance was therefore required to balanced noise performance against distortion. This reached a very satisfactory sweet spot with enough drive left over to put a hearty 8.5V RMS into a 5kΩ external load; two 10kΩ line inputs in parallel.

As the Spartan 5 uses a single amplifier stage, the power consumption is very low indeed, making possible an RC smoothed power supply that doesn't consume any power unloaded. Total power consumption is comfortably below half a watt, so you may rest assured that the Spartan 5 won't be busy racking up excessive costs on your energy bills. Even with electricity prices at 50p/kWhr, the yearly cost will be less than £2.20. According to a conservative calculation, the Panasonic capacitors will last into the next century when left plugged in.

Finally the power supply is a proper linear, split supply arrangement that does away with the switching noise of contemporary cheap switchers while maintaining much better isolation from the mains. Switching supplies also tend to inject noise currents into the ground path and into equipment downstream. Similarly, by splitting the supply, distorted amplifier power currents are kept out of the signal ground where they might easily inject distortion into the signal path. Hopefully you'll agree that this is well worth having.

Happy listening,

Michael Fidler – Classic Audio Ltd.

Test results (use -20dB attenuator)

Serial number	
Powers up, no smoke or bangs, indicator illuminates	
Subsonic filter test 10Hz at 100mV, gain <28dB	
100Hz at 180mV tests	
Gain 32.88-33.38dB both channels	
THD <0.0015% both channels (gen 0.0005%)	
1kHz at 840mV tests (Chan B invert)	
Gain 19.8-20.3dB both channels	
THD <0.0015% both channels (gen 0.0005%)	
MONO switch enabled gain of <0dB	
10kHz at 4.2V tests (input sensitivity -34dBu)	
Gain 6.07-6.57dB both channels	
THD <0.0015% both channels (gen 0.0005%)	
Chan B off, crosstalk <-80dB	

Instructions

Having exercised the wise discretion in purchasing this product over many others, it should be a given that the user knows what they're doing, however for the sake of completeness instructions for basic use are as follows:

- Remove the unit from its packaging and place in proximity to the setup
- Connect the turntable's RCA connectors to the inputs labelled 'MM Input'
- Attach the turntable's ground wire to the binding post on the rear of the Spartan 5
- Connect the 'Line Output' RCA output to a suitable line level input on your amplifier
- Connect the supplied 9V AC power supply to the 'Linear PSU' socket
- For mono discs great reductions in noise and distortion from the record can be obtained by moving the front panel switch downward to the 'MONO' position
- Hot-swapping of cartridge headshells is possible while the phonostage is powered on

Try to keep the Spartan 5 in as close proximity to the turntable as possible so as to minimise the lengths of the turntable output leads and avoid hum pickup, the excess length being ideally coiled and then flattened with a cable tie to minimise the loop area. The input impedance of 48kΩ is marginally higher than the standard 47kΩ, to encourage cable shortening. Choose as short a cable as possible between the Spartan 5 and the amplifier to once again minimise the size of the potential ground loop and avoid hum pickup. Sometimes, if the cartridge is grounded at the tonearm, an improvement to mains hum pickup can be made by disconnecting the ground connection on the Spartan 5. As is often the case with analogue setups, you may have to experiment to get the best effect...

Cautions

Some of these appear obvious but have to be included for the usual reasons:

- Keep the linear AC adapter away from water in a well ventilated space
- Do not use the Spartan 5 outdoors, it is intended for indoor use only
- For best results keep the Spartan 5 out of close proximity switching/power electronics to avoid pickup of interference, likewise keep as much distance between the Spartan 5 and the AC adapter as possible to realise the full advantages of a remote PSU
- Make sure that the connectors are clean before making connection, dirt on the connectors may abrade the connector plating, reduce the effective contact area and introduce noise and blocking distortion in extreme cases
- Please see warning label on the AC adapter for further instruction on safe use

On a more technical note, it may be very tempting to try swapping the op-amp in the Spartan 5 (it’s in a turned socket after all). While the NJM2068 was selected after an exhaustive serach for the best performance, it is also possible to use a couple of other devices. While it is not recommended, if you wish to try using a JFET input op-amp the OPA2134 will work, although with higher mid-band and lower low-frequency noise. In the unlikely event that the NJM2068 becomes unavailable and a replacement part is needed, is is also possible to use the 4580 op-amp, albeit with slightly higher distortion.

The NE5532, LM4562, and almost any devices other than those specified are not suitable for this design. Substituting op-amps not intended for audio use is highly inadvisable, particularly those of the high speed variety. There is a popular saying in analogue design; those who ask for more bandwidth than they need get what they deserve. Not heeding this warning, especially with some of the more exotic devices out there, may provoke circuit instability, turning your phonostage into a self-destructive radio transmitter, dramatically degrading the performance, potentially damaging your power amplifier and consequently your loudspeakers.

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