Austin AudioWorks

The Black Swan
Phono Preamplifier

The Owner's Manual for the most remarkable phono preamplifier

Featuring

- Dual Moving Magnet inputs, Single Moving Coil input
- Flexible Front panel cartridge load tuning
- Balanced and Single Ended inputs and outputs
- Adjustable Gain
- Vanishingly low noise floor
- High definition and clarity performance
- No coloration
- Precise spatial detail

I would like to thank you for enjoying the Black Swan. As the designer and builder of the Swan I offer you this piece of my personal art in the form of a sensual sonic experience you will enjoy every time you listen to your music. Bon Appetite - music, like food is for the spirit and the body.

Barry Thornton

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1. Installation and Setup

1.1. Placement of the Unit

Installation of the Black Swan is very straightforward. All connections are made on the back of the unit and all controls (including cartridge loading) face forward for ease of operation. You will get the most benefit from the Black Swan if the unit is placed where controls will be easily accessible during audio playback.

As with all low noise hardware, it is wise not to place the unit close power transformers, power cords or power mains used for power other products or systems. You want to avoid magnetic field. Heat is not an issue other than try to keep the temperature down, there is a direct mathematical relationship beteen heat and noise..

1.2. Connections

Connecting a standard Tonearm

Two tonearms with **Moving Magnet** or **Moving Iron** cartridges are accommodated and should be plugged into either Input 1 or 2, marked as **MM**. The MM inputs accept standard RCA type connectors and are traditional SE (Single Ended) inputs.

A tonearm with a **Moving Coil** cartridge should be connected via standard RCA type connectors to the **MC** input.

Tone arm ground wires can be connected to any available ground post (marked **GND**) on the back of the unit. The posts accept bare wire, banana plugs or spade lugs. Cartridge loading will be configured via the front panel.

Connecting a Balanced Tonearm

The Black Swan uses a differential (or 'dif') amplifier as a first stage, meaning you can use a balanced turn-table feed as input and the signal path will remain balanced throughout the amplifier.

It is highly probable that your turntable feed is wired in balanced mode but terminated with RCA connectors. If so, you can run the tonearm in balanced mode if you prefer the sound. Go to our website at https://austinaudioworks.com/do-you-already-have-balance-phono-wiring/ for a fuller explanation and a method to determine if your feed is balanced.

To operate the amplifier in Fully Balanced mode, connect the tonearm to the **MC** input and switch the "**B-U**/**B**" switch to "**B**" (see the 'Controls" section below).

Note: When running in fully balanced mode a ground wire from the tonearm is required for noise and safety reasons. Do not attempt to run the amplifier Balanced mode without the ground connection.

Output Connections

Both SE unbalanced (RCA) or balanced (3-pin XLR) connectors are provided.

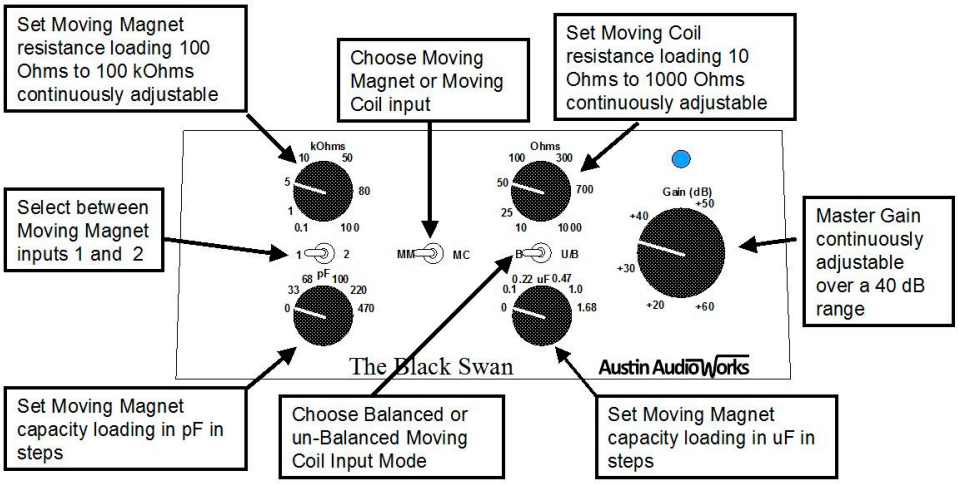
An "AAW Link" is provided as an alternate, balanced 4-pin XLR output. When the Black Swan pre-amp is used with another Austin Audio Works amplifier this allows for a balanced connection via a single 4-pin XLR cable.

The AAW link can also be used to drive a pair of headphones if they are wired with an appropriate 4-pin XLR connector. Pin wiring can be fount in the Technical Information on page 13.

Swan Power

The Black Swan requires a 120 VAC 60 Hz power source. The power supply and the Swan are on all the time that mains power is provided; the unit draws approximately 1.7 watts of power. See more about this in Technical Information.

2. Controls and Operation



2.1. Switching between Input modes

Use the toggle switches on the front of the unit switch between the appropriate input for your system.

Note: Turn your volume control down before switching any of the switch functions.

The **Left Toggle** switches between Moving Magnet (MM) inputs 1 and 2.

The **Center Toggle** switches between the MM and the Moving Coil (MC) inputs.

The **Right Toggle** switches between Balanced mode (B) and Unbalanced mode (U/B). Running the Swan in balanced mode will provide balanced playback only when a balanced turntable feed is connected via the **MC** input. Running the Black Swan in Balanced mode without a known balanced input may provide somewhat unpredictable results.

Make sure to turn your volume down and verify your tonearm is properly grounded before switching to the Balanced setting.

2.2. Setting the Gain

The rotary **Gain (dB)** control sets the system gain to meet the upstream signal level needs. **A good starting setting for the Gain control is +40 dB for either MM or MC operation.** Then adjust it as suggested below to your own preference.

When gain is set too low you can't increase your amplifier's volume enough to get the volume you prefer for playback. When gain is too high it limits your amplifier's headroom, which can result in distortion and clipping as you turn up the volume. It can also give you a thinner, brighter presentation.

There is some science to selecting the correct Gain level but basically you put on a record, turn your system level control (usually the preamp level control) to your "normal comfort" listening setting (11 or 1 o'clock generally), and then set the Black Swan gain to be as loud as desired.

2.3. Cartridge Loading

This section tells you how to operate the loading controls and provides some recommended starting settings for various types of cartridges**.** Because the concepts involved with cartridge loading can be confusing, we have included an "Properties and Use of Cartridge Loading" section later in this document. Once you have your system up and running with the default settings provided here or by your cartridge's manufacturer, we *strongly* recommend that you read that section and go back to adjust and experiment with the controls.

The Cartridge Loading Controls

Cartridge loading settings on the Black Swan are controlled via two sets of rotary dials on the face of the unit. Because Moving Magnet and Moving Coil cartridges react differently to loading, separate controls are provided for each type of input. Both controls, **Resistance** and **Capacitance**, should be set for each input.

Loading for Moving Magnet cartridges

Loading for the Moving Magnet inputs is set via the two left-hand knobs. The top knob adjusts the **Resistance** in kilo-ohms (kOhms) and can be continuously between 100 Ohms and 100 kOhms. The bottom knob adjusts the **Capacitance** in pico-farads (pF) in steps between 0 and 470.

A good starting place for a Moving Magnet or Moving Iron cartridge is to **set Resistance at 47 kOhms, set Capacitance at 100 pF.** If your cartridge manufacturer provides a recommendation for either or both settings, use those recommended settings.

The settings you make here are common to both the MM inputs. If you have tonearms connected to both MM inputs you can adjust the settings while switching between the inputs.

Loading for Moving Coil cartridges

Loading for the Moving Coil inputs is set via the right-hand set of knobs (next to the Gain knob). The top knob adjusts the **Resistance** in Ohms continuously between 10 and 1000 Ohms. The bottom knob adjusts the **Capacitance** in micro-farads (uF) in steps between 0 and 1.68 uF.

A good starting place for a Moving Coil cartridge is to **set Resistance at 100 Ohms, set Capacitance at 0 (zero) uF.**

Moving Coil cartridge manufacturers often provide a suggested a range of values for the Resistance setting. If this information is provided we suggest you set Resistance near the lower end of the range and adjust the knob upward as you listen until you find a preferred setting. Take your time and listen before making quick changes!

2.4. Operating the Black Swan

Once you have made your connections, powered on the unit and adjusted to your initial settings, you're ready to listen! A few recommendations:

Turn the volume down for your first album!

When listening to your first album, and until you get used to the Black Swan in your system, be careful not to turn your amplifier volume level up too high before you put the needle in the groove. With the ultra-low noise floor of the Black Swan there will not be characteristic background 'hiss' to key off of and you may create an un-pleasantly loud, even possibly destructive opening musical passage.

Turn the volume down when switching inputs

Switching between inputs, especially between the MM and MC inputs, may cause gain and volume to shift dramatically. Its suggested you turn down your amplifier volume when switching between inputs or between Balanced and Unbalanced modes.

Your Black Swan can remain powered on all the time

There is no on/off switch: the power supply and the Swan are on all the time that mains power is provided. This will not harm the Black Swan or your system, and the power draw is a minimal 1.7 watts. If you desire you can plug the unit into a switched receptacle.

Experiment with the Loading Controls!

Placement of granularly adjustable loading controls on the front of the Black Swan was a primary consideration in its design. The goal is to get you beyond settling for the 'generally recommended' manufacturer's setting for your cartridge; to instead allow you to experiment during playback and truly get the best performance your cartridge/tonearm/cabling combination can provide.

The reality is that, in the end, adjusting loading is an 'ear-ball' task: you turn the knobs until you get timbre qualities you like. It is an art you will learn now that you have a set of controls for it. It is about personal discovery and revelation.

3. Design Considerations

History: how we got here and why

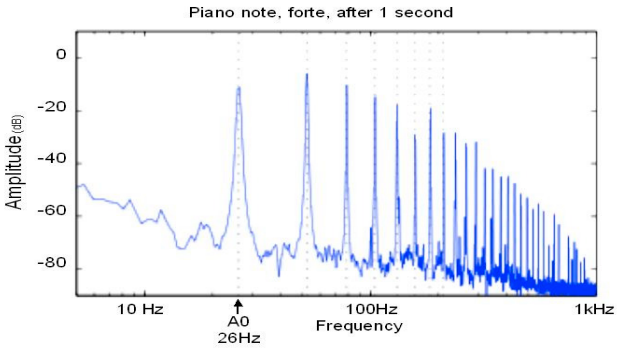
The Black Swan is a step in an evolutionary process that I have been engaged in for just short of 60 years. I started by building a Heathkit system in the late 1950's and quickly became opinionated and knowledgeable enough to start changing things and listening. By the mid 60's I became dangerous enough with electronics to think I could do it better. In college I worked as a tech in a Boutique Hi-Fi store and by the early 70's I was engaged in the design and manufacturing of hi-fi and pro-audio equipment. In the mid 1990's I left audio to start a computer company but still 'tinkered' with audio electronics. I retired from the computer industry, began a company developing medical devices that I have since taken public, and then went back to my first technical love, designing things audio.

The Swan is my first public hi-fi product in years. It is my art, my attention to the sensual pleasures of sound and music. The name 'Black Swan' is from Galen Gereis, creator of Belden's most superb Iconoclast audio cable line. Because of Galen's intense commitment to the Audiophile life, I sent him the very first prototype in the black enclosure you see now and asked for his opinion. When he saw the unit, it was, in his consideration, the ugliest thing he had seen. But he hooked it up anyway and turned the system on, the performance floored him and he said to me "this is truly a Black Swan", thus the name.

It's all about Resolution

Resolution - literally the ability to resolve musical details, is all about overtones (some are harmonics, some aren't) and noise between these overtones. The sound of a voice or instrument has amplitude, pitch, and overtones grouped together as a quality called its timbre.

Your mind can detect these overtones and recognizes them as the sonic signature of an instrument or voice. It can also differentiate overtone patterns to sort out and recognize multiple sounds at the same time. Your mind connects the dots and a sequence of tonal events becomes music that touches your soul.



An example of the complexity of a single piano note is shown above. The pitch of this note is 26 Hz; it is an A0 and shows the spectrum of the note from 10 Hertz (the fundamental) up to 1,000 Hertz (the overtones). All this information is required to be exactly reproduced for you to clearly identify the specific note and instrument. The assorted overtones, while equally spaced in frequency, will vary in amplitude and phase relative to each other. This signature is unique to the instrument and even to the player in some instances. Changes in overtones will let the experienced listener tell the difference between a piano made by Bosendorfer and Steinway.

As you see from the above chart, resolution is not necessarily about high frequencies above 10 kilohertz; it is about what happens in the mid-range to the interrelationships amongst frequencies, and faithfulness and integrity of those signals. While your high frequency abilities may diminish with age, your ear and mind retain an absolutely incredible ability to process this information and perceive resolution.

Designing a Remarkably Resolving Phono Preamplifier

Evolving a Phono Preamplifier has been a thought-provoking exercise. For me, it started with the idea of Resolution. Unscientifically put, the essence of having Resolution is about not letting the overtones mess with each other or be messed with by noise and process generated distortions in the record playback process. These

are added and subtracted information to the original audio signal, stuff that confuses even the best minds making it hard to 'hear' the music offering.

I looked at a single note, the simple product of a single musical instrument; I stand at a piano and hit a key. I see that the sound I hear is made up of four elements or qualities:

- Pitch – The specific Frequency of the note
- Amplitude – The Sound Pressure Level of the note
- Timbre – The quality added to a frequency by the overtones by which we identify the sound
- Soundscape – How our stereo hearing system locates the sound in space

Then I considered two sounds at the same time and saw that resolution is about telling the two apart, the power to resolve which is both which and what. We are good at this because it is what we do anytime we listen to the world we live in. You can sit in any open space, close your eyes, and immediately build a sonic 'view' of a space as well as identify all the individual contributors.

Now do this indoors. Room reverberation (mini-echoes) and noise will lessen your ability to resolve sounds.

So, it appears that resolving power is influenced by noise.

The need for low noise

The why of it is simple - noise energy in the same frequency space as the overtones of the Timbre of the sound masks the overtones and provides 'false data' to the mind of the listener. Remember that all this resolution stuff is going on inside your (and my) head. The ear is a darned good sensor so everything comes through to the mind. The noises disrupt the mental processes we must employ to figure out what the data means. This is a cause of fatigue to the listener.

There are a couple of major noise contributors. The first is not amplifying all the overtones of Timbre the same, some overtones are more; some are less after the amplifier does its work. So, the Timbre is harmonically changed by the added signal levels. One source of these new signals is something called Heterodyning or Inter-Modulation Distortion (IMD). Mixing two pure signals in a less than perfect medium and get four signals back. When you mix A and B you get A, B, A+B, and A-B. How much A+B and A-B depends on the quality of the mixing the two or the linearity of the medium (system). In the case of audio, air is very linear and the ear is very used to it so there is virtually no IMD until you get really loud; moon rocket engine at 100 feet type of loud.

Another kind of noise is made by the electronic hardware that is amplifying the signals. The parts used to make up an amplifier each have noise issues of their own. The amplifying devices (tubes or transistors) themselves are the greatest source of the noise we hear, as 'hiss' or 'pops' and they are less than a perfect amplifying medium.

Designing for the lowest Noise Floor

The input gain stage is the most important system in a phono preamplifier. The Black Swan employs a compound parallel input technique that combines 4 precision low-noise gain cells. The cells are configured such that the stages cancel each other's internally generated silicon-based noise and thus achieve an unprecedented low operational noise character.

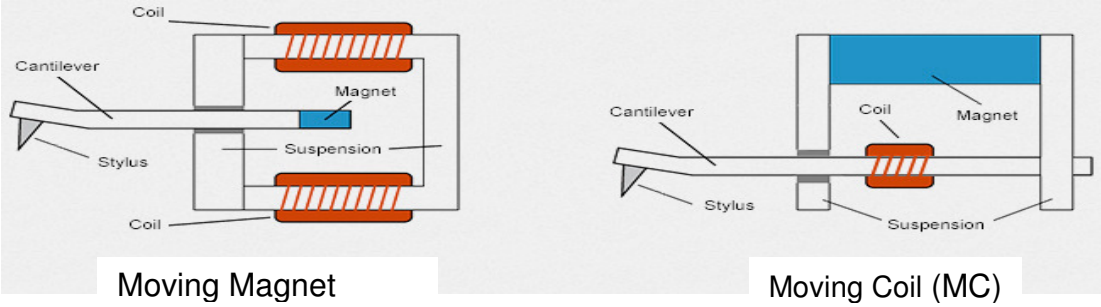
RIAA Equalization

The RIAA equalization in the Black Swan is purely passive. Employing active equalization is to invite time-based dynamic distortions such as Slewing Inter-modulation Distortion and Transient Inter-modulation Distortion. Anytime feedback is used to 'perfect' a filter network's amplitude or phase performance, a price is paid in the dynamic performance of the filter. The choice and use of better components and a bit more design effort offer dramatic sonic improvements that offset any cost savings obtained.

4. The Properties and Use of Cartridge Loading

Your record reproduction system operates in two energy domains, one mechanical and the other electric. There are two interfaces in the system where transducers do energy conversion from one domain to the other and back. The first is your cartridge; the other is your loudspeaker or headphone. This text is about the Cartridge end of the chain of events that gives you a musical signal.

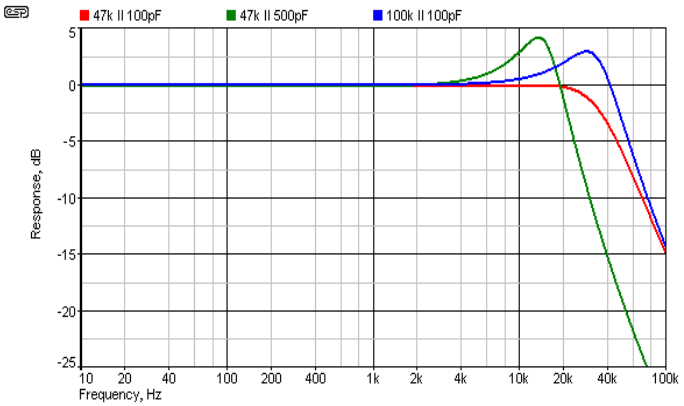
Your cartridge takes mechanical energy from the moving record groove wall converting those mechanical energy variations into an electric copy through the use of a magnetic field. This energy transition is a 2-way portal; you can put electricity into the cartridge and the stylus will move. This whole process, stylus-to-wires, doesn't work perfectly because there are places that energy gets diverted only to reappear later, time delayed, phase shifted, altered or lost. Part of this system, the load on the cartridge (your preamp input), can reflect energy effects back into the stylus. This loading is in the form of the linear effect of the resistance (R) the cartridge 'sees' from the load and the non-linear effect of the capacity (C) the cartridge 'feels' from the loading process. It all gets very complex and, in the end, changes the sound or "timbre" of the cartridge.



Moving Magnet Moving Coil (MC)

Because cartridge makers don't build preamps and vice-versa, some convention was needed for interfacing compatibly between the two, which became a standard loading guideline. For Moving Magnet (MM) it is 47 kOhms with about 200-300 pf in parallel, for Moving Coil (MC) it is 100 ohms.

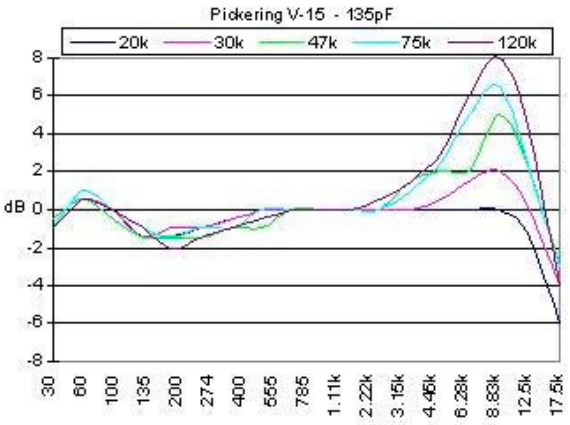
A result of all this is that loading changes the timbre of the cartridge. There has been an effort to describe and predict these changes through the use of cartridge simulations using computers. At right, here is an example of such a simulation for an idealized cartridge. Because these simulations are not based on reality they become gross oversimplifications at best, which leads you to think that the sonic effect of changing the loading is like a tone control of days past.



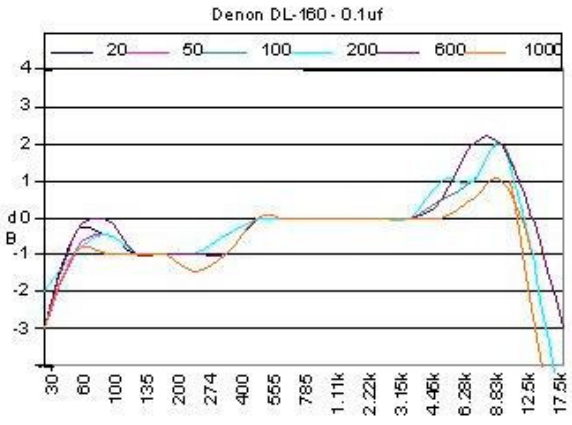
At this point the technical narrative must give way to reflection on personal experience. As I adjusted the two variables, Resistance and Capacity, I heard changes in the soundscape (space) and Timbre at each setting. It was not about the relationship between the highs and lows as with a filter. It went far beyond that. If it had just been general high-end frequency response as the simulation suggested the changes would have been dimensionless. But it wasn't that simple and after looking at the graphs I started to understand what was happening. It became quite apparent that there is possibly a 'sweet setting' for each record. All this is occurring way up front in the audio 'food chain'. As a result, little changes here are effective all the way down the line to where the music illusion occurs in my mind. In other words, one could simply 'tweak' the entire system for each record mastering and pressing.

As I could find no information concerning real records and cartridges, I ran tests with both a MM and MC cartridge using our new Black Swan preamp with passive RIAA and front panel fully adjustable cartridge loading. Here is

the comparison of the output for each test frequency for the V-15 design MM and then the Denon DL-160 high output MC cartridge. I held the capacity fixed and varied the load resistance.



Moving Magnet



Moving Coil

Interesting! Note the 'action' from 1 kHz on down. The loading is affecting the low frequency output as well as the high frequency. I don't think these are electronic in source so I would suggest that we are seeing the effects of the mechanical system from the record groove wall to the coil in the magnetic field. On the low end the fundamental note of each musical instrument or singing voice is modified with respect to its harmonics by both amplitude and phase. Phase shifting is time shifting. A 2-dB amplitude difference is about 25 degrees phase shift.

For a musical note, say that A0 or 26 Hz we considered in the section of Resolution, this is a considerable change in Timbre. That is a time shift of up to 1½ cycles, which equal an apparent distance of about 5 inches as well as significant change in harmonic structure. This says that every couple of cycles it will be 180 degrees out of phase with both the second and up harmonics. What does that sound like? The most extreme example I know of is on the Doobie Brothers *Toulouse Street Album*, the cut *Listen To The Music* where they do this intentionally to the drums at the bridge transition points. Less radical shifting of phase in harmonics is just a change of Timbre.

At high frequencies the same phenomena occurs but with greater phase issues. The flat areas in the high frequency side suggests small multiple resonances occurring at different frequencies, again probably from the mechanical properties of the cartridge.

Flexible Cartridge Loading

Flexible cartridge loading is a key to harvesting the finest output of a phono cartridge. As noted earlier, this signal loading optimizes the timber of the cartridge. There is a very fine relationship between overtones (harmonics) generated by the cartridge. Ultimately the cartridge is not a stand-alone piece of hardware, it is loaded by the preamp. This directly affects its performance through damping the interplay with the groove wall of the records and controlling the error energy stored in the cantilever. Error energy in the cantilever is the results of mismatches in loading that occur in specific frequency ranges based on the mechanics of the cartridge. They can vary with the record's pressing, as each record is a unique creation so the loading needs to be very versatile. The Black Swan offers a selection of general capacity settings and a continuously adjustable resistance for specific listening-based matching. You will find that subtle adjustment may be a good strategy for even specific cuts on a disc as all are slightly different.

So what settings do I use?

Start with the cartidge manufacture's suggested setting. For MM is 47 kOhms and 100 pFd, for MC is typically 100 ohms and at most 0.1uFof capacity. Now that you have the tools available in the Black Swan you can tame and tweak the sound of your cartridge to best match the mechanics of your system and the pleasure of your ear. It is the tool for you to use to unlock the art on the vinyl disc. This is about what you like and loading the cartridge is about tuning in on the magic of Hi-Fi.

5. Technical Information

5.1. Power

The Power Supply is 16 VRMS, it is low-voltage AC and is isolated from the ground and mains power system by its transformer. This transformer is also a big inductive filter to reject line noise. The Swan's internal power system takes the balanced AC and yields a buffered, isolated and regulated DC voltages to power for the amplifiers contained therein.

5.2. AAW Link

AAW link is about the reduction of wiring. All AAW products have this linkage. Using industry standard 4-pin connectors the wiring is the same as for headphones (most of which the Swan will drive directly and is :

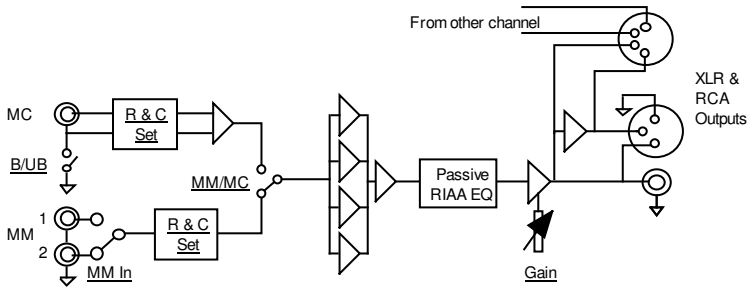
Signal	PIN
L+	1
L-	2
R+	3
R-	4

5.3 A Note On 'Right' and 'Left' channels

The Black Swan is two independent amplifiers with passive equalization sharing a common power supply in a common chassis. While the inputs and outputs as labeled 'Right' and 'Left' there is no internal commitment to either a RIGHT or LEFT channel. The source, that is your cartridge, does have a Right and Left preference based on the mechanics of the stylus and the information incorporated in the record groove. The Right and Left annotations on the preamplifier are offered to facilitate keeping track of this for your convenience.

Signal Flow

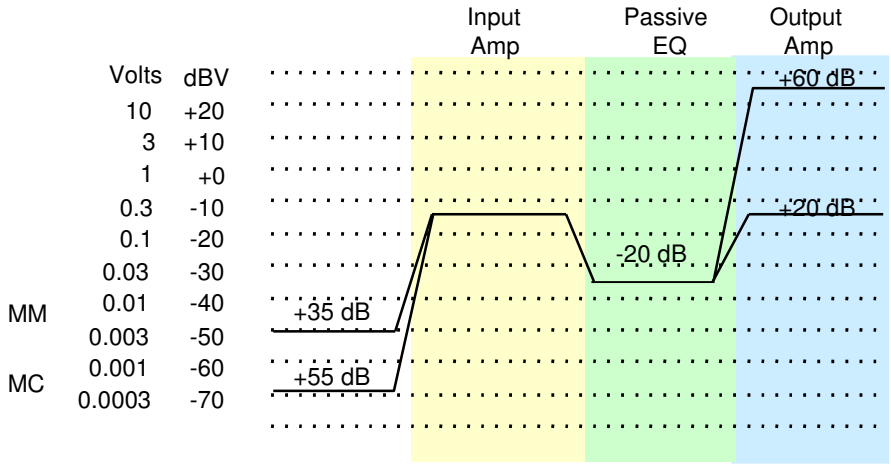
The Black Swan signal flow is represented in the diagram below. This is one of two channels and does not include the power supply system.



Block Diagram The Black Swan

Controls are underlined, boxes are passive subsytstems, triangles are active subsytems

Signal Gain per Stage



Peformance Characterisics

1 –	Output single ended (Left or Right channel into a 10 kOhm load)	9 Volts RMS
	Outut Balanced into 10 kOhm	18 Volts RMS
2 -	Noise Moving Magnet, 47 kOhm, 0 pF setting, Gain 45 dB, input referrence 5 milliVolts, output 1 VoltRMS into 10 kOhm load	-70 dB unweighted -80 dB "A" weighted
	Noise Moving Coil, 100 Ohm, 0 pF setting, Gain 65 dB, input referrence 0.5 milliVolts, output 1 VoltRMS into 10 kOhm load	-58 dB unweighted -68 dB "A" weighted
3 -	Equalization – Reference RIAA standard	+/- 0.1 dB
4 -	Input overload – Moving Magnet	100 mV
	Moving Coil	6 mv
5 -	Distorion (Harmonic) MM at 1 V RMS out Ref 5 mV in @ 1 kHz	0.003% THD + Noise
	MC at 1 V RMS out Ref 1 mV in @ 1 kHz	0.003% THD + Noise

Physical Characterisics

Size 7.9 Inches (201 mm) wide

4.77 inches (122 mm deep

3.6 inches (90 mm) height

2 lb, 6 oz (

