Austin Audio Works
The Black Swan
Phono Preamplifier

Featuring:

- Front panel cartridge load tuning
- Balanced and Single Ended outputs
- Balanced and Single Ended Moving Coil input
- Two moving Magnet inputs
- Adjustable Gain
- Extreme low noise
- High Definition and clarity
- Precise Spatial Detail

The Black Swan

The user manual for the most remarkable phono preamplifier

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

This manual is intended to provide you with the information to get the most from your Black Swan and will cover the following headings:

1 - Installation and set up

2 - Operation and control of the various functions

3 – Signal flow and Gain Selection

4 – It's about Resolution

5 - Insight into the properties and use of cartridge loading

6 - The Design

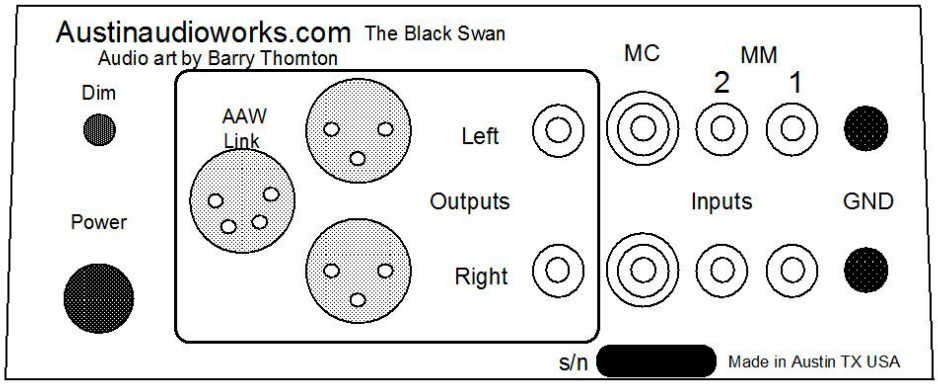
7 – History: how we got here and why

1 - Installation and set-up

The Black Swan is very straightforward and should present nothing new as to set up. All connections are on the back of the unit.

As with all low noise hardware, it is wise not to place the unit in, on, or around power transformers, power cords, or mains powered anything in other products or systems.

Addressing the rear of the unit we see:



The Moving Magnet Cartridge (MM) feeds are via standard RCA type connectors. Two (MM) Cartridges can be accommodated and plugged into either Input 1 or 2. These are traditional SE (Single Ended) inputs. Loading is adjusted from the front panel.

The Moving Coil Cartridge inputs also are standard RCA type connectors and plugged into the MC marked receptacles, but they are implemented a bit differently.

It is highly probable that your turntable feed is wired in the balanced mode but terminated in RCA connectors. This means that you can run them in the balanced mode if you like the sound better. The Black Swan has a balanced input (a difference or 'dif') amplifier as a first stage. It's wired in such a way that you can run either mode by use of the Front Panel B-UB/ switch located between the MC Loading controls. Go to our website https://austinaudioworks.com/do-you-already-have-balanced-phono-wiring/ for a fuller explanation.

The ground wires are connected to either or both grounds on the back of the unit. You can use a bare wire around the post, a Single banana plug, or spade lug. For balanced operation a ground wire from the arm is recommended for noise and safety.

Outputs are both SE unbalanced (RCA connectors) or balanced (3-pin XLR) connections. An alternative method for balanced operation is provided as AAW Link, a single 4-wire connection using a 4-pin XLR wired, as a standard headphone. Though it is not used for headphones, the output will drive a pair. It is a cable reduction system intended to simplify connections in the balanced mode when the Black Swan is used with one of our amplifiers.

The wiring for the standard 4 - XLR Connectors is:

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

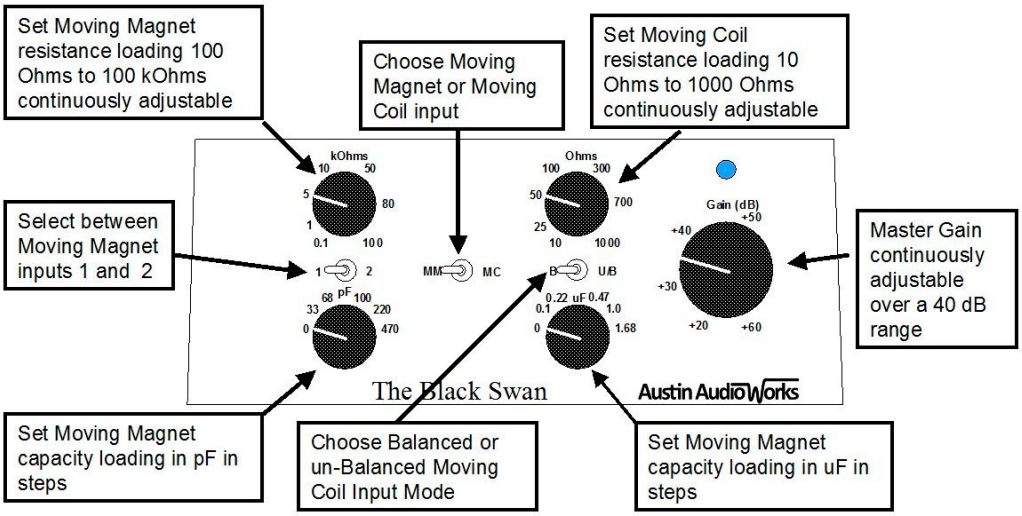
The 'Dimmer' control on the back is for the front panel power LED. The LED is a diagnostic tool showing that the power is on and correct. It is blue and in some installations it's good that it is bright, other times not so. You are offered the choice with this control to turn it all the way off as you wish.

A Note - The Black Swan is two independent amplifiers with passive equalization sharing a common power supply in a common chassis. While we have identified the inputs and outputs as '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.

The Power Supply is connected to a power outlet and to the Swan, and you are finished. 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.

The Power Supply is 16 VVRMS, 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..

2 - Operation and control of the various functions



Switches –

The Left TOGGLE switch on the far left chooses which Moving Magnet input is engaged.

The Center TOGGLE switch selects operation mode for either a Moving Magnet or Moving Coil cartridge by connecting the appropriate cartridge loading controls and the suitable gain structure for best performance.

The right TOGGLE switch determines whether the Moving Coil is operated in the Balanced or Unbalanced Mode.

Note – A couple of warnings

#1 - The switching of the MM to MC switch either way can produce a considerable 'thump' in the output.

#2 – Operating the Black Swan in the BALANCED mode without a known balanced input may have somewhat unpredictable results, if you want to try it make sure the volume of the system is down.

TURN YOUR VOLUME CONTROL DOWN BEFORE SWITCHING ANY OF THE SWITCH FUNCTIONS.

Controls -

The right ROTARY GAIN CONTOL sets the additional system gain to meet the upstream signal level needs. There is some science to it 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.

Cartridge Loading -

Getting an electronic signal copy of the wiggly little grooves on a record is a bit of art as well a science. There are basically three moving parts. The groove moves as it is rotated on the platter of the turntable. The Arm holding the cartridge moves to follow the tip of the needle (stylus) when we put it in the groove, and the cartridge output is based on movement of the tip of the stylus.

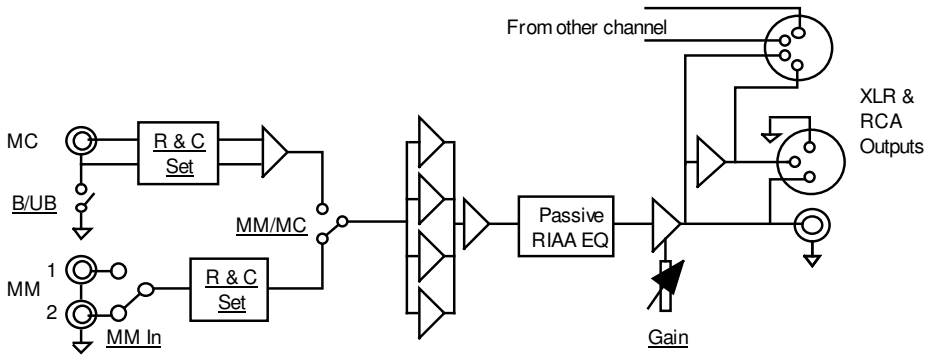
We have found that the cartridge is not the ideal electronic LCR circuit shown in textbooks and simulations. It is a far more complex electro-mechanical system of things that like to store energy by resonating in both mechanical and electrical form simultaneously. The stored energy is "tunable" and we perceive it to be the timbre of the system.

Thus for any given cartridge, record, and turntable/arm combination, a different combination of resistance and capacity will elicit a different sound quality. While it would be great if we could scientifically come up with the right setting.

The reality is this 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.

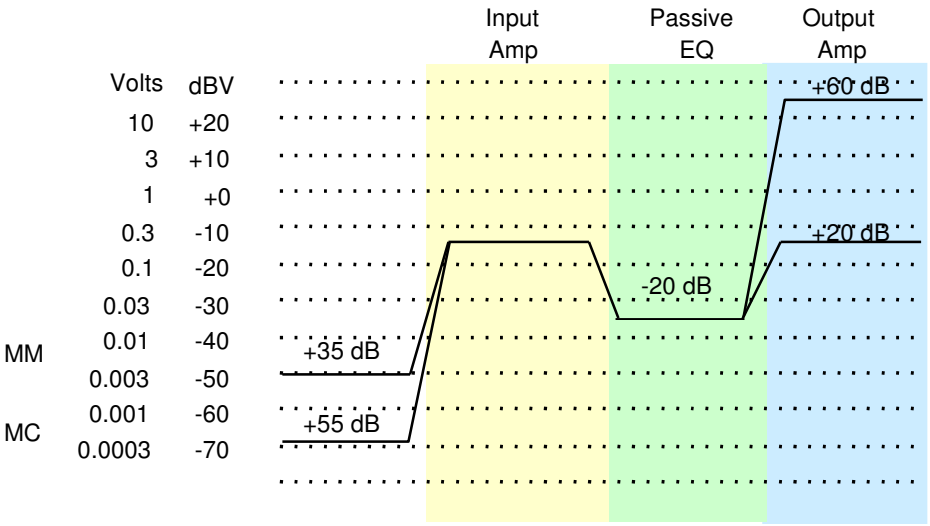
3 – Signal flow and Gain Selection

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

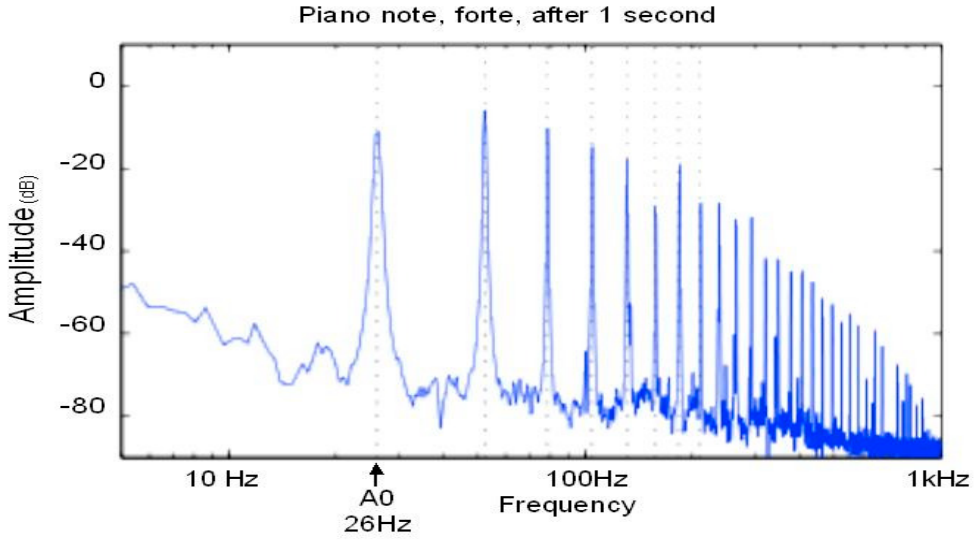
4 – It's all about Resolution

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.

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.

The Black Swan features low inter-overtone noise as well as very low global noise with great isolation



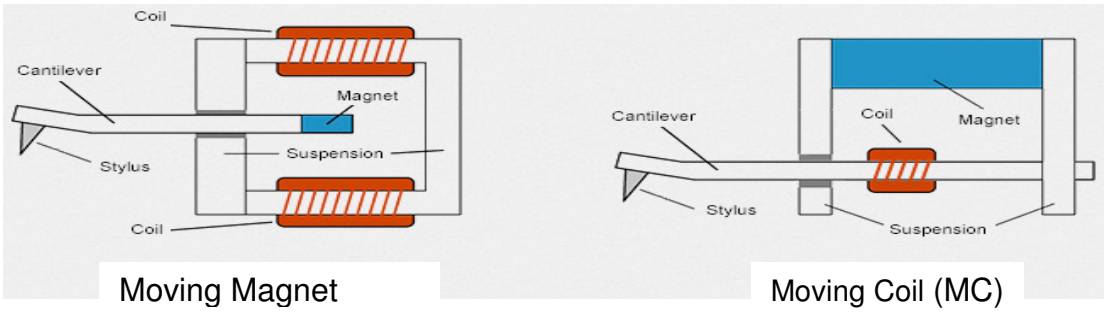
An example of the complexity of a single piano note is shown above. The pitch of this note is 26 Hz; it is an A0 and shows the spectrum of the note from 10 Hertz (the fundamental) up to 1,000 Hertz (the overtones). All this information is required to be exactly reproduced for you to clearly identify 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.

Your ear and mind are absolutely incredible in this process and while your high frequency abilities may diminish with age, 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.

5 - Insight into 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.

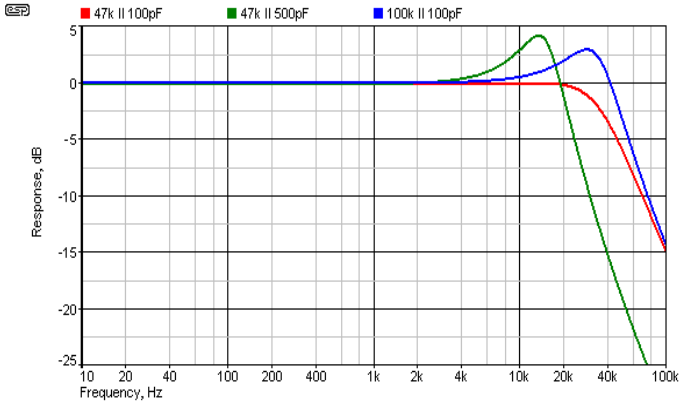
Your cartridge takes mechanical energy from the moving record groove wall converting those mechanical energy variations into an electric copy through the use of a magnetic field. This energy transition is a 2-way portal; you can put electricity into the cartridge and the stylus will move. This whole 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)

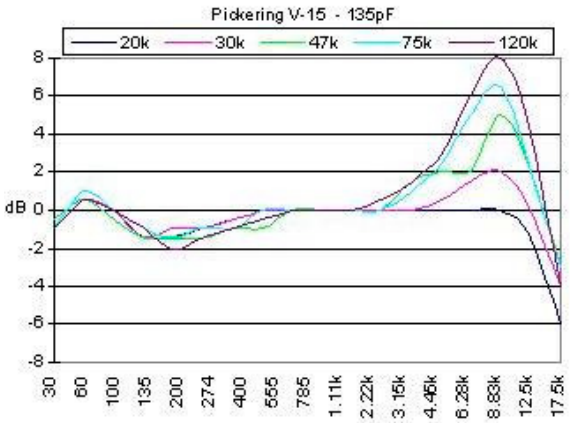
Because cartridge makers don't build preamps and vice-versa, some convention was needed for interfacing compatibly between the two, which became a standard loading guideline. For Moving Magnet (MM) it is 47 kohms with about 200-300 pf in parallel, for Moving Coil (MC) it is 100 ohms.

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. Here is an example of such a simulation for an idealized cartridge. Because these simulations are not based on reality they become a 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.

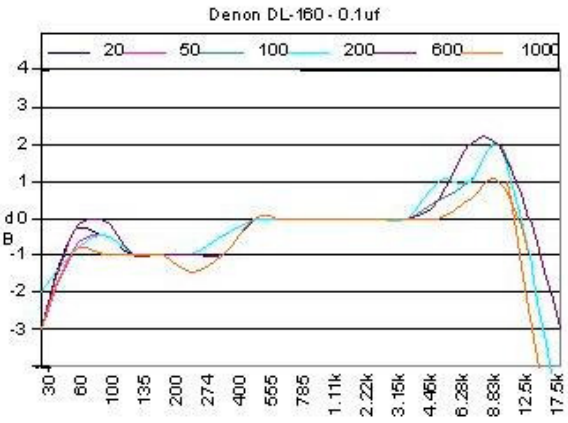


At this point the technical narrative must give way to reflection on personal experience. As I adjusted the two variables, Resistance and Capacity, I heard changes in the soundscape (space) and Timbre at each setting. It was not about the relationship between the highs and lows as with a filter. It went 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.

So what does all this mean? It means that there is no solace offered here. You are on your own. Once you have the front-end cartridge-loading tool, 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.

6 - The Design

Evolving a Phono Preamplifier has been a thought provoking exercise. For me, it started with the idea of Resolution. People speak of 'Resolving Power' in finer equipment and we have discussed what Resolution is.

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 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 have to 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.

The Black Swan combines ultra-low gain stages with passive equalization and front-end 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.

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 configured such that the

stages cancel each others internally generated silicon based noise to achieve an unprecedented low operational noise character.

NOTE - It is advised that until you get used to it you should be careful not to turn your level up too high before you put the needle in the groove, 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.

Low noise is very important to resolution. Noise that appears between musical overtones masks and modifies those overtones altering the timbre of the individual instruments and sound sources. The loss of resolution is the essence of low-fidelity in music systems. All efforts have been made in the Black Swan to negate these losses thus making the fine detail easily available to the ear.

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.

7 – 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 in 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.