I. Introduction

AOpen has been a pioneer in the motherboard field, bringing solid and award-winning products to the PC community, for many years. These achievements include the first Intel-based 440BX chipset motherboard with a military-grade black PCB and a 24K gold-plated heatsink for overclockers. AOpen was also the first to offer space-grade ultra-high precision components for commercial motherboards, providing overall PC system stability and long-term reliability.

Now, AOpen presents the world's first vacuum tube motherboard for game enthusiastic and music lovers, allowing them to totally immerse themselves with their favorite software and enjoy the ultimate in audio performance. The AX4B-533 Tube is also a true platform for tweakers who wish to not only tweak performance, but also the tonal quality of the on-board audio tube. Each PC game has its unique sound effect and character, whether it is engine revs, shotgun pumping or blades chopping through the air and the AX4B-533 Tube can deeply satisfy a gamer's cravings and provide audio-grade tonal quality at the same time.

The demands on PC audio today are high, yet little hardware exists that can do games and music justice

Today, personal computer is playing an even bigger part of one's daily life compared to just a few years ago. This is especially the case with multimedia-enriched systems that provide not only sound, dazzling video and performance, but also are used as video editing gear for digital cameras and camcorders with the IEEE-1394 interface. With the advent of TV tuner and TV-out capabilities and enormous hard drives, one can literally turn their PC system into a TV and video recorder. But what about audio?

What's Lacking is true audio from a PC that can rival hi-fi stereo systems

Most of today's motherboards have audio designs that center on the so-called "AC'97" standards that are certainly sufficient to meet the needs of daily business applications. Technology for both sound cards and on-board AC'97 emphasize a SNR or (signal-to-noise ratio) that's unrivaled by ordinary stereo components that can be purchased from retail electronics chain stores. But what they lack is the ability to reproduce music that is intended to be played back with faithful reproduction. Certainly SNR has a lot to do with music reproduction. However, most of all, faithful music reproduction requires more than just excellent SNR, it requires tonality and depth that truly moves the heart and soul of the listener.

The Perfect PC Audio Solution –Back to The Future

Driven by this premise, a group of geeks at AOpen's Motherboard Division began to think about a fusion of the latest digital technology with Thomas Edison's discovery dating back to 1880 – the conversion of alternating current into direct current through a device called The Vacuum Tube.

For years audiophiles and musicians have appreciated the warmth and tonal quality that flows from sound that is reproduced with the utilization of the vacuum tube. Certainly with current materials, technologies, manufacturing techniques, quality control and measurement equipment, it is possible to manufacture a significantly improved and accurate audio reproduction machine than what was available 30 years ago. Yet, what is available today lacks the ability to pack the punch that the combination of old and new can achieve. By introducing the vacuum tube to the new AX4B-533 Tube Motherboard, AOpen is determined to meet this daunting challenge head-on and deliver a product that will significantly benefit music lovers and gamers who see personal computer as more than just a personal computer. With this new motherboard, AOpen is aiming to entice the segment of the user market that wishes to enjoy substantially better sound effects when playing the latest popular computer games as well as those who desire to use their PC as a bona fide music playback system.

Challenges and Creativity – The AX4B-533 Tube Motherboard

The challenges that AOpen engineers have encountered in this endeavor are many-fold in terms of providing a faithful music reproduction scheme to be combined with the motherboard – commonly referred to as “On-board”. Our engineers have remained undaunted by those challenges. The design of such a novel concept involves not only digital know-how, but also linear electronics and acoustic know-how. Musical aesthetics also play a big role, right from the concept stage, all the way to the testing of such a unique creation. Meeting the criteria of so many existing playback environments is also a consideration that AOpen engineers have taken into serious account.

II. Know more about Tube

What is a Vacuum Tube?

The tube is basically an electronic valve that controls the flow of electrons. It consists of an envelope (bulb, usually glass) from which most air and other gasses have been removed. Inside this near vacuum are two systems. One is called the heater. This is in the center of the tube and is the portion you will normally see glowing orange (some tubes may have more than one heater). The other system consists of the cathode, grid(s), and plate (also called the anode). The plate is the largest metal structure you see inside the bulb. All of this is held to correct locations by thin disc spacers made of mica or ceramic.

Why The Vacuum Tube?

Before we go further, someone undoubtedly will ask, "Why the vacuum tube?" A quick answer would be: "The tube looks cool!" But the real answer does not stop here; there are more legends about the tube that wait to be unveiled.

Why Vacuum Tubes Are Superior for Music Playback

Why use the vacuum tube? Because the tone of the tube attracts listeners in a simple, basic way. There have been too many arguments between solid-state and tube technologies – many experiments and blind tests have been conducted. Even statistical gurus have contributed to the argument on the outcome of these tests.

Skepticism has argued that even an average solid-state amplification device is measurably superior to the best tube device, but the argument may not stand the trial of tonality. So let us make it simple here – We love what we hear regardless of harmonic distortion as well as the limited frequency response compared to a solid-state device. With tube technology, the music is more musical!

Jimmy Page strikes the guitar strings on "Stairway to Heaven" and Angus Young of AC/DC's "Back in Black" share one common attribute– It is the vacuum tube that powers their guitars' souls that express what they want to sound like and what the listener likes to hear.

How The Vacuum Tube Works

Let's take a look at the fundamentals of how the vacuum tube works. In a modern vacuum tube, there are four principal elements that work together to make a tube work. The Filament (heater), Cathode, Grid and Anode (or plate). When the filament is connected with voltage that boils the cathode, the cathode then emits electrons that pass through the grid and hits the Anode. Through this electron flow, the tube will amplify a small AC signal into a larger AC voltage, thus amplifying it. By controlling the grid voltage, the current flow can be regulated and thus creates the desired electronic characteristics, while amplifying the signal (source).

Today, most electric guitar and bass amplifiers are tube-based. Professional audio equipment also deploys the tube as a preferred amplification device. One can even find tubes in digital-to-analog converter designs. The vacuum tube is a natural choice for these music-associated vehicles to depend on.

What's that Silver Stuff on the Glass?

The silver deposit is called the "getter" and is there to help increase the vacuum in the tube. Its color may vary slightly. Sometimes the getter will flow with use, even to the point of becoming evenly and thinly deposited over the entire envelope. The edge of this flow may have a brown color. None of this is important as long as the tube biases correctly and stability.

If you see the getter receding leaving a whitish profile the tube is loosing vacuum and should be removed from service.

Mechanical Handling

Do not bend or force the metal pins coming out of the base of the tube. This could break the vacuum seal and ruin the tube. The same is true of any sharp mechanical shock. You can usually tell if the seal breaks, as the silver deposits that coat the inside of the glass will turn to a white powder.

For The Sake of Nostalgia

As a committed group of computer geeks and jazz music enthusiasts, we at AOpen believe that the vacuum tube can satisfy the listener's ear much more than the average AC'97 or a very expensive PCI sound card. Yes, we understand that we're dwarfed by the tube equipment giants in a number of ways, but with the AX4B-533 Tube, we believe we've found a better way to get outside the box and really hear the music.

So let the tube glow and enjoy it!

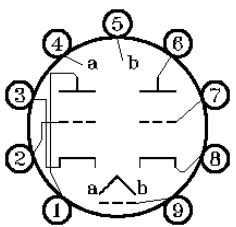
Technical merits inside AX4B-533 Tube

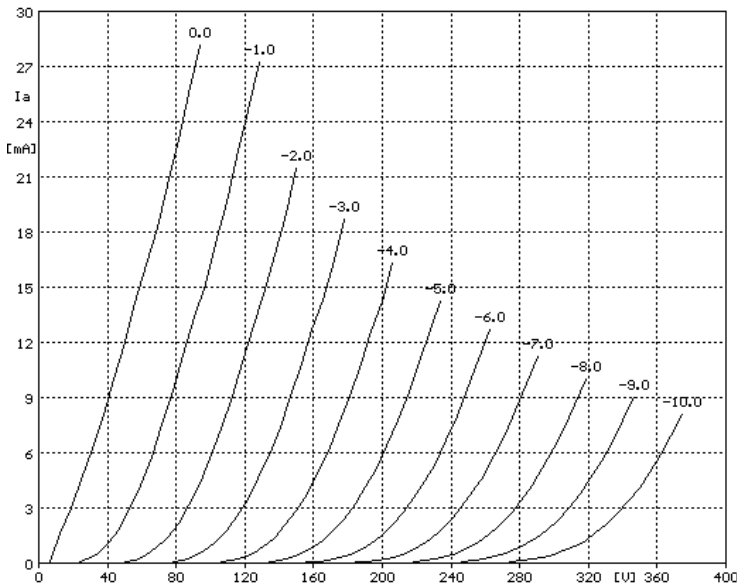
6922 Tube Specification

Nine-pin miniature tubes (Sovtek 6922 in here) have no plastic base. Locate them in their sockets by noting the space where there is no pins. Do not wiggle these tubes excessively, as you might damage the socket or the glass seal.

Specification and max ratings (*)

Filament Voltage	6.3V
Filament Current	365mA
Plate Voltage (max)	130V
Plate Current (max)	25mA
Plate Dissipation (max)	1.8W
Screen Voltage (max)	---V
Screen Current (max)	---A
Screen Dissipation (max)	---W





TubeSound Technology

Fusion of P-4 and The Grand Old Vacuum Tube

The AX4B-533 Tube Motherboard is a fusion of the latest Intel Pentium 4 technology with the century-old vacuum tube for the perfect marriage in audio reproduction. This hot-fusion of technologies over one hundred years apart has merit of imagination that cannot be denied or taken lightly.

Components and Construction

To ensure a full gaming experience and true tonal quality for music playback, AOpen has meticulously selected the finest components from the world's top-rated manufacturers. In fact, AOpen continues to test components that will further enhance tonal quality as well as overall system reliability for the user's total enjoyment.

Every AX4B-533 Tube motherboard is patiently and carefully assembled. They are then inspected and individually tested by AOpen technicians to meet their desired peak performance. Please refer to **Appendix B** for testing methods and equipment.

Noise Isolation

In today's high-performance digital designs, compatibility, stability and reliability are crucial. EMC, ….(add more) are also part of the equation of a successful products. By fusing the Pentium 4 and vacuum tube circuitry, the geeks of AOpen worked for over weeks exclusively thinking about how to solve tube-inherent technicality issues as well as their dreaded by-products – NOISE.

The method we developed back in 1998 in another application, is now working again – this time for this new hybrid product – The method is called the Frequency Isolation Wall (FIW).

PCB

True to AOpen's heralded tradition of unique motherboard design, a black PCB is used for the AX4B-533 Tube. Since the current and voltage of the tube design require more than just a conventional motherboard PCB, the copper trace has been thickened and several quality improvements have been made to ensure long term reliability and performance.

Power Capacitor

A magical ELNA electrolytic capacitor is coupled for voltage output for tonality that's unparalleled. By using very fine conductive particles of super high purity graphite and other "magical" material, this Nichicon electrolytic capacitor has drastically lowered many of the distortion mechanism inherent in electrolytic capacitors design.

Workmanship

Needless to say, AOpen's workmanship is one of many of our traditions and it is applied to this product again with "meticulously detailed" steps to ensure quality.

Power Supply for the tube

Max 668 --- Using Maxim 668 DC-DC converter.

Transformer for the Tube

A high quality EI ferrite core with 0.3mm AWG hyper copper wire that not only meets UL standards but is also able to withstand 266 degree Fahrenheit (130 degree Celsius) operating temperatures. This transformer supplies more than enough regulated voltage and current to power the tube circuitry.

Power resistor

The Vishay – Military and space-grade resistor is once again fitted seamlessly in this new design, providing 1% tolerance. Made with high purity ceramic substrate, proprietary nickel-chrome alloy element, and stainless steel end caps. No magnetic materials are used in any of the construction.

Switching Power supply and DC-DC converter

To make 115V DC available from the motherboard or switching power supply for the tube is a daunting task. The geeks at AOpen have tried different ways to tackle this issue, and have adopted the switching power method for lighting-up the tube. A Maxim 668 DC-DC converter is the heart of the tube power supply, supplying ample voltage for the tube to work under optimal conditions for proper music playback. The design also involves finding a transformer that can work very hard and reliably with circuitry in tandem. After long hours of experiment, we have determined that four transformers have the tonal quality that can rival solid-state amplifiers. Four different ferrites and copper wires are measured subjectively. One stands out and it's been implemented onto this product.

Amplification

Tube

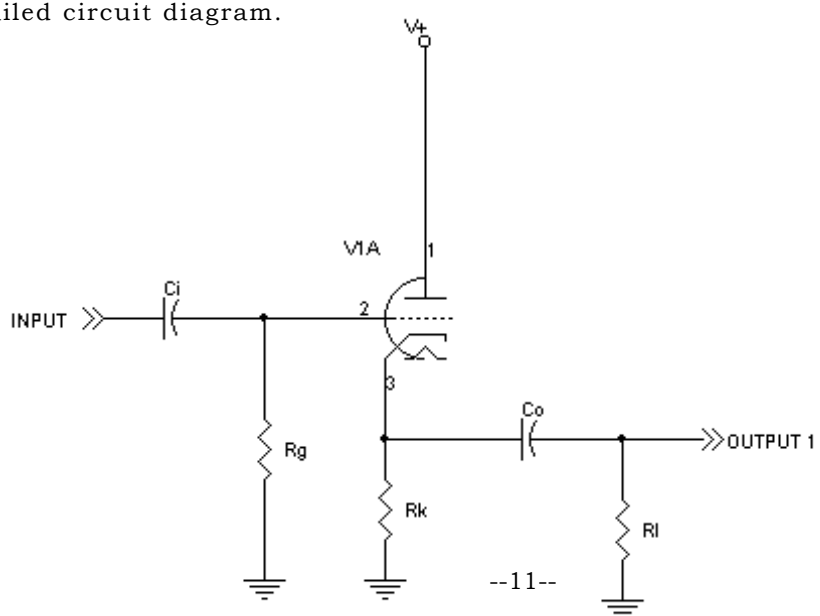
After audition more than a dozen tubes, we have chosen Sovtek 6922 as standard tube to be used in AX4B-533 Tube for its well-rounded tonality for both music play back as well as gaming.

A warm and soft mid range, ultra liquid treble can be achieved. Of course you can do your own experiment by replacing different 6922/ECC88/6H30 dual-triode tube. Please refer to page 26 for compatible tubes for replacement.

Amplification Circuitry

After studying many classic pre-amplifier circuits, we decided to use a single dual-triode (one tube with stereo channel), as a main amplification device. By complying with many criteria, we also decided to follow a long path in terms of providing the most faithful, yet economical way, of doing the signal amplification – Direct Path. In this design, a straightforward amplification is achieved without numerous coupling devices that could add coloration to the music.

Following is a basic circuit of cathode stage, fully-bypassed cathode implemented in AX4B-533 Tube for your reference; for intellectual property issue, we reveal it in a simple way instead of a detailed circuit diagram.



Common-cathode stage, unbypassed cathode:

Voltage Gain (Output 1):

Av = (mu * ra)/(ra + (mu + 1)*Rk)

Input impedance:

Rin = Rg

Output impedance (Output 1):

Rout = [(ra)/(mu + 1)] //Rk

Frequency response (Output 1):

f1 = 1/(2*pi*Ci*Rg) - highpass breakpoint due to Ci/Rg

f2 = 1/(2*pi*Co*(Rout + Rl)) - highpass breakpoint due to Co/Rout/Rl

Where:

Rg = the grid resistor

Rp = the plate resistor

Rk = the cathode resistor

Rl = the load resistance, or the input resistance of the next stage

Ra = the total load resistance, which is Rp in parallel with the input resistance of the next stage, Rl. If there is no Rl, Ra = Rp.

ra = the internal plate resistance of the tube

mu = the mu of the tube

Coupling Capacitors --- MultiCap™

Polypropylene & Aluminum Foil Multiple-Section Capacitors are used throughout the amplification except power supply.

Resistors --- Vishay

1% metal film resistors with high purity ceramic substrate, proprietary nickel-chrome alloy element, and stainless steel end caps.

Tube Socket

A 24K plated ceramic 9-pin tube socket sits on the center of the PCB at a pivotal point. This high-quality audio grade socket will accommodate years of reliable operation.

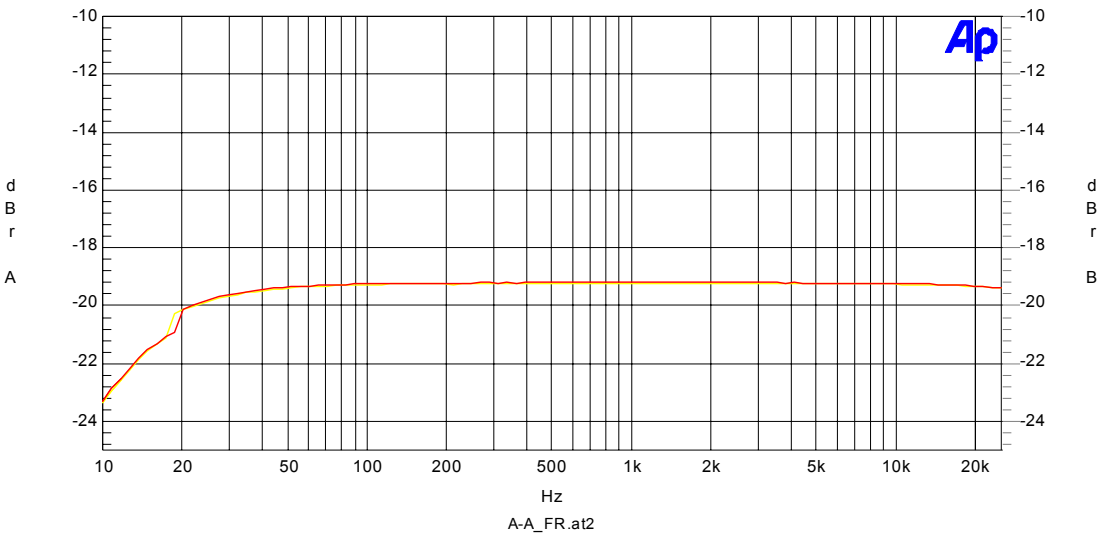
Wire – Cardas Cable

Cardas Audio has always been striving to address every detail of cable and conductor construction. It realized that cable geometry problems are resolved in the cable's design, not after the fact with filters, and it also knows that the sound produced by any stereo system depends on the purity of the audio signal it produces, so it creates the famous "Silent Conductor" that allows them to be so uniquely musical and pure. Other than that, Cardas possess effective methods like enhancing the quality of the sound by using Constant Q Stranding which could reducing the internal rise in inductance, exquisite design that incorporates Cross-field Construction in its manufacture, and so on. It makes perfect sense that Cardas cables is at the leading edge.

Testing Methods

Frequency Reponses

Audio Precision AX4B-533 Tube (Tube OUT) Frequency Response 06/14/02 11:50:52



Conclusion

Yes, AX4B-533 Tube is not quite a true “Stereophile” C-class recommended group of components. Yet, given its original fusion idea and meticulous journey to fruition, we believe it is Class-A for certain.

It is our belief that gamers and music lovers alike will love the AX4B-533 Tube. This unique motherboard requires a personal audition with ears, heart and soul. Anyone who appreciates well-reproduced sound, whatever the venue, will appreciate a system built with this innovative motherboard. Such a system will likely receive as much care and provide as most home and specialty hi-fi stereo playback systems get from their proud owners.

June 2002

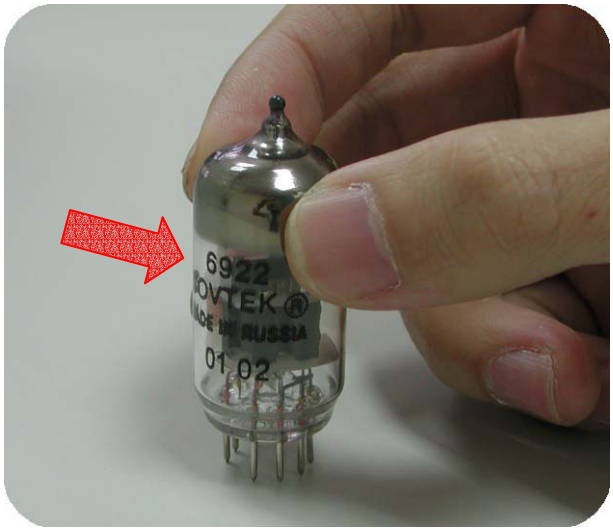
AOpen

III. Power it up

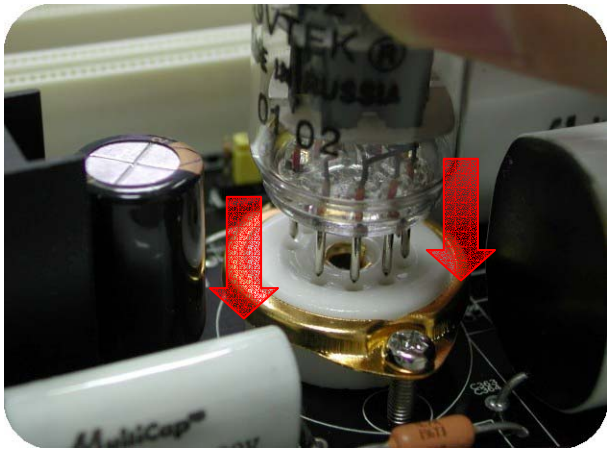
Unpacking your tube & Insertion

1. Please take out the tube carefully from the packing box.

2. Holding the tube, and try not to touch the printed wordings on it as cautiously as you can.

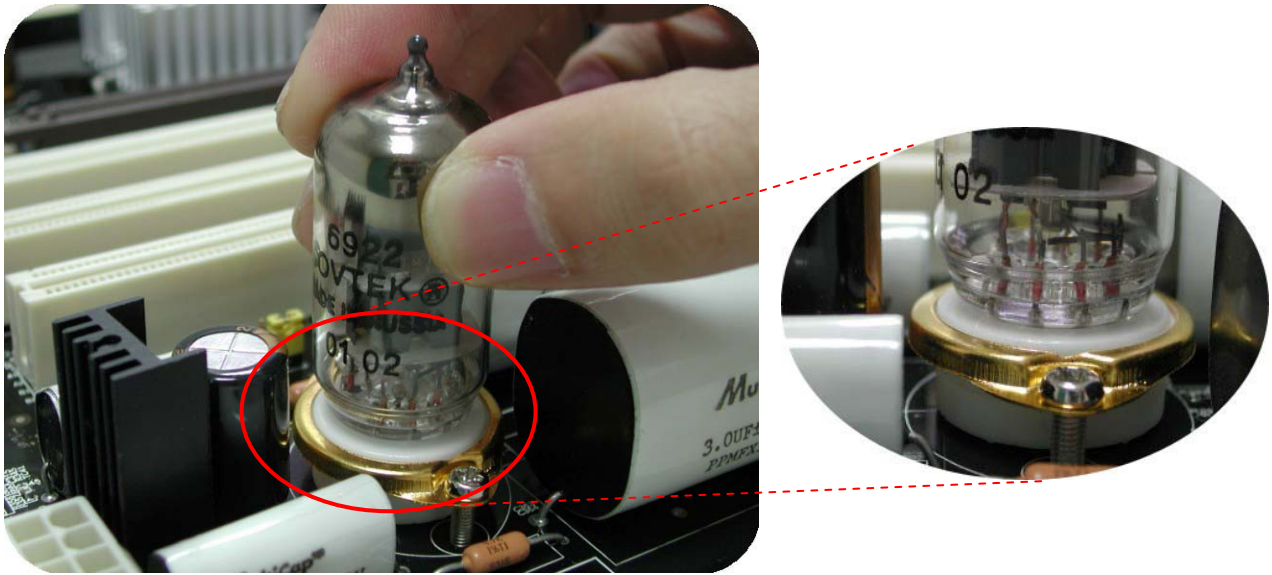


3. Take a good aim on the pinhole, then slowly inserting the tube pins downward into the white basement with balanced strength.



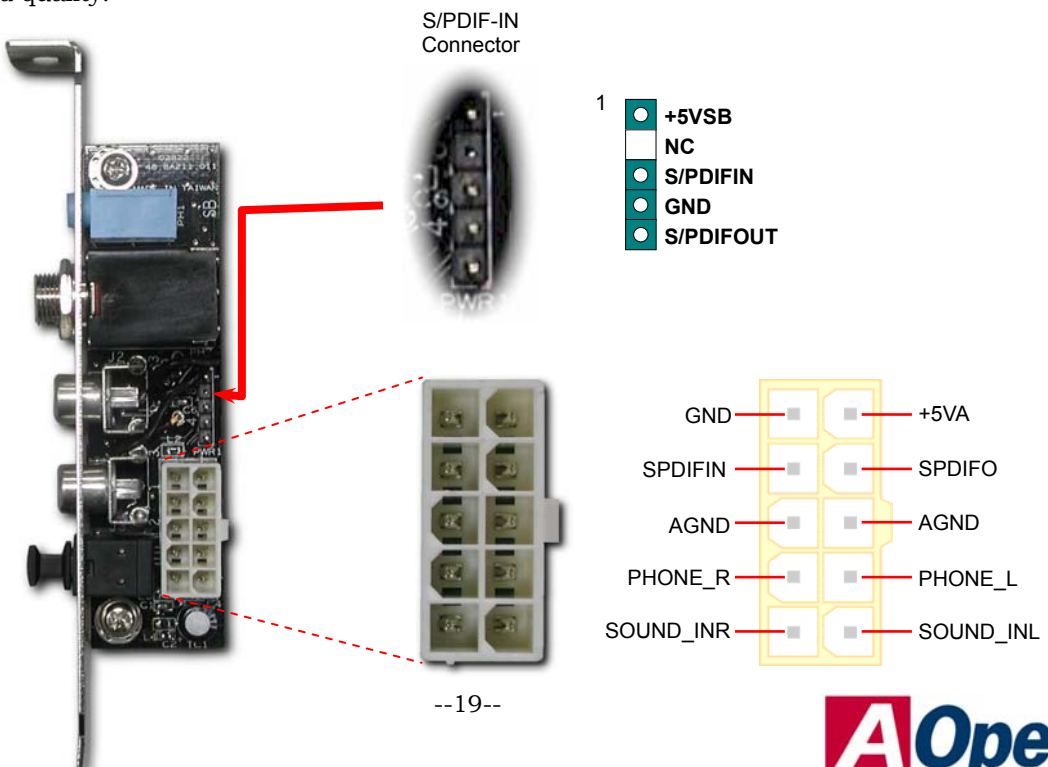
Note: Though some of latest version of Windows support "Digital Audio" through IDE bus, however, in order to use Open Jukebox player, which is driven under BIOS, it is a **MUST** to insert audio cable to CD-IN connector on the motherboard.

4. You may “slightly” swing and press down the tube bilaterally at the same time to make sure that it will be completely inserted.

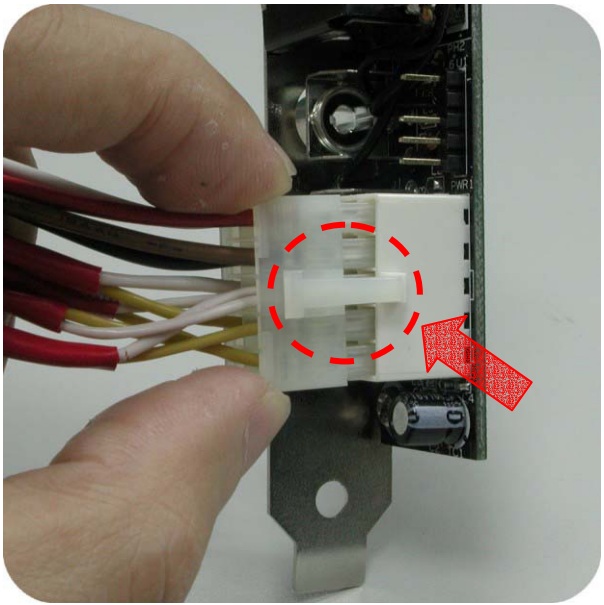


Tube Audio Card

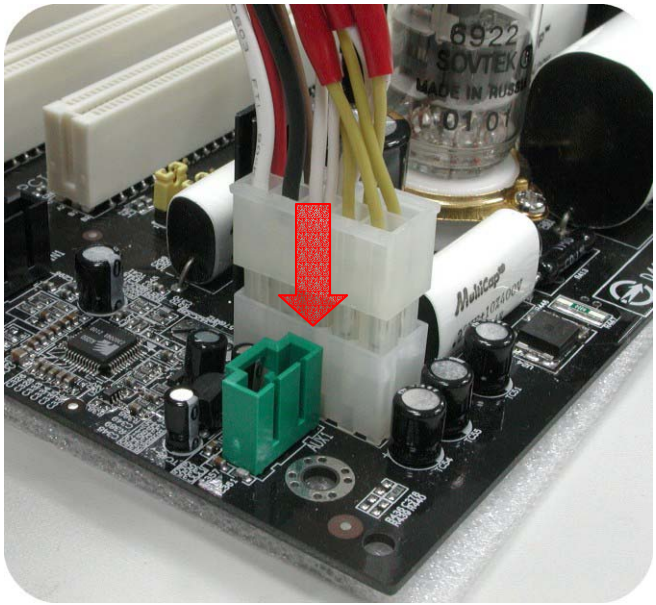
This daughter card is specially designed for better analog/digital audio out put, it's strongly recommended to connect your speaker to this RCA-output instead of the normal "speaker out" on the back panel of motherboard for better sound quality.



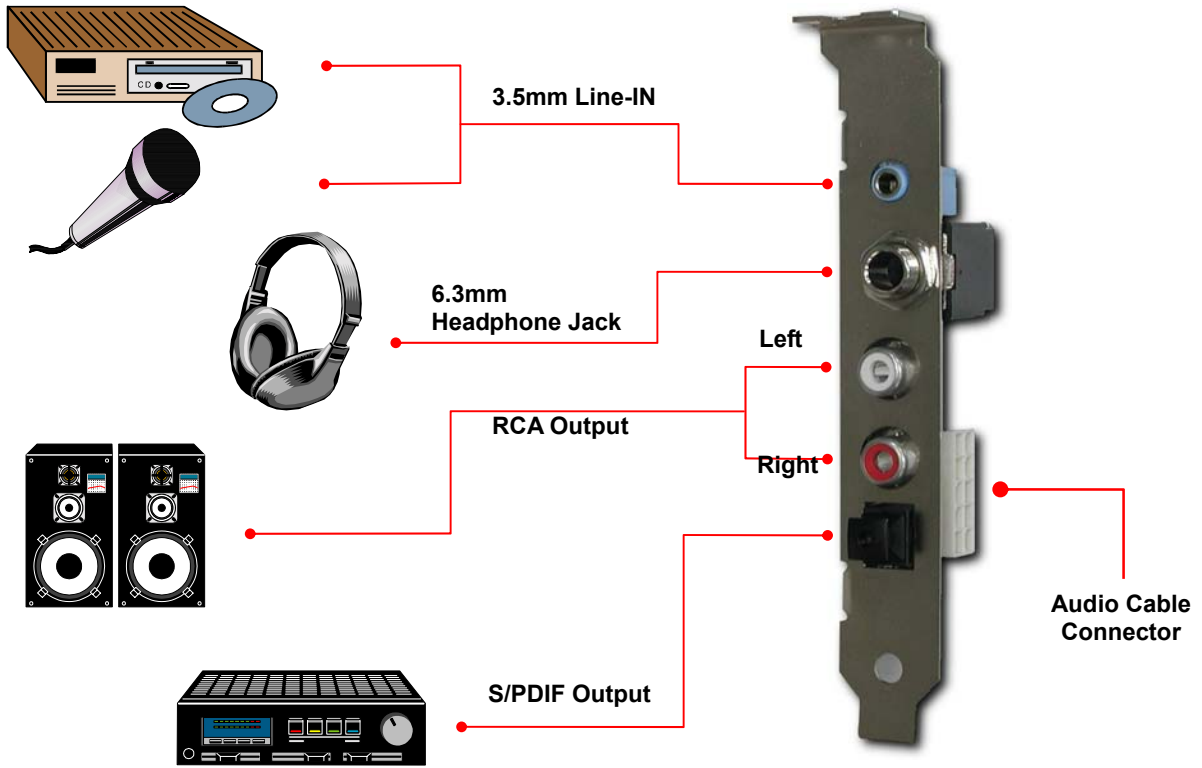
1. Plug the audio cable to the connector on the daughter card, and notice the orientation of the hook.



2. Connect the other end of the cable to the connector on the motherboard, in the same way; you'll not be able to plug it in with wrong orientation.



3. Connect your device to the jack on the bracket of this daughter card.



IV. Let's make things better

Unplugging the tube for replacement

Be Careful - IT'S HOT

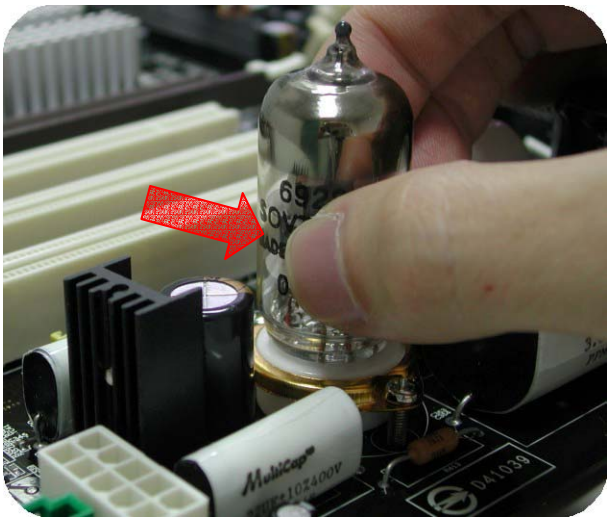
Current tube technology requires high internal operating temperatures. As a result, the glass part of the tube can reach temperatures as high as 250 degrees. Always allow your AX4B-533 Tube to sit switched off for several minutes before you touch the tubes.

Incorrect ways of pulling up the tube:

1. Never hastily pull out the tube while lights is still on: The fuse inside the tube could still be red with high temperature when the power was just being cut off. Therefore, if you pull out the tube immediately right after power off, the possibility is that you might not only be burnt by the high temperature, but also caused a broken fuse by violent shaking, and there goes the tube.

2. Never touching the printed wordings with your fingers: When you pull out the tube, try not to touch the printed wordings with your fingers, because if that's an earlier-designed tube, the wordings on tube would be easily rubbed off after few times touching.

3. Inappropriate pulling angle: Most of the tube basement could be a little bit tight, but remember not to pull them too hard bilaterally, for this could break the vacuum seal and ruin the tube.

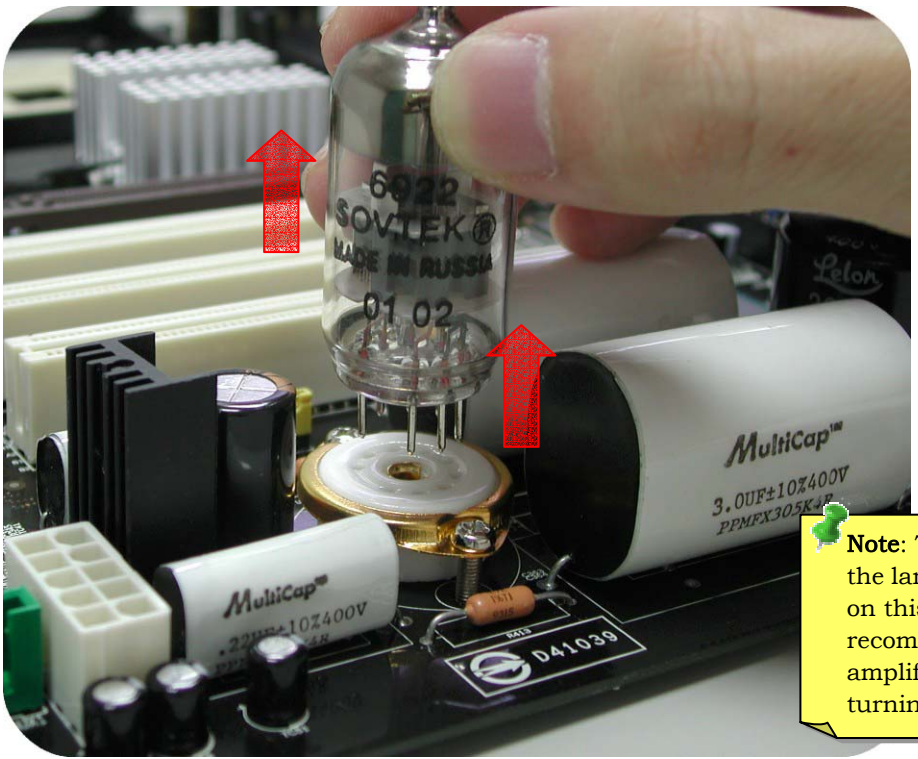


Correct sequence of pulling out the tube:

1. Waiting at least 30seconds right after cutting off the power for the fuse and inner glass to cool off a bit.

2. Holding the tube with fingers, trying your best not to touch the printed wordings on tube; Swinging slightly bilaterally, and pulling the tube upward with balanced strength.

3. Pull the tube out of the base, and put it into box with care.



Note: To prevent loud noise caused by the large current of the huge capacitor on this motherboard, it is strongly recommended to turn off your power amplifier or speaker first before turning off your computer.

Substitution of tube

The following tubes can be used on the AX4B-533 Tube for those of whom looking for different tonal characteristics or just replacing the tube.

General speaking, a low output tube such as the 6922 will have about 5,000~6,000 operating hours life span. If you use it 4 hours a day, it will probably last for over 4 years. Of course, many factors also determine the life of a tube including working voltage, temperature, vibration…etc.

Here is the substitute tube list for Sovtek 6922:

Jan-Philips 6922	Philips E80CC
Russia 6922 / 6H23	Philips E88CC / 6922
Siemens E88CC / 6922	MiniWatt ECC88 / 6DJ8
6N30 or 6N30P	Amperex ECC88 / 6DJ8
Telsa E88CC / 6922	Mullard E88CC / 6922
Telefunken E188CC / CCa	Mullard CV2492 / E88CC
Telefunken E88CC / 6922	Mullard CV2493 / E88CC-01
Telefunken PCC88 / 7DJ8	Mullard E188CC / 6922
Siemens E288CC	Sylvania 6922 / E88CC
Siemens 7308	Sylvania 7308 / E188CC
Sveltana 6N1P	AEG E88CC

Comparison of different tubes

Please refer to the reference chart below for 6922/6DJ8 tubes comparison:

	US code	EU code
Normal	6DJ8	ECC88
High-end	6922	E88CC
Advanced	7308	E188CC
Exclusive	8223	E288CC
Compatible	7DJ8	PCC88
Unique		CCa (unique german code)

**The CCa here is the same as E88CC, which is made of special quality and low noise, and selected out among E88CC high-grade tubes, with longevity and less noise.

You may directly change the mentioned tubes whenever you like, but E88CC, E188CC, E288CC, CCa is the best quality tubes among ECC88/6DJ8 series, with longevity and golden pins mostly. (Most modern or American tubes do not equipped with golden pins)

PCC88/7DJ8 and 6DJ8 are similar in structure, except one thing, and that is the overheating of filament (7V). It could be used to replace 6DJ8/ECC88, too.

The sound trend of various manufacturers of 6DJ8/ECC88/6922/E188CC:

The statement below is just a reference of the sound trend of various manufacturers. You may seek to the individual pages for their details.

1. German made Siemens: Excellent resolution and stage positioning, however the sound is not as solid and thick as England made tube. If your system lacks in resolution, then this Siemens made will be your first choice.

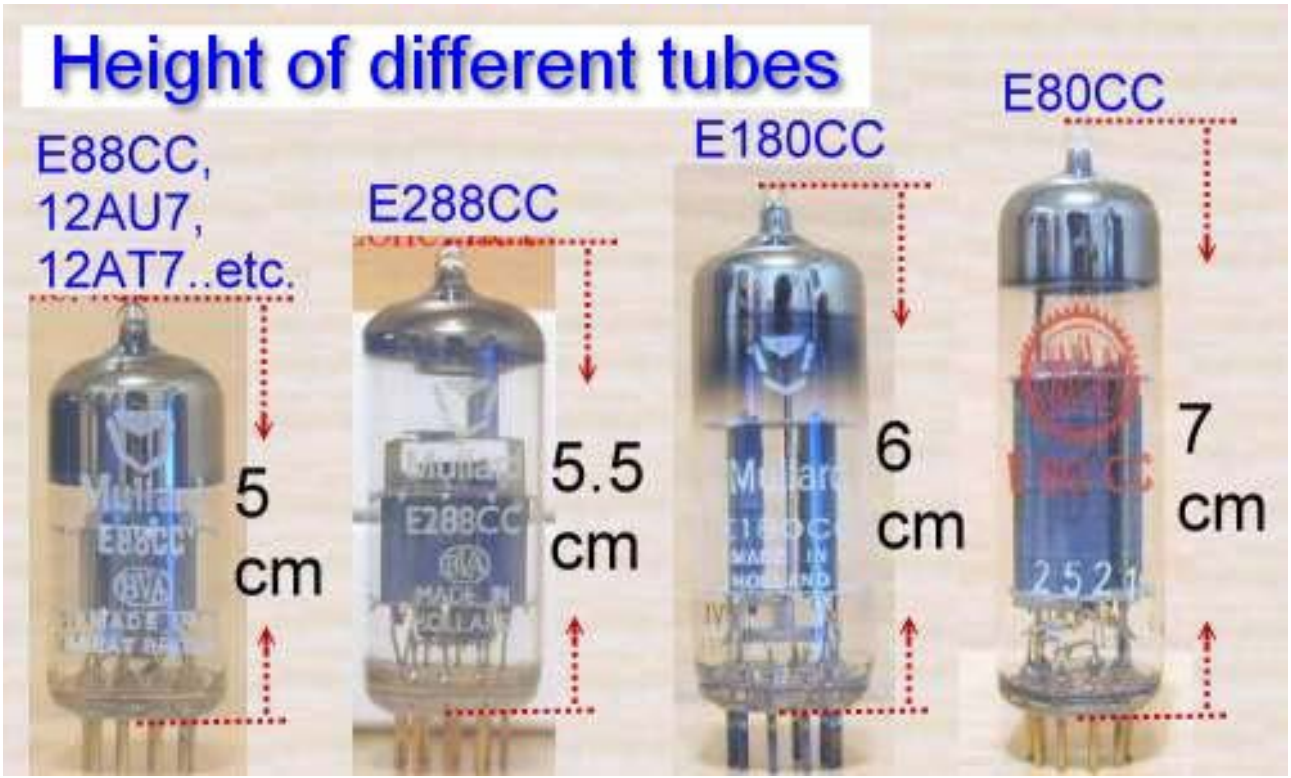
2. England made Mullard, Phlips, Amperex.: Typical England solid style, thick mid range, but of course, resolution is not as good as Siemens. Suitable for system with delicate sound.

3. Holland made Philips, Amperex, Mullard : As a whole, their performance is average in bass, Treble and mid range, with full sound and good resolution. They are more tends to neutral style.

4. Telefunken ,TFK: Nobody could hardly ignore Telefunken if they were enthusiasts of tubes! It definitely is the highest rank among various brands. With impeccable sound, good quality, harmonious sound, longevity, it has been recognized as the best tubes ever (though some one might do not agree with that). Furthermore, Telefunken has stopped produce tubes for a while, and folks are earger to seize one, that makes it incredibly expensive, especially for those Audio tubule, such as E88CC, CCa, ECC82, ECC83...

**Special thanks to WenAudio, www.audio.idv.tw, for the tube thumbnails.

The Height comparison of different tubes:



ECC88 / 6DJ8 type

Amperex Bugle Boy ECC88

This is the famous “Bugle Boy” made in Netherlands in the 60’s. Excellent resolution and sound stage positioning. Clean yet silky sounded infatuated many audiophiles around the world. As for the subjective feeling, this tube offers extended solid bass, wide sound stage, and sweet mid and airy high. I would pay for $200 for this tube for its tone and look.

Amperex ECC88

The next generation of Bugle boy in the 70's. Orange globe logo with big "Made in Holland" print on the glass. Sound quality very similar to the original Bugle Boy. An excellent generation. Hard to find like Bugle Boy.

Philips MiniWatt ECC88

This 1960's Philips MiniWatt no-fault made in Holland ECC88 offers even better "thickness" compare to the Bugle Boy. A must for you to own. If you find this tube in someone's garage or at the flea market, don't barging, just buy it.

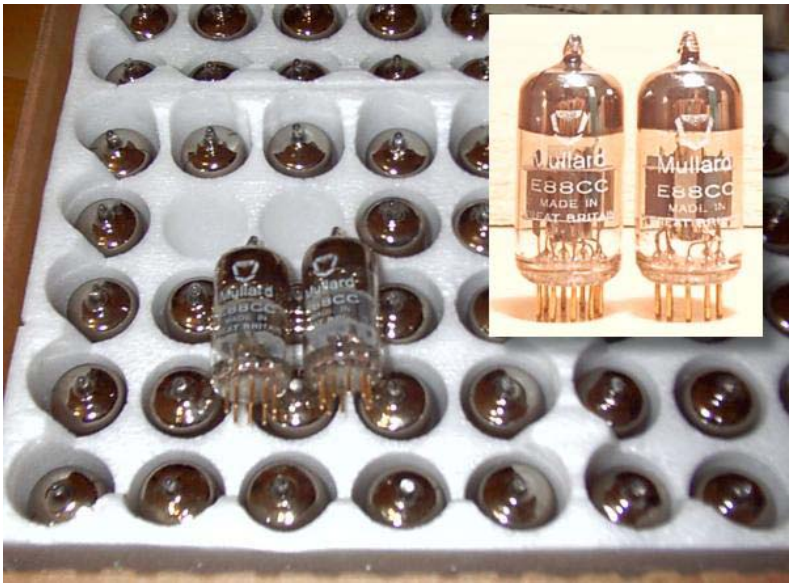
E88CC / 6922 type

Mullard E88CC

This gold-plated pin Mullard E88CC is made by Philips in Holland like its cousins Bugle Boy and Philips MiniWatt. Resolution, solid as rock and thick like Cappuccino's thick crème that makes you feel so comfortable. Yes, it is also hard to come by tube.

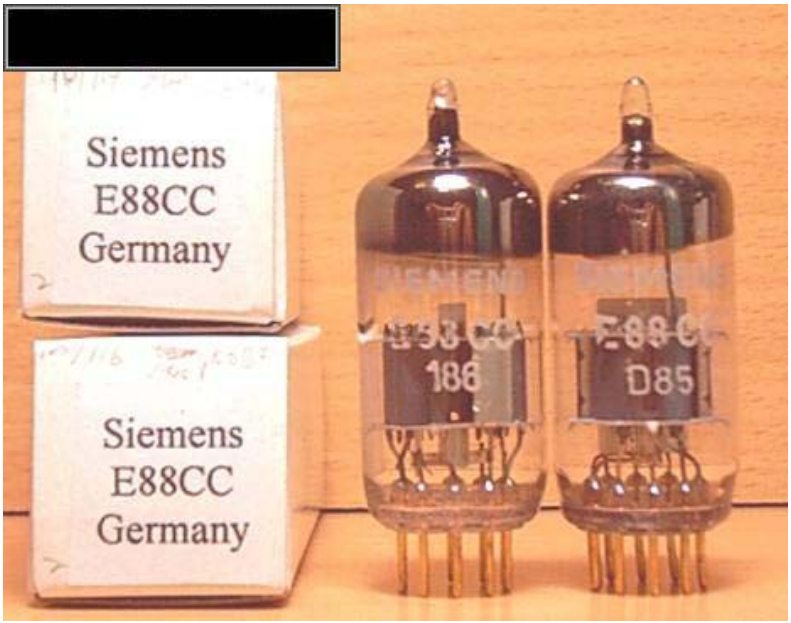
Mullard E88CC

An England made Mullard E88CC with shiny gold tone accent. Musically satisfactory one for the pre. Voluptuous tonality with seamless dovetails between mid to high.Its skin-deep beauty make it best to the pre-amp that has an open chassis design.



Siemens E88CC

Another solid but not hard bass E88CC with excellent resolution and sound stage positioning. This one also meets German's best – Mercedes Benz and BMW precision engineering.



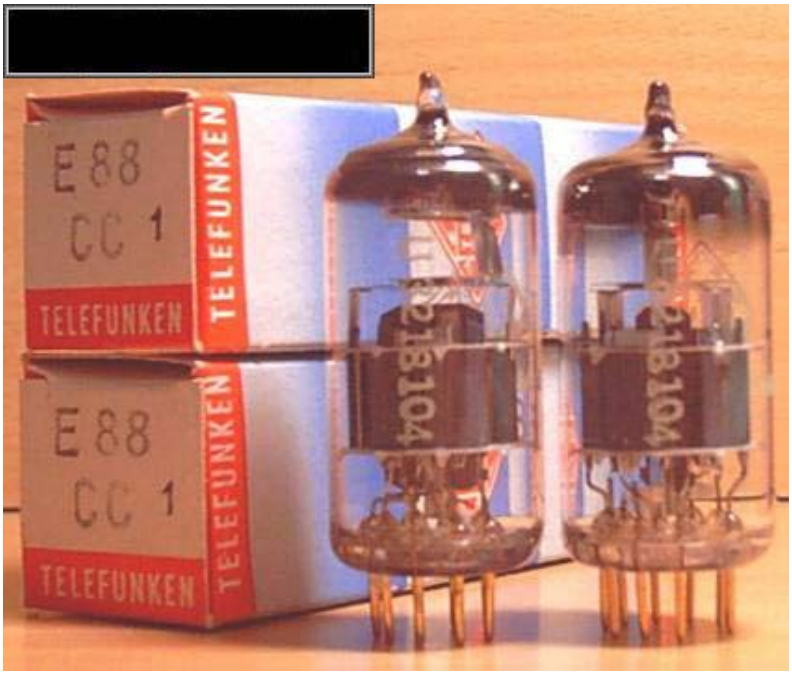
AEG E88CC

AEG is believed to be the parent company of Telefunken. The original company name is AEG-Telefunken. A wonderful sounded E88CC that's worth to collect.

Telefunken E88CC

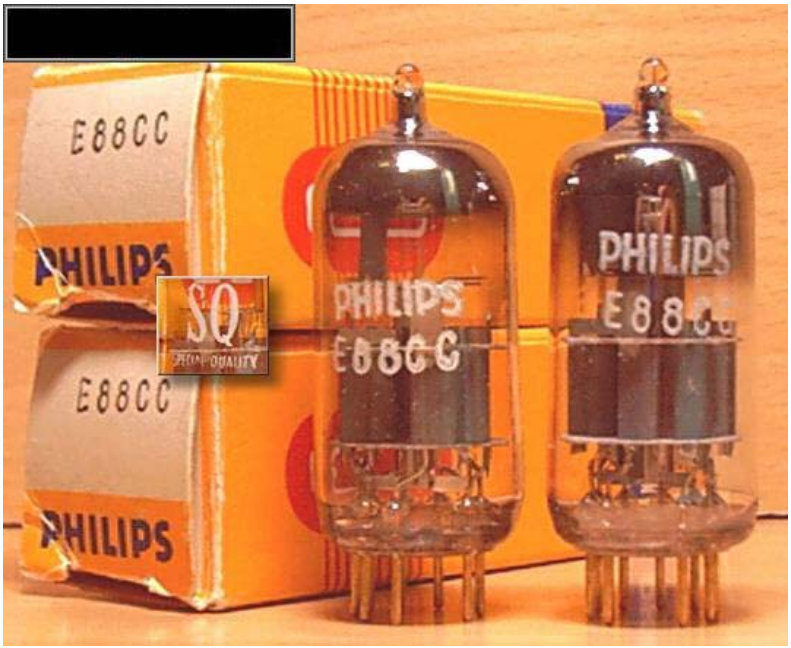
This Telefunken E88CC is as same as the AEG one. A work of wonder with total relaxation.

Telefunken is Telefunken.



Philips E88CC SQ (6922)

Details, details and details. One can hear layers after layers of musical information. Open, airy, a total harmony. If you love chamber or New Age music, this is the one that you can not miss.



E188CC / 7308

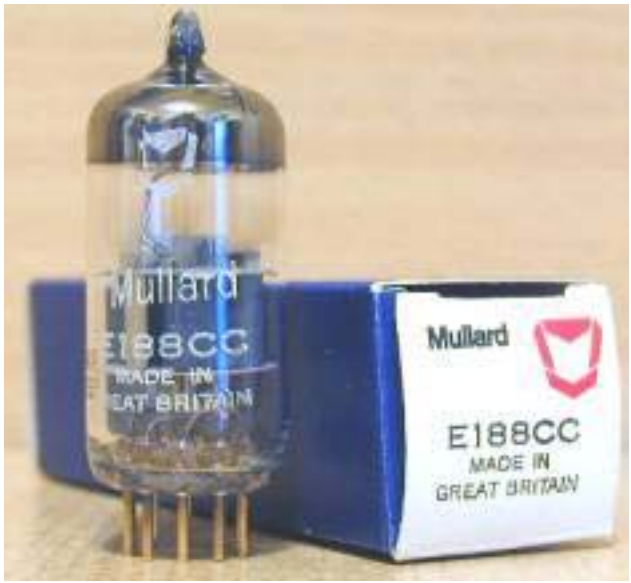
Philips E188CC

Same SQ series from Holland. (Why Holland makes the best tubes?) When the ivory keys were hit, you can feel the notes approaching your ears with force. A sensational tube for the piano solo (Bill Evans's soliloquy)

Mullard E188CC

England made. Similar with Mullard CV4108, but better than it in the sense of space and condensation.

As for its sound stage performance, it fully stretches to surrounding space with smooth flow, excellent resolution, and extended bass and treble as if you could watch the airy flow of flute.



Mullard CV4108

Made in England. Thrilled and impressed it gives us as England Tube always do. Extravagant and clean, plus suitable bass and excellent resolution. Touching people no matter in listening vocal, instrument or piano etc.

Siemens 7308 (American made)

Though not made in German, but comes with a very good quality. Marvelous resolution that could easily triumph some modern tubes, like Philips EGG 6DJ8, Sveltana 6N1P, Tesla E88CC, etc.

Sylvania 7308

American made tube, which use the same structure as E188CC, with splendid resolution and C/P rate as well. Worth buy product.

Telefunken E188CC

1960 German made, with golden pins, outstanding sound, less interference to bass, which is considered the best buy product in TFK E88CC/CCa/E188CC series.

E88CC-01 / CCa

Mullard CV2493

England made CV2493 is equal to E88CC-01, which produces less interference to bass.

CV2493 has always been famous with its charming mid range, long life span, and first-rate quality.

Mullard CV2493

Holland made CV2493 is equal to E88CC-01, which produces less interference to bass.

CV2493 has always been famous with its charming mid range, long life span, and first-rate quality.

Telefunken CCa

1. You will never realize how wonderful this TFK CCa can bring you unless you insert and listen realistic sound coming from it. Nothing was expected at the beginning when I changed my Mullard CV4108 with this TFK CCa, however, when I insert it on, the miracle happen! It's so flawless that no matter from what perspective you pick at, you can find nothing wrong! IF you are still not satisfied with its sound, the only explanation must be your CD or your CD Player. Try it and experience what real sound can bring you!
2. Though always been a faithful user of Mullard 6DJ8, I have not satisfied with its resolution, stage positioning and its bass and treble performance actually. While choosing between Mullard E88CC, which recommended by friends, and TFK CCa, I took a risky shot and purchased this expensive TFK CCa, but luckily found myself making the right decision. As whole performance, TFK CCa comes with appropriate bass-treble range, and sweet mid range, which produce an excellent elegant sound I ever heard. Highly recommended product.

PCC88 / 7DJ8

Telefunken PCC88

No one could resist the incredible sound of TFK PCC88 once they have experienced it. Based on Anthem pre-Amp, try to replace Siemens E88CC with TFK PCC88, you will be immediately moved by the music. It is full of rhythm that you can actually feel the details and music out of the sound. It is getting difficult to find a TFK E88CC/CCa/E188CC lately, you may try your best to get one to possess remarkable sound of it.

After having read so many tubes introduced above, you might be wondering which one is the best? Furthermore, different people have different views. Everyone will have his/her own different answer in the end. To get excellent performance, the arrangement of the sound and the design of the machine play an important role here. I guess you will be able to choose your preferable one once you have personally heard the sound of them.

Telefunken Series, beyond doubts, remains the highest grade in the realm of tube. The best of the best! However, from the perspective of the whole function, I would like to recommend Mullard CV4108, which shows you average or even better performance. Though other tubes such as Mullard E188CC and Holland Made Mullard E88CC produce similar quality of sound, they are still inferior to Mullard CV4108; as for Holland Made Philips E188CC SQ, which its sound trend is different from others, suits much better for spacious scenario like Opera or orchestra, etc.

Basically, the selection of tube depends mostly on the sound trend of your system. If the original sound of your system is fuzzy, with low resolution, you might need to equip Siemens E88CC for your system. However, if you are already satisfied with the resolution and positioning, but disappointed with its thinness, then you might use the thickness England Tube like E88CC to meet your needs. Last, if you would like to improve the whole performance of your system, Telefunken CCa/E88CC will be your only choice!

Appendix A

Useful website for vacuum tubes

Useful Information Websites for Vacuum Tubes

www.thetubestore.com

www.sovtek.com

tube.diyzone.net

www.stereophile.com/shownews.cgi?1368

www.bb.wakwak.com/~s-ito/elec/elec.html

www.thlaudio.com/

www.audio.idv.tw

www.tnbstore.com.tw/

home.pchome.com.tw/travel/horobin/

netcity2.web.hinet.net/UserData/bigcwc/

home.pchome.com.tw/art/allen211/

www.jimcom.net/

www.cypress.ne.jp/kouchi/index.htm

www.audiosite-web.com

www.asahi-net.or.jp/~UP2J-KNST/tube.htm

www.jade.dti.ne.jp/~yoshiba/

www.alphapex.co.jp/

oldtube.com/

www.asahi-net.or.jp/~hp6y-isym/index.htm

Appendix B

Testing equipment list

Music Playback

The following equipment is used to test with AX4B-533 Tube as a preamp for testing and QA before shipment:

Pre-amplifier for comparison

Audio Research LS-1	Audio Research LS-16
Audio Research LS-2	Golden Tube SEP-1
Audio Research LS-7	Sonic Frontiers SFL1-Signature
Audio Research LS-15	

Power amplifier

Audio Research VT50	Jeff Rowland Model 1
Audi Research VT100	PASS X150
Bryston 4BST	USHER R0.8

CD player

Meridian 506.20	Rotel 971
Meridian 508.24	Musical Fidelity A3CD
Wadia 301	Philips LHH 100
Pioneer DV-S9	USHER CD-100

Speaker

ProAc Response 1SC	B & W 602 S2
ProAc Response 1.5	B & W DM303
ProAc Response 2.5	Dynaudio Contour 2.8
ProAc Tablet III	Dynaudio Contour 3.0
ELAC EL212 Jet	USHER CP-8871

Interconnect

Kimber Kable KCAG

Kimber Kable Silver Streak

Kimber Kable PBJ

Earphone

Audio Technica ATH-W2002

Grado SR80

Speaker cable

Kimber kable 8TC (double run)

Kimber Kable BiFocal XL

ZU Cable Julian

CDs

Yamamoto Yoshi – Misty - JVC XRCD

Diane Krall – Look in your eyes

Three Blind Mice

Gary Karr – Audiophile Selections

Ennio Morricone – The Legend Of 1900

Groove Note – Jacintha – Here's to Ben

Rodgers Hart – Blue Moon

Christian Lindberg – Songs for Sunset

B B de Voeux

Dilber – The Art of Coloratura

Testing Equipment:

Special thanks to REALTEK lab for Audio Precision Test.

Game

Our game experience testing includes the following equipment:

AX4B-533 Tube

Intel Pentium 4 1.8A GHz

AOpen H610-340 cooling fan

AOpen 52X CD-ROM

Apacer 512MB DDR

Seagate 20GB hard drive

Panasonic 1.44MB floppy drive

AOpen 19" monitor

Speaker:

AOpen MS-810

AOpen MS-900

AOpen Titanium GT

Harman Champagne SE

Altec Lansing 621

Klipsch ProMedia 2.1

Appendix C

A Letter for Tube Lovers

To: Tube Lovers

Sent: June, 29, 2002

From: AOpen Motherboard Team

Cc: AX4B-533 Tube Staffs

Subject: Letter to Tube Lovers

Following a long and challenging road of designing AX4B-533 Tube, we finally present you this fine piece of product and hoping you will like what you see and hear. This product is designed for both gamers who rely heavily on performance, reliability and audio capability of a motherboard and music lovers who will use it as a secondary or even primary music source when using personal computer.

AX4B-533 Tube is such a rare breed that combines the best of both world – new Pentium 4 performance and old vacuum tube's sound reproduction capability that brings thrill musical and sound effect experience – The Ability to Engage You Musically is the Essence of AX4B-533 Tube.

We would like to suggest you to take following steps to ensure unbiased experience and hoping you will also give us your subjective opinion and comments about our product. These

steps will assist you to properly set up the system and provide you useful resources when needed.

Connection

The audio portion of AX4B-533 Tube can be set up in the following ways:

a. Direct connect to PC multimedia speaker
   2 channel through tube output stage
   2.1 channel through tube output stage
   5.1 channel (front left and right through tube output stage and rest of 4 channels through regular AC'97 output stage
b. Direct connect to a headphone through headphone jack (Standard 6.3mm)
c. Connect to a power amplifier which the stereo speakers are connected to the power amplifier

Warm up / Run-in

Audio components do require a period of run-in (or break-in) to achieve optimum performance. May we suggest you left the power on of the motherboard for at least 24 hours to have both vacuum tube and rest of audiophile components fully break-in before doing the review.

This procedure will greatly help AX4B-533 Tube to achieve its optimum sonic performance. Do not worry about the thermal since the 6922 is only running at very small current for both filament and plate and will not generate excessive heat that causes permanent damage to the

motherboard.

Speaker Selection

PC multimedia speakers may not be able to reproduce realistic sound stage as well as presentation compare to stereo speakers due to its build and costs. Therefore, we do recommend you to acquire a pair of stereo speaker that the tonality suits you for critical listening. As for the game's sound effect, nicely built PC multimedia speakers will get the job well done as well.

There are many inexpensive but solidly built bookshelf stereo speakers that sell for less than US$300 and we recommend you do test with it to experience the technical merits and audio reproduction of AX4B-533 Tube.

PC CD-ROM / Audio CD and DVD player selection

Believe it or not, CD drive will greatly affect the sound reproduction too. If you are using pc CD-ROM, CD-RW or DVD drive, please do swap around with different brands and construction. We guarantee you will find audible differences among each optical drive during the music playback.

Your CD / DVD player's analog output (RCA jack) can be hooked up to the AX4B-533 Tube

with an RCA-to-mini-phone jack (3.5mm) and serve as source. Please refer to the tube manual page 21.

Headphone selection

You can use two kinds of headphones

- 6.3mm headphone
- 3.5mm headphone - via a converter to a 3.5mm plug for the lighter and smaller headphone that can be found in many today's gear such as MP3 player and portable CD player to listen the audio through the AX4B-533 Tube connector via the supplied bracket.

We recommend you acquire a pair of good quality headphone with 6.3mm plug.

Music CD selection

Make sure you have good recording music CDs when testing AX4B-533 Tube. Good recording music CD will give more realistic sound stage, proper imagine, layers of resolution and overall presentation. This music CD will then serve as a reference basis when comparing the sonic performance.

Accessories

Sonic imperfections such as distortion and noise do occurred during any type of music playback even with money-no-object high-end stereo equipment. We are not particularly concerning about the sonic imperfection of AX4B-533 Tube since its technical merit will speak for itself. However, if you do have audio- graded stereo accessories such as interconnector, speaker cables, and even anti-vibration tube ring to decrease microphonic effect, we do suggest you apply to the audition of AX4B-533 Tube for better sonic performance.

Sound quality

Within the audible frequency range, each person does have different subjective preferences and perceptions on how a musical note is presented. These preferences and perceptions presented no right and wrong in a simple sense. Where as a person's dryness may appear to another person's cleanness; a relaxed musical sentence may regarded as laidback and slow to someone else. Airy and openness may be seen as unrealistic soundstage. Again these subjective observation and perceptions will occurred and suit differently.

What to look for when playing AX4B-533 Tube

Digital portion

- Overclockability with 1MHz stepping frequency adjustment
- Watch Dog Timer to assist overclockers to achieve optimum system configuration with highest overclocking capability
- Dr. Voice II
- Ez Winflash for BIOS update and maintenance
- Vivid BIOS for user interface experience
- AGP protection technology to prevent improper AGP card's voltage damage motherboard
- EzRestore BIOS and ProMagic Utility for instant restore of your hard disk

Audio portion

- Open JukeBox for music playback without operating system
- SilentPC Technology to minimize fan noise
- Vacuum tube sound quality
- Build and construction
- Aesthetic and virtuoso
- Technology fusion

The sweetness of a female vocal will touch your heart and soul when playing by the AX4B-533 Tube. Realistic musical note flows from a wind instrument transpired to your ears with measurable distance. Trust your heart when auditioning AX4B-533 Tube.

When playing pc games, you will hear more realistic engine revving of racing cars; swords chopping through the air, punches and kicks have more solid bass and tension of the sound effect. A gamer's must own piece!

AX4B-533 Tube can be hooked up WITHOUT the chassis and most of the time immune from the noise and you will able to see the glow of the tube and the beauty of the motherboard.

If the cooling fan of the power supply does bother you, please use AOpen low noise ATV Pentium 4 power supply for noise reduction.

Final note

You may find the analog RCA output jack of the supplied bracket may not look appealing to you due to it is the PCB mount type. But its electrical characteristics and performance are as good compare to other mounting type ones.

We do welcome your comments and suggestions on this product and will use it to improve our future product design. Please feel free to contact us.
http://english.aopen.com.tw/tech/contact/courage.htm.

Enjoy the AX4B-533 Tube

Best regards,

AOpen Motherboard team