



## Model T

### Audio Reference Power Amplifier

The power amplifier remains the critical design link missing in the ongoing & onward development in the field of recorded music.

Due to the very low impedance of speakers and the currents involved, small aberrations in the amplifier's layout design have a dramatic effect in the drive of the loudspeaker and the senses of space and depth. Changes in textures in the treble and midrange as well as the 'punch' and appearance of lower frequencies yield dramatic changes on how we feel and see music.

The Model T is built in a few unique ways that reduce these issues immensely.

A fundamental shortcoming in the recording arts has been relying on total harmonic distortion measurements as the benchmark of how much an electric amplifier is influencing the audio's presentation and sound. THD and square wave measurements are based on 'steady' tones as evaluation methods – yet, music is a *dynamic* and *impulse based* delivery of inter-related complex frequencies. An analyzer based measurement method that considers all of these complex interactions and how they relate to our perceptions in audio does not exist, and even then, cannot easily point to a 'better' amplifier.

The quest of bringing electrically reproduced sound in a balanced, non-fantastical presentation that aligns with our perceptions and human nature requires piloting primarily using our natural senses through experience.

#### *Why the Power Amplifier?*

Strident frequency bands in a power amplifier are the fundamental source of the lack of separation and space between instruments in music, as well as general fatigue and lack of emotive realism.

These standout signatures frequency bands are best described as complex dynamic music power (current) distortions. These distortions make a larger sonic impact in a power amplifier (in comparison to a preamp) due to the reality that a power amp is physically moving loudspeakers, which operate at a low resistance for the sake of efficiency of current. All considerations in the current paths and design of the power amplifier are ultimately what finalize the overall depth, feeling, resolution, tone and imagery that the power amp can deliver to our loudspeakers.

#### *'Learning The Speakers' and Balance Engineers in the Recording Industry*

The power amplifier and speaker is the basis of all decisions and perception – from microphone choice to preamp pairing and post-production dynamics, mixing and lacquer cutting. In the recording and mastering world, the term 'balance engineer' is often used at every stage of audio recording and mastering. Anyone in the audio industry has to go through the process of 'learning their speakers' in order to use them properly to make a wonderful recording and to be a proper balance engineer for the sake of the heart of the music.

However, if the power amplifier presents sonic signatures in any way, especially if they overlap in odd ways with a certain set of speakers, the engineer has to learn around these aberrations and adjust the sound cognitively around their 'gut feelings' based on what they know the sound to be like with their power amp and speakers. This is not only a chore, but a rather cerebral exercise to check one's own wants and wishes in the music against what is provided from the amp and speakers. This extends into the hifi world as well.

#### *Inside the Power Amp: New Techniques for Removing Sonic Signatures and Improving Current*

Echoes, rings, zings, tizzes, booms, glows, thumps, huffs, fizzes, zips, and any other creative words we find when listening to audio can all be types of, for lack of a better term, 'ringing' or somewhat hollow or 'bouncing' interactions within any piece of electrical audio equipment. The opposite term from all of this is 'properly damped'.

Damped, in this definition, refers to anything which can send a musical wave through it without creating excess anomalies as well as without removing or deadening the actual musical wave itself.

A properly damped circuit, at all of its junctions, means that the interactions at that particular spot do not exhibit these different ringing nodes, however pleasing they can sometimes be in their sense of liveliness and excitements.

The critical notion to consider in the power amplifier is the current, rather than the voltage or frequency sweep itself. If the entirety of the current forces in the amplifier that end up pushing the loudspeaker have 'echoes', like waves of water that slightly bounce off of walls, the result is what we all have heard – different sonic signatures that come out in different ways. Damping in the layout and construction of the entirety of the power amplifier is the key method to great and balanced musical sound.

#### *Oil-Damped Power and Current Paths*

First, the power supply and power nodes are damped using oil-bath capacitors, and each line is independent from the main power supply to a circuit node. This means that currents from each part of a circuit do not influence any other part. The oil damped capacitors by Duelund are far superior in comparison to any film or 'dry' capacitor in the amplifier, and just as one can imagine – a part soaked in oil is mechanically and electrically damped and 'vibration free' in itself from signal flowing across its inner surfaces, which can lead to crosstalk and 'singing' across the power lines.

#### *Solid Core High Purity Copper, Oiled Cotton-Lacquer Wiring*

The power and ground lines themselves are solid core, oil-damped cotton-lacquer untinned high quality copper wire. Stranded wires always 'chatter' between the strands as current and electrons 'jump' from one touching strand to another, causing signatures and smearing, and solid core is always preferred due to this effect. The use of oil damped cotton wire helps reduce the 'line singing' itself by proper damping, and furthermore reduces the effect of 'dielectric absorption' that other wires, which include synthetics such as PVC and Teflon, which cause their own sonic signatures, even when they boast low absorption specs. In short – electrically inert oil has been found to be a long lost key to balancing sound within the amplifier's wiring, the current therein, and the power delivery itself.

As a mention, it was personally found that single or long-crystal 'OCC' copper is not preferred as internal wiring in a power amplifier. Hollow sound signatures seemed to always occur when used in the power circuits, even with a variety of insulations. It is assumed that these 'long crystal' copper extrusions somehow cause or have some sort of internal echo inside of themselves which did not lead to balanced and cohesive audio. They were rather fantastical, however, in large ways!

#### *Independent Ground and Power Runs*

As previously mentioned in brief, cross-talk and shared current through any connection in a power amp causes aberrations for those components. Every node that receives power or that goes to ground receives its own fully dedicated connection. If two parts were found to use the same voltage source or ground current path, even when 'bypassed' for the sake of frequency stability to ground, the reality of the differing phase and time currents needed for those stages result in simple sonic oddities that are eliminated by giving everything their own path.

#### *Point-To-Point Wiring – Eliminating Circuit Board Traces*

The current and interaction therein between every part in the power amplifier was then found to need investigation. An amazing result was found – which is that circuit board traces, being flat copper, have a sonic signature due to their nature. Using the round leads of the parts themselves instead of using flat copper traces sounded as you'd imagine – yielding a more round and full-bodied musicality. There are only three traces used in the Model T, due to heat and assembly considerations.

Point-To Point construction requires using hand-built and hand-soldered methods – parts are assembled 'leg to leg' in an important order during the build. This isn't possible by machine or automation. This historically goes back to tube equipment used throughout the 1950's and 1960's, most of which is still heralded today as the best ever built.

#### *External 'Home Run' Ground Post – Rear of Amplifier*

A dedicated external binding post on the rear of the amplifier is provided for a dedicated 'home run' ground that runs separate from the AC power cable. The main ground of an amplifier provides more than safety – it finishes the establishment of a quiet connection to Earth Ground outside. In many 'audiophile' power cables, the AC power lines are often braided together with the included ground wire. This is done to reduce the overall effect of the wall AC (alternating current) interacting with the ground wire.

A quiet ground is easiest and best made by separating the ground physically from the AC power cord. This is a traditional method used by the telephone industry back in the switchboard days, and was found to be one of the 'last links' for great sonic performance. The ground post should simply terminate into it's own socket directly into a wall outlet if possible. It is not necessary for the ground post to be connected to wall ground – however, for modern electrical code and general safety, it is a requirement.

#### *Less 'Transistor' Sound using High Voltage Current Sourcing rather than Transistor-Assisted Current Sourcing*

Just as written, it is simply found that more transistors always seemed to impart more of the sound of the transistor itself into the audio circuit – even when it is used 'around' the audio circuit, in the power and current source sections necessary for good smooth operation of the audio circuit.

A high voltage supply and high quality damped resistors were found to always be preferential than using a transistor-based active design, and the delicate pitfall of the transistor's 'action' itself imparting a sound, given that resistor noise itself was not a concern in the Model T.

Less transistors make for less transistor sound.

#### *A fully 'BJT' Transistor Design – No JFETS, no MOSFETS*

This was simply found to be more balanced and musical, and intrinsically needing less 'support circuitry' around them for proper balanced operation.

#### *DC-Coupled Inputs and Outputs – No Capacitors in the Signal Path*

Because of the current sensitivity inside of the chassis itself, it was found that the power amplifier itself is best connected 'DC Coupled'. This means that there are no capacitors in the signal path of the amplifier. However, this does mean that no DC voltage can come from the preamp or preceding equipment that feeds into the power amplifier. It is a 'best practice' in the industry anyways that the preamp provides the output capacitor, or is responsible for providing a 'zero' DC voltage to the power amplifier. If a capacitor was provided in the amplifier and in the preceding preamp, the result would be undesirable.

Specifications:

*150W Class AB Peak Watts into 8 Ohms before 1% THD  
8-16W Small Signal Class A Watts (thermally adjusted)  
Minimal global feedback (~10dB) used*

*Input Impedance: 15k $\Omega$*

*BJT Transistors only – no FET's, no MOSFET's*

*Wired Lead To Lead, Point-To-Point – Only 3 circuit board traces used in the entirety of the amplifier*

*Premier oxygen-free solid core oil-damped copper wiring used throughout*

*Power filtering accomplished using premium 'foil-in-oil' capacitors by Duelund Coherent Audio*

*DC Coupled, input to output*

*\*Use AC (capacitor) coupled preamp sources only!\**

*Maximum Input DC Offset Allowed: +/- 5mV*

*Amplifier Damage May Occur With a non-AC (capacitor) Coupled Preamp!*

*Please read Owners' Manuals and/or Check Preamps with a Voltmeter to ensure proper working conditions prior to connecting*

*Dimensions: 16"L x 8"W x 10"H*

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