

KLEI Harmony (Bullet) Plug Technical Paper

The KLEI Harmony (Bullet) Plug takes the highly acclaimed original Eichmann Bullet Plug to a new level of performance and sophistication. It offers design enhancements and new materials. As the next generation Bullet Plug, it also extends and builds on the original plug's superiority over traditional RCA designs, and represents a wholesale rethinking of a connector introduced over eighty years ago by The Radio Corporation of America, as well as an improvement over the original Bullet Plug introduced in 2000.

It is our contention that while the RCA plug is the standard connector in the audio/video industry, it achieves this status not because it is the best possible choice for its intended use, but more by reason of default than any other. The original Bullet Plug set the industry on its ear by offering radical improvements to the venerable RCA plug both in design and performance, and Bullet Plug acclaim was worldwide.

History

Looking to take his effort to the next level, Keith formed KLEI (Keith Louis Eichmann Innovations) in 2013, and committed himself to improving his original Bullet Plug and to creating an RCA connector with superior conductivity, enhanced signal integrity, and higher resolution. Since the RCA jack is so widely used—connecting virtually every component in an audio/video chain and linking entire systems through a network of interfaces—any improvement in its performance, especially over that of the Bullet Plug, would be significant.

To recap--a first evaluation of the traditional RCA jack showed obvious metallurgical shortcomings. Most connectors, even those marketed as "deluxe" upmarket RCA jacks, are made from nickel and gold plated brass or phosphor bronze with a conductivity rating typically less than 28% IACS (International Annealed Copper Standard). As a comparison, the high purity copper used in the vast majority of interconnect cables has a conductivity rating of 100% IACS. Because of this low conductivity and the use of three disparate metals, it is our contention that standard RCA jacks—even expensive, flashy ones—compromise electron flow and diminish the performance of the components they connect.

Nickel is added to the brass or phosphor bronze substrate solely to provide the jewel-like appearance that makes expensive connectors look expensive. While achieving the desired appearance, this comes at a cost—degraded sound or poorer picture quality, as electrons flow through three dissimilar metals with differing electrical and conductive properties.

Conductivity

Metal conductivity in IACS percentages, referenced to copper at 100%, are as follows

- Silver – >105%
- Copper – >100%
- Silver (Machinable) – 92.5% ~ 96%
- Tellurium Copper (Machinable) – 90% ~ 95%
- Gold – 65 ~ 75%
- Aluminium – 60 ~ 65%
- Bronze – 15 ~ 48%
- Beryllium (low/high copper content) – 17% ~ 43%
- Rhodium – 35% ~ 38%
- Brass (low/high copper content) – 25% ~ 37%
- Tungsten – 31%
- Nickel – 24%
- Palladium – 16%
- Platinum – 16%
- Tin – 15%

The KLEI Harmony (Bullet) Plug pins are formed using proprietary high conductivity metallurgical process, with the resulting conductivity being >101% IACS to even >106% IACS. This provides over 360% greater conductivity than the gold-plated brass connectors used in the vast majority of deluxe RCA jacks. Proven metallurgical choices at KLEI result in better signal transfer, and electron flow that is consistent with the highest quality interconnect cables.

Traditional connectors impose a serious compromise to conductivity at the transfer point, component to component. KLEI's proprietary high conductivity forming processes eliminate the nickel/gold plating typically used as the third metal in a confusing composite in these standard RCA jacks.

The company's processes are controlled and supported via mathematical modelling, which creates an architectural and metallurgical relationship between the ground and signal pins. This provides a noticeable *sonic* improvement, when compared to other RCA plugs, and from Harmony Plug model to Harmony Plug model. The metal complement, mass, and other critical parameters, are derived via KLEI's signal to ground mathematical formulae.

Extrapolation, testing, and modeling indicate that our IACS percentages are equivalent, and even superior, to pure (solid) annealed copper ($\geq 100\%$ IACS), even pure (solid) annealed silver ($\geq 105\%$ IACS). They are noticeably superior to Keith's previous copper and silver Eichmann Bullet Plugs. While the metallurgical understandings are significant, paramount, and crucial, the second observation regarding the traditional RCA jack turned out to be ground-breaking. It related to a problem, overlooked for decades, that is intrinsic to the RCA jack's design—something as fundamental as the architecture of the jack itself.

Architecture

The RCA ground collar, which in traditional designs encircles the signal pin, acts as a conductor that transfers electrons from multiple directions between the centre pin and its surface. It is prone to small out-of-control turbulences called eddy currents. These turbulences are nothing less than chaos, exacerbated by the non specific point of ground in the RCA jack's design, since an entire surface encircling the centre pin forms the electrical ground. Capacitive reactance and micro-arcing are additional artifacts of this architecture.

The Harmony (Bullet) Pug design addresses these issues and offers an elegant—and arguably major—redesign to the RCA jack, and in itself is fundamental but extensive. Rather than encircle the centre conductor pin with a formed metal collar as ground, we opted for a single point ground contact similar to star earthing (grounding) in high-end electronics. Our new design, featuring single point ground connection and optimised shape, mass and thickness of the conductive elements, eliminates every vestige of eddy current turbulence, capacitive reactance, and micro-arcing.

We believe we have, with this new RCA blueprint, solved a series of problems that collectively degrade audio/video performance and that do so in an additive manner. The importance of this innovation and redesign cannot be overstated. Its ramifications extend to every RCA interface in which high quality signal transfer is an issue. Extensive listening and critical comparisons played a major role in the evolution of the design, confirming at every juncture the audibility of properly applied science in even the area of RCA connection.

The KLEI Harmony (Bullet) Plug, which can be viewed as the next generation Eichmann Bullet Plug, is the sonic culmination of Keith Eichmann's proprietary signal to ground formulae as applied to the architectural and metallurgical relationship between the signal and ground conductors.

In summary, KLEI's Harmony (Bullet) Plugs represent a further innovation and a totally refined approach to RCA connection. Its innovations and refinements include:

1. The conductive pins incorporate highly conductive materials, such as copper and silver
2. KLEI's proprietary mathematical modelling optimises mass, thickness, and composition of the conductive pins, resulting in enhanced electron flow
3. The conductive pins are arranged to maintain a consistent maximum distance from each other which further improves capacitive and inductive reactance effects and minimizes cross-talk EMF effects that occur in all other phono/RCA plugs. This allows for significantly higher characteristic impedance, than conventional RCA plugs, and makes the Harmony (Bullet) Plug an ideal connector for digital Interconnects requiring RCA connectivity in either 50, 75, or 110 Ohm impedances and low jitter
4. The conductive pins are now much stronger and allow for small and large conductor wires to be soldered to them

5. Further rejection of the idea of using a formed metal collar to encircle the centre pin and serve as the reference to ground, which eliminates co-axial inductive reactances
6. Single point star grounding, instead, to eliminate eddy current distortions, capacitive and inductive reactance, and micro-arcing
7. The ground pin includes thread teeth to star ground a conductive housing
8. Addition of an anti-short shield
9. The head assembly jaw structure has been redesigned and improved to allow an easy snap-like connection to an RCA socket, but still ensuring an ultimate connection
10. The housing assembly uses 2 screws to secure the cable sheath to the Harmony Plug housing
11. An extremely high temperature melting point polymer, with excellent electrical and mechanical characteristics, has been used

Standard RCA jacks	KLEI™Harmony (Bullet) Plugs
<p>Gold plated brass or phosphor bronze with a conductivity rating of often less than 28% IACS (International Annealed Copper Standard).</p>	<p>Contact pins formed using proprietary high conductivity metallurgical processes, provides ultra-high conductivity (>101% IACS and even >106% IACS).</p> <p>Provides over 360% greater conductivity than gold plated brass binding posts.</p>
<p>Solid signal pin. Metal collar completely encircling pin as electrical ground. Total thickness and mass not optimised for signal integrity. Sound quality and electron flow compromised.</p>	<p>Hollow signal pin of ideal thickness and mass</p> <p>Provides a superior electron movement/current flow, and minimises skin effect issues.</p> <p>The result is a cleaner, more open sound, with even further detail.</p>
<p>Heavy plating of gold over a nickel substrate. This is often a cause of poor sound quality as electrons flow through 3 dissimilar metals with differing electrical and conductive properties.</p>	<p>Metallurgy process minimizes oxidation.</p>
<p>Ground collar surrounding centre pin has co-axial inductive reactance effects, which have detrimental effect on electron flow. Eddy current turbulences created as a result of non specific ground contact. Loss of signal integrity due to capacitive and inductive reactances and micro-arcing.</p> <p>Provides a plug with poor and reduced signal transfer resolution.</p>	<p>Patented single point ground pin, with easy connection, and a single point conductive Housing ground.</p> <p>Eliminates eddy-current turbulences, co-axial inductive reactance, capacitive reactance, and micro-arcing.</p> <p>Provides a plug that is linear to over 150KHz, which allows excellent sound and video signal quality, signal integrity, electron flow, and extremely high signal transfer resolution.</p>



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