

Mysteries of Vintage Mic Repair

Dead Caps, Dead Capsules and Schmitt Triggers—Oh My!

Back in February, I set out to compare two versions of the AKG C 414 microphone series, and that column evolved into a “history of” piece. I felt the historic trail was necessary to add depth and background to the comparison. I am still on that trail.

With this, I gained some insight into the AKG C 12 and its made-for-Telefunken Ela M 250/251, the heart of which is AKG’s CK 12 capsule. The Euro versions have an AC-701/k miniature triode (with soldered leads) while the “E” (Export) version, such as the C 12, uses half of a 6072 (a standard 9-pin tube). The circuitry of the C 12 is nearly identical to that of the Ela Ms.

THE “NU” 47

The C 12A “detour” also took me into Nuvistor territory. Introduced by RCA in 1959 for its New Vista color TV tuners, this transistor-sized vacuum tube was quickly embraced wherever a high-performance miniature tube was required. And though it may not have been the best retrofit for the VF-14 (used in the Neumann U47/U48), it was during the research process that I found Neumann’s conversion documentation. This solved a mystery that I had described in the May ’06 issue—a U47 power supply with un-German amounts of extra juice.

After that column was published, I realized that the power supply in question had not been *mis-repaired*, but had been modified to drive a Nuvistor U47. The fact that it was driving a stock U47 meant that somewhere along the way, it had become separated from its mod-mate. This “discovery” finally gave closure to what was fortunately not a catastrophic failure. If you own a U47 with a VF-14, then make sure your power supply is delivering 105 volts (with the mic connected and warmed up). Full documentation of the U47 and its power supply is available at www.tangible-technology.com.

AKG

Most tube-based audio gear is fairly easy to repair. Vintage valve mics, in particular, are so simple that a



The current C-414 uses surface-mount components, but adds additional polar patterns and filter settings.

vacuum tube data manual—plus pencil and paper—will do in a pinch. There is typically only one gain stage, and the external power supply generates all of the required voltages. A solid-state mic must derive all needed “juices” from phantom power, a finite resource that must be efficiently managed.

Early solid-state circuit designs were nearly as simple. (See Fig. 1, the AKG C 414, circa 1970. For Figs. 1 and 2, the pad [C 414] and highpass filter [P48] have been removed for clarity. Between the capsule and the output transformer (aka, the head/output amplifier) are one FET and one transistor. In addition, the DC-to-DC converter comprises a single transistor oscillator, a transformer and three diodes configured as a voltage “trippler.” Now, a surface-mount Hex “Schmitt Trigger” IC is used to generate the capsule-polarizing voltages (the RØDE NT-1A), and for many modern mics, the count of active components—transistors and FETs—is well beyond a dozen.

The most versatile mics tolerate the widest range of available phantom power (9V to 52V), the C 414 EB (circa 1977) being one example, with the output amp consuming most of the available current. However, the C 414 EB-P48 (circa 1982) has no DC-to-DC converter, so it

must have 48V phantom power (via R7 in Fig. 2) to deliver a usable polarizing voltage.

TROUBLE AT THE CONDENSER CORRAL

Having amassed several versions of the 414 (some for repair, others for parts), my quest for schematics began. The introduction of the C 412 in 1970 inspired evolutionary changes that were intended to solve known headroom issues (a pad), add features (low filter, more polar patterns) and take advantage

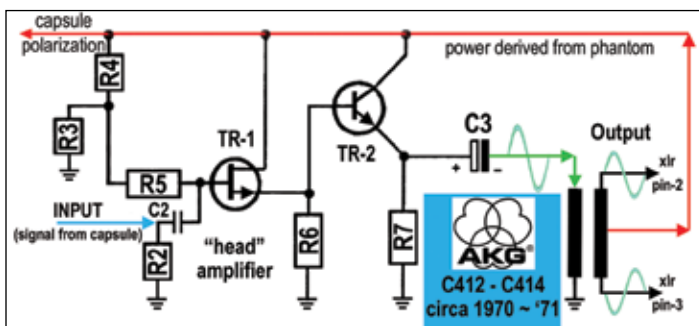


Figure 1: The C 414 head/output amplifier

Raise Your Wireless Standards



Today's PA system requirements demand superior sound to accompany advanced lighting and staging techniques. Trust Lectrosonics and their **Venue Modular Receiver** to deliver the sound, with rock solid RF performance.

The Venue UHF system operates with Digital Hybrid Wireless™ transmitters, and a variety of analog transmitters. The receiver uses a host assembly that includes:

- Six channels in a single rack space
- Built-in antenna multicoupler
- Computer interface included with USB and RS-232 ports
- Compandorless Digital Hybrid Wireless™ technology

For more information, call Location Sound Corp., an authorized Lectrosonics dealer: (818) 980-9891 or outside CA at (800) 228-4429



SERVING THE PROFESSIONAL AUDIO INDUSTRY FOR OVER 25 YEARS.

www.locationsound.com

SALES • RENTAL • SERVICE

Location Sound is a supplier of professional audio and communications solutions for film, video, broadcast, business, institutional and recording applications.

READ...WATCH... LISTEN...PLAY!

Introducing the new and improved mixonline.com!

Mixonline.com is the one-stop destination for all of your pro audio news and features—from daily news to newsletters to in-depth features straight from the *Mix* archives.

Read...Watch...Listen...With the fresh design, new navigation and search features, and a bounty of new content for your eyes and ears, the all-new mixonline.com is now your one-stop destination to just...Play!

- › Online-only feature stories on producers, artists, tours, and new products
- › Up-to-the-minute blogs, videos, and podcasts
- › Interactive reader polls and feedback forums, ie. TalkBack

Plus, find all of the information you need with [enhanced categories](#) for recording, live, post, gear, learn, studio; [enhanced navigation](#) with our annual directories for AES, NAB, NAMM, Education; and our newest member, MixBooks.

IT'S TIME TO PLAY. Visit mixonline.com

TECH'S FILES ↓

of new technology. Remember that many of these features previously resided at the power supply and became more vital as the mic moved closer to the source and rock 'n' roll SPLs were on the rise.

The C 414 (circa 1971) looks like a C 12A. Of the pair in for restoration, one had poor low-frequency response. Capacitors degrade over time—interstage caps “lose” capacitance, the LF output suffers—so the C 414 problem (C3 in Fig. 1) was typical, obvious and quickly resolved.

A C 414 EB-P48 initially had no output because the output transformer (U54) was damaged. Once the output transformer was replaced, it was again possible to “hear the grille” when it was scratched. The P48 version has two PCBs on each side of the mic body: one for the head amp and polar patterns, the other for the output amp and highpass filter. Conveniently, the interconnecting wires between the two allow you to interrupt the head amp signal so a test signal can be injected. This initially gave the impression that the output amp was okay, leading me to suspect (and troubleshoot) the head amp (a dead end).

Electronic components can be drawn differently; check out the FET (TR-1 in Fig. 1 and T3 in Fig. 2). The P48 version had part values on the schematic, so scouring the Web for data sheets and available stock revealed that all but T3 was available. The C 414 “documentation” comprised only a schematic—it had become separated from its parts list. Fortunately, no critical parts were required.

In the product literature, the P48 consumes a mere 1 mA of current, but this broken P48 had a 20V drop across R7—almost 10 times the specified current draw! I pulled the output amp (T4), put the ‘scope on the head amp PCB and—voilà—signal! All of the noises in my shop were now clear. I was at once overjoyed with progress and determined to bring this journey to a happy conclusion.

Comparing the C 414 with the P48, the output-transistor TR-2 is an emitter follower, meaning it does not make the signal “bigger” (as would be the case with voltage gain) but does make it more powerful (current gain). The load (emitter) resistor is R7, C3 blocks the DC voltage but passes the audio signal on to the output transformer.

By contrast, the P48 output transistor is T4, and its load/source resistor is T3, a FET configured as a current source (a dynamic impedance that optimizes the load on T4). After replacing T4 and T3, I *finally* checked the output cap (C11) and it was shorted. (Boy,

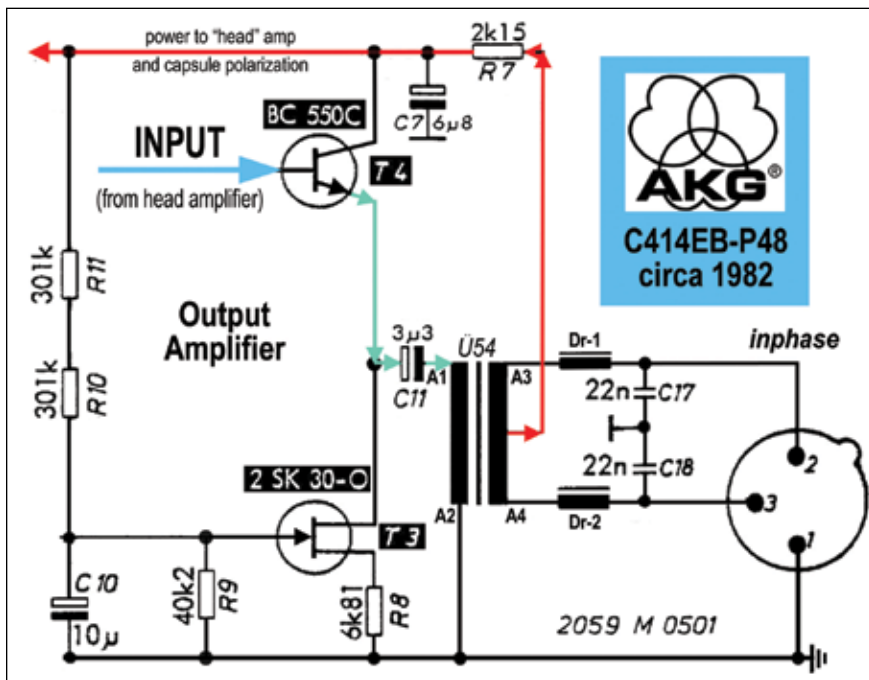


Figure 2: The C 414 EB-P48 output amplifier

did I feel stupid!) This caused the current to flow from T4's emitter straight through the primary of U54, the output transformer—hence the additional current consumption.

With the cap replaced, everything returned to normal. Then I cleaned all the flux off the

PCB because over time, flux absorbs moisture and begins to conduct—something that high-impedance circuits in mics (and 1176 limiters) do not like. After listening for noise and sorting through a few components, the amplifiers were suitably quiet.

END CAP

Perhaps the saddest of my AKG experiences is that none of these mics had their original “brass” CK-12 capsules. All had the “nylon” version, part number 2072-Z-0005 (or 0009), including one sold on eBay claiming an original CK-12 capsule but arriving with a nylon capsule with the diaphragm hanging loose. To my surprise, after cleaning the debris from the backplate and the backside of the diaphragm, I popped all the pieces together and got sound, including the figure-8 null.

Despite my bone-headedness, this journey taught me a lot. Had I found the bad cap straight away, I might not have scrutinized any of the schematics as closely. Now I have greater appreciation for how these mics work and for the technical evolution from version to version. I can't tell you which one sounds better, but the older styles definitely have a softer overload characteristic. ■

Eddie would like to thank Pat Burns at AKG and all of the Web's techno-history buffs, including Ashley C. Styles at www.saturn-sound.com, S.O. Coutant at www.coutant.com and Nick Eipers at www.nickeipers.com.

From console to desktop...

Oxford
Plugins

From strength to strength...

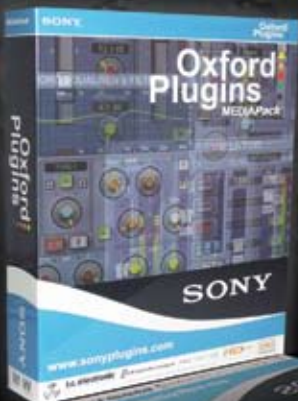
Using many of the same algorithms as the original Sony OXF-R3 digital mixing console, Sonnox's Oxford Plug-in range has been carefully developed with a no-compromise approach, to be THE very best in audio signal processing, where sonic quality means everything.

The acclaimed Sonnox range including the OXF-R3 EQ, Dynamics, Inflator, Transient Modulator, Reverb, Limiter and Restoration Tools plug-ins have become today's standard tools of choice for the quality conscious audio professional.

To find out why, download your Pro Tools, Native or Powercore demo versions today.

www.sonnoxplugins.com

Sonnox



Vintage Mic Repair Never Really Ends

Pull Back the Body to Reveal the Cables

I wasn't planning to write three articles about vintage AKG mics before summer kicked in, but what's on the bench trickles down. This month, the problems are less electronic and more organic. To cut to the chase, when a stereo tube mic has cable issues, it's not a quick trip to the audio store.

THE TOUR BEGINS

After servicing a mic, I usually record a test vocal alongside a "reference" mic, and if time permits, I'll also use it during a session. Even without the comparative analysis, classic mics have an instantly recognizable quality. On room tone, there's a low-frequency extension that makes you feel at one with the space, and then there are those in-your-face vocals that sound thunderous at three feet. There are simply too many things I want to know more about, and having two or more of the same mic helps quantify the primary characteristics, such as output level, "tone" and noise. Of course, with any vintage gear there will always be variables, whether due to production changes, factory-customized options, user mods, age or the result of repairs made over the course of several decades.

To recap (no pun intended) my own Austrian Mystery Tour, it began with a troublesome, somewhat abused solid-state AKG C 414 EB-P48 and the observation that tube mics are easier to service because their circuitry is far less complex. Typically, elderly capacitors are suspect. But unless a failure is obvious, I'm inclined to test first before attempting a wholesale replacement. Some of the capacitor choices in the AKG C 24 were made for me

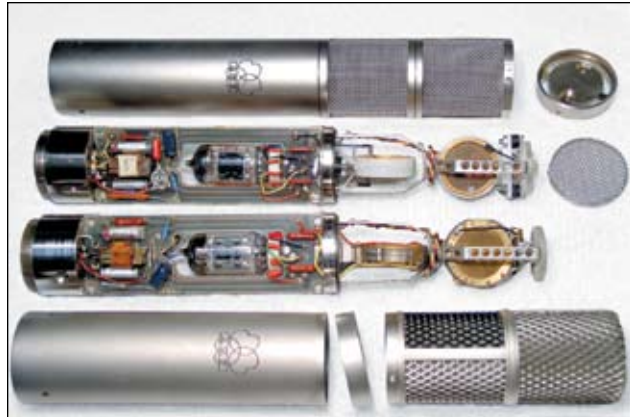


Figure 1: two versions of the AKG C 24—serial number 443 (bottom) with the original brass CK-12 capsules and serial number 986 with the "newer" nylon capsules

due to space limitations in the mic, but I also replaced the electronics' carbon resistors with low-noise, metal-film types to minimize the variables when it came time to evaluate tubes.

Of the three C 24s I'd seen so far, two were Mk-2 versions like the one at the top of Fig. 1. One came with a modified N24A (Mk-1) power supply and a nonstandard (but factory-looking) multipin connector at the base of the mic. The C 24 at the bottom of Fig. 1 is an Mk-1; both mics in that photo came with the newer N24S power supply. (I found schematics for three power supplies, two of which had an external box for pattern control.)

BALANCING ACT

My first C 24 encounter was with an Mk-2 with a bad cathode-bias capacitor that caused the channels to be unbalanced. The older C 24 also had a balance issue that was not resolved by changing the bypass caps—surprise. Fortunately, I had a "compatible" Mk-2 for comparison. Both mics and supplies were swapped until the cable revealed a problem at the power supply end.

I expected to be back in business after finding the break and cutting back past the damage. The results were better but not fabulous, so I used an ohm meter while massaging the cable from end to end. There was no "smoking gun"; two of the conductors had higher resistance than the others, and I was unable to localize the troubled area. I didn't want to whittle the 35-foot cable down to a stub.

Even though years of abuse had eventually taken their toll, the inherent cable quality was still obvious—very similar to what Neumann supplied back in the '60s and '70s. The shield was double spiral-wrapped copper and easy to work with. (See Fig. 2a.) The other mic had a 70-foot cable with a copper-braided shield and loosely fitting,

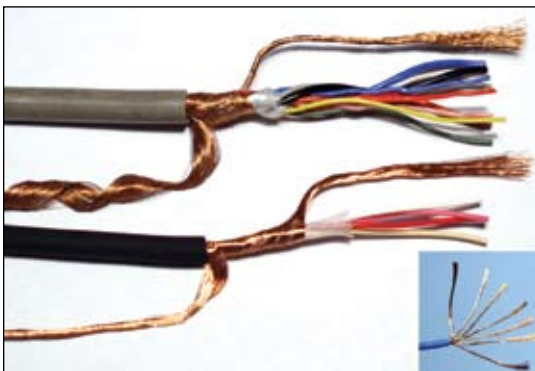


Figure 2a: The damaged cable (above) included a dual spiral-wrapped copper shield, three heavy-gauge wires for high current (inset) and eight thinner conductors for audio, pattern, B+ and spare. Below, Gotham Audio's standard mic cable (GAC-4/1) shows a similar construction style.

color-coded, cloth-over-plastic insulation. It was equally beautiful in its execution, but as you may know, braided shields can be hard to work with (although you'll find a tip in Fig. 2b).

orchestra and reach the control room. The search was on for a replacement cable.

Gotham Audio manufactures GAC-7, a 7-conductor cable for mono tube mics that's similar in construction to the original.

cable has two pairs each of 22 AWG, 26 AWG and 28 AWG for filament, audio and high voltage for the plate and polarizing voltages, respectively.

The C 24 requires a minimum of nine conductors and a shield. Belden had three grades of computer-data cables, each with six twisted pairs (for noise immunity). The extra wires could be paralleled to handle the extra current required by the filament.

At this point, I really wasn't in the position to be picky; in addition to being technically suitable, the new cable would have to fit into the connectors. I also knew the data cables would not have the "feel" that we've come to associate with a fine mic cable—that less-than-technical audio requirement of "cable amnesia," a lack of memory that makes cables easy to wind and unwind.

Thinking there was no alternative, I was ready to buy without samples when I called Kelly Kay at Josephson Engineering to ask for advice. He provided a short Mogami "mono" sample and suggested I call Marshall, Mogami's U.S. distributor that also markets MXL mics. Phil Tennison at Marshall had an 8-pair cable with a braided shield—not quite as sexy as the double-spiral shield, but I was back in business.

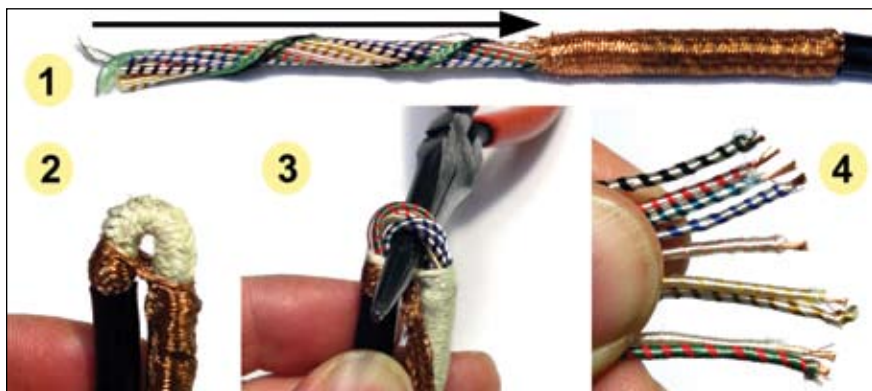


Figure 2b: How to prep a braided shield. **Step 1:** Compress the shield as far back as it will go. **Step 2:** Slowly bend the cable while poking through and stretching the shield until the underlying layer is exposed and a loop is created. **Step 3:** Poke through the loop with a rounded, blunt tool until the wires can be pulled through. **Step 4:** Separate and prep the wires for soldering.

GIMME CABLE

At first, I hoped the long cable could be cut in half, but the customer needed the full 70 feet so that the mic could be flown over an

Five of the conductors are 26-gauge (AWG), each comprising 72 strands, while the other two filament conductors are 20 AWG with 252 strands. Mogami's W3172 6-conductor

From console to desktop...

**Oxford
Plugins**

From strength to strength...

Using many of the same algorithms as the original Sony OXF-R3 digital mixing console. The acclaimed range of plug-ins from Sonnox has been carefully developed with a no-compromise approach, to be THE very best in audio signal processing, where sonic quality means everything.

The acclaimed Sonnox range including the OXF-R3 EQ, Dynamics, Inflater, Transient Modulator, Reverb and Limiter plug-ins have become today's standard tools of choice for the quality conscious audio professional.

To find out why, download your Pro Tools, Native or Powercore demo versions today.

Sonnox Plugins - formerly Sony Oxford Plugins



Sonnox

www.sonnoxplugins.com

SNAKE EYES

At each end of the cable is a 12-pin connector, of which nine pins are essential; the tenth "connection" parallels the shield via the metal shells. I am not sure that any of these mics had its original cable—the style didn't match the mic's vintage—but work had obviously been done: Screws were mismatched, threads were stripped and an entire strain relief was missing. (Compare Figs. 3a and 3b.)

The male end of the cable mates with the power supply, and as I pondered how to do a nice clean job, it became evident that one strain relief was "lost." There was almost no clearance between the strain relief and the solder cups. Figure 3a shows the newly installed Mogami cable with the original strain relief. To make what little room there is, it was necessary to trim 1/8-inch off the solder side of the male plug (plastic and solder cups).

Figure 3b shows a strain relief fabricated from an inverted rubber boot from an XLR combined with a soft piece of red plastic. Screwing the end cap onto the clamshell/metal housing provides enough pressure to secure the cable. I wired each connector twice because my first attempts

weren't very pretty and there was some stress when trying to make everything fit into place.

STAY ON TARGET

You might think I'm out of my mind, but this is what it takes to establish consistency, and the job wasn't done yet. The connectors were defluxed, the silver contacts deoxidized and treated with Caig ProGold. There was a polarity issue on one channel (the power supply had been converted from Tüchel to dual-XLR connectors) and a funky polarity switch.

Although the tubes that came with the mics were acceptable, I checked these for noise over a two-day burn-in period and auditioned several other tubes. The biggest challenge with dual-triode tubes is finding equally "quiet" sections, particularly avoiding "shot noise," a rocky, low-frequency sputtering sound that's more annoying than steady hiss. Several of my NOS tubes tested well in a C 12 (where only half the tube is used), but suffered from this disappointing ailment. One surprise was an Electro-Harmonix 6072/12AY7; there were no rocks and the hiss seemed a bit darker and less obvious.

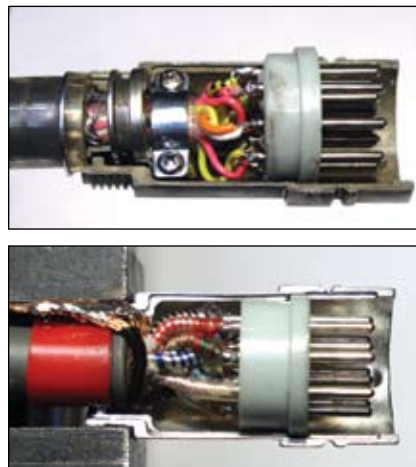


Figure 3a (top): male C-24 plug with original strain relief. Figure 3b: male C-24 plug with home-brew strain relief.

So this repair chapter is over—almost. After each repair and restoration, I anxiously await customer response. I sometimes call months later to see how things are going. But sometimes, no news is good news. ■

Audio files for this comparison can be found at mixonline.com and www.tangible-techology.com/music/mics/c24.html.

IF GROOVE TUBES MICROPHONES ARE PRO AUDIO'S BEST KEPT SECRET, OUR SECRET KEEPERS AREN'T DOING A VERY GOOD JOB.

HARDTOP **CONVERTIBLE** **GT30** **GT40** **GT50** **GT60** **GT57** **GT67** **MD1B FET** **MD1B TUBE** **VELO 8**

GREG LADANYI: "I turn to GT mics every day in the studio."
MICHAEL WAGENER: "GT mics have become an essential part of my setup."
NEWMAN SCORING STAGE: GT tube and FET microphones in use every day for orchestral scoring sessions.

Don't miss out on the secret mic of the world's best engineers and studios! GT microphones are available at the best pro audio dealers around the world.

www.groovetubes.com **Hear the Difference™**

© 2007 Groove Tubes LLC. All Rights Reserved. GT-MIAAC2-1K2