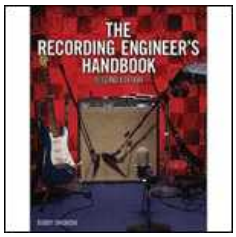

The Recording Engineer's Handbook, Second Edition

by Bobby Owsinski

Chapter 2: Common Microphones

It used to be that every studio had virtually the same mics in their microphone lockers. Not so much because that's all that was available, but because that's what every engineer used. Today, there's a wide variety of mics that will do the job well that range from the all-time classics, to new versions of the classics, to some new mics that are quickly becoming standards, to some very inexpensive mics that still do a great job. Let's take a look at each category.

Classic Microphones

One of the questions that I always got when I was teaching dealt with what the microphones that I frequently talked about actually looked like. It's one thing to speak abstractly about placing a 47 FET on the kick or C 12As as overheads, but unless you know what they look like, you're totally in the dark. Likewise, this book discusses the use of various "classic" microphones, so it seemed appropriate to include a section with not only some pictures, but a bit of history as well.

Classic mics refer to the tried and true. Although they may be old, they have proven over time to provide the sound that artists and engineers have found to be superior. Although one of the goals of this book is to promote the theory that good technique and placement alone are sufficient in getting good sounds, a set of microphones is an important set of tools. Certainly, these mics have proven to be successful tools over the long haul, and having one or more at your disposal will definitely help you in your quest for excellent-sounding recordings.

Michael beinhorn *To me, if you are able to have access to them, you can't really have enough of them.*

RCA 44–Style Ribbon Microphone

Developed in the late 1920s by the famous audio scientist Dr. Harry Olson, RCA's first permanent magnet bidirectional ribbon microphone, the 44, entered the market in 1931. The 44 had a relatively low cost, which helped propel it to its legendary success and vast market penetration of the time period.

The 44 series began with the 44A, which was a relatively large microphone mostly because it used a large horseshoe magnet around the ribbon. The slightly larger 44B was introduced in about 1938, with the 44BX model soon after. All were bidirectional with a frequency response extending from 30 cycles to 15,000 cycles. In contrast with the 44B, the 44BX had the ribbon mounted more toward the rear of the case, which gave it a smaller figure-8 lobe on the back side. The 44B was finished in a distinctive black with chrome ribbing on the lower portion, while the 44BX was an umber gray and stainless steel. All versions of the mic featured two jumper positions within the case—V (voice, which substantially attenuated the low-frequency response) or M (music).

The 44BX was manufactured up to around 1955. The 44B/BX has become one of the classic influences in microphone technology, is still in demand today, and has one of the most recognizable shapes in the world. (See Figure 2.1.)

Figure 2.1: RCA 44BX.

RCA 77 Unidirectional Ribbons

Realizing the need for a directional mic, Dr. Olson developed the unidirectional 77A in the early 1930s. The 77A, B, and C models utilized double ribbons to achieve the unidirectional pattern. Improvements in magnet material allowed a significant reduction in size starting with the B model. The C and D models were capable of multiple patterns. The differences between the 77D and 77DX models are that the 77DX had an improved magnet and transformer that produced a little more output. A screwdriver-operated switch was provided at the bottom of the lower shell with positions marked M for music and V1 and V2 for voice. This switch inserted a hi-pass filter into the circuit that attenuated the low frequencies.

The 77 was discontinued around 1973, but its legacy continues because its shape remains the graphic icon for microphone that is recognized worldwide. This mic can still be seen today on *Larry King Live*. (See Figure 2.2.)

Figure 2.2: RCA 77DX.

Neumann U 47

The original U 47, which was first marketed in 1948, was actually distributed by Telefunken. It was the first switchable-pattern condenser microphone, capable of switching between cardioid and omnidirectional patterns. It uses the 12-micron-thick M7 capsule and VF-14 tube amplifier, which soon became the most popular of all U 47 capsule and amplifier combinations. (See Figure 2.3.)

Figure 2.3: Neumann U 47. Courtesy of Neumann USA.

The U 47 was updated in 1956 when the capsule finish was changed from chrome to matte and the body length was reduced by about 3 inches. Also, the U 48, a cardioid/bidirectional version, was introduced that year. Two years later, Neumann's distribution deal with Telefunken dissolved, enabling Neumann to distribute their own products under their own name.

Neumann U 47 FET

Although now the *de facto* standard outside kick mic (if you can find one), the U 47 FET started its life in 1969 as Neumann's answer to Sony and AKG's FET-based microphones. (FET stands for *Field Effect Transistor*, which means it was solid state instead of tube.) While originally designed to take the place of the tube U 47, the 47 FET never found acceptance in that role. Thanks to its fixed hypercardioid pattern and its ability to take high SPL, the 47 FET eventually found a home in front of innumerable rock kick drums. (See Figure 2.4.)

Figure 2.4: Neumann U 47 FET. Courtesy of Neumann USA.

Neumann U 67

With a streamlined, tapered body shape that has since become famous, Neumann introduced the U 67 in 1960. Thought of as an updated U 47, the U 67 featured a new Mylar film capsule, an internal 40-Hz hi-pass filter, and an amplifier pad switch to help overcome overload and proximity effect during close-up use. A three-way switch for selecting the directional pattern was added for extra versatility. The amplifier was based around the EF 86 tube. (See Figure 2.5.)

Figure 2.5: Neumann U 67. Courtesy of Neumann USA.

Neumann M 49/50

Designed in 1949, the M 49 was the first electronically remote-controlled variable-pattern condenser microphone. The M 50, a lookalike twin of the M 49, shares the same design shape and the AC701K tube, but it is strictly an omni designed for distant orchestral miking work. The mic features a high-frequency boost, and it becomes cardioid at high frequencies. The M 50 still reigns supreme as a Decca Tree microphone of choice for orchestral recording. (See Figure 2.6.)

Figure 2.6: Neumann M 49. Courtesy of Neumann USA.

Neumann KM 84 Series

First introduced in 1966, the KM 84 was the first 48-volt phantom-powered microphone and one of the earliest FET mics. One of Neumann's all-time bestselling mics, it was made in the tens of thousands between 1966 and 1988. The KM 84 has a cardioid pickup pattern, while the KM 83 is omni and the KM 85 is hypercardioid. (See Figure 2.7.)

Figure 2.7: Neumann KM 84. Courtesy of Neumann USA.

In 1988, Neumann introduced the KM 100 series to replace the KM 80 series and incorporated several technical changes into the new series. In this series, the mics are modular with the FET amplifier in the capsule and not in the body of the mic itself. This enables the KM 100 series to have an extremely low profile (important for television work) since the mic body need not be directly attached to the capsule and can be located some distance away. The capsules are also interchangeable, with the AK 30 being omni and the AK 40 cardioid. Thus, the KM 140 is the cardioid mic from the KM 100 series and is the direct descendant of the KM 84.

This AK 40 capsule was retuned just slightly from the original KM 64/84 in that a bump in the upper mids (approximately +4 dB at 9 kHz) was added. The self-noise, output level, and maximum SPL specifications were all improved over the older 84 as well.

Since modularity is expensive, and engineers and musicians with project or home studios could not often afford the KM 140 as a result, the KM 184 was born. The same capsule was used from the KM 140, as well as the same FET, transformerless circuit, making the specs and performance the same. The KM 184 does not have a pad, and the capsules are not interchangeable.

Neumann KM 54/56

The KM 56 is a small-diaphragm tube condenser using an AC701 tube and featuring a dual-diaphragm nickel capsule with three polar patterns (omni, figure-8, and cardioid) selectable on the body. (See Figure 2.8.)

Figure 2.8: Neumann KM 54. Courtesy of Neumann USA.

Despite its size, the sound character of the KM 56 is strikingly similar to a U 47 but with slightly less fullness in the bass and a more detailed top. The KM 54, which is cardioid only, is a brighter, slightly more aggressive-sounding mic, which works great for close-miking guitars and other acoustic instruments where you want to minimize the boominess resulting from the proximity effect when you get close. The KM 53 was the omnidirectional member of the family.

Neumann stopped making the KM 54's all-metal diaphragms in 1969, in large part because their ultra-thin construction was so fragile. Since many thousands of KM 54 microphones had been sold, all of Neumann's stock of replacement capsules was then exhausted in attempting to keep those microphones functional.

By 1970, Neumann devised an adapter to let them use the Mylar capsules of the KM 60/70/80 series on the bodies of KM 53 or 54 microphones, along with a slight wiring change to correct the polarity of the output signal. This modification prevented a KM 53 or 54 with a broken capsule from becoming entirely useless. But the resulting microphone doesn't sound like a KM 53 or KM 54; instead, it sounds more like the model with the capsule being used with a more limited dynamic range.

Neumann U 87

The U 87 is probably the best known and most widely used Neumann studio microphone. First introduced in 1967, it's equipped with a large dual-diaphragm capsule with three directional patterns: omnidirectional, cardioid, and figure-8. These are selectable with a switch below the head grille. A 10-dB attenuation switch is located on the rear, which enables the microphone to handle sound pressure levels up to 127 dB without distortion. (See Figure 2.9.)

Figure 2.9: Neumann U 87. Courtesy of Neumann USA.

The U 87 A has lower self-noise and higher sensitivity (in other words, for the same sound pressure level, it puts out a higher voltage) than the original U 87. The overall sound of the two models is generally quite similar. The U 87 could be powered by two internal photoflash batteries (22.5 V apiece). That option was removed in the U 87 A model.

The latest model, the U 87 AI, features a 6-dB hotter output and a slightly different frequency response in the midrange.

AKG D 12/112

Introduced in 1953, the D 12 was the first dynamic microphone with cardioid characteristics. Originally a standard choice for vocal applications

for more than a decade, the mic's proximity effect and slightly scooped midrange eventually made it a favorite choice for rock kick drums. (See Figure 2.10.)

Figure 2.10: AKG D 12. Courtesy of AKG Acoustics.

The AKG Model D 112 is a descendent of AKG's earlier D 12 dynamic microphone, widely known for its ability to handle high-level signals from bass drums and bass guitars in the studio. The microphone was designed with a low-resonance frequency with the ability to handle very high transient signals with extremely low distortion. High-frequency response has been tailored to keep both bass drum and bass guitar clearly distinguishable in the mix. A built-in windscreen makes the D 112 also suitable for high SPL. (See Figure 2.11.)

Figure 2.11: AKG D 112. Courtesy of AKG Acoustics.

AKG C 12/Telefunken Ela M 250/251

AKG, which stands for Akustische und Kino-Gerate (Acoustic and Film Equipment), developed the original C 12 condenser microphone in 1953, and it remained in production until 1963. (See Figure 2.12.)

Figure 2.12: AKG C 12.

The original CK 12 capsule membrane was 10-micron-thick PVC but was later changed to 9-micron-thick Mylar. The amplifier design was based around a 6072 tube. The C 12 had a remotely controlled pattern selection from omni to bidirectional via the selector switch located in a box between the microphone and the power supply.

In 1965, AKG developed the C 12A, which shared the capsule design with the original C 12 (but not the electronics), but had a whole new body style—one that would foreshadow what was to become the 414 series.

In 1959, Telefunken commissioned AKG to develop a large-diaphragm condenser microphone, which soon became the Ela M 250 (which stands for *electroacoustic microphone*). This design incorporated the same CK 12 capsule but in a wider body with a thicker wire mesh grille, with a two-pattern selector switch (cardioid to omnidirectional) placed on the microphone. The Ela M 251 added a third bidirectional pattern to the switching arrangement. The 251E model indicates an export model and incorporates a 6072 tube amplifier. A plain 251 indicates the use of the standard German AC701K tube amplifier.

There were approximately 3,000 Elas (M and M251s) built between about 1964 and 1969, although Telefunken's original records were lost so no one knows for certain. Because of their full-bodied yet crisp sound, the C 12 and Ela M 250/251 microphones have since become some of the most expensive and highly prized vintage tube mics on the market today.

AKG C 451

With a styling reportedly based upon a large cigar smoked after a creative wine-tasting session, the 451 series was AKG's first FET amplifier featuring interchangeable capsules. Most 451s are usually found with CK-1 cardioid capsules, although some can be found with CK-2 omni capsules, CK-9 shotgun capsules, or the CK-5, which was a shock-mounted version with a large protective windscreen/ball end for handheld use. (See Figure 2.13.)

Figure 2.13: AKG C 451.

The 452 was identical to the 451 except it had an amplifier that required 48-volt phantom power, while the 451 could run on anything from 9 to 48 volts. As 48-volt phantom power became the standard, the 452 gradually replaced the 451.

Subsequent replacement versions of the 451 are the 460 and 480 series. These both feature flatter frequency response, quieter preamps, and more headroom, but never gained the same acceptance as the original 451. A reissue of the 451 with the popular CK-1 capsule, the C 451 B, is currently being produced.

AKG 414 Series

Basically the transistor version of the C 12A (see Figure 2.14), which used a Nuvistor miniature tube, the 414 has gone through many updates and changes through the years. Starting off as the model 412 in the early '70s, the mic was the first to use phantom power (12–48VDC) instead of an external supply. This version was susceptible to radio frequency interference if not modified, and since the grille housing was made out of plastic, it was prone to cracking.

Figure 2.14: AKG C 12A. Courtesy of AKG Acoustics.

The C 414 EB (Extended Bass) was introduced in the late ’70s and consisted of an all-metal silver housing. Early versions had the original brass CK-12 capsule, while the later ones had a plastic injected type. This mic was able to operate on phantom power of 9 to 48 volts. Of all 414 versions, this one seems to be the most desirable. (See Figure 2.15.)

Figure 2.15: AKG C 414 B-TLII. Courtesy of AKG Acoustics.

The C 414 EB-P48 appeared sometime in the early ’80s and is a 48V-only phantom-power version of the C 414 EB. The housing is black.

C 414 B-ULS stands for *Ultra Linear Series* and was introduced in the late ’80s. This mic has a redesigned preamp that provides a flatter frequency response.

The C 414 B-TL is the exact same mic as the C 414 B-ULS except it uses a transformerless output stage, which gives the mic a slightly lower frequency response.

The C 414 B-TLII is the same mic as the C 414 B-TL except it uses the TLII version of the CK-12 plastic injected capsule, which was designed to give a high-end boost to emulate the sound of the original brass CK-12.

The C 414 B-XLS is the latest version in the 414 family, featuring a slightly larger grill and body, decreased handling noise, and higher sensitivity. It also incorporates an entirely new electronics section that does away with the old mechanical switches and replaces them with flush-mounted electronic pushbuttons for pattern, attenuation, and low-pass filter. The XLS has five pattern choices, including a new wide cardioid position; attenuation choices of 0, –6, –12, or –18 dB; and low-pass filter positions of flat, –12 dB at 40 Hz, –12 dB at 80 Hz, and –6 dB at 160 Hz.

The C 414B-XL II is the same as the XLS version except for a pronounced presence peak at 3 kHz.

All 414s feature a multi-pattern switch on the front and a 10-dB pad and hi-pass filter switch on the rear of the casing.

Sony C-37A

Introduced in 1955, the C-37A was Sony’s answer to the Neumann U 47. In fact, the original C-37A was considered the finest general-purpose condenser mike available until Neumann answered it with the U 67, which incorporated many of its features (such as the high-frequency resonance filtered out, the shape of the windscreen, and the built-in low-cut filters). (See Figure 2.16.)

Figure 2.16: Sony C-37A.

The C-37A is a tube mic with a single diaphragm and pattern switching from omni to cardioid that is achieved by a mechanical vent, which is opened and closed with a screwdriver. This is very unique for a large-diaphragm mic (to get multiple patterns with only one diaphragm), and is what some feel is the secret to its sweet sonic character. The C-37A was first manufactured with the power supply model CP2, which used a tube for the main B+ voltage supply. This was later replaced with a completely solid-state power supply—the model CP3B.

The C-37P was introduced in 1970 and was mechanically identical to the tube C-37A except that it used an FET instead of a preamp with a 6AU6 tube. This version of the mic is far less desirable than the original A model.

Schoeps M 221B

The Schoeps M 221B is an interchangeable system in which 10 different capsules with different directional or frequency response characteristics can be attached to a tube amplifier body. Schoeps in general—and this mic in particular—is known for its sweet, smooth sound, especially off-axis. (See Figure 2.17.)

Figure 2.17: Schoeps M 221B. Courtesy of Schoeps GmbH.

As with so many vintage mics, the condition of the capsule membranes is very important in this series because Schoeps no longer manufacturers the M 221 and can no longer replace the capsules. The model that replaces it, the M 222, uses the modern Colette series of capsules and has a different sound as a result.

STC/Coles 4038

The 4038 ribbon microphone was designed by the BBC in 1954 and was originally manufactured by STC and most recently by Coles. Long the favorite of British engineers and used on countless records in the ’50s and ’60s, the 4038 never found its way into many American studios. Somewhat on the fragile side, the 4038 excels on brass and as an overhead drum mic. (See Figure 2.18.)

Figure 2.18: STC/Coles 4038.

Shure SM57

Over the years the Shure SM57 has established itself as the second-most popular microphone in the world (after the SM58). It is widely used in both live sound and recording applications, particularly on vocals, guitar amplifiers, and snare drums. It is used in such a large variety of situations that it often tops engineers’ lists of “the one microphone to be stranded with on a desert island.” (See Figure 2.19.) With a heritage

dating back to the original Unidyne capsule used in the Shure Model 55 in 1939, the cardioid dynamic SM57 utilizes an updated Unidyne III capsule first used on the Model 545 in 1959.

Figure 2.19: Shure SM57. Courtesy of Shure Incorporated.

Introduced in 1965, the SM57 was offered as a high-quality microphone for speech applications in broadcast, recording, and sound reinforcement. Though the microphone achieved some acceptance in the broadcast field, its ultimate success was with live sound applications and recording. By about 1968, the SM57 had been discovered by the fledgling concert sound industry. To engineers at that time (and now as well), the microphone provided a wide frequency response with an intelligibility-enhancing presence peak, a very uniform cardioid polar pattern to minimize feedback and other unwanted pickup, and an affordable price. (The original retail price was about $85 with cable.)

The SM57 has not undergone a major change to its basic design since its introduction and still remains widely available.

Sennheiser MD421

Go to any tracking date, and chances are you'll find a 421 on either the toms or a guitar amp. There have been three basic 421 models: the original 421 in gray, the newer 421 in black (which sounds pretty much the same as the gray), and the new MK II version, which sounds different from the first two. The cardioid 421 has a very useful roll-off switch located near the XLR connector. The response ranges from the flat M (or "music") position to the rolled-off S (or "speech") position. Over the years the number of stops between S and M on the roll-off switch has changed, with five being the most common. (See Figure 2.20.)

Figure 2.20: Sennheiser 421II. Courtesy of Sennheiser.

Sennheiser MD441

The 441 was designed to have more upper midrange and less low-frequency response than the 421, as well as extremely directional response. When used in a live situation, the gain before feedback is indeed impressive. Because of its supercardioid pickup pattern, the 441 excels as a scratch vocal mic and both on top of and under a snare drum. (See Figure 2.21.)

Figure 2.21: Sennheiser 441. Courtesy of Sennheiser.

Beyer M160

The Beyer M160 is one of the so-called "modern" ribbon mics. Utilizing dual ribbons to attain a hypercardioid pickup pattern, the M160 is a lot more rugged than its ribbon predecessors. (You still have to be careful, though.) Although used primarily on acoustic instruments by most engineers, the M160 has nonetheless gained a sterling reputation for use on guitar amplifiers. There is also a figure-8 version of the M160 called the M130. (See Figure 2.22.)

Figure 2.22: Beyer M160. Courtesy of Beyer Dynamic.

Electro-Voice RE20

A staple of any mic locker, the E/V RE20 is a large-diaphragm dynamic mic featuring an E/V innovation called *Variable D*. Thanks to the abundance of ports along the sides of the microphone, Variable D allowed the mic to reduce proximity effect while maintaining a flat frequency response. A favorite of broadcasters since its introduction, the RE20 has found its way into the studio as a kick drum mic, a vocal mic (a favorite of Stevie Wonder), a floor tom mic, and anywhere that a condenser mic would usually be used. (See Figure 2.23.)

Figure 2.23: E/V RE20. Courtesy of Electro-Voice.

New Versions of the Classics

While every engineer agrees that the classic mics sound great (which is why some of them are still in daily use even though they may be as many as 60 years old), there are just not enough of them to go around. This has driven up the prices to the point where only the most successful artists, studios, producers, and engineers can afford them. As a result, there are many new versions of the old classics currently made by small boutique manufacturers at a considerably lower cost than the originals. Although some manufacturers get closer to the original sound than others, all are sufficiently in the ballpark in a way that makes these mics a pretty safe purchase. After all, even the originals didn't sound the same from mic to mic, and if they were made exactly the same today, they wouldn't sound the same as the ones made 20 to 60 years ago due to the aging of the parts.

Even with the original specifications, new versions of the classics sound a bit different because many of the parts just aren't made any more. Capacitors and diaphragms are made differently, transformers and inductors cannot be made the same due to the latest OSHA safety laws, and VF14 vacuum tubes (for instance) haven't been made in at least 50 years. That being said, today's boutique microphone makers do an amazing job of getting close to the original sound with the parts available on the market today.

It should be noted that the AKG C 12/Ela M 251, Neumann U 47 and U 67, and RCA 77 are the most copied, since most of the others, such as the Shure SM57, the E/V RE20, the Beyer M160, and the Sennheiser 441, are still made exactly as they were when they were first introduced. Others, such as the Sennheiser 421 and the AKG 414 and 451 are currently manufactured but have changed their sound over the years (some for the better, contrary to popular belief) due to continual upgrades.

Let's take a look at some of the new classic microphone manufacturers and their offerings.

- Audio Engineering Associates' Wes Dooley has long been both a connoisseur and an expert on ribbon microphones, and his new microphones based loosely on the RCA microphones of old have been drawing rave reviews from recording luminaries around the world (see Figure 2.24). Wes also completes the line with a microphone preamp (the TRP) specially designed to complement ribbon mics.

Figure 2.24: AEA R84. Courtesy of Audio Engineering Associates.

- Bock Audio Designs (formerly Soundelux), named after microphone maven David Bock, currently manufactures an Ela M 251 clone known appropriately as a 251 (see Figure 2.25) and a less expensive cardioid-only version called a 151. Bock Audio Designs is unique in that there's no attempt to make their mics look like the mics they emulate, nor is there an attempt to exactly copy the inner workings at the expense of better performance. For more information on modern microphone philosophy and manufacturing, see David Bock's interview at the end of this chapter. Also check out bockaudiodesigns.com.

Figure 2.25: Bock Audio Designs 251. Courtesy of Bock Audio Designs.

- Korby Audio Technologies takes a different approach to emulate the classics with its Korby Convertible, which comes with interchangeable capsules for U 47, U 67, Sony C-800, or C 12 and 251 flavors. Tracy Korby also manufactures several other mics that provide a different, more modern interpretation of the classics. For more information, go to korbyaudio.com. (See Figure 2.26.)

Figure 2.26: Korby Audio KAT Convertible system. Courtesy of Korby Audio Technologies.

- Mojave Audio is an offshoot of Royer Labs in that all their products are designed by David Royer but none are ribbons. The company has a number of mics that don't exactly physically resemble the classics, but they sure sound like them. The MA-200 is a large-diaphragm tube condenser that knowledgeable users say has a sound similar to the famed U 67 (see Figure 2.27), while the MA-100 is a small-diaphragm tube mic along the lines of the Schoeps M 221 or the Neumann KM 56.

Figure 2.27: Mojave Audio MA-200. Courtesy of Mojave Audio.

- Pearlman Microphones makes a hand-built (as most boutique items are) version of the U 47 that comes in various flavors and prices. For more information, go to pearlmanmicrophones.com. (See Figure 2.28.)

Figure 2.28: Pearlman TM 1. Courtesy of Pearlman Microphones.

- Peluso Microphone Lab is the brainchild of John Peluso, who, like most other boutique microphone designers, has been a longtime mic repairman. Like David Bock, John makes clones of not only the popular 251s and U 47s, but the RCA 77 and the Schoeps CMC line as well. Peluso mics differ from other boutique manufacturer mics in that they're fairly inexpensive. For more information, go to pelusomicrophonelab.com. (See Figure 2.29.)

Figure 2.29: Peluso Microphone Lab CEMC-6. Courtesy of Peluso Microphone Lab.

- Telefunken USA is the modern incarnation of the original Telefunken division that initially distributed the classic, sought-after Ela M 251 and U 47. Today, Telefunken USA builds extremely faithful reproductions of those mics (some at prices similar to their vintage forbearers) in several versions, as well as a reproduction of the RCA BK-5 ribbon mic. For more information, go to telefunkenusa.com. (See Figure 2.30.)

Figure 2.30: Telefunken USA U 47v. Courtesy of Telefunken USA.

- Wunder Audio makes not only microphones based on the classics, but a microphone preamp, an EQ, and even a console as well. The microphone line consists of the standard 251 and U 47, but also the revered M 49/M 50. For more information, go to wunderaudio.com. (See Figure 2.31.)

Figure 2.31: Wunder Audio CM49. Courtesy of Wunder Audio.

The New Classics

While many believe that microphone technology hasn't really improved in at least 30 years, a host of new mics have taken the technology to the next step. Some have even become classics in their own right and can be found as standard equipment in mic lockers the world over.

Audio-Technica AT4050/4033

The AT4050 is a large-diaphragm multi-purpose, multi-pattern condenser mic that's found its way into mic lockers everywhere (see Figure 2.32). Its open and airy top end, low noise, and ability to take punishing SPL levels have made this a go-to mic when your usual favorite just isn't cutting it. It's also relatively inexpensive compared to the similarly featured German and Austrian favorites. The cardioid-only 4033 is a less expensive version of the same mic.

Figure 2.32: AT4050. Courtesy of Audio–Technica.

Heil PR 40

Another new mic that has caught on as a kick drum mic is the Heil PR 40 (see Figure 2.33). The PR 40 incorporates a large 1-1/8th dynamic element for an extended low-frequency response as well as a presence bump from 2.5 to 4.5 kHz. It's also capable of handling very high SPL levels, and its supercardioid pattern provides excellent back-side rejection. Many feel that the response of the PR 40 is sort of a "pre-EQ" built into the mic that makes EQing later either unnecessary or a lot more gentle than with other mics.

Figure 2.33: Heil PR 40. Courtesy of Heil Sound.

Royer R-121

Introduced in 1996, the R-121 is the first radically redesigned ribbon microphone in that it has a higher output than older ribbons, is a lot more rugged, and can take all the SPL you can hand it. You'll see it used where the old favorite ribbons are used (overheads, brass), but in some new places, too (such as kick drums and guitar amps). (See Figure 2.34.)

Figure 2.34: Royer R-121. Courtesy of Royer Labs.

Shure Beta 52

The Beta 52 (or B52, as some call it) is the first mic to give the revered AKG D 112 some competition as a kick mic. The mic is specially designed for kick and bass with an EQ curve built in to attenuate the 300- to 600-Hz "boxy" frequencies and boost around 4 kHz for presence. It can also handle extremely high SPL levels up to 178 dB. (See Figure 2.35.)

Figure 2.35: Shure Beta 52A. Courtesy of Shure.

Shure SM81

Although not a truly recent mic (it was introduced in 1978), the small-diaphragm SM81 condenser has been building in favor through the years until it has now become a clear go-to mic whenever a small-diaphragm mic is called for. Known for its flat frequency response from 20 Hz to 20 kHz, low noise, and RF susceptibility, the SM81 is ruggedly constructed and operates over a wide variety of temperatures. It has a built-in 10-dB pad and a switchable flat, 6-, or 18-dB per octave hi-pass filter (see Figure 2.36).

Figure 2.36: Shure SM81. Courtesy of Shure.

Yamaha SKRM-100 Subkick

The Yamaha SKRM-100 is an answer to the subkick phenomenon that started due to the burning desire to get more bottom end without having to crank up the EQ. The unit only captures 20 to 30 Hz, which is something that you feel more than you hear.

The trend started when a few engineers began to take the woofer from a Yamaha NS-10M, use the magnet to attach it to a mic stand about two inches in front of the bass drum, and plug it into a direct box. (This wasn't a new idea by any means, as engineer Geoff Emerick tried this on Beatles records in the '60s.) See Figure 2.37. The problem is that Yamaha no longer produces the NS-10, and the factory that made the woofer has been closed. So engineer Russ Miller took the idea to Yamaha, who manufactured a unit that contains a 10-inch speaker mounted inside a 7-ply maple shell with black mesh heads, so it's actually a speaker mounted inside a 10-inch drum (see Figure 2.38).

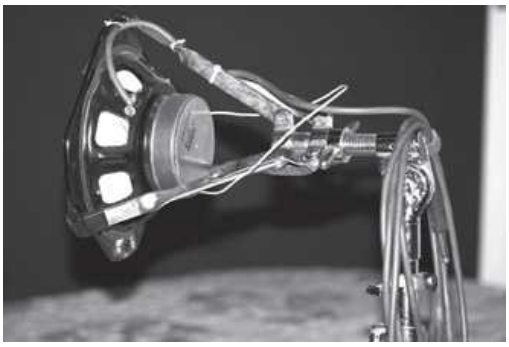

Figure 2.37: A homemade subkick.

Unlike a homemade subkick, the Yamaha subkick is tunable, but some engineers argue that the sound still isn't as good as what you can get from just a raw NS-10 woofer.

Figure 2.38: Yamaha SKRM-100 subkick. Courtesy of Yamaha.

Inexpensive Microphones

One of the more interesting recent developments in microphones is the availability of some extremely inexpensive condenser and ribbon microphones in the below-$500 category (in some cases, even less than $100). Although you'll never confuse these with a vintage U 47 or C 12, they do sometimes provide an astonishing level of performance at a price point that we could only dream about a few short years ago. But there are some things to be aware of before you make that purchase.

Quality Control's the Thing

Mics in this category have the same thing in common: They're all made in China, mostly in the same factory. Some are made to the specifications of the importer (and therefore cost more), and some are just plain off-the-shelf. Regardless of how they're made and to what specs, the biggest issue from that point is how much quality control (or QC—also sometimes known as *quality assurance*) is involved before the product finds its way into your studio.

Some mics are completely manufactured at the factory and receive a quick QC just to make sure they're working, and these are the least expensive mics on the shelf. Others receive another level of QC to get them within a rather wide quality tolerance level, so they cost a little more. Others are QC'd locally by the distributor, with only the best ones offered for sale, and these cost still more. And others have only their parts manufactured in China, with final assembly and QC done locally—and of course, these have the highest price in the category.

You can Never be Sure of the Sound

One of the byproducts of the rather loose tolerances due to the different levels of QC is the fact that the sound can vary greatly between mics of the same model and manufacturer. The more QC (and the higher the resulting price), the less difference you'll find, but you'll still have to go through a number of them to find one with some magic. This doesn't happen with the more traditional name brands that cost a lot more, but what you're buying (besides better components in most cases) is a high assurance that your mic is going to sound as good as any other of the same model from that manufacturer. In other words, the differences between mics are a lot smaller.

The Weakness

There are two points that contribute to the mic sounding good or bad (this can be said of all mics, really), and those are the capsule and the electronics. The tighter the tolerances and the better the QC on the capsule, the better the mic will sound and the closer each mic will sound to another of the same model.

The electronics is another point entirely in that a bad design can cause distortion at high SPL levels and limit the frequency response or change it to something less than desirable. The component tolerances are a lot closer, so that doesn't enter into the equation as much as having a bearing on the sound. In some cases, you can have what could be an inexpensive great mic that's limited by poorly designed electronics. You can find articles all over the Internet about how to modify some of these mics, some that make more of a difference than others. If you choose to try doing a mod on your mic yourself, be sure that your soldering chops are really good, since there's generally so little space inside the mic that even a small mistake can render your mic useless.

Some Good Choices

While new inexpensive mics are coming on the market every day, here are a few that users have been generally pleased with.

Behringer B-1

While everything that Behringer makes is in the budget category, the large-diaphragm B-1 condenser seems to be an item that found some acceptance. It's a remarkable value in that you get a carrying case, shock mount, and windscreen along with the mic.

Cascade FAT HEAD

While other budget mic companies have concentrated on condenser mics, Cascade Microphones have gone a different direction into inexpensive ribbon mics. The FAT HEAD is just about the least expensive ribbon mic on the planet (complete with a wooden box), but it still has a host of very satisfied users.

MXL SP1/2001

Marshall Electronics were one of the first to bring out large-diaphragm condensers for an ultra-inexpensive price. The SP1 is just about the best deal you'll ever find for a mic like this and is subject to many mods to raise the quality. The 2001 is basically the same mic but with more QC and tighter tolerances.

Oktava MK012

A small-diaphragm condenser with interchangeable capsules for different patterns, the MK012 has become a favorite for cymbals, acoustic guitars, and choirs.

Rode NT1-A

Rode actually started as a Swedish company before finally settling in Australia, and it really doesn't fit into this category since all the parts except the capsules are manufactured there. That being said, they produce quality microphones for people on a budget. The NT1-A is the much improved, super-quiet successor to the original NT1.

sE Electronics sE2200A

Built by hand in their own factory in Shangai, sE Electronics mics are one of the few from this class that are finding use by everyday pros and big-name recording artists.

Studio Projects C1

The Studio Projects C series of large- and small-diaphragm condenser mics has become one that has a very high user-satisfaction rating, with

the C1 being the first introduced.

Meet Microphone Designer David Bock

After stints repairing microphones (among other things) at such prestigious facilities as the Hit Factory and Ocean Way, Bock Audio Designs (formerly Soundelux) founder and managing director David Bock went from repairing vintage microphones to manufacturing them. David now utilizes his expertise to produce updated versions of the studio classic 251, although he made versions of the U 47, FET 47, M 49, and U 67 in the previous Soundelux incarnation of the company. David was kind enough to share some of his insights as to the inner workings and differences between classic microphones and their modern counterparts.

How did you get this interest in microphones?

From the very first time I put on a set of headphones and listened to that pair of Neumann M 269s that I used in college, the sound was very seductive. I was always searching to do a great record as an engineer and therefore had a fascination with microphones. Later, I was fortunate enough to have someone show me a little bit about how to open one up and not destroy it, which is kind of the first step. My interest evolved from there as I became a technician, and it became more and more obvious that there was a really small number of people that knew what made microphones tick, so it became a definite worthwhile specialization to me. Plus, there was a lot of other gear that was coming onto the market that was just no fun to work on, so that helped push me into the microphone direction anyway.

How did you get involved in designing your first mic?

I had been modifying some Chinese microphones that someone had brought into the country about 15 years ago, and some people got excited about the results. I had specialized in repairing microphones up until that point, so modifying them was the next step. Then saying, “Why are we always using the same single triode design for microphones? Let’s do something different,” was the final step.

Last we talked, you mentioned how people keep using the same old designs without knowing why they were used in the first place.

Well, at this point it’s really out of control in terms of the copying. If you really want to see it on a larger scale, just look at guitar amplifier circuits. Every guitar amp circuit is a copy of every other guitar amp circuit, and the copy has passed through generations now to where you really have people that don’t know why they’re doing something. That’s seriously true in the microphone world as well.

Isn’t it true that people are copying the original “mistakes” that were made because of the limitations of the technology at the time?

That’s a very logical conclusion and there’s some truth to that, but there’s also another element involved, which is that companies make decisions based on what they have to do to stay in business. They may have parameters handed to them by a broadcast network who is their primary customer. They might also base some of their design decisions on the “bean counters,” where they ask if there is a cheaper way to produce the product. Suddenly, you might get a so-called “classic” design just because it’s so easy to implement that everyone copies it. That’s actually a bigger factor.

What actually makes a vintage microphone so special?

There are a couple of things that go into that. The bottom line is that the ’50s were really the golden age of audio design. Those guys really did know what they were doing when they designed a lot of the key gear that people are still using. They used a lot of the correct techniques, and they had the luxury of decent materials and the time to research things properly.

There is a tone to these things that is harder and harder to duplicate. Not impossible, just harder and harder. They had tubes back then that are harder to get now. The available selection of materials was a lot greater back then. Then there’s the element of chance. Why would someone pay $20,000 for a 251? Well, maybe that particular 251 really does sound unique because AKG’s production was so sloppy and the capsules were so poorly machined that you’re bound to get one that excels beyond everything else, and the rest are just kind of average. Now we have CNC machines that can make these tiny little holes on the capsule backplate all the same, which AKG really couldn’t do.

When you set out to build a mic, how did you determine what you were going to copy?

If I was to have a studio, I know what I’d need to have in terms of vintage microphones, but the vintage market is such a disaster in that you pay too much for something that needs significant repairs and constant attention. So my goal was to build the products that I know I would need if I were to have that studio. If I were to make a record, I would need real microphones, but I couldn’t afford $90,000 in vintage microphones.

When I started building microphones, there was no copying intended; it was merely to forge new ground. Everything was defined by economic and production parameters as well as a little ignorance, since I hadn’t been in the manufacturing game that long. That’s what I was able to do initially, but that wasn’t my goal. So the first few microphones (the U 95 and U 99) established the company enough so I could get to that goal. Once I was able to get there, it was time to emulate a few of the classics that everyone used on great records. I had a client who was a 251 freak that kept bugging me to build one, and it became a several-year obsession for both of us. That’s what led to that first copy, but it was not a short process.

In the case of the 47, which came after the 251, it was even a longer process. There were a lot of things that had to come together since it’s such a complicated construction with a lot of parts. In some ways it was a little easier, though, since I had repaired so many of them, and as a result I had a better sense for what sounded good or bad.

What’s the most common repair that you saw in vintage mics?

The range of problems goes from common to obscure, but the most common thing is a dirty capsule—but that can be true of even a new

microphone. If you wanted to build a dust collector, you would build it similar to a condenser microphone, unfortunately.

As you were trying to build an updated version of a vintage microphone, were you trying to copy everything, including the circuitry, and trying to get it as close to the original as possible, or were you trying to just make it sound like the original?

The sound comes first, but that's not the whole story. The first thing I had to do was try to find what makes the microphone sound the way it does. There were at least 15 points that you have to look at, it turns out, if you're going to emulate the sound of a microphone. The first large problem is, "I want to copy the sound of a 251." Well, which 251? I rented about ten 251s here in town [Hollywood], and you know what? There's no such thing as a common 251. They're all totally different. I could hear it and I could measure it.

Among some of them there is a common thread, though. Frequency response is the primary guidepost because all microphones have their own signature. But frequency response curves don't always tell you everything. You have to take frequency response measurements not only far-field but also proximity [near-field], which strangely are not published and are completely critical to what we believe a microphone sounds like in the directional world. That's key, and it's somewhat of a disservice that most of the larger condenser-microphone manufacturers have not been publishing those graphs for many years. That's why most engineers will say, "Those graphs don't really mean anything." That's because you're always looking at a 1-meter graph, but you're not always putting your microphone 1 meter away from the sound source. So of course they don't mean anything, because they're not telling you what you're hearing. If you saw a proximity graph and a 1-meter graph, you'd have a much better idea of what the microphone sounds like.

So the dissection process continued through a lot of substitutions. You might take a power supply and substitute a different circuit topology and see what it changes, for instance. There are also a lot of measurements that you have to do. Our ability to test things today is definitely better than back when the classics were built, but it's not completely conclusive and opens up a can of worms that says, "If I can't measure it, then I can't hear it," which I completely disagree with. If you worked only toward measurements, you end up with something that actually doesn't sound particularly good compared to things that were designed with listening in mind.

Finally, there are listening tests. My primary listening test is to make a recording of a drum set in a large room. I've got a couple of key locations where I place the microphone to give me an idea about the close and distant pickup characteristics. That's where you start hearing the differences. Microphone capsules are related to drums. If you took 10 DW kits and you tuned them all the same, they'd still sound all different. There's a parallel you could draw toward microphones. You could tune all the snare drums and toms the same and even use measurement devices to be sure that they're the same, and yet the trained ear of an engineer can pick out the differences between them. We can lock onto things that are different about each one.

What was the hardest thing to get right?

Always the capsule, because it's so small, and if you make a tiny change, it makes a huge result. But that's not to say that the capsule is 99 percent of the sound. An 87 and a 67 don't sound that similar, yet they use the same capsule.

How do you deal with parts that are no longer made?

In some cases you can replicate them. In some cases you can improve them. In some cases you have to bite the bullet and say, "I just can't get that part, so I'll have to come up with the closest thing I can." For instance, something like transformer laminations. We don't have the exact laminations that they used in the original 47 transformer, but we came up with something that's a lot closer than an off-the-shelf Jensen [transformer].

But then again, you're not going so much for the part but for the effect of the part.

That's right. But in some cases we've found through the substitution method that some things just have to be duplicated. Like if you mounted the tube to a printed circuit board, it would have a different resonance than if you mounted it with two rubber mounts.

But in other cases, a substitution can be as good or even better. For example, in our 251 we use a large core output transformer with the same turns ratio as the small transformer used in the original. That gives us a little less distortion and a lot more headroom in the low end. At the risk of not being historically accurate but being a lot more useful for today's recordings, I made a decision saying, "I'd rather have the headroom," because it didn't affect anything else.

The original 251s were made out of plastic that could disintegrate in your hands. That's not acceptable, so ours are metal framed. And the way we power the heater on the tube is different than the way they did it in 1960, but we get 6 to 10 dB less noise overall because of it, so that's a useful improvement. So we try to maintain faithfulness to the vintage sound, and wherever that's not compromised we'll make an improvement where we can.

What's the biggest difference in the way microphones are made today from the way the classics were made?

Mass production and availability of quality materials. Also, the need for profitability on a corporate level seems to affect how things are made a lot. I've seen the way Neumann microphones are built, and they're very different from the way they used to be. The way they built their microphones in the '50s and early '60s, I'll be able to keep those microphones running for a long time. Not so with the newer microphones. They still make a great capsule, but they don't make the microphone the same in terms of construction. They're built for ease of production and lowest cost. It's true almost across the board.

So if we were to make a broad statement, microphones are not made as well today as they were 50 years ago.

No, they're not. If you had a "cost is no object" attitude, you still don't even have the same metals available. The quality of brass is different now from what they used in the '50s and '60s, for instance, and an equivalent can't be found.

What is the most critical part of a microphone?

The capsule is the most critical, but electronics play a big part. You can have a great capsule but crummy electronics, and the microphone will sound mediocre. If you have really great electronics but a crummy capsule, then you still won't have a good-sounding microphone. If you have a great capsule and great electronics, then you'll have a really good microphone at that point.

If you were to look in the future of microphone development, where would you like to see it go?

Unless someone comes up with a true digital transducer that's usable, I don't know how much more it can get refined.

What seems like an improvement sometimes doesn't work at all. There have been "improvements" along the way that were commercial flops. I'll give you a quick example. There was a microphone that AKG made, the lowly 414, which has descended into the depths of hell at this point. In their 14 revisions of this microphone, they made one called the P48 EB that used a transistorized cascode circuit. It is the most correct and stable circuit that you can use from a textbook standpoint. It is the only time that I've ever seen it used outside of a secret internal Neumann document from the early '60s, yet it's their most hated microphone of all the 414 versions. So in terms of serious evolution, I'd like to see some, but I'm a little worried the marketplace can't handle real useful advances.

Could it be that the amplifier circuit was exposing the faults of the capsule?

Possibly, since by that time they had migrated to the molded capsule that is generally accepted to be a disaster.

Tell me about developing a version of the 67?

The 67 was actually a fascinating research project because of the patent involved, which tells you exactly how to do it. There are two problems, though, and the capsule is the least of them. You could almost use any capsule because the circuitry is so complex that it will overwhelm whatever capsule you have in there. The circuitry was ingenious. They had simultaneously bass boost and cut in order to get a rumble filter. The big problem is the transformer, which is tricky because it has feedback windings, and the whole circuit is dependent upon the gain of the tube, so the individual tube completely matters in the sound of the microphone. If you have a tube that's getting old and is losing a little of its gain, then the circuit doesn't work as planned and the microphone doesn't sound right.

With the way the business seems to be going, with less and less emphasis on sonic quality, will there be enough people left to appreciate what you're doing?

Anybody who is serious about the profession either evolves to a point where they say, "I can use an SM57 for every track to make a record," or "I'd rather use a high-quality microphone to make a record." You're going to go one way or the other, and most people, if they stay in the business long enough, will usually gravitate to the more exclusive side.