COLES 4038
STUDIO RIBBON MICROPHONE USER'S GUIDE

By Ron Streicher and Wes Dooley

QUICK START

IF YOU CAN'T WAIT TO USE YOUR NEW COLES 4038, PLEASE READ THESE PRECAUTIONS FIRST SO YOU DON'T ACCIDENTALLY TRASH YOUR NEW TOY.

1. ***KEEP YOUR 4038 COVERED BY THE SUPPLIED PLASTIC BAG WHEN NOT ACTUALLY BEING USED.***
   A. THIS KEEPS THE STRONG MAGNET INSIDE THE 4038 FROM ATTRACTING "TRAMP" IRON PARTICLES WHICH POLLUTE THE INSIDE OF THE MIC.
   B. THIS ALSO PROTECTS THE VERY THIN (.6 micron) AND FAST ALUMINUM RIBBON INSIDE THE 4038 FROM BEING STRETCHED IF THE MIC CASE LID SNAPS SHUT OR IF THE MIC'S STAND IS MOVED TOO QUICKLY ACROSS THE STUDIO.

2. ***NEVER PLUG THE 4038 INTO PHANTOM OR "T" POWERED MIC INPUTS.*** "T" POWER WILL INSTANTLY DESTROY A RIBBON (AND ALSO CAN HURT A DYNAMIC MIC). PHANTOM POWER CAN DO THE SAME IF YOU HAVE A BAD MIC CABLE. IT IS BEST TO PLAY IT SAFE BY TURNING OFF THE MIC POWERING AND WAIT A MINUTE. AFTER THIS IT IS SAFE TO PLUG IN YOUR RIBBON MIC. (THIS WILL ALLOW BOTH OF THE MIC PREAMPS' INPUT CAPACITORS TO DISCHARGE FULLY AFTER YOU TURN POWERING OFF.)

3. TO INSERT THE CONNECTOR, LINE UP THE PINS AND PUSH IT IN. TO REMOVE THE CONNECTOR, SQUEEZE THE SILVER OVAL-SHAPED RING AT ITS WIDEST POINTS AND PULL THE CONNECTOR STRAIGHT OUT.

4. ***WHILE THE COLES 4038 CAN HANDLE VERY LOUD SOUNDS AT HIGHER FREQUENCIES, IT CAN BE DAMAGED BY STRONG AIR GUSTS.*** SO AVOID KICK DRUMS AND LOUDSPEAKER BASS PORTS BECAUSE THEY CAN STRETCH EVEN A WELL PROTECTED RIBBON. IF YOU CAN ***FEEL*** THE AIR MOVE, DON'T PLACE THE MIC THERE.

   THE 4038 HAS A 1% DISTORTION POINT AT 110 Hz OF 125 DB SPL; AT 55 Hz THIS 1% POINT DROPS TO 110 DB SPL. THUS LOUD HORN SECTIONS ARE NO PROBLEM, BUT ON BASS GUITAR AMPS YOU SHOULD KEEP BACK TWO FEET OR MORE. ALSO REMIND THE PLAYER TO TURN DOWN THE AMP BEFORE CHANGING GUITARS OR ***SPLAT!*** (JOE CHICARELLI SUGGESTS THAT ON THE BIG MARSHALL STACKS, IT CAN BE USEFUL TO USE A 6" POPPER STOPPER IN FRONT OF THE 4038 AND/OR SET IT AT AN ANGLE TO THE SPEAKER.)

5. ***WHEN USED AS A VOCAL MIC, USE A 6" POPPER STOPPER.*** THIS HELPS PROTECT THE RIBBON FROM BREATH BLASTING, POPPING, AND MOISTURE.

A QUICK TOUR OF THE 4038

It has been said that the railroads built America in the nineteenth century. These “iron horses” ran on “ribbons of steel” and carried commerce from one end of the country to another. In their own way, some of the classic early microphones also helped build America in the twentieth century. From their iron horseshoe magnets and ribbons of aluminum, the sounds they produced traversed the airwaves of the nation. These venerable microphones by such companies as RCA and Western Electric brought us the guiding voices that carried us through the “Great Depression,” World War II, and the entertainment that sustained us through these troubles during the “Golden Age of Radio” in the 1930’s and ’40’s.

Thus it comes as no surprise that when in the early 1950’s the BBC wanted a new microphone for FM broadcast which could continue in this tradition, they chose the principle of the ribbon as the basis for their new design. The proven quality of the ribbon was exemplified by its smooth frequency and excellent transient response, and the “rich” quality it imparted to both voices and music. However, the BBC also wanted an affordable microphone which would better withstand the rigors of use and would be smaller than its predecessors . The result was the Coles 4038 studio microphone.

SO HOW DOES THE COLES 4038 SOUND?

Very good indeed for a wide variety of users. In fact, the BBC / STC design team intended the 4038 to become *the principal studio microphone* for the BBC ... and that it did. Functionally this means that, as with a classic Neve console, nothing sounds bad on a 4038 and many things sound just glorious. As with all mics, the choice of a preamp influences the final sound, although it's hard to find a combination that actually sounds bad with the 4038. (Jim Boyk, the artist in residence at California Institute of Technology has gone as far as building a transformerless all tube mic preamp for his pair of 4038's. He reports that he has yet to find 4038's resolution limit; the better he's been able to tweak his mic preamp, the more he hears. As a concert pianist, he records an instrument that is challenging to all microphones.)

What other instruments sound good with a 4038? Sax players (and recordists such as Keith Johnson of Reference Recordings) report that the 4038 is their mic of choice. LA area **brass** player Malcolm McNab personally owns several pairs of 4038's, as does the award-winning scoring mixer Shawn Murphy, who has been using as many as ten 4038's at a time on the **brass** sections down at the Sony Pictures Scoring Stage. A comment received from Philadelphia was that the 4038 is the choice for sounds that are bigger than life. **Drums and amplified guitar** would fit that description. From way down south in New Orleans came news about capturing the **original Beatles**

drum sound with a good big room and a single 4038 with a tube preamp as the overhead mic. From New York we received an update on that sound, utilizing solid state mic preamps with a pair of 4038's for **stereo drum overheads**, a large diaphragm dynamic for the kick, and a large room to record it in. Bob Rock recently used a pair of 4038's on Metallica as the air mics on a Marshall stack of **guitar amps**. Steve Albini uses the 4038 on single **guitar amps** at a distance of about two feet out.

Acoustic instruments in general seem record well with the 4038. When one high end studio in LA got its first pair of 4038's the chief engineer wondered what in the world they sounded like. He had a pair of Avalon mic preamps available and an **acoustic guitar** was what he first tried. He became another immediate convert. **Violin** virtuoso Itzhak Perlmann recently completed a recording at for Telarc Digital, engineered by Jack Renner, where a coincident pair of 4038's were the principal pickup.

Michael Bishop, also of Telarc Digital used the 4038's on **sax and flute** the following week with very pleasing results. Doug Sax of The Mastering Lab used them for a Sheffield direct to disk project to record a brass choir. **Voices** record well too. One producer was having problems with a female voice on a U47; they liked the midrange, but she was having sibilance problems. Then they tried a 4038, and got exactly the sound they wanted.

If you have ever heard a southern gospel quartet and liked that deep, deep sound on the bass voice, you'll want to try a 4038 close up while using a 6" popper stopper. Bi-directional ribbon mics are the king as far as proximity-effect bass boost is concerned.

This space reserved for <u>your</u> contribution.

AN IN-DEPTH TOUR OF THE 4038

The 4038 has been in continuous production for over 40 years. That's way longer than even the Shure SM58. As they say in the film business, “Its got great legs.” What has given the 4038 such staying power? Audio quality, reliability and versatility are the key elements. It's a classic that just never went out of production. So let's start with a quick physical tour of the microphone and then think about how to use it on a session.

Starting at the bottom, you'll notice that the Coles 4038 uses a different output connector than you are used to. This is the original Western Electric (as in AT&T's manufacturing division) Type-4069 microphone connector. For vintage mic collectors this means there is still a source for this connector; for you it means learning about a new one. If you took the 4069 apart you would find that the three female sleeves are actually individual miniature single-circuit patch bay jacks. This is definitely a legacy from the earlier telephone era. Inserting the 4069 into the base of the microphone is fairly easy: it just slides and snaps in. Releasing it again after use takes a moment's reflection. Look for the silver band around the base of the mic. Notice that a screw holds it in place and that it slightly bulges 90 degrees either side of the screw? By squeezing this band on either side where it bulges out, you'll lift the internal latch pin and then you can slide out the connector. While this can be a careful two handed operation, it's easy to get the hang of it. The BBC owned a number of microphones that employed the 4069 connector and they intended that the connector be permanently left on a mic stand so that it functioned as a quick disconnect mic mounting system somewhat like we use the Atlas LO-2 mic stand quick disconnect adapter. The advantages of the BBC / Western Electric system is that it includes the audio connection and locates the reflective surfaces as far away from the mic element as possible. AEA offers a custom stand adaptor (4069 SA/XLR) for the 4069 connector which provides American standard 5/8"-27 female thread and is wired with a 16" cable and XLR-male connector. Alternatively, the 4070 adaptor directly converts the output to a conventional XLR-male.

Up a bit from the silver connector release band, you will find a rotating ring assembly with three eyelets that protrude around the circumference. Two are opposite each other on the ring and the third is offset about 60 degrees. This mounting system is intended for flying or hanging the 4038. The two eyelets opposite each other are for flying the mic in a concert hall or large studio where the cables can come from opposite sides of the room. The eyelets at zero and sixty degrees are intended for hanging the mic from a large studio boom stand such as the Atlas BS 36W. The AEA 4038ES custom elastic suspension mount uses all three of these eyelets to safely and securely isolate the microphone from mechanical shock when boom mounted.

AEA also uses this rotating ring assembly for our multipurpose 4038SA stand adapter. This mounts to the 180 degree eyelets using 10-32 Allen head screws. The adapter itself accommodates both a 5/8"-27 mic stand and the European style 3/8" mic stud. The European mic mounts are provided both on the centerline and offset to one side to allow symmetrical stereo setups when using our SMP series of stereo microphone positioners — heavy duty stereo bars specifically designed to securely handle the weight of the Coles 4038. The SMP will also support AKG, Neumann, or other large format microphones — in all standard coincident or near coincident arrays.

Next, above the rotating ring, you will find the 4038's yoke assembly. You can use this to adjust the angle of the mic head relative to the connector assembly. While the yoke provides a range of over a 90 degrees from the vertical (it's normal side address mode) all the way to being in line with a mic boom arm, because this is a bi-directional (figure eight) mic, it is generally advisable to angle it to minimize the “plumbing” in the way of the rear pickup lobe. The front (positive pressure lobe) of the 4038 is the side opposite the yoke assembly. The yoke assembly mounts to the microphone head through two short metal pads that penetrate the microphone's acoustical case. These pads are epoxied directly to the magnet assembly. If the microphone is dropped, these pads can be broken loose from the magnet. The good news is that the mic is designed so that even if things start rattling around, the mic does not fall apart. The bad news is that putting the whole thing back together is tedious bench work and if the yoke's pivot rod has been bent, the only way to fix it, is to replace it. Hint: Be careful and don’t drop the mic!

The yoke supports the mic head which contains the 4038's motor assembly and acoustical case. The unique shape of this acoustical casing was carefully worked out for best high frequency response, both on and off the centerline axis. The center top indentations on the front and rear grilles form an acoustic lens for the ribbon behind it. There is a fine mesh protective metal screen on the inside of the perforated metal outer case. Another fine mesh metal screen is positioned only a tenth of an inch either side of the ribbon to provide more mechanical protection and tame the low frequency resonance peak. Finally, there are acoustical wings inside the 4038's case that help extend the low frequency response down to 30 HZ while reducing the mic's sensitivity to mechanical shock.

As with all bi-directional microphones, the principal pickup axes are straight to the front and back. While the amplitude at the rear is the same as the front, it is important to remember that the polarity is reversed. This is equivalent to hitting the "phase switch" on a consoles input — not something we usually do without thinking about it. At right angles to the front/rear

main axis is the null plane. Think of it as a slice of silence. In this 90 degree plane, a figure-8 mic just does not hear much at all. Remember, however, that since the 4038 is a bi-directional microphone, the room tone it picks up from the rear becomes an important part of the overall sound. Therefore, using the 4038 in a room that you hate the sound of can be troublesome at best, unless you use the "slice of silence" to tune most of the room out.

A LITTLE BIT OF THEORY

The operating principle of the ribbon microphone is actually quite simple. A thin corrugated ribbon of aluminum foil (In the 4038's it's 0.6 microns thick, less than the thickness of a human hair, by 0.23" wide and 1" long) is suspended vertically between the north and south poles of a permanent magnet. When sound waves strike this ribbon — or *diaphragm* — and set it in motion, a small current is generated. This current is the electrical analog of the sound wave. Thus, a ribbon microphone can be considered as a motor/generator type of transducer, which converts one form of energy (sound) into another form of energy (electricity). Like a Honda power generator, it's just an electrical conductor being pushed through a magnetic field. Completing the system, an internal transformer matches the ribbon's very low output voltage and impedance (0.24 ohm for the 4038) to an impedance and level appropriate for use with microphone preamplifiers.

Because the ribbon is fixed at both ends and very thin compared to its width and height, it is only free to move fore-and-aft in response to the presence of a sound wave. Thus, the ribbon responds to *differences in air pressure* between its front and back surfaces. If the sound wave approaches the microphone from directly along its principal axis — perpendicular to the plane of the ribbon — this differential pressure on the ribbon will be at its maximum and so will the microphone's electrical output. There are two such maxima, directly to the front and directly to the rear of the ribbon. A well designed bi-directional (figure-8) ribbon mic will have similar frequency response on both the front or rear axis, only the polarity changes. (Keeping polarity straight can be important with both microphones and loudspeakers. When observing many sounds such as plucked strings, drums, brass, and voices on a scope or DAW waveform display, you may see that the signal goes positive higher above the zero line than negative below it (or vice versa). These are *asymmetrical* waveforms. If you change the polarity (marked phase on most consoles) of these signals, it tends to sound as if you made an EQ change. However if you try to EQ back to the original sound, you never can get it back. Thus it is a good idea to watch polarity in microphones, cables, electronics and speakers.).

As the sound source moves from the central axis, the differential pressure

on the ribbon decreases, as will the electrical output. Thus it is easy to understand why a well designed bi-directional microphone has almost no output from sounds arriving from an angle of 90° off-axis: these sound waves strike the ribbon edgewise and exert equal pressure on both the front and rear surfaces of the diaphragm. The result is that there is no *difference* in the pressure exerted on the two surfaces of the ribbon; hence there is no motion, and no output signal is generated.

The term *velocity or pressure gradient* is often used when describing ribbon microphones, because as noted above, as a sound wave passes the ribbon, minute differences in air pressure are created between the front and rear surfaces of this diaphragm. The classic ribbon microphones were the first to have a directional pattern, what we call a figure-of-eight or *bi-directional* polar response pattern. Earlier microphones were omnidirectional *pressure* microphones and responded only to the variations in the absolute air pressure of a sound wave without any particular regard to the sound's direction or distance of origin. Ribbon *(velocity or pressure gradient)* microphones have a well defined figure-of-eight directional pattern and their bass frequency response varies depending on whether the sound source is near or far. A near source will sound bass heavy compared with a far source. This bass boost *proximity effect* is characteristic of all directional mics.

DESIGN OF THE COLES 4038 MICROPHONE

"The BBC-Marconi Type A microphone, believed to be the first of this type to be manufactured in Great Britain, was produced in 1934 ... The performance of this microphone is still good, even by modern standards, but the instrument is bulky and there has long been a demand ... for a smaller version giving an equal or better performance."

With these criteria as the goal, the engineering division of the BBC went about designing a new microphone to meet the growing demands of their FM radio and television production departments. The end result was the BBC's model PGS bi-directional ribbon microphone. Size and weight reductions were relatively easy to accomplish. But along the way, the additional problems of extended frequency response, ribbon fragility, and susceptibility to wind noise, were carefully addressed.

The commercial realization of this microphone is the Coles 4038. The 4038 is first mentioned in print in December of 1955 in the excellent BBC monograph by D. E. L. Shorter and H. R. Harwood on the design of the PGS. The 4038 has a smooth response from 30 Hz to above 15 KHz, exhibiting an ideal 6 dB per octave roll-off at high frequencies. A symmetrical polar response in the vertical direction was achieved through the unique shape of the microphone housing which is designed to function as an acoustic lens. Its

standard electrical output impedance of 300 ohms remains nearly constant throughout the audio passband. Special attention was paid to reducing hum pickup through the use of a shielded toroidal output transformer and starquad style wiring around the ribbon itself.

The 4038's ribbon diaphragm has a very low mass and high internal damping, so transient response is exceptional. The ribbon is made of a special beaten aluminum and is about one third the thickness of ribbons used in the RCA 44s and 77s. The BBC PGS and STC 4038 design team developed a ribbon corrugation pattern that did not quickly lose it's tension. In constructing the 4038, particular attention was given to special internal protection for the ribbon which greatly reduces its susceptibility to damage from either mechanical shock or excessive wind velocity — problems to which earlier ribbon microphones such as the RCA 44 were particularly vulnerable. The practical benefit for 4038 users is that they rarely have to re-ribbon the mics unless damaged by external forces.

"CARE and FEEDING" of RIBBON MICROPHONES

Although the Coles 4038 has been designed to withstand the normal rigors of the recording studio, as with any precision device certain precautions should be taken when handling and using it. These notes apply to using *any* ribbon microphone. The first (and this should be the most obvious but, alas, is not) is that the microphone's greatest enemy is a strong air current. <u>It is extremely foolish to blow into any ribbon microphone to test if it is working!</u> Not only does this present a very high wind stress to the diaphragm — one potentially strong enough to tear the ribbon from its mounting — but it also forces moisture and dust particles from the breath and/or air into the microphone housing and onto the diaphragm. This defeats the two fine mesh metal screens which protect the ribbon. If simply talking into it is not sufficient, the safest way to test whether a microphone is working is to snap your fingers in front of it or, if necessary, to <u>gently</u> scratch the microphone grille with your finger nail.

Similarly, a ribbon microphone is best used only indoors, away from strong air currents such as air conditioning vents or open windows. Rapid movement of the microphone while unsheathed (panning on a studio boom or even while carrying) should likewise be avoided. If the microphone must be used where it will be subject to strong air currents, it should be protected with an external windshield or screen. (In an emergency, even a clean sock or handkerchief will suffice.) With vocalists we recommend the use of the two layer 6" "Popper Stopper." This provides good pop blast / breath moisture protection and allows you to set a minimum working distance to limit proximity bass boost. When not actually in use, a ribbon microphone should be stored in a protective plastic or close weave cloth bag.

Second, and equally important, is to avoid any microphone powering. Remember that a ribbon microphone is nothing more than a conductor suspended in a magnetic field: when the conductor moves, it generates current and *vice versa,* a current presented to the conductor will force it to move. The voltage appearing on a badly wired microphone cable from a "phantom" or other powering system can instantly rip the ribbon from its mounting. This problem is not unique to ribbon microphones. Even rugged dynamics such as Shure SM57s can be damaged by such exposure, even through they might still produce sound. Such exposure also can magnetize and permanently degrade the mic's output transformer.

With "phantom" or simplex powering schemes, the two conductors (pins 2 and 3) are *supposed* to be at the same voltage potential. However, should there be any fault in the cable between the mixing console or power supply and the microphone (such as a shorted or poorly soldered connection) this can produce a *voltage differential* which then will be presented to the connector of the microphone and back into the ribbon. One quick zap, and the ribbon will be stretched or blown out of existence! "T" microphone power is even more dangerous, since it inherently presents a differential of 12 volts between pins 2 and 3. Therefore, before connecting a ribbon microphone, be absolutely sure that the powering is turned OFF for this input channel. Don't take chances: if you can't turn it off, it's best not to plug it in.

Even after you have actually turned off microphone powering, wait a minute or two before you actually plug the mic in. Most modern microphone preamps are transformerless and protect the preamp electronics with a pair of large capacitors. These capacitors are energy storage devices, so it can take a while for the voltage charge to dissipate. If you should happen to plug in a mic when both of the capacitors are not equally discharged, you might lose or stretch a ribbon, even through the powering has been turned "off."

The 4038 is a sensitive studio microphone designed for voice and music pickup. It is not intended for pickup of sound effects such as gunshots or explosions, use in the wind or in situations where the low frequency SPL is extremely high. Like most full range ribbon microphones the 4038 will handle very high SPL at high frequencies and is displacement limited at low frequencies. For example the 4038's 1% THD point at 110 Hz is 125 dB SPL while further down at 55 Hz this 1% point is reduced to 110 dB SPL. For use in high wind or outdoor situations there are specialty announcer microphones such as the Coles 4104 which will withstand 20 to 25 mph wind streams. There is also the old RCA BK5 podium voice mic which some claim with it's rolled off bottom end was designed to survive the sound of a 45 caliber automatic discharged from 5 feet. In the early 1960s, Electro Voice introduced the robust model 664 dynamic mic. (Lou Burrough's was famous for demonstrating that it could be used to pound nails and would then still

function as a microphone. Commented a studio microphone manufacturer when asked how well *their* microphone would handle this treatment: "You buy *my* microphone, I'll buy you a hammer.")

PRACTICE GOOD HOUSEKEEPING

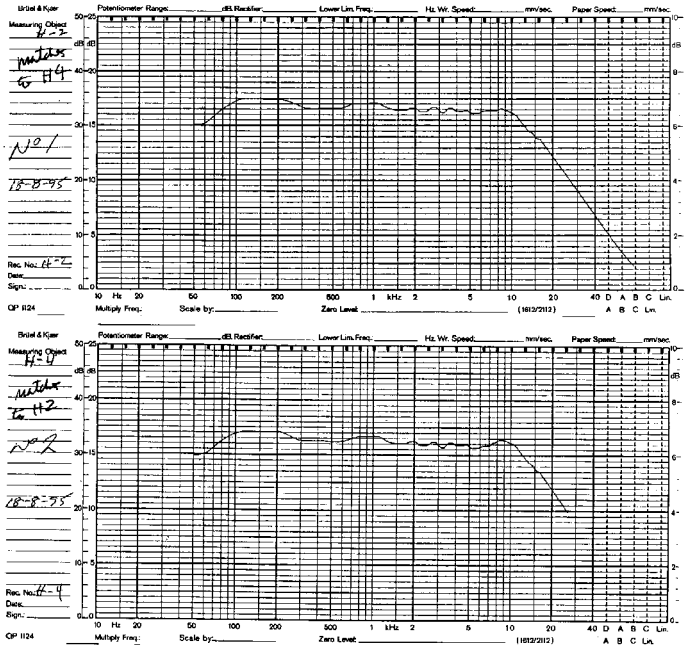
Put your mics away in their cases when not in use, or cover them when left out on stands. Keep your environment clean so as to protect mics in it from being exposed to more dust, dirt, and smoke than absolutely necessary. Microphones are expected to be able to respond to the very minute variations in air motion or pressure which define a sound wave. They just don't do this as well when encrusted with dust, dirt, or a mixture of smoke and hot, moist breath. Studio microphones are designed to deliver original performance levels for a long time under normal conditions. We suggest the the use of an external breath filter (such as a nylon screen) for close vocals. Such a pop filter sets a consistent working distance and limits the amount of proximity bass boost. They are also easier to clean than the microphone's own internal windscreen.

It is also critical that a dynamic (ribbon or otherwise) microphone <u>never be placed directly on any surface</u> without wrapping it in a clean cloth or plastic bag for protection. Dynamic microphones employ powerful magnets and any loose iron dust will be attracted to the microphone. Minute iron dust particles are a fact of life and exist everywhere; some are so micro-fine they can pass directly through both the outer and inner screening and be drawn directly inside, collecting in the magnet gap. When there is a sufficient build-up of foreign matter inside a microphone it restricts the diaphragm's free movement and causes distortion.

If you leave your 4038 in the studio between sessions, cover it with the supplied plastic bag when not in use. Even better, keep the microphone safely stored in its original case and plastic bag. This will protect it from wind and mechanical shock. Try to develop good ribbon habits such as moving your mic only when it's in a protective plastic bag and always closing its case gently. To a microphone, slamming the cover of the case is like like a "smack upside the head." It can hurt.

SPECIFICATIONS of the COLES 4038

Polar response: Bi-directional (cosine, figure-of-eight)
Impedance: 300-ohm is standard; also 30-ohm by special order
Frequency response: 30 Hz to 15,000 Hz (see spec. sheet curve)
Sensitivity:-65dB re: 1 Volt/dyne/cm^2
Distortion: Inversely related to frequency. Like most ribbon microphones the 4038 will handle very high SPL at high frequencies and is displacement limited at low frequencies. For example the 1% THD point at 110 Hz is 125 dB SPL while further down at 55 Hz this 1% point is reduced to 110 dB SPL.
Connector: Western Electric type 4069
Dimensions:197 mm x 83 mm x 61 mm; 7 1/4" x 3 1/4" x 2 3/8 "
Weight: 1.08 Kg; 2 lb. 6 oz.
Finish: Black textured enamel over heavy gauge brass; grille woven monel mesh
Hum rejection: Internal hum neutralizing balanced wiring coupled with magnetic shielding of the toroidal ribbon-to-microphone line transformer reduces response to stray magnetic fields by 30 to 40 dB.



MATCHED PAIRS

Matched stereo pairs of 4038's are selected on an "as available" basis.
(The curves above: H2 and H4 are pulled from one such pair.)