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Groove Tubes

VELO-8

Velocity (Ribbon) Microphone

Reference Manual

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A little background on "Velocity" mics

The VELO-8 name stands for "velocity" microphone, with a traditional "figure 8" polar pattern; hence, VELO-8. "Velocity microphone" is the original name used by RCA, Electro-Voice and others for what we commonly today call "ribbon" mics. They actually worked on reacting to sound wave velocity (or audio wind), so the name fits if you understand the technology.

Most ribbon mics have a very thin aluminum element that looks like a silver ribbon. It is moved (activated) by very small amounts of sound (or air velocity) from instruments or voice. This ultra-thin strip of metal is a double-edged sword.

First the positive: its ultra-thin element can capture details with a smoothness not found in any other microphone technology. It can make a saxophone sound sweet, not harsh. Ribbon mics can do the same for voice and many other instruments that might record too bright or harsh using modern condenser mics.

Now the downside: while its thinness affords highly detailed sensitivity to sound waves, it is also easily damaged or torn if the accompanying air waves are too strong. Higher air pressure levels, like those generated by a closely miked strong vocalist or a bass drum on axis, can easily rip the thin aluminum ribbon element resulting in a costly and time consuming re-ribboning repair adventure. Replacing the torn ribbon is a delicate maneuver, and only possible if performed by a highly experienced mic tech or a factory repair department. Unfortunately, both in the early days and today, a broken ribbon element is quite common. If you find a good mic tech who can repair your ribbon element, it can take weeks or months before you're back in business. The old RCA and Capital studios usually employed a full time tech whose only job was to maintain their array of ribbon mics so studio time was not lost. But those old ribbon tech guys are mostly gone today, and few younger techs have the training and/or experience to do a good ribbon repair. So today, we usually have to search for that rare "ribbon mic guru" and send it to him, or in the case of a newly produced ribbon mic, it would have to go back to the factory... and you wait!

This is one reason velocity mics fell out of favor with most the larger studios, who embraced the more modern and highly detailed condenser mics which are not as easily damaged from higher levels of wind or air velocity common to rock recordings.

Another factor of the ribbon mics'fall from favor with modern studios was that they had very low signal output as compared to the electronically activated higher output condenser mics. They therefore required more preamplification to get similar output levels, which add noise floor to the signal from the increased amplification factor. For an example, listen to the hiss on Elvis's "Love Me Tender" or Patty Cline's "Crazy", both recorded with early ribbon mics.

In fact, ribbon mics can be up to 20dB weaker than condenser mics. This is really a problem today, as most mixers and preamps do not have the low input impedance to match the relatively low output impedance of the typical ribbon mic (which uses a transformer to boost the impedance from 1 Ohm to maybe 100-200 Ohms). Also, the ribbon element's output signal levels are too low as well. Therefore, the "loading" is usually too high, and the preamp too weak to effectively boost the level to the strength of the more common condenser mic. Our ViPRE and SuPRE mic preamps were specifically designed to load the ribbon with a matching balanced transformer winding of 300 Ohms, instead of the industry standard of 2,000 Ohms or higher. These preamps also amplify over 70dB, so this feature set was specifically intended to allow ViPRE and SuPRE to address the special needs of preamplifying a ribbon mic, and duplicate the loading and amplification designs of the old RCA consoles when velocity mics populated the studios in the USA.

How the velocity mic works

Ribbon mics, both then and now, all work on the same basic principle; a thin conductor (usually a strip of aluminum) is suspended and "tensioned" between a magnetic field and is activated by sound waves, and this generates a small signal voltage. This is similar to the way the more common dynamic mic works, which uses its diaphragm suspended in a round magnetic field to generate a signal voltage from its movement activated by sound waves, like a small speaker in reverse.

So why do ribbon mics sound so different? These obvious sonic differences result from variations in the few simple mic components; the ribbon, the magnetics, the transformer, and the interfacing design of these elements. The craft and design to combine these three components is most important, as with any transducer… little things can make BIG differences! Let's look at each of these four areas in detail, and discuss how we created VELO-8 to be the best ribbon mic possible.

1. The Ribbon element: RCAmics had ribbons ranging in size from 2" long by 1/4" wide, down to about a quarter of that size. The thickness of the aluminum ribbon could vary from as thin as 2 microns to as thick as 8 microns. As most of the old ones have been rebuilt (usually with thinnest material available), few can be found with their original RCA-produced elements intact, and have usually been rebuilt many times using whatever thin aluminum they could find. Also, the thin aluminum was hard to come by when RCA got out of the ribbon mic business in the late '50s. One common trick of the old studio techs was to use the aluminum peeled off a gum wrapper, which is about 3 microns. Hand tensioning of the ribbon, or stretching it across the magnetic field, was critical and rarely measured in any meaningful way… the old guys just had a feel for it (or not!). Of course, the way the ribbon is crimped (or not crimped) also contributes to the end audio result as well. This is why so few vintage RCA mics today, even of the same models and era, sound exactly alike. But some common truths are found; the larger the ribbon element the more output level it generated (i.e., the RCA 44), and the thinness contributed to more (or less) detail as well as more (or less) reliability. For example, a thicker ribbon meant more durablity but gave less detail.

We like the old classic velocity mics VERY much, but didn't want to just "reissue" an Elvis impersonator mic, as many have done. However, we did take a page from RCA velocity mics of the '50s, and a few tricks from Bang & Olufsen (B&O) ribbon mics of the '60s, and made ours a unique offering which stresses the advantages of the ribbon mic, but also addresses the shortcomings. For example, our ribbon element is big and thin; VELO-8's aluminum ribbon is over 2 inches long, 1/10" wide, and is just 2.5 micron thick (human hair is about 10 microns, so it's a quarter of the thickness of a strand of hair!). The ribbon element itself is also uniquely shaped; it is very precisely "dual formatted" to have two shapes, and both contribute to detail and reliability. VELO-8's ribbon has both a curved area (in center) and a crimped suspension area at either end of the ribbon to help it hold its precise tensioning. This allows for maximum signal output and good long term stability. It is also precisely tensioned by a special proprietary GT computer controlled system; we call this "ribbon tuning", so they all sound exactly the same (a must for

stereo recordings!).

Lastly, our VELO-8's ribbon is field interchangeable by the user (more on that groundbreaking feature later).

2. The Magnetics: The classic RCA 44 ribbon mics were relatively high signal output devices (as compared with other ribbon mics) which was the result of a larger element and massive ceramic or Alnico alloy magnets placed around the ribbon element; more magnetic field gives more output, just like guitar pickups or speakers. These RCA 44 mics are favorites of engineers both today and then... and captured early Elvis and Sinatra tracks quite nicely. These early Capitol tracks were smoother than the later tracks by these same artists, as they were mostly recorded with more highly-detailed and brighter condenser mics like the Neumann U47. You will also notice more noise floor on the earlier recordings, but who cares? The "feel" of these performances could not have been captured any other way, and the truth is that both were great recordings, but for different reasons!

However, today we have a new magnetic material, Neodymium, that is 100 times more powerful than the best of the old Alnico magnetic alloys that RCA and others used. Also, unlike natural occurring magnets, the new materials can be cast into special shapes. All previous ribbon mic magnetics, both yesterday and today, have been made from off shelf square bars placed in a metal conductor. But instead of using commonly available off shelf magnets, we designed and custom cast a totally new "roof top" shaped magnet that concentrates the magnetic field on the edge of the ribbon and increases signal output. We also used the highest quality aerospace Neodymium material that costs 20 times more than the common Neodymium magnets you'd find on your money clips and refrigerator decorations. Furthermore, we choose to use a "high output roof top" magnet on BOTH sides of the ribbon. Most ribbons today (and then) have just a single sided magnet that uses a steel chassis to pass the magnetics to the opposite side of the ribbon element. This was the most costly approach... but of course, as we are suckers for quality and performance, we believe it was well worth it, as this approach boosts both signal output (while lowering the floor noise) and improves detail (with more depth and frequency response). In short, it simply makes for better recordings.

3. The Transformer: The transformer's job is VERY important as it interfaces the ribbon output to the preamplifier's input. The ribbon element is typically very low impedance, just one or two Ohms, and also needs a significant level boost as well. Therefore, the transformer must boost both the output level and raise the impedance of the ribbon element, with as little degradation as possible

to the signal. It can contribute much to the signal character, or it can degrade it as well. Cheaply made transformers degrade the signal a bunch, but good transformers are costly. This is the main reason studio product designers have moved away from using transformers in general and moved toward the MUCH cheaper "active" differential input stages made with FET or, worse, op amps for both output sections of microphones and input stages of preamps or mixers. However, in the golden years of recording, there were excellent quality transformers placed in both the output stages of all ribbon mics, as well as the input stages of the mixers... life was good, and nicely balanced too!

Today, however, due the the high cost of quality transformers and the very low cost of solid state devices to make active input and output circuitry (and with product catalogs spinning this as some kind of positive verbage like "transformer-less inputs!"), high quality transformers at either end that can do the math BUT not degrade the signal are a rare luxury. But luxurious sounding they are! Adding a high-quality transformer to your mic or SSL console can cost you hundreds of dollars each, yet still many engineers swear by transformers over cheaper and common active input stages. But they also have the added advantage of total electrical isolation, which is not possible with active circuitry. Certainly a cheap transformer can add unpleasant distortion and frequency loss and/or shift, so we don't recommend that. But it's interesting that many customers of lower cost Chinese ribbon mics are now retrofitting them a higher quality Western-made output transformer made in Europe or here in the States that easily cost twice what they spent on the mic! There is a noticeable improvement of course, as less degrading of the signal path occurs. While it's safe to say that the lower cost Chinese components in general just do not measure up to the Western-made product, it's also a fact today that any highly labor intensive hand assembled product MUST be made offshore if the target is to keep the price within reach of the common man's studio. That's why we make mics in the same GT captive mic factory where we have made our condenser mics for nearly 15 years, and use the similar formula of importing the higher quality Western-made critical signal path elements like capsule elements, tubes and transformers.

So the "GT Rule" with transformers is to go big *and* stay home! We went big, and we looked no further than the 118 freeway to find our favorite microphone transformer builder, Cinemag. This company has been a GT partner/vendor for many years. Cinemag designed and produces our custom multi-stage variable input transformer at the heart of the ViPRE mic preamp, which sounds incredible! The Cinemag company is co-owned and operated by Tom Reichenbach in Chatsworth, California. Making transformers is a lost art today, but it's a family tradition for the Reichenbachs; Tom learned from

perhaps the very best “wire winder” ever, his dad Ed Reichenbach. Ed owned and operated Reichenbach Transformer company during the golden age of Los Angeles studios. He made transformers for all applications, including for the studios. One of his outside sales guys was Dean Jensen. Dean specialized in studio customers and audio manufactures and helped design transformers to fit their demanding needs. Dean was a sales engineer, Ed was the designer and manufacturer. Later, Jensen formed his own sales company and named these “Jensen” transformers gaining (at that time) a high reputation for making perhaps the best sounding transformers of the day. But Dean’s offices were always located inside Ed’s transformer factory and Ed actually made these classic Jensen transformers! Unfortunately, when Dean died, his business went into a bankruptcy proceeding which resulted in the Jensen brand name being sold to a former employee, and Ed simply retired and sold the Richenbach factory. Soon after that, Tom started his own transformer business under the direction of his dad. Frankly spoken, we’ve sampled all the best transformers at every price point made today, and Tom’s transformers out perform them all every time... so we stayed with Tom on the VELO-8 project and it really paid off. Here’s what Tom and GT came up with in this latest collaboration.

The VELO-8 transformer uses pure nickel core laminates with multi-tapped output windings that allow the level to be switched between 75 Ohms (most detail) and 300 Ohms (most signal strength). We also added a High Pass filter for both windings so there are four switched selections located on the lower rear side of VELO-8’s body. The highest signal level is achieved in the 300 Ohm position. The 75 Ohm position will have less output but also will be obviously “altered” and so will provide more natural detailed results, but it will require more preamplification that may not be available on some mixers (but perfect for ViPRE and SuPRE either way!). Also, the low frequency roll off can be useful as ribbons really produce a lot of information in this the ultra low bandwidth area which could make a voice, drum or guitar sound too boomy.

4. The Design: Actually the size and shape of the ribbon, placement of the ribbon in the magnetic field, and quality of the coupling transformer which boosts the impedance of the ribbon’s output are the most influential components to the end result, but without a coherent design to combine them all could be lost! Our VELO-8 design is an original (not another “Elvis impersonator”, please!); it has higher than normal output levels as a result of the increased magnetic field created by our custom formed dual “roof top” magnets and special designed Cinemag transformer. It offers a dual contrasting ribbon placement design that produces different, but desirable, sounds from both the front and rear of the mic. Now, the engineer has two different sounding sides to choose from; the back side is less bright than the front side.

The dual contrasting sides, combined with our four selectable impedance and roll off options, give you eight different ways to use VELO-8! By the way, we think you will use all eight for various applications... and that was the idea, options are a good thing!

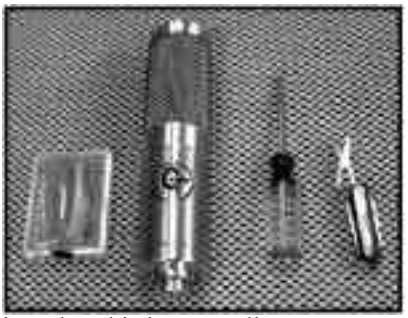
4a. VELO-8's Field Replaceable Ribbon! This is perhaps the most revolutionary part of our design: our exclusive field interchangeable ribbon assembly. We anticipated that many of our customers will have never owned or operated a ribbon mic before (mostly because more folks can actually afford our VELO-8 as opposed to other ribbons). We also know that they will probably NOT read our several cautionary statements about ribbon preservation ***(i.e., STRONG AIR DIRECTLY ON THE RIBBON WILL CAUSE DAMAGE! ALWAYS USE A POP FILTER WHEN CLOSE MIKING!).***

So when and if the ribbon gets blown out with your girlfriend's best attempt at a Janis Joplin cover song, you can be back in business in about 10 minutes, and not 10 weeks! How is that possible, you may ask? Because our VELO-8 ribbon is mounted and precisely pre-tensioned on a unique circuit board material so it can be replaced in minutes; the process involves removing just four screws on the chassis, and another four screws on the motor with a simple procedure that takes about 10 minutes, start to finish!

"So How To?": Notice when you unpack your VELO-8, there will be a small pre-tensioned ribbon assembly mounted on a small PCB and sealed in an anti-static package in your VELO-8 carrying case. By the way, the design of the VELO-8 vertical storage case has an important purpose: keeping VELO-8 upright in storage will avoid "ribbon sag" which can occur over time and degrade the performance if stored horizontally. The following chapter of this manual will show you, step-by-step, how to quickly replace your VELO-8 ribbon assembly should it be necessary. So, if this should ever happen to you, you can take comfort in two realities: first, you can whip out your spare ribbon and replace it in 10 minutes (NOTE: the extra ribbon sub-assembly is included in the VELO-8 package!), and secondly, you can send us back your broken ribbon sub-assembly in its special plastic package and we'll return it to you for a reasonable service charge!

Replacing your VELO-8 PCB ribbon assembly

1. Getting Started



Begin with a flat, clean, non-metallic work surface... a wood table is perfect. Make sure to remove all metal items that might be attracted to the VELO-8's very powerful magnets. You will need a VELO-8 replacement ribbon (obviously), a small #1 Phillips screwdriver, a pair small scissors to open your anti-static non-hermetically sealed ribbon assembly pouch (we like these small Swiss army knives, but this is not really necessary, any pair will do) and a pair of soft, clean hands (do what your Mother says; wash your hands!)

2. Disassembly

2a. Using the #1 Phillips screw driver, carefully remove the two chassis mounting screws located on the bottom of the VELO-8 on either side of the XLR connector. CAUTION: Be sure to keep all screws a good distance from the open mic chassis as VELO-8's magnets are extremely powerful and so can attract metal objects in close proximity, and at a great velocity, possibly damaging the ribbon element.

2b. Carefully slide off the bottom portion of the chassis/shell (downward), taking care not to damage the impedance and roll-off switch.

2c. Carefully remove the (2) #1 Phillips screws located directly underneath the platform housing plate which divides the internal chassis. These two screws attach the platform assembly to the top head shell/screen.

2d. Carefully (did we say "carefully" enough yet?) slide off the top head/shell (upward), being very careful not to touch the motor assembly. Note that the threaded inside part of the mic head is magnetic and can stick to the ribbon motor... so keep it centered as you lift it off... you can do it!

2e. Disconnect the cable lead connector from the motor assembly to the PCB near the impedance switch, and carefully (there's that word yet again) slide the connector harness through the round opening (should we be so common as to just say "small hole") located between the upper and lower portions of the VELO-8 motor mounting platform. Move this assembly away from the motor.

2f. With one hand, hold the sides of the motor assembly and PCB keeping slight pressure on the PCB to ensure its alignment when the screws are removed. This sounds hard, but it's not, and you will feel so accomplished when this is finally over.

2g. Remove the top screws first and move these away from the work area. Keep consistent pressure on the PCB and remove the bottom screws.

2h. Slowly (and shall we say, carefully?) lift the PCB up and away from the motor assembly. Now you are ready to change out with the new PCB ribbon assembly

2i. Use your scissors (bet you thought we forgot about the scissors, eh?) to cut the anti-static pouch at one end. Try to preserve the old bag to repack your PCB assembly for reshipment back to us. Now set your new ribbon on the table, and get ready to re-ribbon!

3.0 Reassembly:
Basically, these reassembly steps are in reverse order, so many of you will find these truths to be self evident, but in case you like the full hand-holding instruction session, here goes:

3a. Carefully (maybe I should try "cautiously" just one time, what do you think?) place the bottom of the PCB at the base of the motor and hold with one hand, this means the PCB ribbon assembly will be at an angle so as to slide evenly into the gap between the magnets.

Now slowly lower the PCB into the area between the two magnetic pole pieces, making sure at all times that the ribbon does not touch anything in the process. Remember this is gum wrapper thin aluminum, one-quarter the thickness of hair and VERY fragile... so any strong breath, or touching it against anything could rip it to shreds (well, maybe not shreds, but it wouldn't be a happy moment if you inadvertently broke it at this delicate and late stage in the game).

3b. Hold the PCB against the motor chassis with one hand, ensuring that the holes on the PCB are lined up with the holes on the motor assembly, and carefully (are you getting tired of this word yet? I know I am!) insert one screw at a time. Then, using a #1 Phillips screw driver, just snug up all four screws but do not overtighten them until all four are in place and "snug" tight.

3c. Gently tighten the screws in an "X" pattern. They do not have to be torqued with a wrench, they just need to be tightened equally to keep the ribbon as centered as possible. Overtightening the first screw can tend to offset the ribbon and so we recommend this alternating "X" system like you'd use on a drum head.

3d. Use caution (isn't that better than carefully again?) as you guide the PCB connecting wire and plug back on through the access way (or "hole") and replug (is that a word?) it back into the mating socket.

3e. Place the top portion of the chassis over them motor assembly, making sure not to make contact with the motor, and replace screws to secure the top of the head/shell to the mounting platform and mic chassis.

3f. Replace the bottom portion of the shell to the chassis, again, "carefully" noting the orientation of the graphics and impedance switch which is a tight fit so gently nudge it into place and replace the last two screws to hold it all together.

That's All! Now let your girlfriend finish tracking that Joplin cover. But this time use a GT Pop Filter!

VELO-8 Specifications

Microphone Type .....Velocity (Ribbon)
Operating Principle.....Electro-dynamic pressure gradient
Polar Pattern.....Bi-directional (Fig-8)
Generating Element .....2.5 micron corrugated aluminum ribbon
Ribbon Dimension .....0.10" x 2.10" (2.50mm x 53.14mm)
Magnetics.....Custom-Formed Rare Earth Neodymium
Frequency Response.....20Hz - 16kHz ±3db
Sensitivity.....-50dBV Re. 1V/Pa
Selectable Output Impedance .....Low: 75 Ω, High: 300 Ω
Recommended Load Impedance....Low: 300-600 Ω, High: 1200-2400 Ω
High Pass Filter.....Apprx. 50Hz in rec'd low impedance window
Maximum SPL .....138dB @ 0.5% THD
Output Connector.....XLR
Polarity .....Pin 2 hot for positive pressure (front of mic)
Dimensions .....8-1/4" long (20.5cm), 1-7/8" (4.7cm) max. dia.
Weight.....1.3 lbs. (590g), mic only

Groove Tubes Microphone Family

Model: GT Hardtop
Diaphragm: 3/4"x 6 microns
Electronics: FET
Patterns: Hypercardioid
Address: Top
Applications: An affordable, high-quality stage vocal mic with permanently attached ball windscreen.

Model: GT Convertible
Diaphragm: 3/4"x 6 microns
Electronics: FET
Patterns: Hypercardioid
Address: Top
Applications: Winner of the 2006 TEC Award for best sound reinforcement microphone, the Convertible is a true condenser that switches between a vocal or instrument mic with a removeable ball windscreen.

Model: GT30
Diaphragm: 3/4"x 6 microns
Electronics: Class A FET
Patterns: Cardioid (omni & supercardioid optional)
Address: Top
Applications: Excellent on stringed instruments, overhead cymbals and vocalists who already have a deep voice. Great for close-miking anything without proximity effect.Good results for most other applications.

Model: GT40
Diaphragm: 3/4"x 6 microns
Electronics: Class A Tube
Patterns: Cardioid (omni & supercardioid optional)
Address: Top
Applications: The ultimate acoustic guitar mic. Exceptional on stringed instruments, overhead cymbals and vocalists who already have a deep voice. Excellent for close-miking anything without proximity effect. Very good results for most other applications.

Model: GT50
Diaphragm: 1.1"x 3 microns with Disk Resonator
Electronics: Class A FET
Patterns: Cardioid
Address: Top
Applications: A classic fixed-position cardioid mic, with warm Class A FET electronics. Good for male and vocals, choirs, pianos, ochestral micing and other applications.

Model: GT60
Diaphragm: 1.1"x 3 microns with Disk Resonator
Electronics: Class A Tube
Patterns: Cardioid
Address: Top
Applications: All sources will benefit from its tube warmth and character.use it for lead and backing vocals, guitars, strings, and anything else that benefits from a tube mic with a set Cardioid pattern.

Model: GT57
Diaphragm: 1.1"x 3 microns with Disk Resonator
Electronics: Class A FET
Patterns: Cardioid,omni,figure 8
Address: Side
Applications: Excellent on vocals and grand piano. A good all-around instrument mic. Excellent sensitivity and pattern flexibility for duets, stereo and ensemble recording.

Model: GT67
Diaphragm: 1.1"x 3 microns with Disk Resonator
Electronics: Class A Tube
Patterns: Cardioid,omni,figure 8,super-cardioid
Address: Side
Applications: Exceptional on vocals and grand piano.A great all-around instrument mic. Excellent sensitivity and patter n flexibility for duets, stereo and ensemble recording.

Model: Model 1B-FET
Diaphragm: 1.1"x 3 microns
Electronics: Class A FET
Patterns: Cardioid
Address: Side
Applications: Excellent on vocals. A great all-around instrument mic.

Model: Model 1B
Diaphragm: 1.1"x 3 microns
Electronics: Class A Tube
Patterns: Cardioid
Address: Side
Applications: Exceptional on vocals. A great all-around instrument mic.

Groove Tubes Microphone Peripherals

ViPRE: Groove Tubes'award-winning microphone preamplifier.
Variable impedance input • Variable rise time • All tube, balanced Class A design • Precision gain control • Authentic VU metering

SuPRE: Stereo tube mic and instrument preamplifier.
• Two-channel stereo microphone and instrument preamplifier • Variable transformer impedance settings on each channel • 72dB of gain on each channel

The Brick: Tube preamplifier, line driver, and DI.
• Tube mic/instrument pre for the studio and stage • Can run 1000 feet and more without the losses of simple direct boxes. • High-quality sound • Sturdy construction