

Loudspeakers

Red Rose Classic Ribbon

Some stunning sonic strengths earn this speaker a place in the pantheon of truly great speakers, and at \$8000/pr it is very reasonably priced for the performance it delivers. The system is a midi tower with a narrow front panel (which helps stereo imaging). Driver complement includes carbon fiber cones for the single 10 inch woofer (abetted by a vented enclosure), and a pair of carbon fiber cone 5 inch drivers for the lower midrange and midrange.

Then, at just 1800 Hz, a moderate sized ribbon takes over, to handle the upper midrange and the entire treble portion of the spectrum. This means that most of music's overtones, including all the information (about musical transients starting and stopping) that provides articulation, is provided by one single driver, and a very fast and linear driver. Thus, most of music's harmonic texture and timbre information, as well as all of its articulation information, is very accurately and coherently revealed. This ribbon is a larger sized version of the ribbon tweeter first seen in Red Rose's tiny R3 mini-monitor, which brought sensational transparency and open, airy sound to the trebles of the R3.

It's not entirely unexpected, then, that this larger Red Rose system, utilizing a similar but larger ribbon to bring you more of the musical spectrum, should deliver excellent transparency. And, boy does this system deliver! Transparency is outstanding, throughout the whole musical spectrum (obviously the carbon fiber cone drivers are doing a good job of complementing the ribbon's prowess). Musical transients sound fast and airy, without the artificial hardness or sizzle we usually hear from small dome tweeters covering the same range.

The other chief strength of this system is its bass. The Red Rose Classic Ribbon has incredible, stunning bass quality. This is better quality bass than we have ever heard from any other full range system, at anywhere near this price. What makes this bass quality so outstanding is its high definition, which also implies lack of coloration and lack of temporal hangover. For example, when a double bass is played, you hear the string gruffly resonating, the large cavity of air in its wooden body resonating, and the subtle sound of the wooden faces (sounding board) of the instrument's body resonating. You hear all these musical bass sounds revealed more clearly, more naturally by this speaker system than by others.

Why does the Classic Ribbon provide such superior bass quality? There are two simple reasons: what it does do, and what it doesn't do. What it does do is to accurately track the bass waveform of the original musical instrument, as it was recorded. What it doesn't do is add its own spurious contributions, contributions that color the bass and also obscure true musical bass information (thereby degrading bass definition). In virtually all other speaker systems, you can hear the woofer itself woofing, as it pumps air back and forth, especially because it continues to pump air back and forth after the musical bass transient has stopped. This temporal overhang and ringing is particularly noticeable and intrusive (hence degrading of music) because of two

exacerbating factors (which also compound each other). First, because the bass overhang continues temporally after the musical bass transient has stopped, it usually sticks out like a sore thumb, because there's probably relative silence in the bass after the first transient has stopped, with no second bass transient coming along until some time later. Second, the bass overhang is also particularly noticeable and obnoxious as a foreign coloration because the ringing of the speaker's bass system continues with its own intrinsic pattern or periodicity, which is different than the periodicity of the music's bass transient that just stopped. Thus, the speaker's bass loses definition, because the pitch (or apparent frequency) of the system's intrinsic ringing, imposed as a foreign coloration on the music, is different than the pitch of the original musical bass transient, so the ear gets confused by this contradictory information. Indeed, if the different ringing pattern of the speaker's bass system lasts longer than the music's original bass transient, the intrinsic single foreign pitch imposed by the speaker's foreign ringing pattern on all music may predominate over the variety of musical bass transients coming in off the recording, in which case the speaker will impose a classic case of one note boom on all of music's bass (which is the ultimate in low bass definition).

Obviously, for a loudspeaker to give you high quality bass with good definition, it has to be able to accurately track each incoming musical bass transient, and stop when the musical transient stops. How does the Red Rose Classic Ribbon system accomplish this? It is a vented bass system, in order to augment the output of the single 10 inch woofer driver, and thereby give you more extended bass and more powerful bass. But its vented bass system is deliberately designed to be different than that in most other speaker systems.

Vented bass systems are usually the worst offenders in ringing overhang and thus poor bass definition. They are the worst overhanging ringers because, when designed according to the Thiele-Small textbook formulas, their system bass response curves have sharp corners and steep slopes in the frequency domain, which automatically imply long ringing in the time domain. This long ringing misbehavior is especially severe from the port (or vent or passive radiator), because in the classic Thiele-Small textbook designs the port has a sharply peaked response shape, which implies very long ringing, thus bad bass coloration and poor definition.

Note that the overall amplitude response of such a badly behaving bass system looks flat when plotted on a graph, so a naïve engineer might erroneously think that all is well. However, a probing analysis of the components of this apparently well behaved amplitude response curve will reveal severe problems to a knowledgeable eye. The steep slopes, sharp corners, and sharply peaked port response all portend severe ringing. Moreover, the periodicity of that spurious ringing will correspond to the corner frequency of the response curve and/or the peak frequency of the port's tuning. The human ear/brain, hearing this periodicity of ringing, uses its time windowing capability to interpret the spurious ringing as being excessive amplitude response at the frequency corresponding to that periodicity. So in the end we actually hear such a bass system sounding just as though it has an excessive amplitude peak in its response (again, that one note boom), with heavy excess energy at that frequency dominating and overriding the original sound of music's natural bass transients. Such a bass system might appear visually to have flat bass response on paper, but to the human ear it doesn't sound that way, and that's all that really counts.

This means that speaker design engineers who follow the Thiele-Small textbook parameters are barking up a tragically wrong tree. Following the textbook, these engineers try for maximally flat bass amplitude response and maximally extended flat bass amplitude response. But those are exactly the wrong goals to be pursuing. For they guarantee bad bass quality: poor transient response, long bass ringing, poor bass definition, and a heavy one note boom.

Moreover, these would still be the wrong goals for the engineer to be pursuing even if we didn't care about bass quality -- even if all we cared about were impressively deep bass extension. You see, human hearing is actually very insensitive to bass quantity, so it's not a big

deal to our hearing perception if a speaker's bass energy at some low bass frequency happens to be flat, or 3 dB down, or 5 dB down. On the other hand, human hearing is quite sensitive to frequency or pitch, and therefore also to the harmonic or timbral composition of each musical transient. Most musical transients contain an infinite spread of frequencies, with constituent timbral content all the way down to DC (you might think of a violin as being one of the highest frequency instruments in the orchestra, but we measured the actual spectral content of a single violin string pizzicato pluck, and it extended all the way down to 0 Hz!). Thus, if you want to hear truly accurate reproduction of musical transients of all kinds, including of course bass transients, then you want your loudspeaker's bass system to extend as low in frequency as possible, with at least some response (but not necessarily flat response).

Now, all real speaker systems poop out at some point in the bass, long before they reach DC. Given that we can't make it down to 0 Hz, our next best goal should be to get some sort of audible response out of a bass system, down to as low a frequency as possible. Note emphatically that it does not have to be fully flat response, since our hearing is quite insensitive to hearing whether a speaker's output at say 20 Hz is flat, or 3 dB down, or 5 dB down. So long as the speaker's response output is loud enough to make an audible contribution (let's say 10 dB down or less), then the lower in frequency it can audibly extend, the more impressive the bass quantity will sound, since it will have more of the stomach kicking impact that only response down to DC can provide (one of our labs is within earshot of a military explosives range, so we know what DC bass sounds and feels like).

It turns out that Thiele-Small textbook bass designs, that try for maximally flat extended bass amplitude response, actually deliver poorer quantity of bass as well as poorer quality bass. That's because they spend all their effort to maintain maximal flatness of amplitude bass response, and thus they poop out more quickly after they finally give up their quest for flat response. There's a sharp corner at the bass frequency where they give up their quest for flatness, and then they take a very steep dive, so that all bass frequencies, below the corner where flat response gives up, are reproduced at much lower amplitude levels. This means that these bass systems reach the inaudible threshold (say 10 dB down) very soon, at a relatively high bass frequency (say 25 Hz). And thus you and your stomach can't enjoy much quantity of impact or kick from these bass systems. About all you do get out of these systems, in terms of bass quantity, is that mid-bass or upper bass boom from the ringing port tuning.

In contrast, engineers can design alternative bass systems designs that don't follow the textbook Thiele-Small guidelines for vented bass systems. One alternative is simply a sealed bass enclosure. If you look only at the flat portion of amplitude response, you'll see that this sealed kind of bass system does not extend as low as a Thiele-Small vented system design. But you have to look at the whole bass picture. When you do, you'll see that something dramatic important happens as these two kinds of designs plunge downward, at very low bass frequencies, from their flat amplitude sections at higher bass frequencies. The Thiele-Small vented bass system dives much more steeply than the sealed enclosure bass system, in fact twice as steeply. It poops out much more quickly for very low frequency bass energy, the kind that really kicks you in the stomach. By the time we reach say 20 Hz, the sealed box system is in fact putting out as much quantity of bass as the Thiele-Small vented system, and when we look at 10 Hz, we see that the sealed box system is actually putting out more quantity of bass than the Thiele-Small vented system. Again, since human hearing is relatively insensitive to gauging exact quantity of bass, it's relatively unimportant what bass frequency the flat portion of the curve extends down to, or even (as is commonly quoted in specs) what the 3 dB down point is. The spec that would be far more relevant, to quantity of bass and impressiveness of bass impact kick, is the lowest bass frequency that a bass system can reproduce audibly, say its 10 dB down frequency (technical aside: even this spec could be modified, to take into account the absolute acoustic watts a speaker can generate at very low frequencies). If we look chiefly at the 10 dB down point

of bass systems, we'll see that Thiele-Small textbook designs are actually inferior in quantity of low bass, giving you less impact kick -- and as we saw previously they are certainly very inferior in quality of bass.

Why then would anyone want to engineer or listen to a vented bass design? Because vented bass systems can put the rear wave of a woofer to constructive use, instead of dissipating and wasting it inside a sealed box. The key question then becomes how best to put this rear wave to constructive use. In particular, how to put it to good use without degrading both quantity and quality of bass. Is there an answer? Yes. And it's a surprisingly easy answer. All we have to do is think out of the box (pun intended), and dump our silly preconceived notion that bass amplitude response has to be flat, down to the point where it finally gives up and dives. Since our hearing is quite insensitive to bass amplitude, it doesn't matter that much if bass amplitude response is flat. Instead, what matters most is that a speaker's bass amplitude response be heard (and felt), down to as low a frequency as possible.

It turns out that, if the design engineer deliberately misaligns and mistunes his port, deliberately disobeying the Thiele-Small textbook, he can create a vented bass design that gives us the best of both worlds that really matter: more quantity of bass and also higher quality of bass. The one thing such a design does not do well is something that we now know does not really matter: its amplitude response does not stay absolutely flat down to the corner where it finally dives.

How does the design engineer misalign and mistune his port? The principle is simple. Instead of making the port's amplitude response a sharp, narrow peak, he makes it a broad mesa, with a wide, flat plateau top. This amplitude response profile inherently has much less ringing in the time domain, which already improves bass quality a whole lot. It also extends the power amp's tight, accurate control of the woofer to lower frequencies (since the port doesn't unload and allow loose woofer flapping until a lower frequency than the usual narrowly peaked port tuning does), thereby further improving transient accuracy, definition, and quality for all music (and virtually all musical transients have surprisingly deep bass components, like that violin pluck). Furthermore, this wider amplitude response profile from the port also improves the quantity of low bass impact and kick, since the skirts of this wider amplitude profile extend to lower frequencies than the usual narrowly peaked port tuning does. Incidentally, this wider amplitude profile should also make music's warmth and lower midrange regions sound clearer and cleaner, because the woofer won't be flapping as wildly when the port unloads, so there will be less modulation distortion of the upper frequencies also reproduced by the woofer driver.

This wideband port tuning thus improves both the quality of bass and also the quantity of low bass kick. Its only technical drawback is that the help this wideband port gives to the woofer, in extending its bass response to lower frequencies, does not bring that extended shelf quite up to the flat amplitude level of the rest of the spectrum. Instead, the extended bass shelf from this wideband port tuning sits at a slightly lower level, perhaps 3 dB down. We refer you to IAR issue 35 for a more complete discussion of this topic, including measurements that illustrate this phenomenon.

Having this shelf at a slightly lower level than flat is not a severe price to pay, since human hearing is not very sensitive to amplitude differences in the bass, so extended bass at a 3 dB down level is almost as good as equally extended bass that's flat. On the other hand, the benefits we get in return for this small sacrifice are very audible and very important. In return for accepting a hardly audible 3 dB lower level for this extended shelf, we get the benefit of a shelf that extends to an even lower frequency, and that improvement is highly audible as better bass impact and kick. As part of this extension we also get a lower bass frequency for the 10 dB down point in amplitude response, so again we get more low bass impact and kick that's audible and feelable. Even more important, in return for accepting a hardly audible 3 dB lower shelf for this

extension, we get much better quality bass, with much better definition, musical accuracy, tunefulness, and neutral lack of coloration and temporal hangover.

You get to hear the music's bass, instead of the speaker system's bass.

Over the years, we've found that, whenever we hear a vented bass system with high quality bass, it usually has wideband port tuning that disobeys the Thiele-Small textbook, either accidentally or deliberately.

In this case, Victor Tiscareno carefully tuned the bass system of the Classic Ribbon speaker for the best quality bass, deliberately disobeying the usual Thiele-Small guidelines and giving his vented bass system a wideband tuning. The sonic payoff is the absolutely stunning bass quality we hear from this speaker system. All other speaker engineers should listen to the bass from this speaker system, and learn from Victor's achievement here.

With its stunning bass, effortless trebles, and wonderful transparency, the Red Rose Classic Ribbon is obviously a great loudspeaker system. But it isn't quite perfect. At least not yet. We hear two slight foreign colorations from this system.

First, there is a slightly rubbery coloration around 200 Hz, which we suspect is the rim suspension of the woofer misbehaving, perhaps because it imperfectly terminates motional energy of the woofer cone and then radiates this energy on its own, imparting its own intrinsic material coloration pattern. In IAR issue 35 and succeeding issues we discussed examples of such misbehavior, and we showed how nearfield microphone measurement with real time FFT analysis could quickly pinpoint the nature of and even small sources of such colorations that unfortunately affect the performance of the system as a whole (partly because our human ear/brain is so sensitive at picking up and discriminating among various material colorations, having evolved during caveman days when it was crucial to discriminate whether that sound behind you was a wooden twig snapping or something else).

Second, there is a slight metallic tinge to the otherwise beautiful music emanating from the ribbon tweeter. True ribbons are inherently linear at the upper part of their range (beyond which they evince a well behaved Gaussian rolloff), so we don't think that upper frequency resonances are the culprit here (as we would if this were a planar magnetic sounding metallic). But ribbons, like cone and dome drivers, do have a low frequency resonance, where the ribbon starts excessively flapping on its own, thereby also emitting vibrations that are characteristic of the material that is flexing (metal), rather than being characteristic only of the music signal's commands. We suspect that this ribbon driver, even though it is larger than Red Rose's tweeter ribbons used in their mini-monitors, is still not up to the task of handling music down to the 1800 Hz frequency at which it is crossed over in this speaker system. In other words, the crossover frequency of 1800 Hz is too low for this particular ribbon driver. The metallic coloration we hear might be arising because the ribbon is being excited too close to its low frequency resonance, and thus is going into spurious vibration modes that naturally sound metallic. Or the metallic coloration we hear might be arising because the ribbon is being overdriven in amplitude by frequencies that are too low and demand too much excursion, thus forcing the metal of the ribbon to flex too much, which then results in a metallic coloration being emitted as the overly flexed metal strives on its own to return to an unstressed condition.

Hopefully, minor design adjustments could fix these two slight colorations. Then the Red Rose Classic Ribbon would emerge as an all around winner without reservation, a flawless great speaker, and an excellent value to boot.