



## Some Notes on Coupling Capacitors

One of the most common questions that shows up on DIY forums is what coupling caps to use in a particular application. For those who do not know, coupling caps are used on the output (or input) of a circuit to block DC while allowing AC to pass. Since music is AC, this is a good thing. Ideally, the best cap is no cap, but this is not always practical. This article compares several different caps. In general these are mostly inexpensive. This is for the practical reasons that a) this is usually what people want to know about, and b) it is what I have more of. As nicer caps come into my possession, I'll add them to the list, but it is not likely to happen too often. For now I am more interested in the differences between various inexpensive parts.

The battle one must fight in choosing a cap is the appropriate size and voltage. Coupling caps, together with input and output impedences, create high pass filters. This means that frequencies above a certain point are passed while those below are not. Further, the rolloff is gradual meaning that at a certain point the amount of a particular frequency will be diminished by a certain amount. Fortunately this is predictable, and people often talk about the 3db point which is the frequency that will be cut by 3 decibels. This is significant because the dropoff below this point is very steep making this the lowest effective frequency that is passed. To determine what this frequency is, you simply use the formula

$$F = 1 / (2 * \pi * C * R)$$

where F is the frequency, C is the capacitance, and R is the impedance (impedence is resistance for AC.) As a last consideration, the capacitors will also induce phase distortions in frequencies up to about 10x higher than the 3db point. What this means is that it is good to choose a low 3db point, like in the 2Hz range which keeps all phase distortions out of the audible range. Unfortunately, of course, as caps get larger, they tend to get more expensive, and so there becomes a tradeoff between size and price. Since different caps sound different -- and more expensive ones generally sound better -- sometimes, when on a budget, it is worth having a higher 3db point in exchange for better signal integrity.

In case you don't want to do the math, here are some rules of thumb for values:

Input Z	uF
500K	0.1uF
250K	0.22uF
100K	0.47uF
50K	1uF
10K	4.7uF

Choosing voltage is a lot easier. The voltage rating of a cap needs to be higher than any voltages that will be applied. In a solid state circuit, this is almost never a concern as most caps used for coupling are at least 200V, and usually higher (the exception to this is the use of electrolytics like Blackgates which is touched on a bit below.) In a tube circuit choosing a properly rated cap can be more important, but as long as the cap's voltage rating is higher than B+, you are usually okay (exceptions to this are beyond the scope of this article, but they do exist). One thing to consider is that some high voltage capacitors are said to perform better at higher voltages. If used in low voltage circuits, they are said to sound a bit flat. My tests did not reveal huge differences, but in places with less than a volt of DC I have found some caps to sound flat.

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With that said, I decided to start keeping notes on various caps I have tried. In general, all of these were tried in the same circuit and were simply clipped in with alligator clips. The value I used, unless noted, is 4.7uF which is common for a source or preamp output. By same circuit, I mean a few things. In the low voltage applications, for the source, and the place where the caps were inserted in the circuit, I used my own [non over sampling usb dac](#). Additionally, I initially used a Millet Hybrid headphone amplifier with Grado RS-1 headphones, but since the Millet has electrolytic output coupling caps, I switched to a Pimeta with AD843 opamps with no caps in the signal path. While I generally enjoy the Millet a bit more, it is certainly not the end all of resolution. The Pimeta resolves better making it better for these tests.

For the early high voltage tests, I inserted the caps as the Parafeed cap in a 6N6p based parafeed linestage. The 6N6p uses a Bottlehead style CCS as a plate load, is LED biased, and has Magnequest (B7) nickel core 15K:500 parafeed transformers. I used a [small single ended mosfet based power amp as a headphone driver](#) to drive Grado RS-1's, and for the source a Cary 303/200 cd player. Thus, after the source, the tested cap is effectively the only capacitor in the signal path.

For later tests, I used the cap as an output coupling cap on my [AD1865N-K based NOS DAC](#) that uses an 8416 in a grounded cathode configuration with a CCS plate load. This was connected either to my [single feed single ended spud amp](#) or a version of my [Less-pressivo](#) which uses custom wound Electra-Print output transformers, which render it no longer a Less-pressivo (more on this later). The amps either use 7788/E810F's of 6C45's, depending upon my mood.

Last, this page is intended to be similar to [Tangent's opamp comparison page](#). It should be noted, however, that the distinctions between film capacitors are a lot more subtle than the distinctions in opamps. Almost none of the caps reviewed here (except for the Panasonic bipolar electrolytics) have been bad by any means. Most of them would be fine choices in a circuit, and I have used them all at various time and in various places. Also, my methodology is a lot sloppier than Tangent's seems to be, so take this all with a grain of salt. These are just impressions.

The rating scale:

1. Terrible. Don't even bother.
2. Decent, but not the end all of resolution.
3. Very good. Limitations will only be noticed on very revealing equipment.
4. Almost as good as no cap. Choosing one cap in this range over another is personal preference.

Extra ½ points given for particularly good value -- So, a 3½ could perform a little less well than a 3 if it costs a lot less. If there are two ratings, the second is for the high voltage position.

Capacitor reviews being really subjective, the score bands are wide. Just because two caps are both rated "3" does not mean they are the same. Instead, it means that reasonable people could probably argue over which is better, though they may have very different characteristics. However, because the caps may be good or bad in a variety of different ways, a detailed linear scale is not really very useful. There will therefore not be any "2.9's" or "3.2's".

Finally, while I think that all the "3's" are better than all the "2's", and the "4's" are better than the "3's", there is clearly bleeding at the margin, and I'll try to note which caps are marginal. I have recently demoted a few caps out of the "4" class and made it harder to get in. I needed to either do that, or add a "5" class. Enough equivocating, on to the ratings ...

Brand	Type	Price	Where to get them.	Impressions (Low Voltage)	Impressions (High Voltage)	Rating
Panasonic ECG	ECW-F(B) Metalized Polypropylene, 250V	\$3.14	Digikey part number PF2475-ND	These are tolerably good. They are a bit on the bright side, lack some bass, and are slightly hard in the midrange. They do, however, pass a fair amount of detail, and in a dull sounding circuit might be a decent choice if one's budget is tight. Not as good as either the Solens or the BCs, but tolerable.		2
Solen	MKP-FC (Metalized Polypropylene), 400V (5.1uF version tested)	\$2.65	These can be found just about everywhere including Parts Express, Percy Audio, Parts Connexion, Welborne Labs, etc. It is worth noting, as well, that Solen makes these caps for lots of other folks who rebrand them.	These seem to be the standard caps which is slightly unfortunate. They are warm, and while not really harsh, they do lack detail and have some midrange grain and glair. Further, it is almost as if there is a veil over the music with these caps. To their credit, they sound more natural and less metallic than the Panasonics with better bass. Between the two, these are probably slightly better, but only slightly, and both could do well in the right circuit, and badly in the wrong one (these circuits being opposite.) I used these in my speaker crossovers, but only because I needed several large values and these were affordable.	The higher voltage seemed to help to undo some of the warmth with these caps. Further, they are still a little harder and edgier in the mids than some other caps and are a bit sibbilant, and they can thus become fatiguing over time. Compared to others, like the Sprague motor runs, they do have a bit more detail, but seemed a little less pleasant. Fine for budget projects, but can be easily bettered.	2
Solen bypassed with 0.1uF Vitamin Q	-	\$2.65 + about \$1 on ebay	There are dealers that sell Vitamin Q's, but they charge a ton for them. They can often be found for cheap on ebay.	The note here is that this made a world of difference. Bypassing causes its own phase distortions apart from the ones caused by the low pass filter, and whether bypassing is a good idea in a particular circuit depends whether the good done by the bypass cap outweighs this harm. In the case of Solens, bypassing can offer a huge improvement. The Vitamin Q cap here added some midrange lushness, a ton of top end detail, and did almost no harm.	Again, a huge improvement. Most the harshness of the Solen's is more or less gone with an added midrange clarity and richness. Still not as nice as the Auricaps, but the price is about a fifth as much. Indeed, if I were building a system on a tight budget, this is what I would probably use.	2 ½, 3
Axon True Cap	Metalized Polypropylene, 250V	\$2.75	Michael Percy Audio.	Percy sells these as being essentially the same as Solens (and for all I know they might be made by Solen), but to my ear they are slightly more detailed and natural sounding though there is still a bit of midrange grain. If you have a choice between the two, I think these sound better. There is a good chance that the difference		2

				here had to do with these being 250V caps and the tested Solens being 400V. Thus, you might take this as a review of 250V Solens? Maybe, maybe not.		
BC Components	MMKP 383 Metalized Polypropylene, 2.2uF 250V tested	\$3.25	Digikey part # BC1829-ND	These are the light blue box caps that everyone seems to end up with from Digikey. They only come in values up to around 2.2uF, so if you need larger you are out of luck with these. Overall, they are not a bad sounding cap. They are less grainy in the midrange than Solens or Axons, and are also slightly less warm and syrupy perhaps even bordering on hard sounding. Additionally there can be a little bit of lispy-ness on the top end, though this does not stand out as a strong characteristic. This puts them right between the Panasonic and the Solen as far as brightness, perhaps suggesting that they are the most neutral of the bunch. However, the resolution seems to be slightly better than either of those, though only slightly. The biggest down side is that they are a little slow and sluggish sounding, and thus lack dynamics and don't pop on the bass so well. This can make them a little boring. Worth a try, particularly if you are mounting them on a PCB.	Basically the same as before -- pretty clean and clear, not harsh at all, but a bit on the slow side.	2
Kimber Kaps	Metallized Polypropylene, 200V	\$15.38	These used to be available from more places, but now the only ones I am aware of are Parts Express and Soncraft. I got mine at a closeout sale from Welborne.	These have the detail of the Panasonics above (and then some) without being metallic or bright. If anything, while a little on the cold side of neutral, they are still both smooth and detailed. Not a bad cap, though not similar in sonic signature to my experience with other Kimber products like their cable. Overall, while clearly better than any of the cheapie caps (Solen, Panasonic, Axon, BC), a bit too expensive for what they do.	.	3
Kimber Kap bypassed with 0.1uF Vitamin Q	-	-	-	Almost no change from just the Kimber, at least not for the better.	.	3
Aerovox AFPS	Metallized Polypropylene, 200V	\$3.49	These came as a bag of 8 different values (as small as 1.5uF, and as large as 20uF!) from the Electronic Goldmine. Buy two bags to get pairs, though since each bag is a little different you might need more than 2 to get useful sets. Whatever, for \$3.49, buy	These are really nice caps. Solid bass, clear detailed mids and highs, very little grit or grain. Clearly better than the Solens or the stuff from DigiKey, these give the Kimber Kaps a run for their money. In fact, I couldn't tell the two apart (see note in the high voltage review). Won't replace the Jupiters (see below) in my preamp, but I would think they are about as good as a polypropylene caps is going to get without spending a bunch.	Ever since writing about how much I liked these, I have received tons of emails asking about them. Having not used them in a while, I got to second guessing myself. Maybe they aren't really as good as I thought. After doing another test, I am happy to say that they really are that good. To put it in perspective, they are clearly not as good as the Auricaps, and after extended listening, not as good as the Kimbers either. But, compared to the Solens, Axons, etc, they are clearly a step up. I still think the Solen with the Vitamin Q bypass is better, the Aerovox having a little less resolution and a little less detail and being a little colder, but only a little. Still a real bargain.	3

			10. (For the high voltage test I used 3uF/200V caps, one of the 4.7uF's having become leaky -- which might be a problem worth considering.)			
Sprague 500P9042F6	Motor Run Oil Cap, 5uF 360VAC	\$7.00	Surplus Sales of Nebraska	These are really nice. They are fluid, slightly recessed in the midrange, and slightly on the warm side with a big open top end. Detail is good, and the sound is natural with no harshness to speak of. Overall while not the end all of capacitors, a nice buy for the money. Indeed, while it is likely a bit of a crap shoot buying surplus caps, I think they are the best value for money and my first choice unless I want something in particular. Even if I do want something in particular, it would need to be in the \$30-40 per cap range with new caps to better these. There are lots of NOS motor run caps floating around for cheap, so try a bunch.	The higher bias and more resolving system did little to change my basic impression of these. Clearly not the most resolving caps, but a nice balanced sound. Not harsh, maybe a tad recessed in the mids, and maybe a little flat compared to some of the better caps which is probably a result of the lack of resolving power. But, they do have a nice roundness to the mids, which makes them slightly less resolving, but also slightly smoother than the Solens. So, over all, a pretty nice capacitor.	3
Blackgate N Series	50V bi-polar electrolytic	\$3.25	Michael Percy Audio, Parts Connecion, and a few other places.	Saying anything about Blackgate caps is entering into a religious war. Some people swear by them, others find them to be all hype. To me, in a signal path, they sound slightly more grainy and less detailed than good film caps. However, they also seem to have a warm fuzzy sort of sound that can be really pleasing (though I have heard this is unique to the N series.) One particularly useful thing about them is that they are small and come in large values and thus can be used where film caps do not fit, or do not exist (which is particularly the case if you need a large cap such as at the output of a headphone amp where 470uF is a common size, and 1000uF is not unreasonable), and this may be where they are best.. However, I'll note that people like Audiosector who are neither space nor value limited use them as output caps in their TDA1543 based NOS DAC. So, all of that is to say that there are times that they might be the right choice, and times that they are not. Fortunately, in the 4.7uF size, it is not particularly expensive to figure this out.		2 ½
Jupiter Condenser Company.	Paper and foil in beeswax, 600V	\$40.00	Percy Audio, Welborne Labs, Parts Connexion	These are really spectacular caps, as they had better be for the money (I also bought these on closeout from Welborne and paid about half the typical	The high voltage review is about the same as the low voltage one. Excellent resolution, clear clean sound without a touch of hardness or artificiality. Less pronounced midrange than the Auricaps,	4

				asking price.) Other than a slightly warm leaning, they are about as good as no cap. Liquid mids, clear bright highs, strong full punchy bass ... Beyond this level, I think it is just personal preference, and not that any other cap is better.	and more balanced bass as well.	
Mundorf	Silver Oil (1uF/1200V)	\$38.20 (for 1uF)	Sonic Craft, Parts Connexion	.	<p>I've been avoiding Mundorf caps for a while. They are the new kid on the block, and they seem to excel in goofy audiophile marketing (oil-impregnated Silver-metallized Polypropylene, special counter-inductance winding). But, even with that, they still seemed like metalized polyprop caps which, to my ear, aren't typically the endall of quality. If you look through this list, the best caps are the film and foil, and my favorites overall don't have any plastic in them. Further, the counter-inductance winding sounded like two caps in series, and really, if one cap is a bad thing, can two be anything but worse?</p> <p>Well, after a talk with Jeff at Sonic Craft, he convince me that these were the real deal and were worth a try. In fact, he said that other than the Sonicap Platinum, these were the best coupling cap he sells. So, I gave them a try and really all I can say is so should you. Like the Jupiters, these are into the class of caps where choosing one over another is simply preference. They are a step up in quality from any other plastic cap, or any other metalized cap, I have tried. They are crystal clear with a sweet midrange. Further, they don't seem to have the artificial paper in oil sparkle on top. Moreover, while maybe a tad warm, they really just let the sound of the circuit come through. With tubes that are raw sounding, the caps sounded raw and a little warm. With tubes that are bassey, the caps were bassey; with tubes that are sparkley, the caps were sparkley, and a little warm. In other words, (and unlike the Auricaps below which dominate a circuit) while they do have a character (all caps havea character), it is one that lets the character of the circuit through. These have now replaced some Auricaps on the output of my DAC</p>	4
Audience Auricap	Metalized Polypropylene, 4uF, 450V	\$23.00	Percy Audio, Welborne Labs, Parts Connexion	.	<p>This review is revised a bit as I have had more time to live with these caps. These look the same as the Kimber Kaps. Same yellow covering, same green epoxy ends, same red and black leads (though not Kimber TCSS in this case), but that is where the similarity ends. Many, if not most, metalized polypropylene caps seems to have a plastic-ey sound to them. This is not the case with the Auricaps. Instead, they are warm and sweet with a pronounced midrange. Resolution is pretty good, though not quite as good as the next level of caps. They also seem to roll off on both the treble and bass. The sweetness, in a cold circuit could be a welcome thing, but in the test circuit which borders on the warm and sweet already, it was a little too much. Anyway, these are quite nice, and a decent bargain in caps.</p>	3
Clarity Cap SA	Metalized	\$5.85	e-	.	These caps had the misfortune of being	2½

	Polypropylene, 3.3uF, 630V		speakers.com, diycable.com, etc.		dropped into a circuit that had previously been sporting the Mundorf Silver Oils. And, as budget caps, they were bound to get the losing end of that stick. But, after listening to them for a while, their good (and bad) qualities started to come out. These are the top of the line, I believe, Clarity Caps (I have some of the less expensive PX caps to try too, but their voltage rating of 250V is too low for my test rig so they'll have to wait). Even at that, they are dirt cheap (and www.e-speakers.com will even ship them for free!). Their basic characteristic is one of flatness. This is both good and bad. The bad is that they lack the top end sparkle, detail, and dynamics of expensive caps. They have nowhere near, for instance, the resolving power of the above tested Mundorfs, or even the Auricaps for that matter, sounding a little muddy in the mids. On the other hand, they do not have any hardness which can be a problem with a lot of plastic caps. They also don't have as much euphonic bloom of something like an Auricap, so they seem a little more true to the source. The goodness of this, of course, is relative to the circuit they are used in. But, if you are looking for a budget cap, I think these are a good choice. If they cost \$18 like the Auricap, they would be way overpriced, but at \$6 are a good option -- a nice step up from something like a Solen.	
DIY HiFi Supply Obligato	Metalized Polypropylene in Oil, 4.7uF, 630V (w/ radial leads)	\$6.75	DIY HiFi Supply		DIY HiFi Supply has these custom made in a variety of sizes, some large enough for power supply use. They stress that they are very tightly wound without any voids. There is also a premium (axial leaded) version, but being cheap I have not tried them. Overall, these caps are quite good, and considering the price, very good. Maybe not quite as resolving or as euphonic as the Auricaps, these caps are just very neutral with no appreciable flaws. Bass is solid if maybe a little sluggish, treble is clear without any hash, and midrange is where it should be. Really, for the money, I doubt you can find a better cap. The only real downsides I see is that shipping can be a bit slow as they come from Hong Kong, and because they need capacitor clamps and are 40mm in diameter (I can't find 40mm clamps anywhere), they can be tricky to mount. Get some of these, you won't be disappointed.	3½
A.S.C.	Metalized Polypropylene in Spearinol, 50uF 330VAC tested	\$14.00	Part # X386S-50-10-330 at Allied Electronics, also stocked in a few values by Parts Connexion, Percy, and sometimes Welborne Labs.	These come in smaller values, but I have the 50's around for a power supply. Welborne uses these to good effect as the "Ultrathin" cap in their DRD amplifiers (though they also bypass them with a film and foil in the highest end version.) These may be one of the best deals going in caps, particularly in large value film caps. Overall they are very nice sounding. They don't quite have the resolution or liquidity of the Jupiters, but they are way way cheaper too. In comparison, they sound almost as good as the Sprague motor run caps		3

				(though not quite as good as the Obbligato caps) offering a good balance of tone and resolution.		
Panasonic	Panasonic 4.7uF/50V BP (Bi-Polar) Electrolytic	\$0.24	Part # P1199-ND at Digikey.	These come in lower voltages for the same price. If you buy 10, the price drops to \$0.15. Also, they are a pretty shiny blue color. That's the good news, and unfortunately, that's really the only good news. When it comes to power supply caps, I really like the Panasonic FM series. In fact, I like them over Nichicon Muze KZ caps finding them warmer and smoother sounding. They are not quite Cerafine, but they are not that far off either. Anyway, I was hoping that some of the FM magic would rub off onto the bi-polar and that these might be cheap giant killers. Instead, they are harsh and grainy sounding. Still, worth trying because they are so cheap, but they made my dac sound like a cheap consumer grade cd player rather than the magical beast that it is. I'm not even sure what to do with the rest of the 10 I bought. Oh well.		1
Nichicon	Muse ES series 4.7uF/50V Bi-Polar Electrolytic	\$0.45	Michael Percy Audio.	Surprisingly, these are larger than the similarly rated BlackGate N series. They are reportedly favored by James Bongiorno of SAE, GAS, and Sumo fame as coupling caps. My experience is that their sound is very warm and full with a <u>lot</u> of deep bass. Really, if you like lots of bass this is your cap. However, they seem to lack dynamics, are a bit (just a bit) sluggish, and add a bit of a veil to the music. Unbroken in they also have that characteristic Nichicon Muse upper midrange hardness but this goes away after a few hours use. However, the treble resolution is not great. They are tons better than the Panasonic Bi-Polars, and tonally even compete with some of the film caps. Since they don't cost much they are probably worth experimenting with.		2 ½
Nichicon/Sonicap	Muse ES series 4.7uF/50V Bi-Polar Electrolytic bypassed by Sonicap Gen 2 0.22uF/200V	\$0.45 + \$3.30	Michael Percy Audio, Sonic Craft.	I am not always a huge fan of bypassing, but in this case, it worked really well. The high end opened up and mids were liquid without a hint of grain. There are too many permutations to try bypassing every cap by every other cap, so I can't say how the Sonicap compares to other bypasses, but I can say that this combination was great and absolutely worth the experiment.		3
Sprague	Vitamin Q 0.47uF 300V (96P47403S2)	~\$4.00	ebay		In the past, I have not evaluated Vitamin Q's on their own because they are hard to find in high enough values and high enough voltages. But, I retooled my	3½

				<p>testing rig to increase the input impedance of the amplifier to about 100K which means I can get away with a 470nF cap as a coupler and still have a decent 3db point.</p> <p>So, it was time to try the VitQ's. If you read a lot of internet forums, the reputation for these caps is that they are soft and gentle, maybe rolled off a bit, and overly lush. Interestingly, this is not only almost exactly wrong, but it describes a lot of the polypropylene caps pretty well. Instead, Vitamin Q's, which are paper in oil, are extremely clean and clear, and have a sort of sparkle to the top end. If they have a fault, it is that they do not exaggerate the bass, and maybe miss some resolution compared to the very best caps. But, really, this is a maybe. These are really good, really musical, caps. They are not bloomy in the mids at all, which actually allows things like female vocals to sound strong and incisive, not like they are in the Star Trek soft focus of an Auricap. Obviously, these are not going to be everybody's cup of tea, but I find I can get lost in the music more easily with these as my couplers than just about anything else. Highly recommended.</p>	
Surplus Soviet Paper in Oil	K42Y-2 0.47uF/500V	~\$2.00	ebay	<p>These, along with the Soviet Teflon caps, have been all the rage on the audio boards lately. They are super cheap, and for the money represent a pretty good bargain in audio. Unfortunately, while they are good for the money, they are not as good as some of the made for audio capacitors, or other surplus caps, that are available. Overall, they are flat sounding in the midrange, and they lack the resolution of some of the better caps. They also seem a little grainy and hard in the mids and treble. Their best quality is probably their bass resolution which is strong and punchy. These are a great value and good to keep on hand for experimentation, but they are not something I'd use in equipment I was listening to regularly. A sizeable step down from a Vitamin Q and on the low end of the "2" category.</p> <p>An update -- paralleling a bunch of these together seems to change their character considerably -- think of it as a home made multicap. Anyhow, I needed a 2uF cap for a project and paralleled four 0.47uF together, and the sound was warm and smooth and very detailed. I won't speculate on the why, but, at least so far, this seems to be working pretty well. This puts them in category 3.</p>	2½ (3 in   )
Reliable Capacitor	MultiCap RTX (polystyrene) 0.47uF 400V tested	\$17.65	Percy, SonicCraft, Parts Connexion, Handmade, etc.	<p>I was warned against these by one of the vendors being told that they are clinical and cold which most people don't like. Now, he did say that about 1 in 100 people swear by them, but I also recall the words "solid" and "state" being thrown in there somewhere, and not in a good sense. I may be in that small group, but I find these to work pretty well. Like with the Vitamin Q above, these are not bloomy in the mids, which allows the mids to sound good on their own. Instead, they are very balanced from top to bottom, with maybe a small emphasis on the</p>	4

				<p>bass. Really good bass, good mids, and good treble without the PIO sparkle and just a touch of sweetness. Additionally, the resolution is quite good. You might think of these as the little brother to a Teflon cap. They are not quite as resolving, but the tonal character is similar. Now, if you are running, and liking, resistor loaded 12AU7's, these are likely not for you. But, if you want to buy a cap that is balanced and has very little influence on the sound so you can get on with other things, these are a pretty good choice.</p>	
Sonicraft	Sonicap Gen I, Metalized Polypropylene, 2uF, 400V	\$11.25	Sonicraft, GR Research	<p>These are the house brand of caps from Sonicraft. Perhaps owing to the lack of a middle man, they are priced lower than a lot of their competition. However, from a performance standpoint, they are, in many ways, a step up from many of the more expensive "audio" caps.</p> <p>In audio reviews, people often talk about omission vs. comission. Omission, simple loss of resolution, is generally considered to be less of a sin than comission, the adding of "color" to the sound. Many polypropylene caps, Auricaps being the canonical example, add a midrange bloom to the sound while rolling off the frequency extemes This is, of course, both omission and comission, and the comission is welcomed by many. The Sonicaps, on the other hand, don't do the comission part, and don't do the omission to the same extent. Instead of rolling off the frequency extremes, they are just neutral, flat, almost unnoticable, caps with maybe a touch of bass emphesis. If anything, resolution is not as good as the best caps, but it is very close. It is, in character, essentially a slightly less resolving Mundorf Silver/Oil with slightly better bass. Moreover, that loss of resolution is very small and manifests itself in a sort of flattened body and overly smooth midrange -- which is not always a bad thing. But, as I say, it is hardly noticeable.. These are a clear step up from Obbligatos, and probably a nice step up from Auricaps. In fact, they are close to being category 4. They are probably a nice half way stop between the category 3 and category 4 caps, which may necessitate adding a new category. Highly recommended, but give them a few hours to sound their best.</p>	3½
V-Cap	Oil Impregnated Metallized Polypropylene (OIMP), 4.7uF, 250V	\$60.00	V-Cap.com, Parts Connexion	<p>There is no way around the fact that these are really expensive caps. I use them for parafeed duty in the output stage of a DAC with Magnequest nickel core output transformers, and these caps cost 60% of what the transformers cost (they cost the same as the steel core version). This bears mention because people often are willing to use caps over transformers for coupling because transformers tend to be really expensive. It is also worth mentioning that while these are less money that something like a Mundorf Silver/Oil 4.7uF cap, they are also only rated at 250V compared to Mundorf's 1200V rating, so in a sense you get less for your money. That said, in another sense you do get something else for your money which is a really special capacitor. These are, simply</p>	4½

put, the best cap I have used in this size. Yes, some other caps (perhaps including V-Cap's own teflon capacitor) might be better overall, but in general either they do not come in such large sizes, or they are way too rich for this reviewer's budget (for comparison, V-Cap's 3.3uF 250V Teflon cap is close to \$500, and Auricap's 3uF 200V version is \$200 with the 600V version at near \$1000). Indeed, AudioNote's 4.7uF 300V Copper foil and mylar in oil, the same basic technology, is almost 3x the cost. So, in its price range, I think this is about as good as it gets. So, what *are* the sonic qualities, you might be asking? It's hard to say, but basically, they are clear and just get out of the way. Really, that's about it. What more could you want?

Last, here is a partial list of dealers for various obscure capacitor brands. Digikey, Allied, Mouser, and Newark are also places to look.

Who	What
<a href="#">Michael Percy Audio</a>	Relcap, Audiocap, Multicap, Jupiter, ASC, Unlytic, Dynamicap, Wondercap, AuriCap, Hovland, Solen, Axon
<a href="#">Parts Connexion</a>	Audio Note, ASC, Auricap, Cardas, DynamiCap, Hovland, InfiniCap, Jensen, Jupiter, MultiCap, RelCap, Solen, Unlytic
<a href="#">SonicCraft</a>	Audiocap, Auricap, Cardas, Dynamicap, Jupiter, Kimber, Multicap, Mundorf, Relcap, Sonicap
<a href="#">Handmade Electronics</a>	Cardas, Hovland, Relcap, Solen
<a href="#">Madisound</a>	Bennic, Carli Mylar, GE, Hovland, Mundorf, Solen
<a href="#">GR Research</a>	Axon, Sonicap

As a final note, there are a number of other capacitor comparisons. Here are two that are pretty extensive -- you'll notice a fair amount of disagreement:

<http://www.humblehomemadehifi.com/Cap.html>

<http://www.vhaudio.com/21capacitorshootout.pdf>

Also, Jon L., originally at Head-Fi and then republished at Enjoy The Music, has done a pretty comprehensive roundup of capacitors, many way more expensive that I am willing to play with, that is worth a look. Part 1 is [here](#), and part 2 is [here](#).

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