Subject: Piezos / 2 way designs
Posted by Paul C. on Wed, 09 May 2001 17:00:14 GMT
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I am afraid the Motorla piezo tweeters are not taken seriously.I have used the Motorolas successfully for a number of years in two way spkrs, for home stereo as well as PA/musical inst use.I am a saxophonist, have experimented for many years with various speakers for good vocal and wind inst reproduction.(See my articles on Sax On The Web, http://listen.to/saxophone/ and there also you will find one I have, Playing With A Mic... general advice to wind players in using PA equipment.)I first noticed the Motorolas many years ago at Radio Shack, and had seen the KSN1005a and KSN1001a (fluted 4khz horn, aka "Superhorn") and KSN1025 (2"x6" 1800hz horn) sold by them, and also used in a number of musical inst speakers. I was intrigued by the simplicity.I had read some good remarks on the KSN1025 in Speaker Builder magazine's letters section. I was impressed with how flat these were, rivaling some much more expensive tweeters. I was less than impressed by the 5khz peak in the little KSN1005... a harsh one note cymbal sound.Please refer to http://www.ctscorp.com/pzt/ffpzt-home.htm You will also find a good piezo application article there, which tracks exactly with Wayne's advice.Since my introduction to these tweeters many years ago I have concentrated on the 1800 hz unit for use in simple, yet effective 2-way systems.CTS/Motorola has now expanded the 1800 hz driver line to other varients using this same basic driver: A cheaper, and less satisfactory KSN1176 2"x6" horn similar to the 1025. There is another 2x6 varient, the KSN1141b, that is a high power 2x6 1800hz unit that is part of their "Powerline" 400 wt (!!!) series. Now we are talking serious horsepower. Also in the Powerline series, KSN1141b 2x6 horn similar to the KSN1025, and a 4" square (outside shape, round horn) KSN1165a. These are all 1800 hz units.They make a separate 1 3/8" x 18tpi screw in horn driver, KSN1142a, also in the 400 wt Powerline series. I have used this with the Motorola KSN1151a 10" x 5" horn lens. But it sounds quite similar to the 1025/1141 with built on horn lens... save your money.I have had the same experience as Wayne Parham, and doubted the 92 db SPL's of these Motorola drivers. I had used them with good results with woofers rated 95-99 db/wt/m. Wayne tells me that by his actual measurement, the Motorolas measure 96 db/wt/m at 2.83v (equiv to 1 wt at 8 ohms). My golden ears agree (OK, laugh, but being a musician, I know what REAL instruments sound like).Roll the woofer off at 1500-1600 hz with just a coil (6db) and zobel. I find it best to just wire the tweeters above with no other attached components, and choose a woofer of 95-99 db SPL. You may luck up on a likely woofer with a natural rolloff at this point. These Motorola 1800 hz units all have a built in 22 ohm 1/2 wt resistor. The two times I have smoked a KSN1025, the resistor was burnt, but soldering in a new one had it working again with no problems.I have just recently purchased the larger KSN1188a driver. These extend down to 800hz... YES!!! 800 hz - 20 khz range. I have them teamed up with a larger 5"x15" horn lens (Parts Express #260-099, at $9 ea a real bargain!). So far, so good. New cabinets will soon be finished to mate these to some Pyle MH1560 15" woofers. So far, I just set them on top of existing cabs. But the sound is very promising.I would be glad to hear, as per my other thread, of others use of the KSN1188a's, either for home or pro audio use. I know these have been on the market for a while and used commercially. Comments?BTW, MDF does not cut it for "roadworthy" cabinets... I use birch ply. If there are resonances, I can't hear them... and certainly the strength of the ply vs MDF weighs heavily in this decision. MDF does not hold up well, in my experience, in equipment that must be moved around.Have you guys seen spray on truck bed liners? That stuff makes a great finish for road gear! Looks like black wrinkle vinyl from a few feet away. A commercial sound company in the next town had 15 pair sprayed by a local outfit, after first trying it out for several months on a pair of their rental PA speakers. Give this stuff a

consideration for your next project.One more note, I have also wired 8 ohm resistors across the terminals of piezos, making them appear to be 8 ohm dynamic units electrically, and used them with L-pads and 6 db (caps) xovers, crossing them from 1800 hz up on up to 6000 hz. This works well, with little or no SPL loss.

CTS/Motorola

Subject: Re: Piezos / 2 way designs
Posted by Paul C. on Wed, 09 May 2001 17:19:22 GMT
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From CTS' website: "CTS Piezoelectric Products is a leading U.S. manufacturer of high performance PZT ceramics and piezoelectric devices. Piezoelectric Products began as part of Motorola, Inc. in 1969 and was acquired by CTS in 1999."

Subject: Re: Piezos / 2 way designs
Posted by Stan C. on Wed, 09 May 2001 17:32:41 GMT
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Hi Paul,I am listening to the Studio one Pi shipped by Wayne and am very pleased with the sound. I am driving it with low power 300B SE tube amplifier. I'd like to know, from your experience, how much time is needed for the tweeter to properly run in? The sound improves quite a lot after 20 hours of playing. Should I expect more improvement? How much more run in is recommended? My second question is, are they made of tight manufacturing tolerances? Do you see the need to match them? I like the simplicity of the tweeter implementation, and my friends are all impressed with the good clean sound it delivers. Almost forgot, it is so cheap to own.Stanley

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Subject: Re: Piezos / 2 way designs
Posted by Paul C. on Wed, 09 May 2001 19:09:10 GMT
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I have not really noticed a break in period. Thought it was me... Hah!The CTS/Motorola tweeters seem very consistent to me. I just buy them. There is a KSN1025 (2"x6", 1800 hz) available from Radio Shack, lacks the high power protection, but is still a sturdy unit, for those of you who want to check them out, experiment right away.I agree with a posting elsewhere on here by Wayne that the harshness many hear is a mismatch of levels... these tweeters are more sensative than the advertised rating. And he gives a solution to this problem.Mine was different, I used the 8 ohm resistor across the terminals, then used an L-pad, and used a 12 uf cap on the hot lead coming to the L-pad. Before discussing with Wayne the SPL on these, I had already dialed my L pad down -5db to match the 1165a's more realistic 96 db SPL to my woofers' 92 db SPL.I see no apologies necessary over using these "cheap" tweeters... they perform!

Subject: Re: Piezos / 2 way designs
Posted by Crazy Dave on Thu, 10 May 2001 17:48:30 GMT
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Hi Paul,This was a very informative post. I have also thought that the KSN1188a had a lot of

270-099 (I believe this is the correct part#) over the 270-095 (made by CTS). Was it price or are there other considerations?Dave

Subject: Re: Piezos / 2 way designs
Posted by Paul C. on Thu, 10 May 2001 18:31:19 GMT
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I think the KSN1188a is a later version of the KSN1086 (if I remember the old number correctly), and with its 800 hz - 20 khz it is right where I want to cross to the horn. 15" Woofers begin to narrow their dispersion above 1 khz.As far as the horns... (FYI other guys, the Parts Express 270-099 is a no-name ABS plastic horn appx 15.2" x 5.125" for a whopping $8.80. The 260-095 is a 16.5" x 6.25" horn for $23.80... still a great price. There is also the 270-095 10.3" x 4.9" horn from CTS, $14.25.)I had never used the 270-099 before, but I figured, how bad could it really be?

And at $8.80, I was curious. As it turned out, it is quite thick material, has an aluminum threaded insert in the throat. While it may not hold a heavy dynamic horn driver in daily pro use, the very light KSN1188a driver (or KSN1142a) should be no problem.Well, these cheap horns look VERY good and sound just fine to me. I intend to use them again on future projects. I can see no reason to spend more on the very slightly larger 260-095 horn, or smaller CTS made 270-095. If I am going to a better horn, it will have to be a much, much more expensive unit.I have also put these KSN1188a drivers on the CTS made 270-095 horn. They sound just as good on either horn. The 270-099 cheap horn is thicker, stronger looking than the smaller CTS horn. IF I were building a small PA or floor monitor, with 10" or 12" woofer, I would probably use the smaller Parts Exp 270-095 CTS horn with KSN1142a driver (1800 hz driver) with a 10" woofer, and either the 1188 or 1142 with the same small CTS horn with a 12" woofer... to better fit the baffle board.So, for a mere $37 plus shipping, the KSN1188a and the 270-095 make a heck of a good horn/lens combo.

http://www.partsexpress.com/pe/pshowdetl.cfm?&DID=7

Subject: Re: Thanks, you make a very strong agument for this driver! NT
Posted by Crazy Dave on Thu, 10 May 2001 20:50:48 GMT
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No text!

Subject: Re: Thanks, you make a very strong agument for this driver! NT
Posted by Paul C. on Fri, 11 May 2001 00:04:29 GMT
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Thanks, Dave! Another thing...Every time you introduce a new driver, you have phase and response issues. For transients, "time alignment" etc is important. Keeping the transients intact is difficult if you introduce a crossover and another driver right smack in the middle the audio spectrum where it really affects things (5khz on up). Now if the crossover is down lower, where the wavelengths are longer, it is not as difficult to keep everything in line. AND if you can make it a 6db crossover, you are doing even better. Now, the issues here are power isolation for the tweeter, and if the crossover is low, a driver that can go low will usually not be able to produce the top octave.Well, Motorola piezos to the rescue... no problem with low frequency energy as the

impedance is very high down low, and the tweeter does not produce these frequencies. Also, these tweeters have plenty of top end range... in fact, in excess of what is really needed.And on top of everything else, I like the KISS approach.

Subject: Lens info!!!
Posted by Paul C. on Fri, 11 May 2001 15:49:40 GMT
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I just got this from Roger Moleski at CTS... The Parts Express #270-095 (5"x10") is the CTS (formerly Motorola) KSN1151 constant directivity horn lens. The Parts Express #270-099 (5'x15") is the CTS KSN1196 exponential horn lens. This is the $8.80 lens.Mr. Moleski said the KSN1188a (800hz) driver will work in both lens equally well, no loss of low end response with the smaller 1151 lens. He commented further that all of their screw-on drivers will work on either of these lens.Spec sheets are no longer available from CTS. Their spec sheets all say Motorola and they cannot give these out.The piezo products division was acquired from Motorola by CTS in 1999, and it is the same product, made and sold by the same people. Nothing has changed but the sign in front of the building (and I suppose, who signs their paychecks!). But he assured me their products continue to maintain the same high quality.

Subject: Re: Thanks, you make a very strong agument for this driver!
Posted by Crazy Dave on Fri, 11 May 2001 17:36:18 GMT
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Hi Paul,It is my understanding that piezos are self limiting with regard to low frequency, that is, the impedance of the driver makes it act as its own high pass filter. This would make the crossover very simple. I think that you could get away with 1 inductor on the woofer and a resistor across the terminals of the piezo.It's too bad that the spec sheets are not available. I'd like to see what rate the 800Hz piezo rolls off at. I'd also like to see how flat the response is. Of course, at the

over, the PYM1555 (292-236), PYM15128 (292-240, a little pricey), and PYM1578 (292-238) all look like they might be a good match. Also, the Dayton "Cast Frame Driver w/ 4" Voice Coil" (295-080) looks like it would work well in this application. It's a little pricey but still in range.Good info on the horn. My guess is that you would get the best performance with the 270-099 would

sound best because it appears to have a much smoother transition in the horn.I also like the KISS aroach.Dave

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Subject: Re: Thanks, you make a very strong agument for this driver!
Posted by Paul C. on Fri, 11 May 2001 23:12:19 GMT
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My Pyles are some older models, MH1560, no longer catalogged, at least not under that number. These are 15" musical inst / PA woofers.I have used these in several cabinets and with several horns. But the easiest to use, by far, are the CTS-Motorolas.The 1188's I have sound very good. Yes, I wish I had a response graph to look at, but my ears tell me they are just fine.According to what I found on the CTS site, and talking to Mr. Moleski today, wire a 20 ohm 10 wt resistor in series with the 1188's. The 1188's also have the same Powerline protection circuit as the KSN1165, 1142, etc. The various 1800 hz Powerline drivers need no outboard resistors, or other parts of any sort.

Subject: Re: Thanks, you make a very strong agument for this driver!
Posted by Crazy Dave on Sun, 13 May 2001 03:53:54 GMT
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If you wired a 20 ohm 10 wt resistor in series, wouldn't it attenuate the output of the driver? I thought that you would want it parallel (across the terminals). Note that I don't have any experience with piezo drivers.Dave

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Subject: Re: Thanks, you make a very strong agument for this driver!

Posted by Paul C. on Sun, 13 May 2001 06:58:54 GMT
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"If you wired a 20 ohm 10 wt resistor in series, wouldn't it attenuate the output of the driver?"The 1800 hz drivers (KSN1025a, KSN1165a, KSN,1141, KSN1142a)already have a 22 ohm resistor already built in, in series...I think that is the value, it has been a while since I tore into one. They need no outboard parts for protection. CTS advises adding a 20 ohm, 10 wt resistor in series with the larger KSN1188a (800 hz horn driver). The piezos have such a high impedance in their response range, 20 ohms is nothing. There is no noticable drop in output in audible range.But what happens is that way up high, 30khz and higher, the impedance drops very low... a piezo acts like a capacitor, not a resistor. A 20 ohm resistor in series gives the amp some load. If you have some stray signal, or occillation, with an amp that can respond up to 100 khz, as modern amps can, then you will have a problem.So, the resistor protects the piezo (and the amp, too) at those very high, inaudible frequencies.The only reason I ever wire a resistor across the terminals... I have used an 8 ohm 20 wt resistor across the terminals to make it act, to a crossover, as if it were an 8 ohm dynamic driver. Then you can put an appropriate cap in series with it, and cross it over at a higher frequency if desired. Or you can put an L-pad between the cap and the now "8 ohm driver".Try this experiment... hook some wires to your amp's output and connect them to the terminals of a piezo driver. No other parts. Put on some interstation FM hiss, white noise, whatever. Now, get your 8 ohm resistor, and touch it across the terminals (parallel)... hear a difference? OK, now wire a 20 ohm resistor in SERIES with the piezo driver, turn on some noise and listen. Use a piece of wire to short around the resistor. Hear a difference? You won't.I don't usually attenuate the piezos... I just chose a woofer that is in the 95-98db SPL range. Plenty of those available.

Subject: Re: I hope everyone interested in piezos reads this whole thread
Posted by Crazy Dave on Mon, 14 May 2001 16:25:31 GMT
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Paul,You have given quite a lot of useful information on these drivers. The DIY press usually ignores the subject of piezos. I have gotten a great deal of information on what I considered a "hidden art" before these posts. Your posts have taken me a lot further in understanding these interesting drivers. Piezos are a natural for the DIYer. They are simple, cheap, and rugged, have

values of the inductor for the woofer on the 800Hz driver (when you get you system fine tuned). Let us know when you get any more interesting data.Dave

Subject: Re: I hope everyone interested in piezos reads this whole thread
Posted by Paul C. on Mon, 14 May 2001 17:47:13 GMT
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Dave: You will like this... my home stereo spkrs are some SpeakerLab designs nearly 20 years old. This system is 2 cft sealed, 10" woofer, 3" Audax cone midrange, and the little 10mm dome Polydax tweeter. Crossover was 800/6000 12 db all the way. 92 db SPL and F3 = 40 hz. Well, I had replaced one of the mids about 10 years ago, Audax said they were no longer in production, and steered me to Madisound, where I got the last one on the shelf. So, replacing those was out.I blanked off the midrange hole, took out wire cutters and hacked out the crossover... what a pile of parts! I put in a zobel for the woofer, 10 ohms + 17 uf in series across the terminals, and a .7 mH inductor in series... a simple 6db at 1800 hz or so. I installed KSN1165a's in place of the tweeters, with an 8 ohm resistor across the terminals, to make them look like an 8 ohm driver to my meager crossover. I wired the 1165 and resistor to the L-pad, and from the L-pad back to the hot lead a 12 uf cap. I dialed the L-pad down about -5 to sound right with the woofer.These speakers never sounded so good.I will be using the KSN1196a 5x15 horn lens and KSN1188a 800 hz driver with only a 20 ohm resistor in series with the piezo, and 1.5 mH inductor in series with my older Pyle MH1560 woofers (15", 60 oz mag, 97 db SPL...) and exact box design not determined yet. I formerly had the Pyles in a 6.3 cft ported box with a Pyle H3910E horn crossed at 2500 hz 12 db/oct. I am sure the 800 hz horn assembly will give better dispersion and sound better as it will carry more of the midrange.

Subject: Re: Sounds great! It may be getting time for me to break out the table saw. NT
Posted by Crazy Dave on Mon, 14 May 2001 18:44:42 GMT
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No text.

Subject: Re: Sounds great! It may be getting time for me to break out the table saw. NT
Posted by Paul C. on Mon, 14 May 2001 21:39:58 GMT
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The Pyle MH1560's (and there are comparable newer models available now, PYM1555, PYM1578, PYM15128) and KSN1188a combo will be for PA use. Wayne assures me these Pyles will give good performance in a large touring horn arrangement.

Subject: Re: Piezos / 2 way designs
Posted by DJ Z on Mon, 14 May 2001 22:09:03 GMT
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Excellent articles, and right on time. I have just ordered a couple of piezos and will be bookmarking all this info.

Subject: Re: Sounds great! It may be getting time for me to break out the table saw. NT
Posted by Crazy Dave on Tue, 15 May 2001 14:15:52 GMT
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Parts Express:PYM1555 292-236 300W 95.8db $59.90PYM1578 292-238 400W 97.5db $79.90PYM15128 292-240 600W 96.6db $139.75Assuming that the 800Hz Piezo can keep up with 97.5 db (1w/1m) efficiency, the PMY1578 looks like the deal (although the aluminum basket, 4" VC w/ Kapton former, 125oz magnet, and 600W power handling capacity of the PMY15128 looks good). Otherwise, the specs on the woofers look identical.Any idea of how Pyles would work in a base-reflex home installation? I know there are people who swear by them. I think they would perform well using Wayne's alignment (early, shallow roll-off).What kind of impedance load do you think a system like this would present? Could it be smoothed out enough for vacuum tubes or is this a transistor only system?Dave

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Subject: Re: Sounds great! It may be getting time for me to break out the table saw. NT
Posted by Paul C. on Tue, 15 May 2001 16:23:36 GMT
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Dave: I have used earlier Pyles (MH1560) in bass reflex speakers, and they worked just fine. Boxplot (and I will send you a plot I ran on these three) looks good, too. The 1188's are about 96db, and the woofers you list at 97.5 db SPL, you are only talking 1.5 db difference... hardly worth worrying about.I just ran the 1578 specs thru BoxPlot for my brother, and with a 5 cft ported cabinet, F3=52 hz, two 3" dia x 3.2" long ports. With 8 cft you can get down to about 45 hz.The 15128, in a 5.14 cft box, F3=44hz, 2 ports 3" dia x 1.61" L. The 96.6 db SPL should match the 1188 well.

Subject: Re: Sounds great! It may be getting time for me to break out the table saw. NT
Posted by Paul C. on Tue, 15 May 2001 16:59:26 GMT
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Dave: I see no reason the woofer would present a problem to a tube amp. For the 1188, you could put a 20 ohm 10 wt resistor in series with the 1188 driver. So, no matter how high the freq, there has to be at least 20 ohms present, right? The, in parallel with the 1188 and resistor, an 8 ohm non inductive resistor. So, now the whole thing looks like 8 ohms. So, come from the hot lead of the spkr's input terminal with a 25 uf cap (10 uf + 15 uf cap paralleled).

Subject: Re: Sounds great! It may be getting time for me to break out the table saw. NT
Posted by Crazy Dave on Wed, 16 May 2001 14:46:28 GMT
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Hi Paul,Thanks for the Boxplots! I'll check my home e-mail for them. Given the efficiency, it looks like I could go the cheap rout and use the PMY1555 and still get good result (assuming that Pyle's specs are correct). I don't need the high power handling capacity and I could use the money I saved on air-core inductors, polypropylene caps and good non-inductive resistors. There are not that many parts; I might as well use good stuff. I have used expensive wire in the past (when I got

it free because I worked in a high-end stereo store) but good quality twisted pair 18 gauge solid core copper wire seems to work fine (as well or better) for me as long as I don't make it too long.With regard to speakers, it amazes me what a better value pro gear seems to be. Its more rugged, presents easier loads, has lower distortion, is more linear, handles more power, is more efficient, has a wider bandwidth and is cheaper. When you spend more money for JBL, the specs are incredible (so is the sound). Actually, it was hearing some JBL speakers that first made me realize that I should be looking at pro speakers. I couldn't get over the clean dynamics.Thanks,Dave

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Subject: Re: Piezos / 2 way designs
Posted by Jon Risch on Thu, 17 May 2001 04:39:39 GMT
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Piezo's can be crossed over, and to great advantage. Here's how:Add a resistor in parallel, and the driver can be made to look like a current driven device to any outside components, such as a crossover cap. However, to keep costs and power dissipation down, 8 ohms is way too small of a value. The impedance of most piezo's is still quite high at 20KHz, so use a 22 ohm resistor, this makes any series crossover cap smaller and less expensive, and the resistor dissipates less energy. Use of an 8 ohm parallel resistor will also tend to lose you a little bit of output level. For most piezos, use of a 22 ohm resistor, and a 4-4.7 uF cap will allow the response to be identical to what it was in stock form, but rolls off the lows at 6 dB/oct below 1 kHz or so. This actually increases the power handling of the piezo, as it is voltage limited. Exceed the voltage used to pole (polarize the piezo element during manufacture) the unit, and it will loose sensitivity, and eventually burn out. Most pro grade piezos will handle 35 volt transients, and 28 volts continuous, which are 150 watts and 100 watts into 8 ohms respectively. Add in the cap and 22 ohm resistor, and the power handling could effectively be quadrupled, as the LF voltages are not imposed upon the unit, just the HF voltages. Piezo's crossed over in this manner don't sound as harsh and spitty, and tend to be quite a bit more reliable. Many of the piezo units have a mild peak just before they roll off in the LF, so making the series cap a little smaller can actualy flatten response, and provide even more protection and smoother sound. For the smaller piezo units that cut off at 4-5 kHz, a series cap of 1.5 uF will do the trick, larger units that go down to 3 kHz can use a 2.2 uF, and the large compression driver units meant to be mounted on a horn need about 5 uF, as they do not peak, and any higher would lose the sloping LF output even more.Attenuation, HF roll-off AND the crossing over can all be done at the same time. To attenuate, place a cap in between the piezo and the 22 ohm resistor that is shunting across the unit, then if HF roll-off is desired, use a series resistor in this location too. Then the series crossover cap should be in front of the 22 ohm shunt. Looking from the amp, first the series crossover cap, say 4 uF, then the 22 ohm shunt from hot to ground, then a series cap of about 0.15 uF for 6 dB attenuation, and then a series resistor of about 30-50 ohms to tame the very top end, then the piezo itself.I hope this will help shed some light on how to put a piezo to best use, and make them sound quite decent.Jon Risch

Subject: Re: Piezos / 2 way designs
Posted by Paul C. on Sun, 20 May 2001 12:56:41 GMT
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Oh, I forgot one of the most important things. There are some very inexpensive knock-off on the market, avoid them, and buy the real CTS/Motorola items.