Published in four Sections

Radio World

A—Editorial
B—Buyers Guide
C—Satellite Times
D—BEE

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McMartin-Telex Talks End

Minneapolis MN ... Telex Communications Inc, announced in late June they were attempting to buy the assets and certain liabilities of McMartin Industries Inc, of Omaha, Nebraska. The somewhat strange announcement came in a letter to McMartin's creditors offering to assume, a certain proportion of McMartin's debts.

Ansel Kleiman, Telex's President, told *Radio World* that McMartin was a respected manufacturer doing some $9 million in sales and had an excellent product line. He believed that McMartin's line of equipment will complement Telex's to a remarkable degree. He observed that unfortunately McMartin has operated at a loss during recent years and has a large amount of debt.

Kleiman noted that McMartin had attempted a major expansion about 3 years ago without adequate capital, had to pay high interest rates for money, then got caught in the general business downturn, and unfortunately could not recover. Over-spending in other areas also added to the company's woes.

Telex believes, according to Kleiman, there is good growth potential in the US broadcasting market. Above all, however, his company believes there is a tremendous growth potential for overseas sales, primarily in 3rd world countries. Kleiman states Telex has extensive contracts and experience in this market and will be able to supply excellent turn-key installations to 3rd world countries, especially after the acquisition of McMartin.

McMartin President and Founder, Ray McMartin, told *Radio World* that under the terms of the proposed agreement Telex would purchase the McMartin Omaha factory and continue production there with McMartin's 200 plus employees. McMartin noted that he will not stay with the company if the purchase occurs and has no plans other than looking for something that will challenge him.

As RW went to press, McMartin and Kleiman reported that negotiations had concluded unsuccessfully. McMartin pointed to his company's backlog of international contracts which will sustain them. Kleinman noted that the two companies could not reach concrete agreements, and Telex is looking to buy another communications company.

Recession Takes Toll?

Success story

Also in the news this month was another well known transmitter manufacturer, Wilkinson Electronics. Wilkinson's founder, Guffy Wilkinson, died in 1981 and in November, 1981, the company was sold to Television Technology Corp. The purchaser moved the factory to the parent company's plant in Arvada, Colorado on July 1, 1982. Wilkinson will continue to manufacture transmitters, power line suppressors, and solid state plug-in replacement rectifiers. Wilkinson executives John Tiedeck and Jim Ballig have moved to Arvada while Jack Neff remains in a marketing position in the East and Bill Johnson remains as a con-

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Stereo Update

Washington DC ... FCC type acceptance of the Kahn AM stereo exciter has been delayed beyond the expected date of June 15, 1982. Senior FCC Science and Technology officials will not tell why there is a delay, but it is understood that the FCC ran into some unexpected snags that were not anticipated.

In trying to be fair in the application of new rules the Broadcast Bureau and the Office of Science and Technology were discussing ways and means of not being overly restrictive while at the same time not overlooking something. Approval of the Kahn exciter is, however, expected momentarily.

Meanwhile, Leonard Kahn reports 14 major market stations are ready to begin AM stereo broadcasting when acceptance is received. Kahn also reported he is discussing with major domestic and foreign manufacturers the construction of receiv-

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LABEL

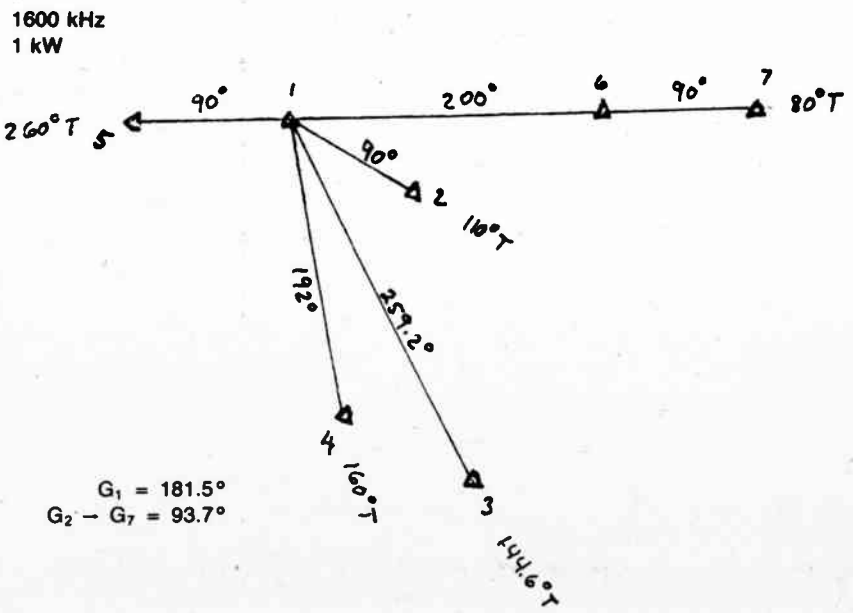
Benefits of Parasitic Re-Radiation

by Grant Bingeman/Sr. Eng.
Continental Electronics

Dallas TX ... When an AM radio station is licensed DA-N or DA-2, it often must contend with re-radiation from unused towers. This re-radiation distorts the licensed pattern. Used intelligently, such perturbation can prove beneficial.

For example, because of irregular ground conductivity, a NONDA pattern may be weak in certain directions. Correct "detuning" of those towers, which are normally considered only as part of the DA, can help to fill in these holes.

Figure 1



DAY		NIGHT	
TWR	CURRENT	TWR	CURRENT
1	.5∠0°	5	.49∠–104°
2	.7∠95°	1	.35∠–14°
3	.35∠95°	6	.7∠–90°
4	.5∠0°	7	1∠0°

Without actually measuring the current magnitude and phase in the parasitic elements, it may be difficult to tell how much non-circularity is caused by irregular ground conductivity, and how much is caused by re-radiation. In fact, the curve-fitting process described in FCC 73.186 tends to obscure the real magnitude of the scattering problem.

Try plotting your actual measured field values for the ½, 1 and 2 mile contours, then compare these with the smoothed-over, unattenuated version of your NONDA pattern as it appears in the proof of performance. If the measured values are accurate, each of the 3 attenuated contours will have the same general shape; only their size will differ.

But often the proof-of-performance NONDA pattern is much smoother, more circular. Which pattern should you believe?

It is certainly useful to know in advance what a NONDA pattern looks like for a given parasitic situation, so that the scattering and ground-conductivity effects may more readily be separated in practice. The moment-method allows us to obtain a theoretical scattering pattern that fits reality quite well.[1]

Consider the seven tower DA-2 as shown in Figure 1. Both patterns use four principal and three detuned towers. The tall tower is common to both arrays. What happens to the NONDA pattern when the parasitic towers are terminated in various impedances?

First let us look at the cases where only one parasitic tower is brought into play, and the others remain detuned with +j250 ohms. When tower 3 is terminated with half an ohm of resistance at its base, and tower 1 is driven, the pattern of Figure 2 results (± 1.8 dB circularity).

It looks like a typical "omnidirectional"

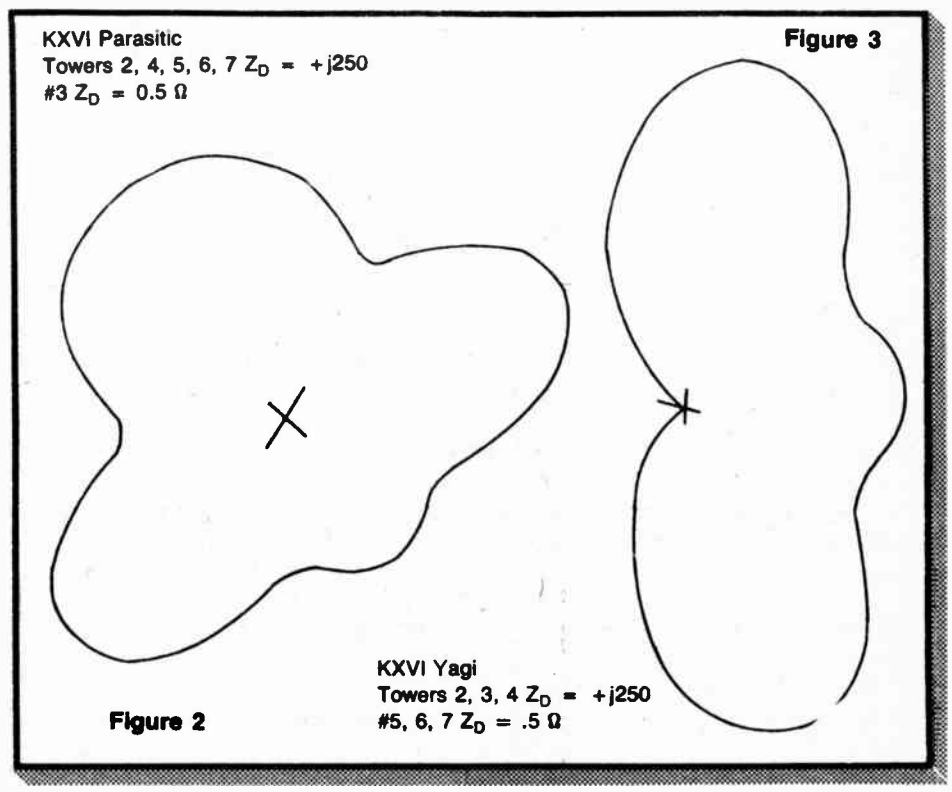


Figure 3

Figure 2

FM pattern. A similar pattern is obtained when tower 7 is the parasitic element, but the overall bearing of the pattern is changed according to the axis of the two towers.

A somewhat more directional pattern (4 dB max, −2 dB min) occurs when tower 2 is the parasitic element. The situation with tower 4 parasitic shows about the same maximum gain, albeit at different bearings, but its minima are not as weak as those of the tower 2 case. The directionality of these patterns can be adjusted by increasing the termination reactance at the base of the parasitic tower.

When more than one active parasitic tower come into play, the minima are generally deeper, and the maxima greater (Figure 3). Domestically the usefullness of such patterns would be limited to cases of extreme ground-conductivity variation. But did you know that medium-wave parasitic directional arrays, such as a yagi, are in common use outside of North America, but are not considered fully adjustable by our FCC, hence are not permitted?

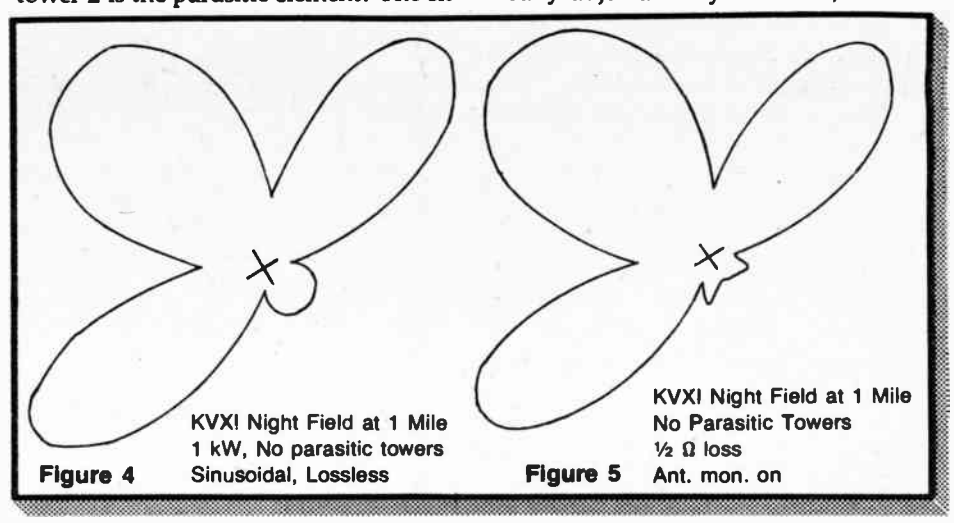


Figure 4

Figure 5

Many more combinations can be produced with these seven towers and various terminating impedances, but there is no need to belabor the point. Detuning can make or break your licensed pattern. Incidentally, the moment method can also be used to analyze the directionality of side-mounted FM antennas, and can be far less expensive than test-range modeling.

Other alternative

The other side of the coin is "scattering" of the intended directional pattern, which can be a real pain along the null radials. In the presence of parasitic elements, the actual pattern may differ from the licensed pattern if the prinicpal tower currents are adjusted to the theoretical values only. This is one reason why the final antenna monitor readings differ from the theoretical operating parameters in many cases.

I should include a few words about

(continued on page 6)

Hidden Microcomputer Costs

Part IV

by Roger Skolnick/Pres
Media Service Concepts

Chicago IL ... It is apparent that microcomputers are less expensive than mini-computers or shared-time systems. Software also costs less, and the programs you experimentally write are free. The combined hardware and software costs of a properly used micro system should be easily justified over both the short and long term.

Just as the purchase price of an automobile does not reflect such operating costs as gas and insurance, your initial cash outlay for a microcomputer system will need to be augmented with future expenses. Among the more obvious are diskettes ribbons, books and other supplies that are regularly used. Paper costs can mount, especially if you demand attractive, pre-printed forms of logs and bills.

Concealed expenses

Additional operating expenses incurred by the presence and use of a microcomputer are not immediately obvious. Depending upon your internal cost accounting, these may eventually show up as increases in such diverse areas as electric bills, insurance, finance charges, and space rental.

There will be access and telephone charges if you use a modem to communicate with other computers. And don't forget the cost of new pre-packaged software programs that seem attractive. It is very easy to get "hooked" on micros, eagerly anticipating the next software or hardware addition.

Computers and peripheral equipment have been known to malfunction, leading to expensive repair fees when warranties expire. Many microcomputer dealers offer maintenance service agreements similar to those you can purchase for other equipment. These are often a wise investment, especially if you depend on your micro for daily, core operations like logging, billing and music selection.

Your station's own CE or consultants may not be able to handle micro repairs, and you probably should not insist on their services if they show the slightest hesitation. Some hardware manufacturers will void your warranty if service is performed by an unauthorized individual.

Your labor costs

A major hidden cost we have briefly mentioned in previous articles is the time you and members of your staff contribute. Learning how to operate hardware and software takes time. Writing special applications programs takes time. Coordinating activities and being your station's computer literate takes time. And time is a hidden cost!

A novice could realistically spend several days just learning the basics of machine operation. These include starting the micro, copying disks, and mastering the routines necessary for day-to-day operation.

It takes half a day just to read the manual or tutorial section of a pre-

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Digikey Handbook

Dear RW:

Could you please send a mailing address for acquiring the Digikey Handbook as mentioned by Mark Durenberger in his March column?

Walter S. Labucki/CE
CJCH/Hailfax NS

RW Replies: Try writing Digikey Corp., Thief River Falls MN 56701, Tel: 218-681-6674, for their catalog

Digital or Analog

Dear RW:

I am a regular reader, and find Bill Sack's "Audio Process" column most enjoyable and informative. However, I must disagree with his conclusions about digital audio.

I do feel that 40 or 50 kHz may be too low for a sampling rate, and a 14 bit word may be marginal, but to say that digital audio, with a 100 kHz sampling rate (the rate required if the audio bandwidth is expected to approach 50 kHz) will never sound as good as analog, ignores the facts. First of all, we don't need a 50 kHz audio bandwidth. Normal human hearing extends to somewhere between 15 and 20 kHz. A 15 kHz square wave sounds exactly the same as a 15 kHz sine wave, because the second harmonic falls above human audibility. There is no reason to retain a bandwidth in excess of 20 kHz.

Mr. Sack's objection to the sharp lowpass filters could just as easily be extended to the filters required for FM stereo, which everyone seems to live with quite nicely. Moreover, the objectionable effects of these filters can be minimized by careful design. Perhaps the response ripple could be located above the filter cutoff frequency.

As for word length, the shorter the word length, the greater the "quantization error," as it's called. The audio effects of quantization error manifest themselves in the form of noise and distortion. I think it can be shown that noise and distortion in a 16 bit digital system challenge the best efforts to measure them.

Yes, the technology is in its infancy, and wrinkles need to be ironed out, but I definitely think it's the way to go. Wow and flutter, tonearm/cartridge resonance, off center records: all things of the past. My question is: Why digital audio for broadcasters? Most refuse to do justice to analog!

Karl Uppiano/CE
KCID/Caldwell ID

RW Replies: Anyone else out there want to join the debate? We can't argue about your last sentence, Karl.

Add to Mailing List

Dear RW:

I would much appreciate it if you would put me on the mailtng list for *Radio World* newspaper. I generally have to borrow a copy from one of my Chief Engineers when I want to check an article of interest.

Thomas H. Montgomery/DE
Federated Media/Elkhart IN

RW Replies: You're on our list Tom, and anyone else who wants their own copy, just let us know.

Dear RW:

Once again you have done it with expertise! Thanks a million. We had about 6 calls on the field strength meter and it moved out on the third call.

Harry M. Randel
HMR Prod/Scotch Plains NJ

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Bill Sacks on the Audio Process

Replacing Passive Mix Busses

Arlington VA . . This month I want to discuss how to replace passive mix busses in older consoles. These passive mix busses are fine for most formats where a simple DJ mix is all that is required.

The isolation your console gets between sources from an active mix buss is not required if you're just mixing a few turntables and cart machines onto a program buss. More complex formats, such as news/talk have more complex mixing/isolation requirements which demand the use of an active combining (summing) amplifier.

Summing amps

In theory the summing point of the opamp configuration shown in Figure 1, should be a zero impedance node, but opamps are real world devices with finite gain. This mode of operation takes advantage of the very low Z of the summing point.

The approximate summing point impedance can be determined by dividing the feedback resistance by the product of the open loop gain times the closed loop gain. This means that with a 10k feedback resistor and an open loop gain of 40 dB (at 20 kHz) and a closed loop gain of unity, the summing impedance at 20 kHz is slightly less than 100 ohms.

In short, the summing point is not a true short to ground, but close enough for broadcast work. Refer to Figure 1 again if you don't understand how the sources are isolated from each other.

Visualize R_1 and R_2 as the series elements in a classic "Tee" pad with the zero impedance summing point as the shunt leg. The isolation improves as the opamp performance approaches the ideal. The usefulness of this isolation is best shown in a mix-minus situation.

One example is a telephone talk show where 2 mix busses are used independently in the console. Let's call them the program and audition busses. The program buss is routed to the transmiter and the audition buss is assigned as the mix-minus buss. The mix-minus buss is used to feed the telco transmit through a hybrid circuit.

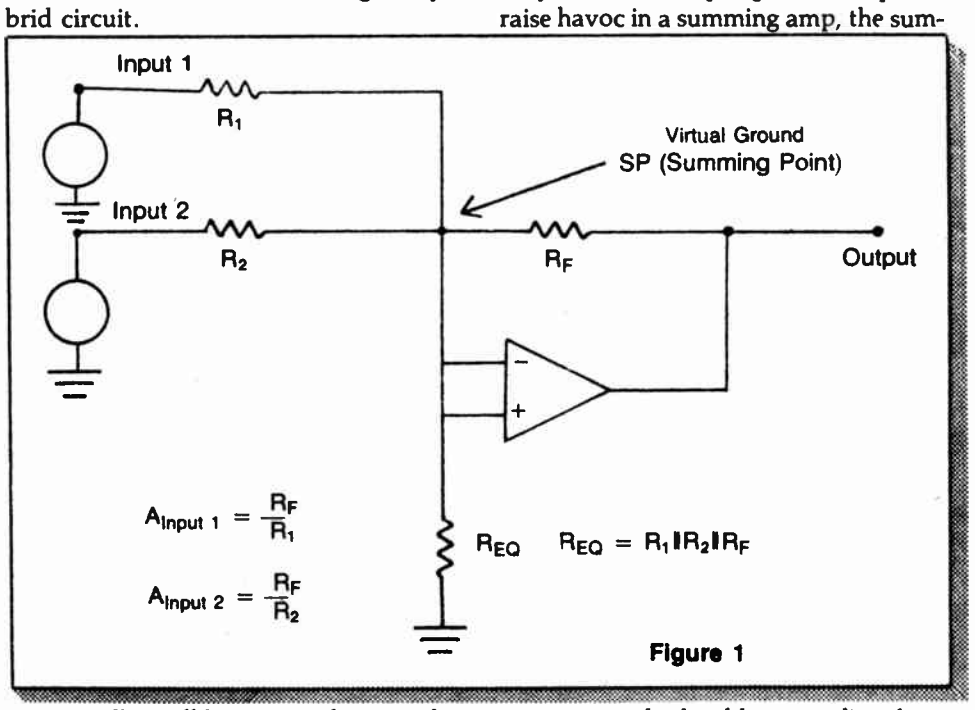

Figure 1

The caller will hear everything on the mix-minus buss and the feed to the mix-minus buss is everything minus the caller. The program buss includes everything on the mix-minus buss plus the caller. The people out in radioland hear only what is assigned to the program buss and not the mix-minus buss.

This isolation is also useful in producing live news and public affairs programs because you can have guests taking phone calls, and they don't have to wear headphones. The mix buss feeding the speakers is minus the news studio microphones. It's the telephone hybrid circuits which are notorious for their poor isolation which are usually the limiting factor in these systems.

It is relatively simple to build active combining networks if you plan the grounding system and cable routing carefully. Since a simple ground loop can raise havoc in a summing amp, the summing grounds should return directly to the same physical point as the noninverting input of the opamp.

One of the most common situations is a group of faders or pots which are to be mixed together. A common ground buss running across the bottoms of the pots can destroy all of the isolation that you have built. Each pot should have a separate ground return to the opamp, and shielding the ground wire is a good idea in an RF field. The shield should be directly connected to the opamp ground point with the end at the pot floating or optionally connected to the bottom of the pot through a 0.1 uF capacitor.

Input stage noise

The number of inputs that the active mix buss can handle is limited by the input stage noise of the opamp. Though the ideal opamp would allow you an infinite number of inputs, the real world dictates that as the number of inputs rise, so does the output noise of the summing amplifier. The noise gain is A(noise) = Rf/R1, R2, R3, R4, etc.

It is important to use metal film resistors and to keep the summing point wiring close to the opamp and as short as possible. This means the input summing resistors should be physically mounted next to the opamp.

The input impedance of each input is equivalent to the value of its input resistor. The gain of each input is determined individually and is the feedback resistor divided by sum of the input resistor and the output resistance of the source feeding it.

The output impedance of devices labeled 600 ohm electronically balanced output is actually 300 ohms resistive be-

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Benefits of Parasitic Re-Radiation

(continued from page 2)

moment-method antenna analysis versus the standard approach. The standard method assumes sinusoidal current distribution, as occurs on infinitely thin wires, but the moment-method makes no such current assumption.

Because of the finite radius of real towers (in this case, 24 inches for the tall tower, and 12 inches for the rest), real-world current distributions and impedances differ from the sinusoidal versions. Even without scatterers, an obvious difference between the two approaches appears in the minor East lobe of the night patterns (Figures 4 and 5).

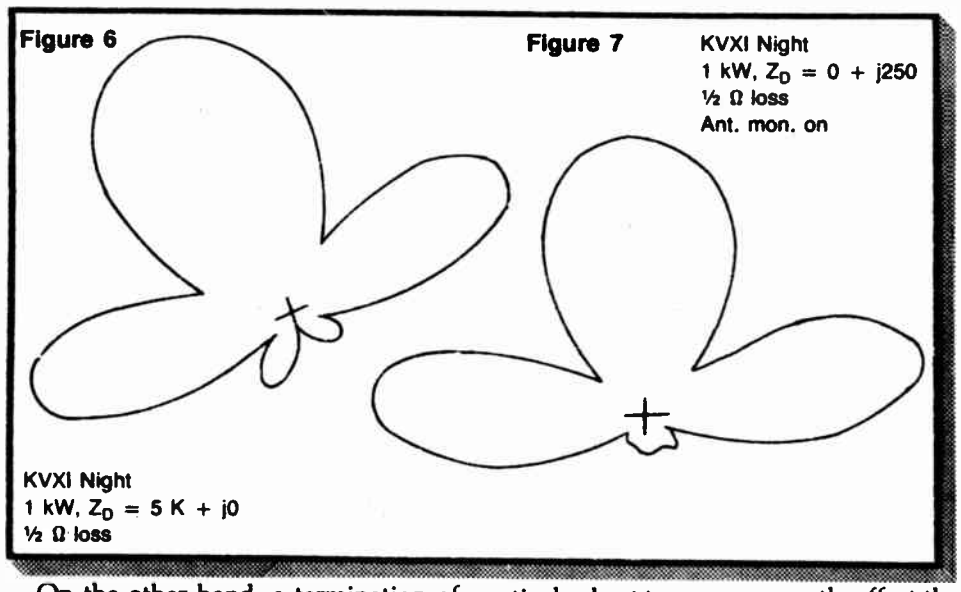
This is probably attributable in the main, to the current distribution along the tall tower.[2] Note how the phase begins to change at a considerable height above ground.

Also, the West lobe is larger and the North and South lobes smaller in Figure 5. But assume that this new pattern is still acceptable from the standpoint of interference and coverage, so no change in the antenna monitor values need yet be contemplated.

Scatterer effects

Now what happens when we add the effects of the scatterers (Towers 2, 3 and 4) while maintaining the same monitor values? Detuned with 5000 ohms (floating the towers and leaving, say, a static drain resistor in circuit), the effect is rather dramatic (Figure 6).

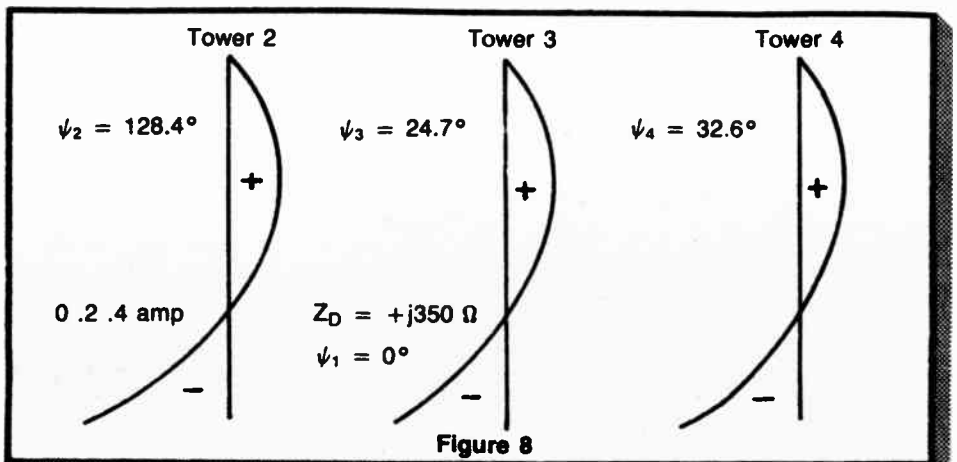
The North and South lobes are reduced, the West lobe is increased, and the East lobe has split down the middle and spread over to what used to be two null radials. Not so good. However, a base termination of +j250 ohms produces quite satisfactory results (Figure 7).



On the other hand, a termination of −j250 ohms creates a disaster. In order for a parasitic tower to become invisible, its current must be divided into opposing, equal-area loops (Figure 8). Fortunately, these particular towers become invisible simultaneously for both the horizontal and vertical patterns.

So far we have established that relatively short towers can greatly affect the pattern even when they are floated, and may be used to compensate for azimuthal variation in ground conductivity. Of course, the same holds true for other conducting structures, such as water towers. But it is important to consider scattering before the final array design.

One reason for this is the fact that in an antenna proof of performance, the directional pattern is calibrated by the NONDA pattern. Unfortunately, scattering will affect each pattern differently, as we have just seen, so this compromises the calibration.



Also, not only will a scattering study ease adjustment, it will lend greater confidence to the phaser design. After all, a phaser is designed for a specific set of antenna parameters. If those parameters end up significantly different from the theoretical values, do you still have a wideband phaser? Will the antenna couplers burn up? How many parts will have to be changed in the field, and how many hours will be wasted waiting for those parts to arrive on site?

But you see my point. It is far better to let the computer do the work whenever practical. The great versatility and power of the moment-method could be used to a much greater degree in broadcasting than it has been. It is particularly useful in reducing the design error when tall towers are used in an array.

Notes

1. Kuo and Strait, "Improved Programs for Analysis of Radiation and Scattering by Configurations of Arbitrarily Bent Thin Wires," Scientific Report No. 15, Syracuse University, 1972.

2. For each situation, the antenna loop currents were maintained at the licensed values, the tall tower loop current was sampled 90 degrees from the top, and the short towers were sampled at their bases.

(Ed Note: Additional figures supporting this article may be obtained by contacting Grant Bingeman at 214-381-7161.)

Buy-out

(continued from page 1)

sultant.

Dr. Byron St. Clair, Television Technology's President, told *Radio World* that the new company will concentrate on the AM and FM transmitter and related RF equipment that has been Wilkinson's best known product. St. Clair estimates that the new company, Television Technology/Wilkinson, can shortly double and even triple the $1 million in sales previously done by Wilkinson.

St. Clair plans to improve the spare parts inventory position of Wilkinson and thereby offer faster customer delivery. St. Clair also noted that the FM exciter in Wilkinson's FM transmitter line, which had been considered somewhat weak, has been redesigned and improved to state-of-the-art performance levels.

Wilkinson, according to St. Clair, has always been strong in the international market and he plans to maintain this position. He also plans, however, to improve domestic sales by the better use of 10 or more well placed distributors who, with spare parts on hand, will be able to react quickly to customer demands.

Debate On The Phase Chaser

by Dave Howe
Howe Audio Marketing

Boulder CO . . . This article is in response to Bill Sacks' comments regarding the Phase Chaser which appeared in the March, 1982, issue of *Radio World*. Although I sensed some admiration of the Phase Chaser product, Mr. Sacks did criticize its use in a radio station's program lines. He assumed that even if the Phase Chaser does correct for phase, it will generally degrade overall audio performance.

Nothing could be further from the truth. In order to address some topics for the benefit of Mr. Sacks and to enlighten readers of *Radio World*, the following answers are provided to very common questions which have arisen since the introduction of the Phase Chaser.

• **What is the time-delay scheme used in the Phase Chaser?** The time-delay network which is in the audio path and which is used to correct a time error is voltage controlled. It consists of cascased, all-pass, voltage-controlled, phase-shift networks which approximate a time delay network.

The baseline delay through either the left or right channel is 15 microseconds when no correction is applied. The maximum delay in the left or right channel is 1 millisecond with full correction (delay) of one or the other channel.

The voltage-controlled time-delay networks is not a digital delay line or "bucket brigade." Hence, there is no clocking noise or quantization distortion.

Since the time-delay network used in the Phase Chaser is a class of RC filters (ie: all-pass phase-shift network), there is a group delay that exists which is common to all filters and equalizers. This is usually an inconsequential effect compared to the potentially degrading effects of other available schemes.

• **How does the cross-correlator work?** The cross-correlator used in the Phase Chaser compared (through a comparator) a "direct" signal (left channel in this case) with a phase-modulated signal (right channel in this case). The output of the comparator is a maximum at a particular angle of modulated phase.

If the maximum at a particular angle common (coherent) signals of the left and right channels are "on time" relative to each other. Maxima at non-zero modulated phases indicates a time offset.

The cross-correlator used in the Phase Chaser is totally analog and strictly computes the cross-correlation function over a time delay of 0 to 1 milliseconds. Digital cross-correlators are available but are too costly now to consider for general audio use. At a lower cost, the analog approach has sufficient range and accuracy making it the desirable choice.

Note that the cross-correlator output is a wideband measurement of the delay offset in the time domain. There are no frequency sensitive elements or filters. A systematic time offset in the audio signal will produce a sensed time error, but signals of random phase and frequency produce no sensed offset.

• **Can the Phase Chaser be left in the program line?** Yes. This question is actually two questions in one. The first is,

(continued on page 14)

The Radio Doctor

Live Phone Calls — Almost

by Henry B. Ruh

Ellittsville IN . . . One of the most difficult problems which faces a number of stations is how to handle the live phone call. Over the years various schemes such as 2 reel to reel machines with a tape loop between; one reel to reel machine with an extended tape path and a re-located play head; a delay cart machine using a short length audio cart, typically 7 seconds; straight to the air without delay mechanism; or a digital delay unit of some sort have all been tried. Each of these has its benefits and risks.

Your choice

If your station is dealing with a continuous program where live phone calls are a basic ingredient, then you will need to utilize one of the methods above. Many times, however, there is a need to put a phone call on the air, even with some exchange in conversation, where a full fledged delay system is not needed. You are running a contest, for instance, and caller number 8 wins the prize. You do not need a delay system to air every call, since the first 7 are not needed on the air. You can't interrupt the music fill you use between the announcement and the 8th call, yet you want a spontaneous and live sound when you do air the 8th call. You want to put the call on, as it also helps insure an honest contest, and involves your audience. What do yo do?

A friend, Don Jeffers, now CE at WCFL Chicago came up with an ingenious system which provides the best of both worlds. It's also great for traffic reports, and the phoned-in information which may not come in at the exact time you want to insert the material on the air.

What it does

Basically, it works this way. A single tape recorder is dedicated to recording only from one source and that is the phone. The mic preamp in the console has an output attached ahead of the key switch so that the mic output is always fed into the phone network.

When the phone rings the machine is started. The DJ answers the phone, and the mic picks up his audio (at much better quality than if he were speaking into the phone) and mixes in the live mic without putting the mic into audition or program or que. The machine records both the caller and the DJ.

When the correct call is reached finally, it, as well as all preceeding calls, is recorded with the exchange with the DJ. When the call is finished, the tape is stopped, then cued to the point in the specific call where you want to start airing the call, and at the end of the on-air event the tape is played back.

The effect is that it sounds just like the call came in exactly at the right moment. The air flow is undisturbed, any editing can be done, and extraneous calls are eliminated. You also have a record of the calls received should there be a question as to who won.

The tape can be kept and played later. The DJ can also write down the pertinent information during the following program period, free of the pressures to get it down exactly when the call comes in, or placing the caller on hold to get the information after the call is cut off the air.

You have preserved the "delay" safety factor to pre-screen calls for bloopers, you have also protected the station from airing calls which may not have been connected with the contest. The programming flow has been preserved, and the caller is almost live, on the air. The machine can also be used for simple air checks by adding a circuit to the rec/play circuits to begin the recording whenever the mic is keyed on.

For traffic and weather reports, as well as other similar material, the caller can record the info. The DJ, having heard the info can key an intro which includes some vital point in the call: "Well Joe, how's that accident on the JFK affecting the traffic?" (start tape) "The traffic on the JFK is backed up for 3 miles due to the truck which jack-knifed and burst into flame blocking all 3 lanes." It adds variety to simply asking, "How's the traffic today?"

Needless to say you can use the same tape over and over again until you wear it out and you didn't have to invest in more hardware. You just used a tape machine you probably already had in the control room/studio.

Audio Distribution Systems:

by Scott Hochberg/Pres.
Logitek Elec Systems

Houston TX . . . I am always somewhat amazed when I talk with a station engineer who has spent a small fortune on his studio monitors, bought top-quality tape decks, has the latest state-of-the-art processors, but hooks it all together with a stack of resistors, or, worse yet, just hangs everything on a common buss. For some reason, many engineers consider even the most basic active audio distribution system to be a "frill," totally non-essential to proper operation and good sound. Reliable, high-quality audio distribution is not a luxury, it is a necessity in a properly operating radio station.

No hype

Now, it's no secret that we make an audio DA, and a darned good one at that, but before you dismiss this article as more pure hype from someone trying to sell his products, stay with me a while and let me plead my case. First of all, we've all learned the importance of matching impedances in audio systems. While we now realize that it isn't always necessary, or even desirable, to feed a 600 ohm input from a 600 ohm source, it is never a good idea to overload an output.

If you take your console's 600 ohm output transformer and feed it into your 600 ohm processor, your 600 ohm aircheck machine, your 50K ohm unbalanced house monitor amp, your phone coupler and whatever else you happen to need a program feed for, sooner or later your console's output is not going to do what it's supposed to do.

Further, once you've hooked that output to even one unbalanced input, or if any of the lines just happens to become unbalanced through the work of gremlins (I know this never happens at your station), you've just destroyed the common-mode noise-cancelling of the whole system.

OK, you say, but the console at my station has a separate output for the program feed which we use strictly for airchain purposes, and another output which we use for all the other feeds. Fine. But is that secondary output on the console really a good re-creation of the program feed? On many consoles, especially the less expensive ones, it isn't even close. And what is so great about taking that feed and overloading it, or unbalancing it?

True, it's not your air feed, but if you're taping from it, it could in some cases get on the air later, particularly when you've got a remote or a news feed. Besides that, why feed your monitors inferior material? Don't you really want to hear your signal at its best? Or would you rather have to tell people, "Oh, that's not how we really sound. Go turn on a radio and you'll hear us sounding a lot better." What then, is the purpose of house monitors?

While we're talking about monitors, what about the air feed that you may be taking off your Belar and feeding all over your station as "the gospel truth" of how you sound on the air? Modulation monitors are rarely designed to drive a large number of power amps spread out all over the building. They don't have the current drive, and are usually unbalanced, so at the very least you need a whole box of balancing transformers.

If what you really want to know is how you sound on-the-air, then it's your responsibility to make sure that your house monitors are as good as possible, so that no matter where you are in the station, you will hear any problems which develop, and be confident that what you are hearing is really what the listeners hear.

The one somewhat credible argument I've heard against using distribution amplifiers is that every additional piece of equipment is one more piece of equipment to fail, and who needs more down-

A Frill or A Necessity?

time? But I'll take issue here too. First, a DA is inherently a reliable piece of equipment compared to tape decks, consoles, etc. It has few mechanical parts, is seldom touched by human hands once installed, and is relatively simple to build with plenty of extra capability.

Second, it has more potential to save you downtime than to add to it, since, by isolating often as many as 8 to 10 devices from a central feed, a failure in any of those downstream devices, or an unbalancing of any of the output lines, does not affect the operation of the other equipment. So even though the DA itself can, and will, fail once in a long while, its presence prevents the inevitable failures of downstream equipment from propagating through the system in the form of increased noise, excessive loading, or outright damage to other equipment. You can't do that with a resistive coupler without sustaining huge losses in signal level, and, therefore, in signal/noise performance. In a direct-coupled system, you can't do it at all.

Third, if you're going to go with the reliability argument in its pure form, then you've also got to throw out your processors, your jack fields, and the "extra" bays on your FM antenna. The point is that we do have some very reliable DAs on the market so the possible downside of using a DA is heavily outweighed by the benefits of its use.

Look for

What should you look for when buying a DA? Look for the same kinds of things you look for when buying other audio equipment. First, it should be virtually transparent, soundwise, from input to outputs. This means low distortion (THD and IMD), high S/N ratio, and excellent frequency response.

Our ADA-8 distribution amps typically show less than 0.01% THD or IMD, with a worst case THD of 0.05% and worst case IMD of 0.01%. We get at least 74 dB S/N from a typical 0 dBm line level input, and we're better than ± ¼ dB on response from 20 Hz-20 kHz.

Another very important spec is output isolation. This is measured by feeding a signal back up one of the outputs and measuring its level on a parallel output. Thus it is a good indicator of how well the amp protects downstream devices from each other's failures. Here we typically read −80 dB on our units.

One spec which is often overlooked is output drive capability. This gives you a good indication of how much abuse the amp can take before it fails. A good DA should be able to sustain total shorting and grounding of all of its outputs simultaneously, with full input drive, for a reasonable (longer than instantaneous) amount of time. Our DAs will.

Unfortunately, some DAs seem to crater at the mere hint of an improper output condition (like an unexpected unbalanced line), which leads some engineers to argue that DAs simply are not reliable. Obviously, one bad design should not condemn the entire industry, but it never hurts to ask someone who owns a particular DA for a recommendation, or to try it yourself if the manufacturer will let you have one on approval.

Similarly, we hear reports of some brands of DAs which act like AM or FM radios when in the vicinity of a transmitter. Here again, you're probably best off trying one before you fill your rack with half-a-dozen imitation air monitors

Other concerns

Of course, DAs are available in all sizes, shapes and configurations. In general, those with individual level controls on each output are more expensive than those with a single level control for each input channel. This is not only because of the cost of the additional controls, but because these units generally must have a separate output stage for each output control.

DAs without individual output con-

(continued on page 16)

In The News

AM & FM Happenings

More Daytimers

Washington DC ... In mid-June the FCC decided to accept applications for new daytime radio stations to be operated on the 25 clear channel Class I-A frequencies. These new stations would all be located within the night interference protected service area of the clears whose frequency the new stations would share.

The Commission furthermore stated it would accept applications for increased power by daytimers in the same circumstances. The FCC believes this move would meet, at least partially, the demand for new daytimers and for power increases for existing stations, while at the same time not jeopardizing clear channel objectives.

Daytime stations, according to the FCC, can operate in the sizeable zone between the daytime and nightime clear channel service areas without precluding potential fulltime operations. Additionally, these daytime operations will not compromise considerations in clear channel negotiations with Canada.

In 1980 the FCC changed its longstanding rules governing the clear channels to permit fulltime stations to operate on all the clear channels, while maintaining the Class I-A stations' reliable nightime areas of 1,500 miles diameter. The FCC estimates 125 new fulltime stations could be established on the clear channels, and about 300 applications have been received thus far.

In 1980 the Commission deferred action on daytime stations, since it intended to consider separately the question of daytime protection to the clear channel stations. The FCC also wanted to leave open the question of possible unlimited operation by existing daytime stations on the clear channels.

FM channel assignments

Washington DC ... The FCC recently streamlined and updated its FM assignment policies and procedures to speed up processing of petitions for channel rulemakings thereby expediting service to the public and to the petitioners.

This rulemaking, taken in late May, recognizes that many changes have occurred in the 20 years since the Table of Assignments was adopted and that current FCC policies and requirements are outdated and cumbersome.

First aural service will be given highest priority with co-equal status given second aural service and first local service. These priorities rank the relative importance of the service to be provided.

The number of FM channels available to a community was deleted and the Berwick Issue, which concerns whether the party involved really intends to serve the designated community or a larger one nearby, will no longer be used.

If no interest is shown in the community where preclusion would occur, the proposal will be considered without regard to its preclusive effect. Preclusion refers to the fact that assigning a given channel precluded assigning that channel and adjacent channels in the same general area.

The rulemaking deleted the policy calling for making only Class A FM assignments to smaller communities and Class B or C to larger ones and dropped the policy against assigning two different classes of channels to a particular community. The policy of not assigning a channel to avoid a comparative hearing has been dropped, and in cases where the status of a community is not in issue, the FCC eliminated the requirement for demographic data.

The Commission said these changes can relieve parties of filing burdens and delays, benefit the public through early institution of additional radio services, and reduce the FCC's administrative and cost burden in rulemaking requests.

Passive Busses

(continued from page 5)

cause it will feed an active summing network only from one side of the differential output. The other side of the differential output should be left open; you can also make use of this extra isolated unbalanced output.

One thing to watch for when feeding active summing networks from output transformers are effects on the frequency response caused by the reactive nature of the transformer output characteristics.

You can find more detailed information in the "IC Op-Amp Cookbook" by Walt Jung. It's a "cookbook" that should be within easy reach.

Type Acceptance Filed

On April 27, 1982, we filed a request for Type Acceptance. According to reports, this was the first such request submitted to the FCC.

On issuance of a Type Acceptance the following stations will initiate AM Stereo operation:

- **Baltimore/WFBR**
- **Boston/WBZ**
- **Chicago/WLS**
- **Ft. Wayne/WOWO**
- **Kansas City/KMBZ**
- **Los Angeles/KHJ**
- **New York/WNBC**
- **Omaha/WOW**
- **Philadelphia/WFIL**
- **Pittsburgh/KDKA**
- **Salt Lake City/KSL**
- **San Antonio/KTSA**
- **San Francisco/KFRC**
- **Washington, D.C./WMAL**

These stations have procured our initial production units and, as you know, other major stations* will be installing the equipment as soon as it is available. Since many of these stations are No. 1 in music, in their cities, we believe that as soon as receivers become available the "marketplace" selection process will be firmed-up, leading to what we hope to be the selection of a single system as a de facto standard in the United States. After some 20 years of delay, the Fowler FCC "marketplace" decision has surely gotten things moving. I believe, within six months it will be all over and AM will be on its way to its new quality image. No new broadcast technology I know of, including color TV and FM stereo, ever moved as fast.

RECEIVERS. We are pleased to report the initiation of conversations with almost every major receiver manufacturer in the US and in the Far East. It is our belief that AM Stereo can provide AM radio a brand new image, especially if better quality receivers are made available.** The receiver manufacturers have been forced to produce narrowband receivers because of spectrum congestion. Receivers are designed to meet "worst case" interference situations. For car radios this has driven frequency response down to 2.2 kHz (6 db)! Instead of curing the problem, this narrow banding of receivers has caused broadcasters to use unusually high amounts of pre-emphasis, further aggravating adjacent channel interference.

NEW SELECTIVITY. We are now providing receiver manufacturers with information concerning our new patented techniques of "Asymmetrical Sideband Selectivity." This type of selectivity, besides being inexpensive and easily integrated, automatically adjusts selectivity to optimize signal to adjacent channel interference. As an example of how this system works, if a listener to your station drives far from the station during the daytime, when you have little adjacent channel interference, his receiver will remain broadband providing high fidelity reception. On the other hand, if the listener drives at night to a location where, say you have interference 10 or 20 kHz below your carrier frequency, the receiver will sense that interference and drop the lower sideband response. Assuming that your interference is not serious above your carrier frequency you will still get reasonable quality under such conditions. In other words, this new patented system adapts automatically to interference.

PERFORMANCE OF OUR SYSTEM. We guarantee that the system will provide:

1) AM Stereo without the loss of a single mono listener. No loss of modulation or coverage.
2) Stereo listeners on the first day you initiate stereo broad casting. (FCC record incorporates reports of better sound with two conventional radios than competitor's special expensive receiver.)
3) Stereo reception to your 0.5 mv contour free of:
   (a) Clicks and pops,
   (b) stereo ghosts,
   (c) stereo platform sway motion,
   (d) unusual antenna problems.

MORE TO FOLLOW at a later date. Your comments would be appreciated.

*See May 1982 ad in Radio World for partial list of stations.

**We have been granted permission to announce that we are presently negotiating with three US manufacturers; McKay Dymek, Mura Corporation, and Radio Shack/Tandy Corp. As you will note from reviewing our free booklet, entitled "What they say about the Kahn/Hazeltine stereo system", the Sony Corporation (which evaluated all 5 of the stereo systems) has given us excellent grades.

Kahn Communications, Inc. • 839 Stewart Avenue • Garden City NY 11530 • 516-222-2221

And AnotherThing!

2nd Thoughts on Composite Clipping

by Mark Durenberger

Minneapolis MN . . . I'm having second thoughts about Composite Clipping which I'd like to share with you. A few weeks ago, tired of the phase-rotated sound at our FM stations, we began a general hands-on review of audio processors available off the shelf.

In a few days the lab was occupied by demo units from here and abroad and we had a lot of fun learning what the manufacturers were up to. We also learned quite a bit about the state of the "art" of quality control.

On the heels of a couple of weeks' experimentation with a full-fledged radio station, complete with stereo generator, STL, exciter, mod monitors and tuners we thought we had a pretty good handle on what we could do with audio processing circa 1982.

The new breed

But then we once again entertained a suggestion that we try the new breed of composite clipper which "did not disturb the pilot" and whose action was "inaudible." When you try a clipper which sounds better than any other you've tried you immediately look for the trade-offs. From what we saw and heard I have fairly or unfairly drawn conclusions which reinforce my dislike of composite clipping.

The claim of "not adding distortion" cannot be made by any composite clipper manufacturer! One of the more obvious distortions: in the presence of a lot of L+R, predominantly mono material, clipping products (harmonics) are shoved into the L−R. When material is predominantly L−R, difference-frequency IM shows up in the L+R.

There are more valid reasons for not clipping the baseband but it all leads you back to second thoughts about why the clipper is needed in the first place. When we were first introduced to composite clippers we were told that they were absolutely necessary to take care of the overshoot in an STL system.

Somewhere along the line you see, we all believed that the STL had to pass perfect square waves if they followed the audio processor clipping. This is not true.

Proper design

Correctly band-limited audio will not ring an STL. It all comes down to proper filter design in the processor.

If the RMS section is adjusted to do all the work of controlling audible energy, and if the following soft or hard clippers are properly adjusted, then a carefully-designed filter can be installed to remove many of the clipping products. And the STL and transmitter aren't subjected to such severe steep wave-front information. The result is less peak flashing.

Distributed clipping is one approach to proper integration. Another is a "final filter" just ahead of the STL.

That leaves the sole purpose of a composite clipper to increase clipping density and "loudness." You can do much the same thing in the main processor clipper, can't you? Leaving the pilot and the stereo baseband alone!

Buy a composite clipper if you can't get that extra clipping density elsewhere, but expect artifacts. And after you've tired of this approach, go into the master clipper and do the work there, in conjunction with some good filters!

Debate On The Phase Chaser

(continued from page 7)

"What is the audible consequence of inserting a Phase Chaser?" and the second is, "Is the music from disk affected?" Each can be separately dealt with.

Except for a 15 microsecond group delay, there is no audio change with the use of the Phase Chaser in the program line. Since the voltage-controlled time-shift network is not digital, but is approximated by using cascaded all-pass phase-shift networks, the distortion and signal-to-noise specifications are as good or better than present-day equipment.

The use of transformerless active-balanced inputs and outputs further insures uncompromising performance. The short 15 microsecond group delay has no perceptible effect; this delay is the zero-point (or baseline) delay through the Phase Chaser when no time correction is applied.

If this delay is a concern to the purist, then the majority of filters, equalizers, and amplifiers would not be acceptable in the program line. Most limiters, compressors, and "processors" would be certainly disqualified.

Is music from disk affected? No. And, the mono rendering is phase-correct as long as the disks contain properly recorded stereo material. Improperly recorded material can exist in two classes: older recordings originally done in monaural and "synthesized" to create a stereo effect, and recordings which by themselves are not mono-compatible.

Examples of the first are some so-called "Oldies" albums which create a type of "fake" stereo generated from original monaural music. This type of material usually contains intentional left-vs-right time shifts and abundant filtering and phase-to-frequency errors. Examples of the second are harder to find but do occasionally exist.

In modern multi-track recording techniques some material is intentionally or mistakenly recorded out of phase, partially or totally. One known case involves a recording in which one of two vocals is recorded in-phase and the other vocal is recorded exactly out-of-phase. The stereo rendering has both vocals, whereas the mono rendering has only one!

The Phase Chaser will not correct this situation. The rationale used by the record company is that an unusual psychoacoustic effect can be created (in stereo, that is).

• **Will the Phase Chaser correct a fixed phase error?** Yes. But the Phase Chaser was principally designed to remove a changing phase error such as in stereo cart playback. From the factory, the Phase Chasers are adjusted to return to zero phase error with no signal applied. Dynamic phase fluctuations around this zero-point are corrected.

The Phase Chaser, however, can be adjusted to compensate for a known fixed phase error using the "offset" adjustment (which is internal). It's possible then to correct a fixed stereo phase error in telephone lines or an STL.

The Phase Chaser will return to this new "zero-point" with no signal applied. Phase fluctuations around this new zero-point are corrected in the usual manner.

• **Why does the Phase Chaser do so much for such a low cost?** The greatest cost is in the cross-correlator. This part of the Phase Chaser is essentially an analog computer. That is, the audio signals going in are treated as time-series data. Two particularly expensive IC's are used in the cross-correlator which perform the algorithm and which are also carefully matched.

Laser-trimmed opamps are used in the error-correction feedback loop in the integrator portion. This ensures a negligible long-term drift in the accuracy of the phase correction. Furthermore, low-temperature-coefficient, high tolerance resistors and capacitors are used in the all-pass filters to keep the audio phase match stable.

Although the Phase Chaser is small, it is an efficient, high grade instrument.

• **What precautions need to be observed in the installation of a Phase Chaser?** If in the stereo pair of lines the phase error changes inconsistently as a function of signal frequency, then the phase problem is not easily solved. This situation exists if one channel is equalized differently than the other. Filters and many processors are phase-shift networks.

To phase match the stereo lines, the system transfer characteristics (spectral response) should be identical between the left and right channels before applying the Phase Chaseer. Filters can, of course, be used, but the left and right channels should have the same phase to frequency responses. This is true for the cart and reel record-playback process as well as other stereo lines.

(Ed Note:For more information the author can be contacted at 303-442-3231.)

CHOOSE THE WRONG AM STEREO SYSTEM AND EVERYONE IS BOUND TO HEAR ABOUT IT.

What they'll hear will tell them that you chose a system that doesn't provide the ultimate in AM stereo today.

Choose Motorola's C-QUAM system and everyone will be happy. Because, as many broadcasters are starting to see, we believe there are good reasons why C-QUAM is the best AM stereo system.

Most important is the fact that it delivers better AM stereo over the widest range.

For example, C-QUAM performs better because it has lower sensitivity to noise, mistuning, interference and incidental phase modulation in the system.

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C-QUAM has consistent pilot tone recognition.

And, of all AM stereo systems, C-QUAM is one of the least expensive and easiest to manufacture stereo receivers for.

Our integrated circuit decoder has no adjustments, and therefore quality control in the finished receiver can be higher.

So, when you're evaluating AM stereo systems, don't make any snap decisions. Consider the system that will satisfy your listeners first. C-QUAM. From Motorola. For more information, call Dick Harasek, 312/576-3591.

MOTOROLA A World Leader in Electronics

Engineering Management

One + One = Three!

by John M. Cummuta
KNEI/AM-FM/Waukon

Lansing IA . . . Just as it takes 4 suits to make a full deck of cards, Richard Wood and his 3 associates have combined their varied talents to serve upper-Midwest broadcasters from their bases near Madison WI. Wood, who operates Skyline Communications, Ltd, specializes in antennas and towers for TV and FM radio stations. But, in concert with Jim Crooks of Broadcast Communications Services and two of their colleagues, he provides complete power-panel-to-antenna-beacon service.

Previously we talked with Mark Persons of Brainerd MN who goes it on his own, servicing around 30 client stations. This time we'll look at a different approach to filling some of the cracks that may open during this period of evolution in radio broadcast engineering.

Background

Whereas Persons grew up under the wing of a broadcast consulting engineer, Wood logged most of his miles in 2-way radio. A few years ago he entered broadcasting as an engineer with WIBA in Madison. "I was working with WIBA," he says, "and I could see when I began there that union organized broadcast engineering was doomed, because there was no apprenticeship program."

He then began to branch out and took his technical knowledge and newfound broadcasting experience and worked as a 20-hour-a-week contract engineer for WMAD/Madison. He has since worked that down to 10 hours a week and counts WMAD as one of many clients whose engineering needs are met by this entrepreneur.

After 2 years in contract engineering, Wood analyzes his approach to the business differently than the all-around engineer. Because of his experience in 2-way radio, he feels more confident in the RF area and is admittedly "still learning" the wiles of audio. He specializes, most of the time, on transmission lines, towers and antennas. He's proving that you don't have to be Marconi to provide a needed and appreciated service for the radio and television broadcaster.

You can band together with other engineers whose talents and experiences compliment yours. This pool-of-talent concept may prove to meet the economic needs of both the engineers who decide to stay in the under-paying world of broadcasting and the budget minded broadcast manager.

Wood, however, does not see contract or field service engineers replacing the total engineering effort at the station level. "I'm in agreement with Mark Persons that the station should maintain a Chief Operator to take care of the day-to-day maintenance. They shouldn't try to just have someone who comes in every few weeks," he says.

Other trends

Another trend that Wood sees as dangerous is a tendency for some managers to interpret recent FCC actions to be saying that radio can now operate nearly maintenance-free; that money need not be "wasted" in this area. He gave the example of one medium market station he's familiar with that employed 14 engineers 10 years ago, cut that to 7 when they went combo, and now they only have 2. "If management doesn't put the money into the operation to allow it to maintain itself, it's hopeless," says Wood.

Unlike many who believe that the FCC will be forced by manpower restrictions to devote even less time to enforcing the technical standards, Wood feels that the commission may capitalize on the new laissez-faire environment. "The FCC is going to take advantage of managements that are reducing their engineering staffs," he says. "Whereas in the past the FCC would talk with the engineer and work things out, they're not going to talk with the manager: they're going to fine him. They may not increase their inspections, but they will

(continued on page 19)

Headphones for Broadcasters

by Robert H. Lowig
Beyer Dynamic

Hicksville NY . . . In the March issue of *Radio World* I discussed the basics of microphone applications in broadcasting. As stated, the microphone is usually the first link in the audio chain. Oddly enough the headphone in many cases is the last link in the chain, solving a multitude of problems where loudspeaker monitoring is impossible.

There are many types to choose from: open air, closed systems, and even bass reflex headphones. All serve the same purpose, affording the broadcaster a portable private monitoring system.

Headphones are electro mechanical devices that convert electrical energy into acoustical energy. There are 2 transducer types that perform this function, dynamic and electrostatic.

The dynamic type is by far the most popular. In this type of transducer a coil of wire is mounted to a diaphram with the coil suspended in a magnetic field of a permanent magnet.

Electrostatic case

Electrostatic headphones work on the same principle as condenser microphones, only in reverse. There is a fixed backplate that is polarized by an external DC power supply as well as a movable diaphram.

Since electrostatic headphones require an external power supply, they are not popular for broadcasters. This being the case, we will cover the dynamic type of headphones available.

The closed system: This type of dynamic headphone traps a volume of air between the ear and the transducer because of an ear cushion that surrounds the ear and is pressed firmly against the head. There are two advantages to this system.

First, it attenuates the outside ambient room noise by approximately −24 dB. This gives the user a sense of isolation and allows him to monitor without external distraction of noise. Likewise, this system prevents sound from escaping, allowing the user to monitor in locations where loudspeakers are prohibitive.

The open system: In this system the air is not trapped between the diaphram and ear as the ear cushion (usually foam) simply rests on the ear. The user will still experience the feeling of being in touch with his surroundings.

The semi-open design: This headphone utilizes the best features of the open and closed system. An ear cushion that encloses the ear is used but the rear of the transducer housing maintains openings to the surrounding air. The results is a better bass response than the open system, while still maintaining a feeling of being in touch with room surroundings.

Bass reflex

The bass reflex type: This headphone design is relatively new and incorporates a closed design that utilizes the same principle as the bass reflex loudspeaker. Soundwaves generated from the backward motion of the diaphram are channeled through a series of ports that reroute the soundwaves to exit at the front of the diaphram.

These ports are designed at a given length, allowing the soundwaves to exit at precisely the same time the diaphram moves forward. The result is reinforced bass response.

Comfort is important. How a headphone feels is important in making a selection. Ear cushions play an important role in determining the fatigue factor of a headphone. Closed systems tend to become bothersome after long periods of wear, because the ear pads are tightly pressed against the head.

Open systems simply rest on the ears and are usually lighter. However, bass response is compromised. The semi-open design is the best of both worlds, being quite comfortable, while still maintaining good bass response.

Ear Cushions come in 2 types, superaural and circumaural. All closed system headphones use circumaural ear cushions that completely enclose the ears.

Semi open types also use circumaural ear cushions, but are not pressed to the ears. The open type use superaural ear cushions that rest on the ear and are by far the most comfortable.

Engineering Management: Joining Forces

(continued from page 18)
likely fry the ones they catch, so the word gets around."

Wood believes that in today's world of broadcasting there are more and more managers seriously looking at doing without a fulltime engineer. He says that these managers must still have someone on the staff who can at least ask intelligent questions and give reasonably accurate answers over the phone, and who can do minor maintenance and preparatory repairs before the field service engineer arrives. He believes that field service engineering comes in all flavors and the management has to decide just how much of their technical work they want done in-house and how much they want to pay outsiders for.

Even the technically oriented manager should resist the urge to try to do everything himself, Wood cautions. "Some General Managers see this as an opportunity to cut overhead, but if they go too far with it they could put themselves out of business," he says.

Wood charges $25 an hour for straight field service work and $50 an hour for antenna and other tower work. "It's a lot more than me and my belt," he says. "I've got the spectrum analyzers and time domain reflectometer. I don't just climb up there and say, yeah it's here."

Among Wood and his colleagues they have about $25,000 in test equipment, but he says you can start out with less than that. It might even be possible to work out an arrangement with your present station manager to use or rent his test equipment in a field service side-business.

Wood says that if you want to branch out, the main element of success is an openness with your present boss. "You have to be right up front with your manager, because sales and programming are so cut-throat and secretive, that it's hard for him to understand that engineers can talk with one another and help one another." he says.

The point is that if you have the contacts and believe that you "know it all" when it comes to engineering, you should feel free to strike out as a field engineer. But if you're not yet the all-around electronic wizard you hope someday to be, you can still provide valuable support to the broadcasters in your area.

This can be done by your serving them only in the areas of your direct experience, or like Richard Wood, joining with others whose backgrounds compliment yours and offering the full spectrum of broadcast engineering services. In any case, there are stations out there in bad need, and your phone call or letter might lift a management burden and open a new career door simultaneously.

Hidden Costs

(continued from page 3)
packaged program. This is done to obtain a simple understanding of what the program will do. Initial, actual operation of a program is also time-consuming, since you will make mistakes. Learning programs is a slow, time-consuming process.

Reading a manual is not like casually enjoying the latest best-seller. Software documentation is improving, but manual writing is one of the weakest areas in the industry.

Many software houses rely on their program authors to also write the manual. This leads to terse, often technical descriptions not easily understood by users. Software authors are sometimes too close to their products to be able to successfully translate their work into effective instructions.

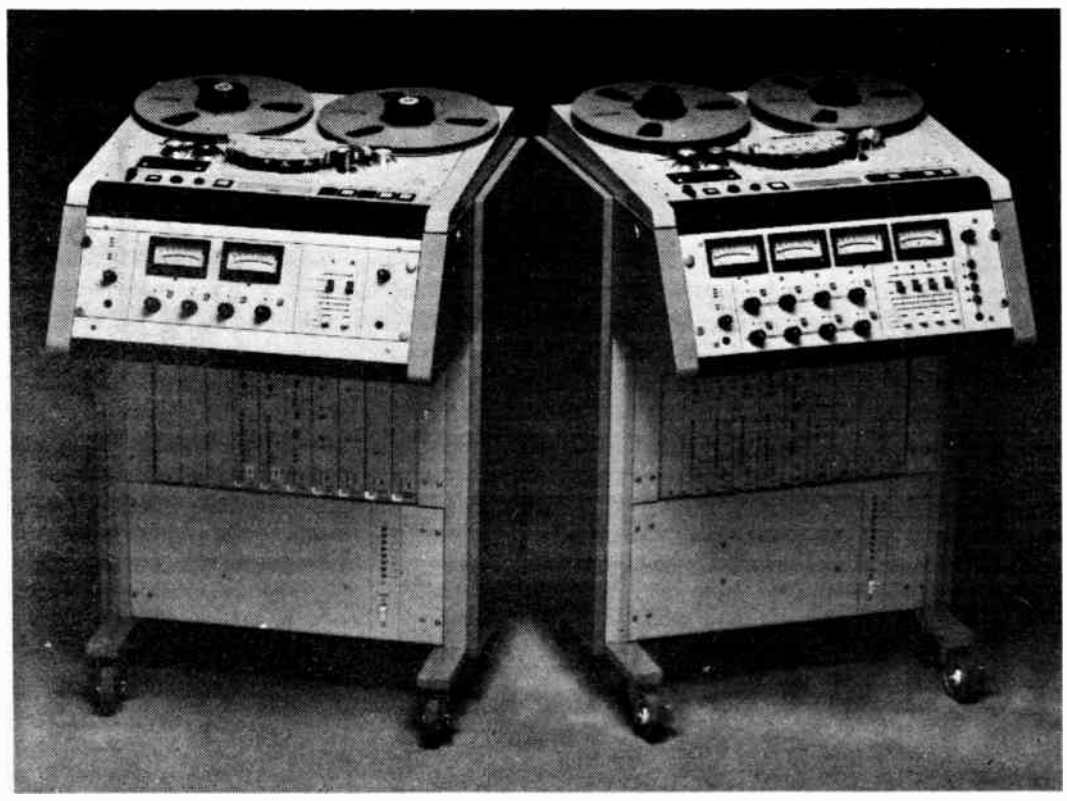
Combating overkill

Microcomputers can be labor-saving devices when properly applied to time-consuming tasks. Good software can save many hours in activities ranging from electronic calculating to accounting and word processing. You can organize contest winner lists, keep inventories and do the payroll.

A smart manager recognizes all of the costs and carefully evaluates each project. Frankly, some infrequent or marginal tasks are better done without computerization.

The presence of an inexpensive microcomputer system will not justify the hidden labor and supply expenses for those jobs that can really continue to be performed manually. It is foolish to make the proverbial mountain out of a mole hill. Every potential microcomputer application should be tested for potential overkill!

If you're the one who runs the station, read this ad.



Otari MTR 10 Series Professional Two and Four Channel Production/Mastering Recorders

Okay, we know you may not be impressed that these machines are the hottest to hit the professional audio industry this year.

Or care that two years of research went into the Auditronics 200 Series On-Air Console. Possibly the most reliable, simple-to-use broadcast mixing console yet.

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