# RADIO GUIDE

A Forum for Radio Engineers

*Ray Topp Editor/Publisher (507) 280-9668*





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## Computer BBS Call

On page 18, of this issue, we have started a permanent listing of all broadcast related computer bulletin boards. Numbers and information listed were gleaned from my own files and information supplied by others. I would like to expand this listing to include the specific services & files that each BBS has to offer. Any Sysops out there -- please give me a call, and we'll get your specific information listed in the next issue of Radio Guide.

There are quite a few good BBS systems out there, but in my opinion, most engineers don't know about them. Well, here's your chance to let the engineering community know you exist.

Speaking of BBS systems, I know I've said that Radio Guide has been working on a national technical BBS. Well, we're still working on it, and we're almost there. Believe me, it's worth the wait.

## The Bare FAX

Why is it that, ever since the advent of the FAX machines everyone uses all these ridiculous expressions? The "bare FAX," or "just the FAX please." And would the one station that has not obtained its FAX machine via a trade-out, please call me.

On page 20, of this issue, we've included a FAX transmittal sheet with the names and numbers of Radio Guide Advertisers. You can copy or cut out this 8½ X 11 sheet, and send it to an advertiser, should you wish more information regarding their products and services.

At the same time, you may want to let them know what you think about the Radio Guide and thank them for their advertising support. It's important to let them know that you read the Radio Guide each month.



## And You Thought I Was Done

I could be wrong, but are some of you not writing articles for Radio Guide because you don't want to see your name in print? It's possible. There are probably some of you who have technical information to share, but just don't have the courage to tack your name to it. We've all been there. "Was it skill, or just dumb luck, that allowed me to fix that problem?" "Is it really fixed; have I covered all possibilities?" "I'm probably the only one who doesn't know this!" Those fears are not groundless, but don't let them prevent you from writing your technical information down and sending it to Radio Guide for publication. We are all in various stages of professional development, and none of us -- **NONE OF US** -- are at the point that we can say we are an expert in all areas of broadcast technology.

I'm sure you have known someone in broadcasting who seems to be a "guru." Yet, when you actually get to know them, it's not surprising to find that, although they really do have expertise in certain areas, in many others you are, at least, their equal -- if not more experienced. What actually sets them apart from the engineering community is that they have taken the time to write and share their knowledge with others. This is all I'm asking you to do.

## In This Issue . . .

# Corrections - Info & Help

## Satcom 1R Crystal Info

***From Bill Monroe - WEEO***
***Wayneboro, Pennsylvania***

*Bill called with information regarding Satcom 1R digital receiving gear. It seems a short time ago, Satcom 1R, transponder 19, went down. It also seems that many stations did not have a crystal for the backup transponder. Bill says that International Crystal is aware of the specs, and has data on file for the crystals for Scientific Atlanta as well as Fairchild gear. All you have to do is let them know what unit you've got and what transponder number.*

*The crystals cost only $15.00 plus shipping. They can cost up to $60.00 from other "normal" sources. You may want to give them a call or write to them:*

**International Crystal**
**P.O. Box 26330**
**701 W. Sheriden**
**Oklahoma City, OK 73126**
**(800) 426-9825**

*Thanks for the tip - - editor*

## AEL Help Wanted

*Jack Parker, of WVBE-FM, needs a technical manual, or a copy of same, for an AEL FM2.5KD transmitter. Give him a call at (513) 621-6960, if you have any information on this transmitter. He can also be reached at home at (606) 371-2231 - - editor*

## Alternative Control Ladder Test

***From K. Scott Johnson, CE - WINA/WQMZ***
***Charlottesville, Virginia***

In the June issue of Radio Guide, Bob Howe of WGBL suggested a way of troubleshooting series-wired interlock switches in a transmitter. His circuit involved a latching relay, and could conceivably require several trips to isolate the switch that's causing the trip. There's one easier method; one that I've used successfully several times in such situations.

My solution was simply to mount a small fuse (rated at less than 50% of the holding current of the high-voltage or control relay) across each overload relay contact or interlock switch contact. Then, when the transmitter trips, the fuse across the open switch or relay contact blows. Find the blown fuse, and you've found the offending switch/contacts. Of course, you need to have the transmitter's low-voltage supply off, until all doors are closed and interlocks engaged, or you'll blow the fuses before they have a chance to tell their tale.

## So How Come You Never Write?

**If you have any short tech-tips, send them in. Remember, it doesn't do anyone any good if you keep that information to yourself. Don't assume that everyone knows about your special technical tip - - so send them in! Editor**



## Is Everything OK?

**If we're doing alright, let us know. If we're not serving your needs, let us know that too - - and at the same time be sure and tell us what you think needs correction, modification or expansion.**

**Remember, Radio Guide depends upon your suggestions for its content, direction and its very existence. You've said you've wanted it, so here it is. Please, help to create a useful technical publication.**

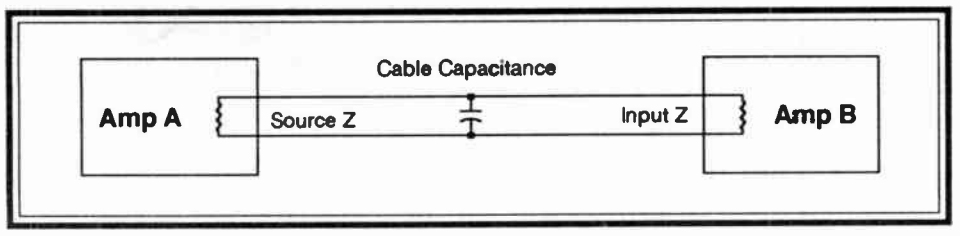
# Effects of Cable Capacitance

***By Greg Hahn - WRKA***
***Louisville, Kentucky***
***(502) 423-9752***

You're probably familiar with the effects of RC networks in pre-emphasis and de-emphasis circuits. They cause intentional changes in the frequency response.

The same thing can happen in the interconnection of any two pieces of audio equipment when the capacitance of the cable starts adding up on long runs.

The Belden catalog says 8451 cable has a capacitance of 34 pF per foot. Most cable that I have found, is in the ballpark so I will use a nice round 30 pF per foot for my calculations.




The diagram shows two amplifiers connected together with 1000 feet of our 30 pF per foot cable. This gives us the equivalent of a 0.03 uF capacitor. The total resistance of the circuit is the output impedance of amplifier A in parallel with the input impedance of amplifier B.

The cut-off frequency, Fc, is the point that the high frequency rolloff reaches -3 dB. It can be determined by the following formula:

$$Fc = \frac{1}{6.28\,(RC)}$$

Where R is total resistance of circuit in ohms, and C is total capacitance of cable in farads

If the output Z of amplifier A is 600 ohms and the input Z of amplifier B is 10k ohms, our total R is 566 ohms. Plugging those into the formula above, we get:

$$\frac{1}{6.28 \times 566 \times 0.00000003} = 9378 \text{ Hz}$$

If this is the program feed to our FM transmitter, we have a problem. Since the capacitance of the cable cannot be easily changed, we'll have to change the resistance of the circuit.

If we terminate the end of the cable at the input of amplifier B with a 620 ohm resistor, that will make the load Z 584 ohms. This, paralleled with the 600 ohm source Z, gives us 296 ohms for circuit R. We now have:

$$\frac{1}{6.28 \times 296 \times 0.00000003} = 17{,}932 \text{ Hz}$$

This is a much better situation, but due to the gentle rolloff characteristics of the RC network, it's still not good enough for top notch audio. We need a cutoff frequency of 30 kHz or better. At a 30 kHz cutoff, you will be down approximately 1 dB at 15 kHz. You'll be down 0.5 dB at 15 kHz, with a cutoff frequency of 40 kHz.

The best way to lower the resistance of the circuit is to use an amplifier with a very low output impedance to drive the line. Many of the active balanced outputs on the newer equipment have output impedances of 100 ohms or so. With an arrangement like this, you wouldn't even need that 620 ohm terminating resistor and your cutoff would still be over 50 kHz.

Another way would be to use a transformer to lower the source impedance to 150 ohms. Use another transformer at the other end to convert back to 600 ohms and step up the voltage to your original level. (the second transformer should be terminated with 600 ohm load)

Don't trust the manufacturer to give you the true output Z. The figure they give may be the proper load for their equipment. The true output Z can be found by running a 1 kHz tone through the amplifier under test. With no load connected to the output terminals, measure the output level. Then find the resistance value, when placed across the output, required to drop that level by 6 dB. This resistance is equal to the true output Z of the amplifier.

# Battery Operated Audio Tracer

***By John A. Bredesen, P.E. - KLCC-FM***
***Eugene, Oregon***

Anyone who has worked around audio systems knows that it's necessary at times to be able to go to any point in the path to trace a signal, when troubleshooting. A traditional way is with a pair of headphones. This works (after a fashion), but it loads the circuit and, given the relatively low level of the typical line, can be difficult to hear, if the location isn't quiet.

A solution to the problem is to use some type of amplification. You can drag out an amplifier and a speaker, look for an "unused" power outlet near the project, and hope that a ground loop doesn't interfere with the feed. A simpler solution is to get a small battery powered amplifier/speaker combination, and consider it another piece of test equipment. Radio Shack has such a device (Catalog #32-2031) for around $18. It's powered by four "C" cells and has the bonus of a mike level input. It's quality won't threaten JBL or Bose, but it's good enough to tell if the signal has bad distortion or hum. It comes with 3.5 mm mini-jacks for both inputs, but these can be changed to whatever pleases you. I think there would even be room for an XLR type connector for the mike input, which would allow you to do quick mike checks.

One problem with any battery powered equipment is that of leaving it turned on when you're finished with it. Radio Shack also has a solution to that problem! For about two bucks, you can get an LED with a built in flasher. It's the same size as a standard LED and can be mounted on the front panel through an appropriately sized hole. I did this with the amplifier/speaker here at KLCC. One word of caution -- be careful with the supply voltage. It is rated up to 5 volts (without a dropping resistor) because of internal circuitry. In the case of the amplifier/speaker, the four batteries provide 6 volts. A series resistor won't work because, when the internal CMOS chip has the LED turned off, there is no significant current to cause a drop across the resistor. This results in the full supply voltage being applied to the LED flasher. The simple solution is to place a regular LED in series instead of a resistor. This provides a second flashing source which can enhance the visual alert. More diodes can be placed in series for higher voltages. Of course you can always use a voltage divider, but this has the disadvantage of increasing current draw from the battery.

# Capstan Plunger Tales

***By John Gaboury, CE - KAWC Radio***
***Yuma, Arizona***

It was a dark and stormy night. The reel to reel playbacks leered menacingly at me. I knew what the problem was -- but I didn't know what to do about it. The capstan roller wouldn't keep constant pressure when the machine was activated by the sequencer and . . . wow, wow!

The capstan solenoid pushes a flexible rod, instead of pulling like a sensible solenoid. As a result of that, and poor geometry, the solenoid plunger was galled, and the ridges would allow varying degrees of engagement. The machine and the company were out of production, and no spare parts were available. I had one spare solenoid which I could install, and wait a week until the "wow" started again.

I thought of the hammer on my Colt .45, put the spare plunger in my pocket, and the next day went to the friendly local gunsmith. He said, yes, he could case-harden the plunger. He took the plunger, put it in a pie tin with a raised center, and poured the tin full of a case-hardening powder (Kasenit). He heated the plunger cherry red, then tipped it over into the powder. After it cooled, he took a file to the plunger, and it turned the file! I now had a plunger which was extremely hard on the outside, soft inside, and retained all of its magnetic properties.

Case hardening is a process which causes malleable iron or mild steel to absorb carbon to a depth of several thousandths of an inch. This gives a very hard and durable surface. Other processes such as nitriding and cyaniding can produce the same results, but are far too dangerous for any but the expert. The deck kept proper capstan pressure throughout the rest of its life.

# 4, 6 & 8 MIXER, SINGLE AND DUAL CHANNEL STEREO, ..... $1395 TO $2950!!

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*xL82S* shown

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Huge expanded scale, -40dB to +3dB, multi-colored LED VU meters (4" & readable in bright light across the room); Four individual meters on dual channel units; Switch programmable muting on each mixer and input; Nine input selects on the last channel; Mono sum output: Plug-in modules for ease of service; Optional switch programmable remote control start/stop; Remote start/stops use front panel input and output selects or input select and pot up start/ pot down stop; Double shielding for total RFI protection...and as you'll see in the rest of this ad ...much, much more.

**FOR THE SKEPTICS**
Anyone can write an ad touting the virtues of their product. Well, we have always felt that we haven't passed muster until you say so. That's why all RAMKO products are shipped on a two week trial basis. You're the final judge. No ifs, ands, or buts! Simply put, if at any time within two weeks of receiving your equipment you are not entirely satisfied, or have just changed your mind, return it in like new condition. Upon verification of condition an immediate refund (less shipping charges) will be issued, for prepayment or C.O.D.s, or your account will be credited if purchased open account. What more could anyone ask? Pricing that will save you hundreds of dollars...Unsurpassed quality & performance...A no risk opportunity to prove to yourself that you get exactly what you want and everything we claim is true. **And,** everything we manufacture is backed by **a 2 year warranty.**

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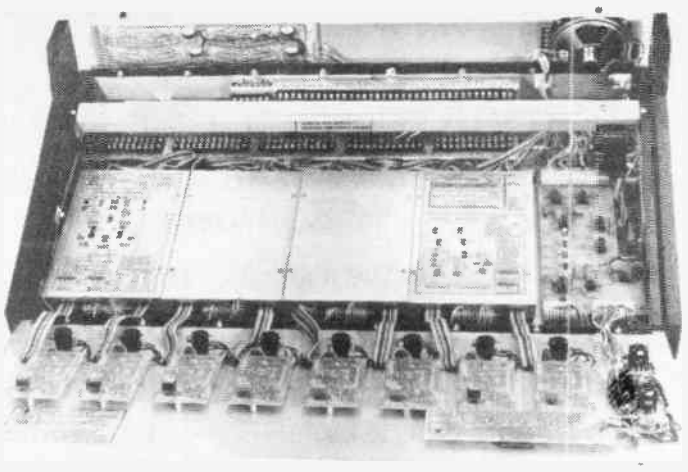
**FEATURES OVERVIEW:**

**1. EXPANDED SCALE VU METERS** (-40dB to +3dB) multi-colored LED.
**2. PLUG-IN SHIELDED INPUT MODULES.**
**3. MIC/LINE SELECT JUMPERS ON EACH CHANNEL.**
**4. MONO/STEREO FEED SELECT ON EACH CHANNEL.**
**5. GAIN SELECT PATCH PANEL ON EACH INPUT.**
**6.PROGRAMMABLE MUTING SWITCHES ON EACH INPUT.**
**7. NINE INPUTS ON LAST CHANNEL.**
**8. 2 WATT CUE AMP.**
**9. ROCK SOLID, SHORT CIRCUIT PROOF SUPPLY WITH LED INDICATORS.**
**10. MONITOR SELECT/GAIN CONTROL.** Prog1/Prog2/External.
**11. PHONES SELECT/GAIN CONTROL.** Prog1/Prog2/External/Cue.
**12. INTERNAL CUE SPEAKER.**
**13. VCA CONTROLLED MIXERS.**
**14. PADDED ARM REST.**
**15. MONO SUM OUTPUT.**
**16. PLUG-IN IC'S THROUGHOUT.**
**17. FOUR INDIVIDUAL PWR. SUPPLIES.** Meters, Cue amp., Power amp., Main audio.
**18. INSTANT ACCESS.** Two, quarter turn fasteners.
**19. ILLUMUNATED 5 MILLION OPERATION IN/OUT SELECT SWITCHES.**
**20. HIGH VOLTAGE SOLID STATE AUDIO SWITCHES.** Cannot be overdriven nor damaged by overvoltage.
**21. EXTERNAL 20 WATT POWER AMP.**
**22. ON AIR LIGHTS RELAY.**
**23. REMOTE START/STOP OPTION.** Programmable for operation from in/out select switches or mixer pot-up start & mixer pot-down stop.
**24. COMPLETE INTERNAL LABELING.** All labeling for in's & out's, gain adjusts, programming, levels, etc., is provided internally for easy installation.



**PARTIAL SPECIFICATIONS**

INPUTS: Two per channel except the last channel which has nine. Balanced bridging 1k ohms in mic mode & 150k ohms high level. Input #1 of each channel programmable mic thru high level. Input #1 of each channel may be strapped for mono or stereo feed.
OUTPUTS: Balanced low impedance, +25dBm max into 600 ohms. May be used balanced or unbalanced. Stereo sum balanced out. Program outputs factory set for +8dBm but may be recalibrated for any other level.
METERING: Expanded scale, 4" solid state tri-color with VU ballistics. 2 each on single channel units & 4 each on dual channel models.
MONITOR: Stereo, muted monitor outputs @ +4dBm. External 20 watt stereo amp included. Three position selector for PRO1, PROG2 & EXTERNAL in.
CUE: Mono-sum to 2 watt internal amp & speaker and phones. Switch programmable speaker muting.
S/N: Mic level in @ -50dBm & +8dBm out; -68db. High level @0dBm in & +8dBm out; -75dB (typically -78dB).
DIST: Below noise floor. Typically .009%.
RESP: 10Hz-20kHz; ±1dB
CROSSTALK: PROG1 to PROG2; -70DB.
SIZE: xL4..19"W x 8.5"H x 17"D.
xL6..25"W x 8.5"H x 17"D
xL8..30"W x 8.5"H x 17"D
POWER: 115VAC, 50/60HZ, 40W. 230VAC available at additional charge.
FINISH: Polyurethane Carbide black, Linear white, Ramko Grey.

**MODELS & LIST PRICES:**

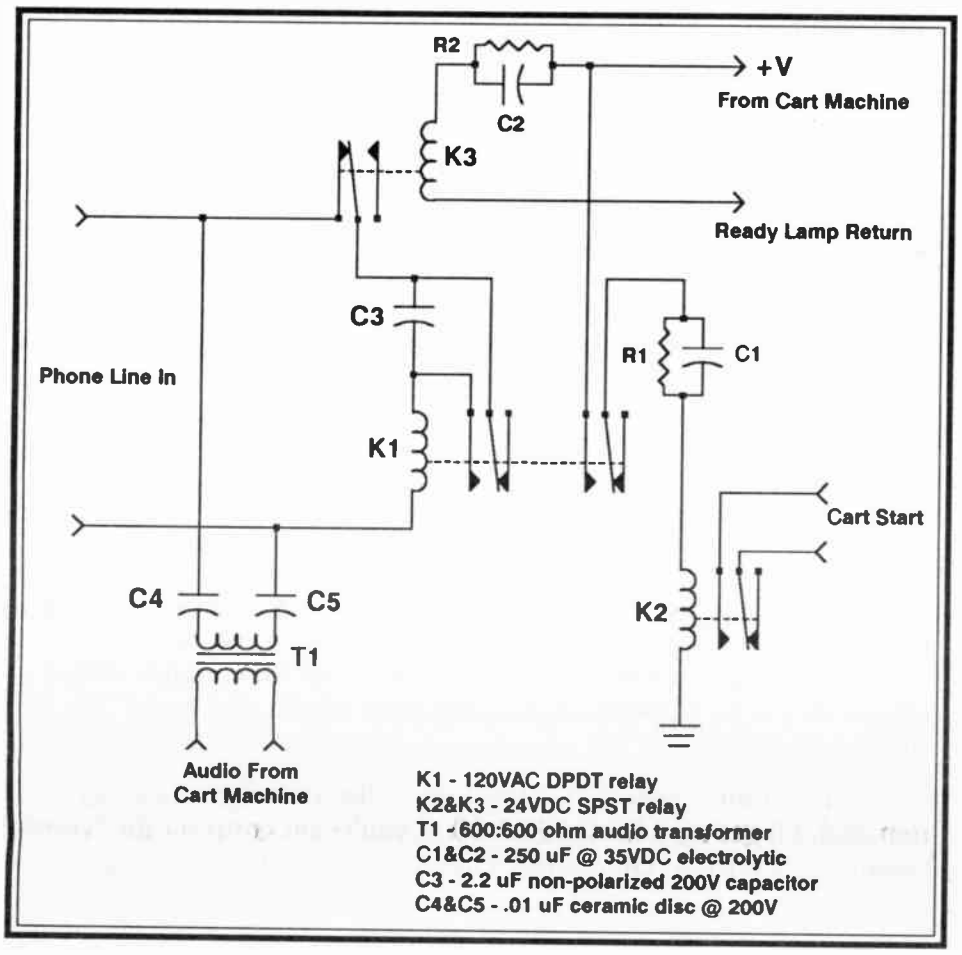
**xL41S** ..... **$1395**
4 mixer single channel stereo
**xL42S** ..... **$1650**
4 mixer dual channel stereo
**xL 61S** ..... **$1975**
6 mixer single channel stereo
**xL62S** ..... **$2375**
6 mixer dual channel stereo
**xL81S** ..... **$2650**
8 mixer single channel stereo
**xL82S** ..... **$2950**
8 mixer dual channel stereo
**RSS4** ..... **$225**
Remote start/stop (xL4)
**RSS6/8** ..... **$325**
Remote start/stop (xl6 & xL8)
**LF6** ..... **Contact factory**
Linear faders; Available6/89
**LF8** ..... **Contact factory**
Linear faders; Available 6/89
**PS230B** ..... **$50**
230VAC power source

# Listener Information Line

***By Jay White - KASH/KKSD***
***Anchorage, Alaska***
***(907) 522-1515***

It seems, more and more, that if I'm not coming up with new ways to do things, or looking for the perfect way to save time or money, my job just isn't exciting anymore. I must admit, when the GM told me we were going to start a sports scores call-in line, I considered two things: the old answering machine that the announcers have such a hard time putting messages on, and the $200 magic box that answers the line and plays a cart. This isn't saving time or money.

Here's a circuit that I came up with to solve the problem:




As the ringing voltage reaches K1 (120 VAC relay), through C3, it is latched on, by bypassing C3. The second set of contacts on K1 delivers +VDC from the cart machine to the RC network of R1 and C1, providing a momentary voltage to K2 to start the cart machine. Cart audio is fed through T1, C4 and C5, back to the caller.

The line is "hung up" by using the remote ready lamp voltage to open the normally closed contracts of K3. Firing the relay through R2 and C2, provides the momentary function to unlatch the K1 relay, thus disconnecting the line when the cart cues up.

This is a pretty generic circuit that will work with most cart machines, with minor modifications.

# IGM Automation Tip

***By Dave Bickford - WMKS***
***Springfield, Vermont***

Attention IGM EC automation users. Be sure the only files on your EC software disk are **AUTOEXEC.BAT, CONTROL.EXE, FILE.TDY,** and **COMMAND.COM** (or any that IGM may have added recently). We had the extremely annoying problem of the switcher starting two sources at the same time. We'd end up with a spot over music or two spots at the same time.

We checked out every possible cause, from noise on the cue tracks of carts, to possible interference from fluorescent lights. Finally, after numerous phone calls to IGM, they had me check the files on my disk. Somehow certain files that were on my DOS disk ended up on the disk I was using for the EC system! After re-formatting that disk and copying the correct files from a new disk supplied from IGM, the problem went away. Our EC has been working perfectly ever since. Many thanks to IGM's Rick Sawyer for his infinite patience.

# Old Tapecasters Never Die

***By David M. Raley, PE***
***Laurel Hill, North Carolina***
***(919) 462-2292***

If your station is one of those that can afford to dispose of its cart machines as soon as they are scratched, just turn the page; nothing here will be of any use to you. This is written for the technician who has to maintain, with spit and bailing wire, a barn full of junk that should have a log chain thrown around it and be pulled into the river.

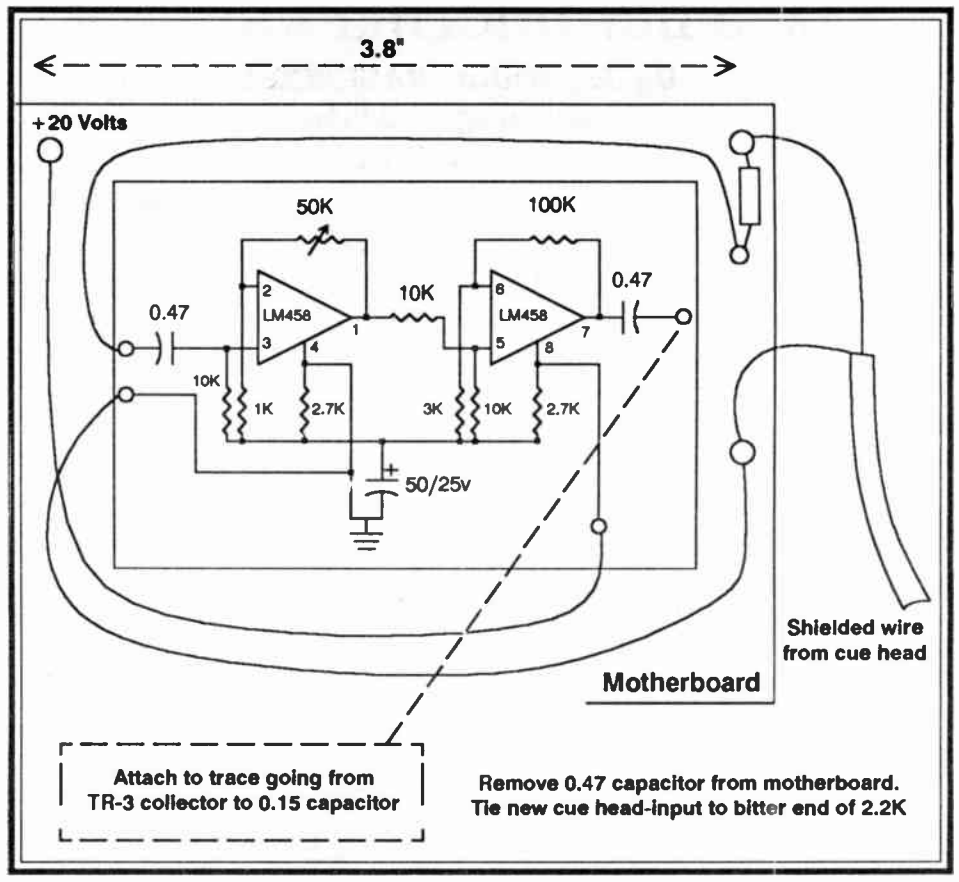
Understand from the beginning that I mean no denigration of Tapecaster. The old style manual lever Tapecasters are, if anything, too rugged. At a time when all the good little "state-of-the-art" machines have had the decency to melt through the cracks in the floor, that old "topless wonder" still puts in a day's work. But...

From time to time, after the heads are worn through to the mounting stud, they will miss a cue. Somebody once told me that if the heads were so worn that cues were missed, the audio quality would have suffered so much that any sane person would replace them. The missed cues were a feature, like the "cry strips" on a car's brake shoes, to let you know that it was time for a change. Well, we're talking radio here; that leaves out the sanity part. Besides that, some heads do wear unevenly.

Now, 101 station managers out of 50 will tolerate bassy sounding spots 1,000 times longer than they will abide a cart running through. I once had to put the old heads back in; they sounded better to a person who shall remain nameless. And (sorry Tapecaster), sometimes they run through just for the exercise.

When, a few years back, I told a certain station manager that he couldn't turn up the cue gain because there was no control for that, he had me install a pot for that purpose and was astonished that it didn't help. If you are associated with such a person, or if you just want to save yourself some grief, read on. The solution is at hand.

What we have here is a straight forward two stage audio amplifier with variable gain in the first stage, built around an LM1458 dual OpAmp. It replaces the three transistor pre-amp of the Series




700, and will doubtless work in many other similar machines. The gain of our circuit, at full throttle, is 20 dB higher than the original circuit. You may have to adjust it down to eliminate false cues. The layout isn't critical. It is better to build it on a small piece of perf-board and attach the in/out and power to the mother-board, rather than drilling on the mother-board itself.

Remove the three input transistors that it will replace and any other un-needed parts that are in the way of a flat fit. Keep the attaching wires reasonably short. Separate the two boards with a couple of pieces of weatherstripping such as you use under the pinch roller rod.

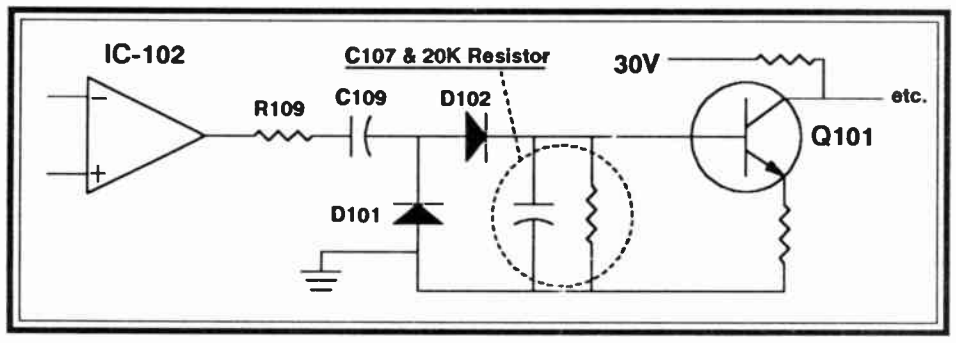
Parts should cost $10.00 or less. If there is a great outcry of demand, I'll get up a kit for $15.00. If you're on contract for "routine repairs," be sure to charge the station extra for this field change.

# Otari Falsing Fix

***By Mark W. Croom - Broadcast Technical Services***
***Pequot Lakes, Minnesota***
***(218) 568-5369***

When I came to KTIG as an announcer about five years ago, I was warned that "certain programs are not to be played on the live-assist system." It uses four Otari ARS-1000 reproducers with a Persons 3A programmer. The reason given was than some of these syndicated, high speed duplicated program reels would cause false stops (and false advances) at unpredictable times. It was a problem we had lived with ever since the system was installed. After I took some technical training, I decided to attack the problem and see if anything could be done about it.

What I found was that the 25 Hz detectors had no delay time built into them, so they would respond to 25 Hz tones only milliseconds in length. Many of the programs we air here are recorded sermons and the like, and if a speaker would crowd his mike and create a "pop," it would cue the detectors, even though it was not a true cue tone. Other types of low frequency noise would also cause false cues and their attendant disruptions in programming.




After some experimentation, I came up with the following solution, which has worked well in our machines: (1) Increase the value of electrolytic capacitor C107 from 10 uF to 47 uF. This increases the charging time so the machine is less sensitive to brief bursts of noise in the 25 Hz range. (2) Add a 20K (or so) resistor in parallel with C107 to provide a "bleeder" resistance. This makes the detector less sensitive to brief but repetitive noises which might cause false cuing. It seemed easiest to me to add this resistor underneath the board on the solder side. You may want to insulate the leads with heat-shrink or something similar. If you have experienced this problem, I hope this will help you to a more trouble-free automation experience.

# More ITC-3D Parts Tips

***By Vince Edward - WBGM***
***Tallahassee, Florida***
***(904) 385-1156***

In the June issue of Radio Guide, Larry Fiebig gave out a great tip, on 3Ds that wouldn't run when the start button was pushed, or would chatter the start relay. C206 is the first part I replace when my decks show these symptoms; it works every time.

Here are three more tips, for 3Ds that drive you nuts:

1. Audio "pop" when a cart re-cues. Pull the cue board on the deck that pops and swap it with another deck card. If the audio pop disappears, replace C27 on the offending board.

2. Audio "pop" on one or more decks (swapping cards makes no difference). Flip the machine over and replace C13 (a,b,c) on the utility card. If you're careful, you can do it without removing the card.

3. Cart runs and runs . . . and runs, without re-cueing. You get a complaint that a deck won't re-cue. So, you pull the lid and jack up the cue sensitivity a bit. A couple of days later, the same complaint; again, you use the same cure. This cycle continues until, oh-oh, no more adjustment on the pot! You pull the cue card and check every part. Didn't find anything wrong did ya. Thought so.

Change C205, C207, and C210. These caps, over a period of time, will dry out. Although they may check good on your meter, they are unable to pass audio. 4.7 uF can be used in place of the 5 uF caps, and it works every time.

# RCA BTF-20E Pointers

***By Meryl Valnes, CE - KVOX AM/FM***
***Moorhead, Minnesota***
***218-233-1522***

In February of this year, I was sitting at home trying to recuperate from a long night's work, when the phone rang. The operator on duty said the FM transmitter was off the air. Our station broadcasts at 99.9 mHz with an RCA BTF-20E transmitter.

When I got to the station, I tried turning the transmitter on. I got plate volts and plate current, but no RF output. Upon opening up the transmitter, I found what was left of the center conductor of the feed line going out of the transmitter and the finger-stock of the loading control, lying on the tube shelf -- and five nice holes in the outer conductor of the feed line.

After the parts arrived, I put the transmitter back together and found that the transmitter would not load up properly. I could only get 13 kW of power output (our normal power is 18.5 kW). I should point out my transmitter has always been hard to load up properly, and would just barely make 105% of operating power.

After spending several nights trying in vain to find the problem, I telephoned Jim Droege in Beatrice, Nebraska. He suggested trying to re-tune the driver for a better match to the final, since I had low PA grid current and high PA screen current.

Before I could try this, however, I burned up the same parts again, plus about 6 feet of feed line connecting with the harmonic filter, contaminating the harmonic filter. Once again, I ordered the parts for the transmitter, plus 6 feet of 3 1/8" feed line, and a 90 degree elbow. I called Jim and had him come up to give me a hand.

We took the harmonic filter down and found black soot throughout the entire filter. Using the RCA manual and the harmonic filter information book as guides, we thoroughly cleaned the filter. A drawing in the literature showed the filter should be installed 24 inches from the top of the transmitter cabinet. Ours had been installed 7 feet from the transmitter. As long as we had the harmonic filter and all the feed line down, we decided to install the filter by the book's specifications.

### Loafing Along

After we had everything put back together, we determined the driver was tuned up properly, re-neutralized the transmitter, and tuned it up. When we had everything ready to go back on the air, we checked the tuning and loading controls. They were within an inch of being where the book said they should be. Now I am able to get about 21 kW out of the transmitter, and it loafs along at 18.5 kW. I don't know for sure that moving the harmonic filter fixed my loading problem, but it was the ONLY thing that was changed.

What knocked us off the air in February? I was missing one or two of the fingers on the finger stock for the loading control of the transmitter. As I was having problems with the exhaust fan in the transmitter room, I can only guess that the heat built up inside the transmitter, causing continued deterioration of the finger stock for the loading control.

The second time this happened, I know what caused it. When my transmitter was installed, the modulation monitor tap was on the 90 degree elbow of the feed line. The exhaust fan had gone out again, and the center conductor of the "N" connector fell, and shorted out the feed line.

My suggestions to keep this from happening to you are: 1) Keep a close eye on the finger stock for the tuning and loading controls. When they show signs of wear, replace them. They cost about $120 per control. 2) If you have your modulation monitor tap in the feed line, REMOVE IT. On my transmitter, J4 on the top of the transmitter was not being used. I am now using it for my modulation monitor. If something should happen to it, it will fall on the Teflon shelf, with very little harm. If I had done this before, I would have saved myself $9600!

I should point out that last fall I had put a new 4CX15000 into my transmitter and replaced the tube socket. I am currently using the same tube that went through all the problems and am expecting to get another year or so of life out of it.

# CD Interface

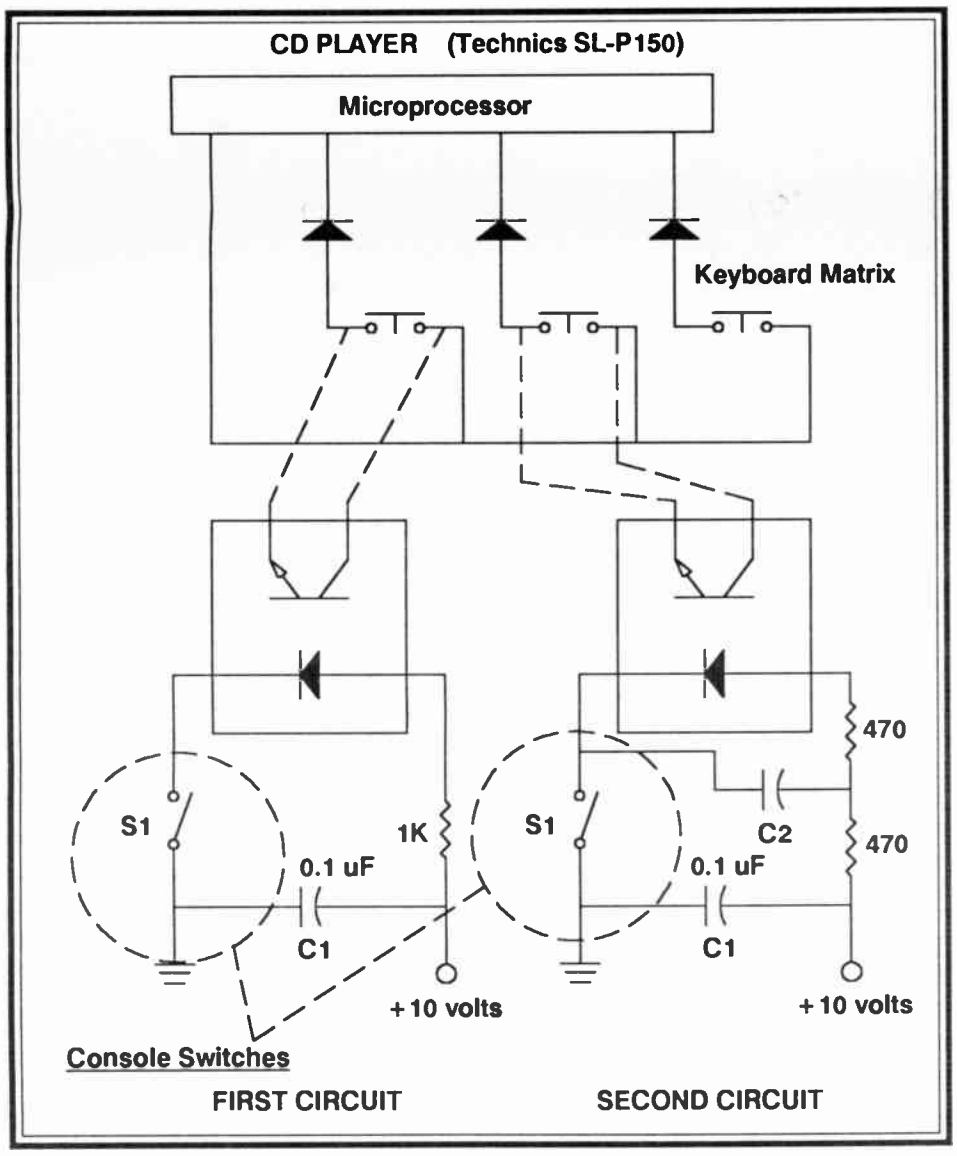
***By Ted Fuller - WRNA***
***China Grove, North Carolina***

I chose opto-isolators over relays for my consumer CD player-to-broadcast interface needs. Relay contacts sometimes have trouble with very low currents and may eventually develop intermittents. I was also concerned about using relays in a matrixed keyboard circuit, which is directly connected to a very sensitive micro-processor. Optos are low-current, low noise drivers with high isolation. The entire remote interface had to be located inside the CD player, and it had to be small.

I mounted all the components on a small PC board, and placed it directly behind the CD keyboard. A single shielded cable ran from the board trough a small hole in the CD, and on to the console. Three inches of wire connected each opto-isolator directly to the terminals of the PLAY and STOP switches. Short, isolated wires at this point will help prevent static damage.

10 mA though the opto-diode will provide sufficient conductivity through the opto-transistor to act as a closed switch (for General Electric HA23A1 and HA1SA1 opto-isolators). Opto-transistor polarity is important here, and the keyboard pulses must not be distorted. Diodes may be found in the CD circuit between the keyboard and the micro-processor, and may help determine polarities. A schematic of the CD may help speed connections.

The interface was powered by 10 volts un-regulated as found inside the CD. Avoid connections to regulated portions of the CD supply, as regulator overloading and erratic operation of the CD may result. Looking at the schematic, S1 was a relay contact on the console control broad. Some consoles may have logic capable of driving the opto-circuit directly, without any mechanical switches.




The first circuit was the one I used, since there was no need to eliminate contact bounce. C1 helps to prevent RF and unwanted pulses from entering the CD power supply, since some electrolytics in some supplies may pose a high impedance at RF.

The second circuit will help with contact bounce. Care must be taken in the circuit placement of C2, to avoid false triggering and too much C2 discharge through the opto-diode. Use a small value of C2 so that the opto-transistor will change states quickly. In the worst case, add a Schmitt Trigger.

# Open Delta Alert

***From R.V. (Bud) Stuart - Sturadco***
***Susanville, California***

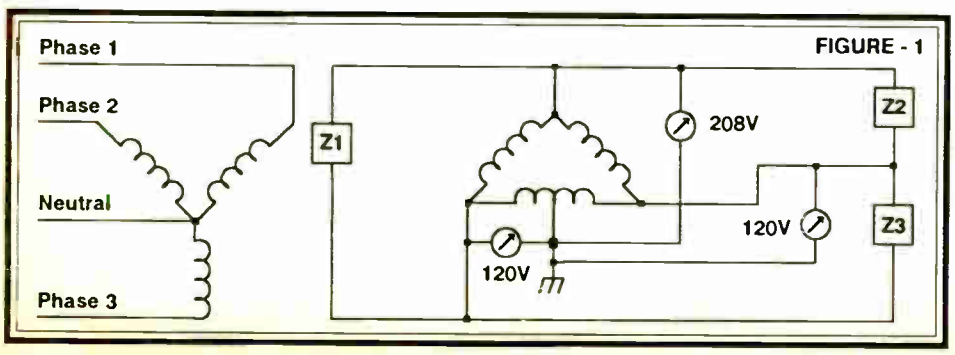
I dug out this information from an RCA Bulletin dated 1977. This might keep some of the younger techs, just making their first three phase installation, from having problems -- by always insisting on CLOSED DELTA connections for their transmitter installations.

Always check voltages before making any connections on three phase power, and beware the "wild leg" for 120 volt equipment.

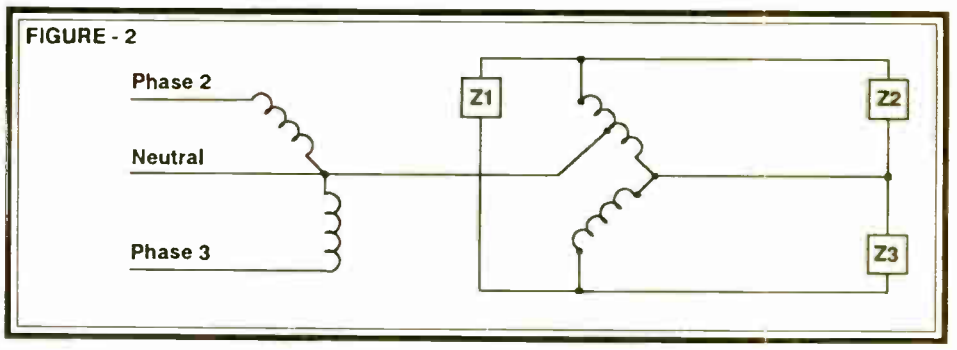
## RCA Technical Bulletin (GTB-1)

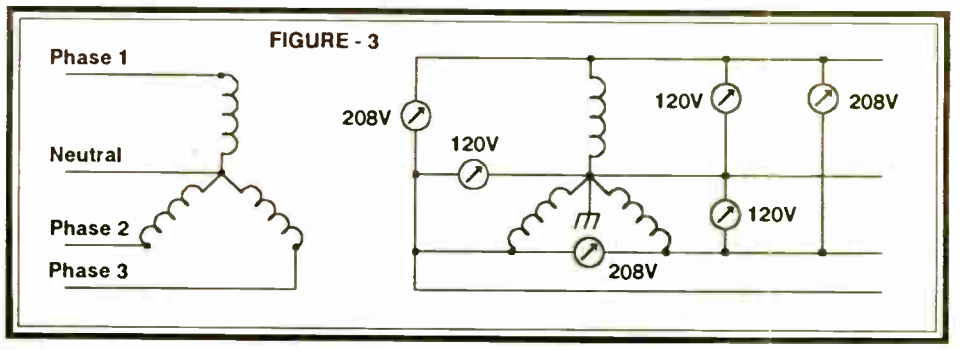
**Three Phase Power Input to Broadcast Transmitters**

The purpose of this bulletin is to recommend the conventional CLOSED DELTA three phase power connection for your transmitter. DELTA connection is preferred for transmitter operation because it offers superior phase-to-phase regulation and stability. Refer to Figure-1 for conventional DELTA three phase analysis. Caution must be exercised when connection 120 volt equipment, when utilizing the DELTA connection, for most equipment will not survive "high leg" (208 volt) connection




The conventional **WYE** connection also offers good phase-to-phase regulation and stability. It is often utilized for transmitter reduced power output. Refer to Figure-3 for the conventional **WYE** connection.




To be expressly avoided, is the OPEN DELTA three phase connection, sometimes referred to as the "SCOTT" connection, "Phanton Three Phase" connection, or "V-V" connection. A two transformer connection on a three phase line is very likely an OPEN DELTA system. Due to the inherent susceptibility to third harmonic distortion, phase shift, and line transient disturbances, OPEN DELTA power connection is undesirable for radio broadcast stations or similar installations. Because of this lack of stability, ratings of rectifiers and filter capacitors may be exceeded, resulting in frequent component failure. Refer to Figure-2 for a diagram of the OPEN DELTA connection, which is to be avoided.

# Gentner VRC-1000/2000 Metering System Failure

***By Don Colbert - KLSE/KZSE***
***Rochester, Minnesota***

Broadcasters who use the Gentner VRC-1000 or VRC-2000 remote control systems, may be surprised to learn of at least one additional error message which cannot be programmed and which is not sufficiently documented to be easily understood. It is called "metering system failure." It can occur whenever one of at least three conditions exist. These include:

1. A DC analog input voltage which exceeds the range of the analog to digital (A/D) conversion system (ie. -5 to +5 volts DC or 0 to +10 volts DC).

2. A DC analog input voltage which is within the range of the A/D conversion system, but contains noise signals which peak outside the range.

3. A faulty multiplexer and/or A/D converter. This problem is mentioned as a possible cause of metering system failure in the Gentner manual, trouble-shooting section. However, no mention is made of this problem causing an error message.

When a metering system failure occurs, all disable functions are locked out, including the manual disable on the command module. Since the A/D converter is continuously sampling the metering lines, error messages keep on accumulating. As soon as an alarm message is erased, either by entering the (#) or (010) codes, another is instantly generated. Therefore, the Gentner will continue calling the telephone numbers on the call list. These latter statements apply if the fail-safe has been disabled to allow the transmitter(s) to stay on.

Here are some suggestion for isolating the cause of the problem:

1. Remove the metering input cable connector from the back of the Gentner. If the Gentner alarms can now be cleared, the problem is most likely to be in the voltages coming from the transmitter(s). If the alarm condition still is present, the trouble is probably in the Gentner.

2. Assuming that disconnecting the metering inputs cured the problem, reconnect the metering cable to the Gentner (so the metering lines are properly loaded) and check the voltages on each line with a digital voltmeter and\or DC-connected oscilloscope. Any lines whose voltages (DC or DC plus noise) exceed the 10 volt range of the Gentner, should be removed from the punch block. The trouble should disappear as soon as the offending voltage(s) is/are removed.

WARNING: An excessive voltage on any of the metering inputs may cause spurious pulses to appear on the other input lines. It has not, as yet, been determined if this phenomenon is caused by A/D fold-over or internal breakdown of components, which allow multiplexer and/or A/D pulses to feed back into the input lines. If these spurious pulses disappear when the Gentner is shut off or the metering cable connector is removed, they are being caused by an overdriven input line.

AT KLSE/KZSE, a faulty power meter calibration potentiometer, on a Gates FM-1C transmitter, produced a DC potential of 13 volts. The plate current and plate voltage sampling inputs were within the normal rage. In addition, plate voltage, plate current and power were being sampled from a Harris FM-25K transmitter. The overvoltage on the Gates power metering line caused 3 volt pulses, with a repetition rate of 16 Hz., to appear on top of the DC analog voltages coming from the three Harris sampling lines. There were no pulses on any of the Gates sampling lines. Removing the metering input cable connector caused the Gentner to settle down. With the connector block back in place, power was removed from the Gentner and the pulses disappeared.

Suspecting some weird relationship between the Gentner and the Harris analog board, the board was exchanged with a new spare. No luck. Finally, a DC check of the individual metering input lines on the punch block revealed the overvoltage on the Gates FM-1C power circuit. The line was removed from the punch block and the Gentner was restored to normal operation. Until a replacement potentiometer can be installed in the Gates power metering circuit, power is being calculated using the Gentner's indirect method.

# RPU Range Increase

***By Patrick Keogh - WNFL/WWKFX***
***Green Bay, Wisconsin***
***(414) 468-5445***

Here at WNFL we had a need to increase the range of our RPU system into an adjacent market. Our system consisted of a standard Marti RPU on 450 mHz. We use RPT-25 transmitters with 5-element yagi antennas at the remote site, and use a BR-10 Marti receiver with a colinear vertical (6dB gain) antenna with 7/8" Heliax at 240 feet, on one of our AM towers. The usable range with this system was 10-15 miles.

The adjacent market of Appleton, some 15-25 miles to the South, was of interest to our sales department, from the time that we absorbed an FM station in that market and moved our studios up to Green Bay. Our ability to do remote broadcasts some distance past our known Marti range, became a reality when the following scheme was implemented.

Since you can't tamper with the power output of remote transmitters (legally), or very well have sales people perched on rooftops with 42-element long-john beams, I decided that we'd do something to the receiver. I came across a company known as Advanced Receiver Research, in a ham magazine, and looked them up. They offer a line of compact, high quality, receiver pre-amplifiers for the communications industry. They can be reached at Box 1242, Burlington, CT, 06013, or phone (203) 582-9409. The prices of their products are very much within the budget of most broadcasters.

I selected a Model P432VDG, which has 16 dB of gain. This unit is designed for service in the 430-450 mHz Amateur Band. It has bandwidth usable for our RPU, which is at 450.450 mHz. The pre-amp is enclosed in a small box the size of two match boxes, and has BNC connectors for input and output. The design of the pre-amp uses low-noise GaAsFETs for better rejection of overloading and intermod.

The pre-amp was inserted between the output of a duplexer and the receiver. We use a duplexer with our base transmitter/receiver in place of a T/R relay, to achieve so degree of intermod rejection in the receiver. Our studio site is within a couple of miles of a well occupied hill, where most two-way services for the community are located. Our duplexer, or the use of a bandpass cavity, is recommended by Advanced Receiver Research to keep the pre-amp from possible overload by out-of-band signals. Without the use of the cavity, the benefits of the pre-amp might be completely wiped out from the crud coming into it and wiping out your RPU signal.

A cheap Radio Shack AC adapter was pressed into service to power the pre-amp. This system expanded our useful range 5-10 miles beyond our previous coverage. We can now get a usable signal into Green Bay from the Appleton area, which opened possibilities to the sales department.

The pre-amp has proved very reliable in our application and has been in use for three years now, with no problems from lightning. Also, remote locations that were noisy or hit-and-miss, were cleaned up with now usable signals. The price of the P432VDG pre-amp was $79.95. A bandpass cavity can be had for about $150-$180. Of course, since we had a duplexer, our outlay was for only the pre-amp. I would suggest this project for any station that needs more RPU range, or one that just wants to clean up scratchy spots. Although not a cure-all, it sure helped us.

# Technics SP-15 Tip

***By Bill Tilton, CE - KELA/KMNT***
***Centralia, Washington***

I have had several of these turntables fail, apparently because C4 (100 uF 250 V) on the Power Circuit Board is a little underrated. The symptoms include failure to start reliably. A dead spot develops every 90° rotation. Replacement of C4 solves the problem.

I have also noticed that the speed increment switches develop mechanical problems due to dust or grime collecting around the push-buttons. A thorough cleaning improves operation. This also applies to the start, stop and speed lock controls.

# Harris FM TX Tips

***By Kyle Magrill - Daytona Group***
***Ormond Beach, Florida***
***(904) 672-2304***

Here are a couple of technical tips for the Harris FM-series of transmitters. Unfortunately, I do not have the schematics at hand, so I cannot give the exact part numbers.

The recommendations are as follows:

1. On FM-20, 20H, and 20K series, make sure that the hose clamp, which secures the anode strap, is placed evenly around the tube. Improper alignment may result in poor contact between the tube and strap, which almost invariably leads to arcing that can destroy the straps. It is not a bad idea to use two clamps for this purpose. The FM-25K, although using a different cavity, also exhibits similar problems, and benefits from a second clamp.

2. With respect to the FM-25K, the area above the cavity where the high voltage feed-through is routed, is very inaccessible due to the need to remove a large number of screws on the back cover plate. Never-the-less, it is important that this area be cleaned occasionally to prevent catastrophic arcing of the high voltage components and wiring present in this area.

3. A low efficiency (less than 80%) problem with a 25K revealed no obvious signs of failure and the 8990 tube tested good. Close inspection of the tube socket revealed that several very small wires, all designated as part of L8, were missing. L8 connects the cathode to ground. Apparently one or more of these small wires had broken free and several more appeared to have burned up. Replacing them with resistor leads solved the problem.

4. It is fairly common for the bias bridge to fail in the older FM series of transmitters. If this occurs, the transmitters will continue to operate in a grid-leak fashion. They will exhibit unusual tuning characteristics and most importantly, if the drive falls below a minimum point, the tube will become a diode, and "super-conduct." If that happens, you will get a current overload. This symptom may happen while the operator is adjusting the tuning or loading of any stage. Usually, the final will be reacting more or less normally when, suddenly, the PA current meter will jump up simultaneously with an overload trip-out. Use the test points provided inside the front access door to test output of the bias supply. I have seen this problem in the 20H, 20K and 2.5H, but since the supplies are all the same, it could happen to any one of the series.

# Sparta 602-A TX Fix

***By Michael Martindale, DE - KVON/KVYN***
***Napa, California***
***(707) 252-1440***

Here is something that engineers with an older Sparta Model 602-A FM transmitter should know.

I received a call one morning, telling me we were off the air. Ironically, was the same morning of the 30-second silence campaign. I arrived at the site and discovered smoke in the transmitter building. After the smoke cleared (about 2 hours), I was finally able to enter the building. I assumed a short and that the breakers had tripped. What I did find, was a short in the screen supply, and that the breakers HAD NOT tripped. The systems was still hot, meaning the machine was cooking itself.

I lost a cap, choke, rectifiers, various other parts, and yes -- the transformer. The insertion of HV fuses on the AC side of the rectifier stack can prevent this from happening. There is a mod kit available that is easy to install and will save you a lot of headaches and money.

# Collins 831G Socket Problems

***By Paul Easter***
***D&E Broadcast Services***
***Corpus Christi, Texas***

A Collins 831G transmitter, I maintain, had burned up a driver plate transformer in January of 1989, and then another one in early June of 1989. When the first one failed, we checked the transmitter completely, especially the overload circuits. We could find no reason for the failure. The transformer looked like it had slowly overheated over a long period of time, then shorted, primary to secondary, feeding 220 VAC into the driver plate supply rectifier and filters.

The driver plate transformer was the only expensive spare part the station had, leading us to believe that the transformer had failed in the past. When the transformer failed the second time, we were even more suspicious. (A few months later, while we were cleaning out the storage building at the transmitter site, we found a third driver plate transformer.)

We coupled our 'scope to the output of the transmitter (at the line section for the wattmeter), and started looking. If you tuned the driver plate tuning capacitor just right, the carrier would start to "pinch off", that is, heavily AM modulate. This was also the point where the grid current would peak on the PA tube (the next stage). For a few micro-seconds at a time, the carrier would go away. I wouldn't have believed it, if I hadn't seen it for myself.

We examined the transmitter and socket again, hi-potted everything twice, and found nothing. We were getting very tired, so we decided to call it a night, and tuned the transmitter so that it wouldn't exhibit AM modulation.

The next night, we found a few small burn marks on the screen ring of the tube itself. The socket looked fine, so we cleaned everything carefully and re-inserted the tube and tried it again. The problem persisted. We then removed the "chimney" (also called an air guide), and re-inserted the tube. We examined the socket very carefully with an inspection mirror. the screen collet seemed to be out of alignment in the back left area of the tube.

We found that both the screen collet and the stand-offs in the tube socket were threaded. If the collet is taken apart and re-assembled improperly, there is a gap between the screen ring on the tube and the screen collet. Further examination proved this to be the case. The tube socket had been replaced some time ago (the old one was on the spare parts shelf). After removal of the collet and re-assembly, the problem was gone. The fingers of the collet were at the very top of the screen ring of the tube, though. We felt that this was a little too close for comfort.

We removed the tube, and inserted a brass washer under each of the stand-offs. The fingers of the collet now touch the screen ring right in the middle. The tube socket alignment, in this transmitter, is very critical. Since the amplifier is grounded-screen, the screen collet alignment is especially critical. Of course, whenever any work is done on the socket, especially the screen collet, the neutralization should be checked.

Any time a socket is re-assembled (in any transmitter), a few minutes with an inspection mirror and a good light is time well spent. Mechanical drawings of the critical assemblies in transmitters would be helpful, when problems like this occur.

## Use Your Fax Machine

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# 3-Phase Xfmr Configurations

***By Michael Hendrickson***
***Hedberg Broadcasting Group***
***Blue Earth, Minnesota***

An article in the June 1989 issue of Radio Guide, brought to mind that there are many younger technical people in the field who may not be familiar with three phase power. Many stations do not require three phase power because they operate at a lower power level. This article is intended to give some brief information on three phase power transformer configurations as supplied by the power utility.

Normally the radio station is only concerned with the secondary connection of the power transformers. These connections supply the power to the station. There are two types of connection configurations, the **WYE** configuration and the **DELTA** configuration. The **DELTA** configuration can come in two variations, the **CLOSED DELTA** and the **OPEN DELTA**.

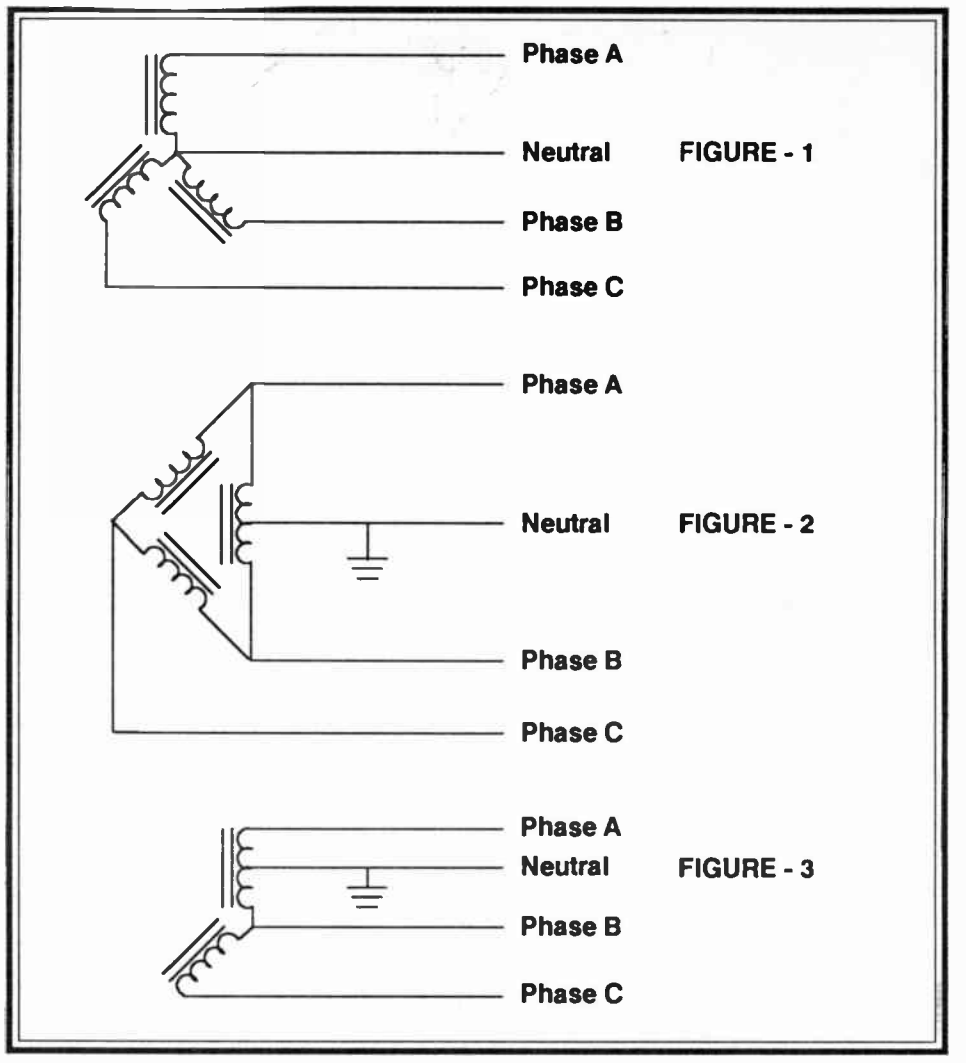
The **WYE** configuration (figure 1) is a 120/208 volt secondary. The voltage from each phase to the neutral is 120 volts. The voltage from phase to phase is 208 volts.

The **CLOSED DELTA** (figure 2) and **OPEN DELTA** (figure 3) each supply a 120/240 volt secondary. The voltage from Phase A or Phase B to neutral is 120 volts. The voltage from Phase C to neutral is 208 volts. The voltage from phase to phase is 240 volts. Phase C is normally referred to as the "wild leg." The National Electrical Code specifies that Phase C is NOT to be used for any load connected from Phase C to neutral. Phase C is to be used only for phase-to-phase loads.

There is no problem with having a **CLOSED DELTA** configuration supplying power. The problem with a **DELTA** configuration arises when the power utility supplies you with an **OPEN DELTA** (figure 3). The power utility likes the **OPEN DELTA** configuration simply because it requires only two transformers instead of three. Each of the voltages specified for the **CLOSED DELTA** apply to the **OPEN DELTA**. The problem with the **OPEN DELTA** is that the phase relationship of each leg can vary as well as the voltages, depending upon the load. Harris Corporation has an excellent paper describing the problems with the **OPEN DELTA** configuration.

I have found, over the years, that if you specify to the power utility that you need three phase power, the utility will normally supply you with a 120/240 **OPEN DELTA** configuration. I have met with considerable resistance when I told them I wanted a **CLOSED DELTA**. In a couple of cases I was told there would be a special charge for the third transformer. However, when I told the same utilities that I wanted 120/208 three phase, there was no problem, even through the **WYE** requires three transformers. I now automatically specify 120/208 three phase when I need three phase power.

If you are in the situation where you have service with an **OPEN DELTA** configuration, the fix is simple. Request that the power utility supply the third transformer, and close the **DELTA**. There will be no change in the secondary voltages in the electrical service. If you request the utility to change the configuration to a **WYE**, you have to remember that the secondary voltages will be 120/208 and NOT 120/240.




For more information on the **OPEN DELTA** problems, see the paper published by Harris Corporation: Susceptibility of the Open-Delta Connection to Third Harmonic and Transient Disturbances. The paper was issued in 1967, and revised in 1969.

35th Annual
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# BROADCASTER'S CLINIC

October 16-19, 1989
Madison, Wisconsin

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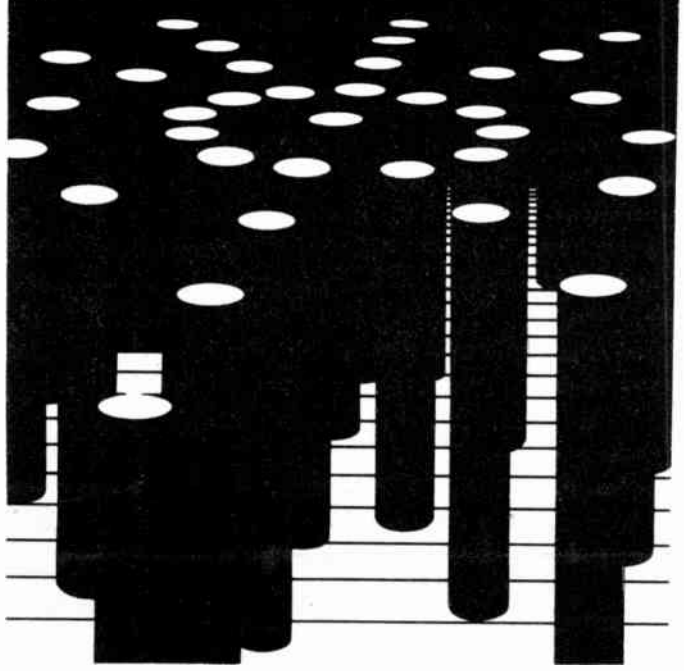

## GENERAL CONFERENCE INFORMATION

**DATES**
Monday through Thursday, October 16 through 19, 1989

**LOCATION**
All sessions of the **Broadcasters' Clinic 1989** will be held at the Holiday Inn Southeast, Highway 12 and 18 at I-90, Madison, Wisconsin, 53704. Phone: (608) 222-9121.

**FEE**
$100 - Any two days
$135 - Any three days
$160 - All four days

Fee covers program materials, continental breakfasts and luncheons as indicated, refreshment breaks, the Pizza-Engineering forum, and two evening receptions with hot hors d'oeuvres (cash bar).

You are entitled to an 80% refund if cancellations are received prior to October 9, 1989. Enrollees who do not cancel are obligated for the full fee. Substitutions may be made at any time.

**ACCOMMODATIONS**
Please make your own room reservations with the Holiday Inn Southeast, Highway 12 and 18 at I-90, Madison, Wisconsin, 53704. Phone: (608) 222-9121. We suggest that you make your reservations before September 25, 1989, while discounted rooms are being held for the Seminar. Please specify that you are attending the **Broadcasters' Clinic 1989.**

**CREDIT**
Conference enrollees can earn up to 2.8 Continuing Education Units (CEUs) from the University of Wisconsin.

**INFORMATION**
For further conference or exhibitor information, contact Don Borchert, Director of Engineering, WHA Radio and Television, 821 University Avenue, Madison, Wisconsin 53706. Phone: (608) 263-2157.

This program is offered by UW-Madison in cooperation with UW-Extension.

**MONDAY, OCTOBER 16**

7:45 am Registration and Continental Breakfast

9:15 **General Broadcast Engineering Sessions**

The Educated Technologist Citizen
*Mark Durenberger, Director of Network Development*
*WCCO Sports Networks, Minneapolis, MN*

A Practical Approach to Getting the Greatest Benefits from NRSC
*William Ammons, CRL Systems, Tempe, AZ*

FMX™: Consumer and Professional Applications
*Thomas Keller, Broadcast Technology Partner, Springfield, IL*

12:15 pm Luncheon

1:30 - 4:30 **Concurrent Workshops**

Antenna Systems for Radio
*Don Markley, D.L. Markley & Associates*
*Ralph Evans III, Ralph Evans & Associates*
*John Saddler, Federal Communications Commission*

Technical Management
*John Commuta, President, Market-Line*

FX 50: The FM Exciter with Audio Performance that *Rivals CD Specifications*
*Ed Anthone, Design Engineer, Broadcast Electronics*

7:30 Our Famous Pizza-Engineering Forum
*Mark Durenberger*

**TUESDAY, OCTOBER 17**

7:45 am Registration and Continental Breakfast

9:00 **Engineering Sessions: Radio**

Where Are You? Use the Global Positioning System
*Garrett Lysiak, President, Owl Engineering, St. Paul, MN*

Off-Premises Monitoring and Remote Control Via Satellite
*Peter Burk, President, Burk Technology, Teppell, MA*

Do Folded Di-Poles Really Work? (discussion based on experience)
*Lawrence Behr, President, L.B.A. Group, Greenville, NC*

950 MHz Aural STL/TSL Systems (including alternatives in congested areas)
*Jeff Nordstrom, Allied Satellite*

12:15 Luncheon

1:30 **Engineering Sessions: Radio**

I S D N: Its Impact on the Broadcast Engineer
*A presentation by AMERITECH*

Satellite Communications for Broadcast: A Ku Band Update
*John Brimrose*
*Mark Durenberger*
*Ray Connover*
*RCA/GE Americom*

*And More . . .*

4:30 **Equipment Exhibits Open**
Reception and Cash Bar

**WEDNESDAY, OCTOBER 18**

7:45 am Registration and Continental Breakfast

9:00 **Engineering Sessions: Radio and Television**

Integrating Leading Edge Technology in Current Audio Production
*Bill Mullin, Operations Manager, Pyramid Audio*

Compact Disc: Theory and Maintenance
*Denon America, Parsippany, NJ*

Utilizing CAD for Broadcast Applications
*Kahn, Phillips & Associates, Oak Park, IL*

PC-Controllable Automated Video Measurements
*Mel Infanzon, TEKTRONIX*

*And More . . .*

Noon **Equipment Exhibits Open**

6:30 **Engineering Forum**

*Moderator: Ken Dixon, WHA Television*

**THURSDAY, OCTOBER 19**

7:45 Registration and Continental Breakfast

9:00 **Engineering Sessions: Television**

Television Station Automation
*David Bird, Broadcast Television Systems*

How Expansion and Contraction Can Cause Problems in Rigid Coaxial Transmission Line (discussion of solutions)
*Andrew Corporation*

Multi-Channel UHF Antenna Systems
*Ernest Mayberry, LDL Communications, Laurel, MD*

The D2 Format: Field Reports
*William Carpenter, AMPEX Corporation*

12:15 Luncheon

??? Adjournment . . . See you next year!

# Broadcast and Media Related Computer Bulletin Boards

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**If you have any additional information regarding the content of these and/or any other BBS systems let us know that too.**

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**Broadcasters Forum 602-395-9978** (Broadcasters Info.)

**Trillion 616-530-0821** (SBE and Ampex Information)

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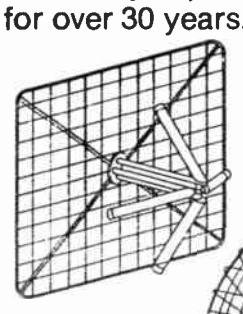

JAHD CP
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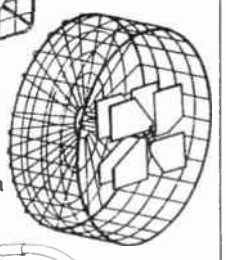

JSDP CP Spiral
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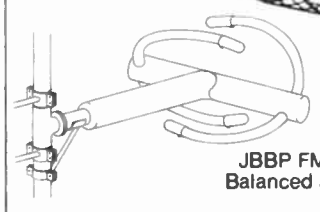

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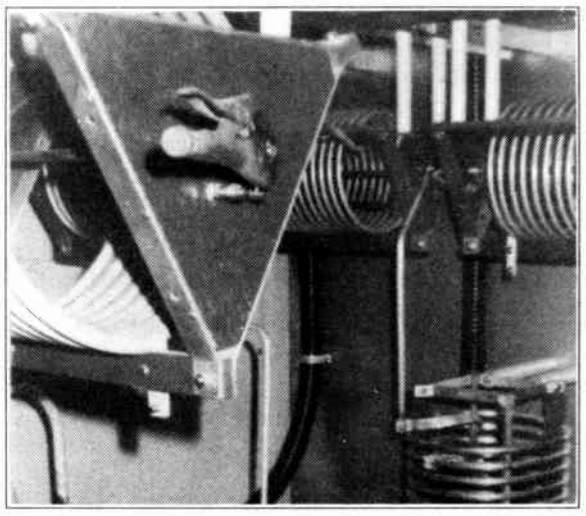

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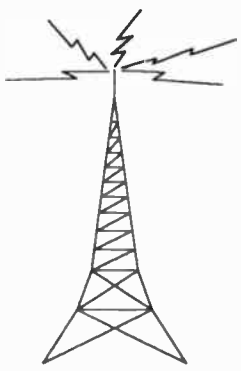

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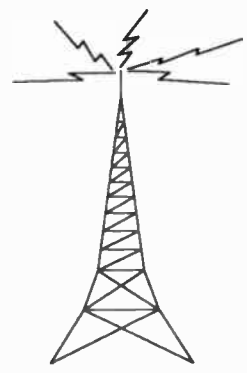
**Advertisers FAX Numbers are Listed Below**

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Volume 2 Issue 9 September 1989 *A Service of Rochester Radio Publications*


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