

# RADIO GUIDE

EL PASO  
5710 TROWBRIDGE DR  
KBNM AM/FM  
Attention: CHIEF ENGINEER  
TX 79925-3341

BULK RATE  
U.S. POSTAGE  
PAID  
ROCHESTER, MN  
PERMIT 445

Address Correction Requested

A Forum for Radio Engineers  
Ray Topp Editor/Publisher (507) 280-9668

January 1989

Volume 2 - Issue 1

Copyright 1989 - Rochester Radio

511 18th Street SE

Rochester, MN 55904

## IT'S BEEN A GREAT YEAR, BUT JUST WAIT . . .

Despite all the bumps, warts and mistakes, we're still here. It's great to have the support of both the manufacturing and engineering communities. Radio Guide was born of the same philosophy that guides most successful radio stations. Choose a target audience, give them the programming they want and need, and then sell to the clients that wish to reach them. It's a simple but effective idea - - so we gave it a shot.

Choosing the "target audience" was easy. I've been in radio engineering for around 20 years, so creating a nut & bolts publication for radio engineers seemed the natural thing to do. The need was there, but the technical articles weren't.

The "programming" is a bit different in Radio Guide. The direction and content of this publication is up to you. What you send in, is what gets printed. So, as I've said before, the success of Radio Guide is in your hands.

In the past few years, the word has gotten around that engineers do not specify equipment general managers do. Most of us can agree that the GMs do hold the purse strings, and usually

decide when to buy. But how many GMs do you know have the knowledge to decide what to buy? Times have changed. There are a lot more contract engineers than before and many station engineers serve dual (or triple?) duty. But let's face it, while GMs, PDs, etc., are more knowledgeable than before in the technical areas, who has to install, maintain and repair the gear, and should have the greatest input during equipment selection? The engineers - - whoever or wherever they are. This is why advertisers are finding out that Radio Guide works for them. It is this final, and often maligned, "sales" factor that helps the Radio Guide work for us as well.

Our advertising space will be kept uncluttered and straight forward. Our technical copy will remain practical, useful, and unbroken by a plethora of mini-ads. Most importantly, I WILL listen to your suggestions and I WILL incorporate them into the Radio Guide. This really is your forum, and the proof is not in what I say but in what you see - - just watch. With your help, Radio Guide can become the publication you've always wanted!

Ray Topp . . . Editor

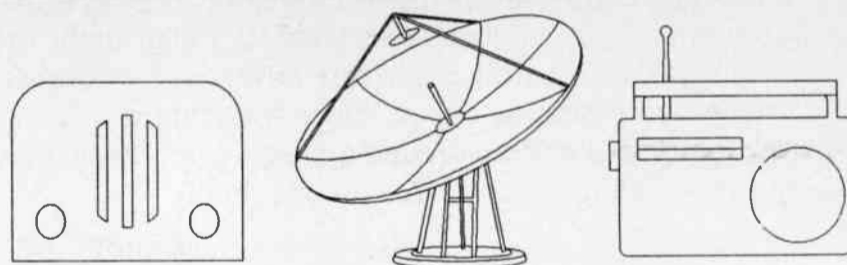
### Availability of FCC Rules in Loose-Leaf Form

The Commission now has available, through the Government Printing Office's Superintendent of Documents, the loose-leaf form of its rules. Below is a list of Volumes and Parts, together with stock numbers and prices as quoted by the GPO.

Publication	Stock Number	Price
Volume I (parts 0,1,19)	00460-4	9.00
Volume II (parts 2,5,15,18)	00459-1	11.00
Volume III (parts 73 & 74)	00471-0	17.00
Volume IV (parts 90 & 94)	00474-4	11.00
Volume V (parts 21,22,23,25)	00462-1	10.00
Volume VI-B (parts 41,42,43)	00463-9	2.25
Volume VII (parts 61-69)	00462-1	10.00
Volume VIII (parts 76 & 78)	00473-6	4.00
Part 13	00458-2	1.00
Part 17	00461-2	1.50
Part 80	00475-2	6.00
Part 87	00466-3	3.25
Part 95	00467-1	2.00
Part 97	00468-0	3.00
Part 99	00469-8	1.25
Part 100	00470-1	1.00

Further information may be obtained directly from the GPO Bookstore at (202) 783-3238.

*Editor's note: These are the long absent, 8 1/2 x 11, full size rules & regs. They are 3-hole punched and fit into regular size loose leaf binders. You won't need a magnifying glass to see the text and diagrams on these. The GPO actually takes VISA or Mastercard too! Who says the Fed is not up to date? Don't waste your money on so-called "rules services". This is the real thing - - and cheap too!*



### --- CONTENTS ---

Page 2	Letters to the Editor
Page 3	Robot Remote
Page 4	Is Noise-Free Radio Real ?
Page 6/7	Interfacing TX Remote Status Indicators
Page 7	Cart Deck Solenoid Tip
Page 8	Cart Deck Timer Interface
Page 9	Slate-Cue Oscillator
Page 10	Tips From the Field
Page 11	Contract Engineers & Computer BBS List
Page 12	Transmitter With A Heart Reader's Service Card



## We Get Letters . . .

Dear Ray:

Back in the October issue of Radio Guide, I made a plea for help concerning my Harris 2.5K transmitter that kept burning up its loading capacitor. Since then, I've received a whole lot of phone calls from concerned engineers with lots of good ideas and advice. Thank you.

By the way, I received 10 calls in two weeks from Indianapolis; Huntsville; DeKalb, IL; West Plains, MO; Muskatine IA; Stockton, CA; Bradenton, FL; Chicago; Cedar Rapids; and here in Flint. I'd say your Radio Guide is really a success.

The most common advice was to put in a vacuum variable; I think most of us can understand the logic of that. But, considering that this transmitter had operated for seven years previously without this problem, I really wanted to fix the problem and not the symptom.

Anyway, after the problem eluded me and some other very good engineers, I decided to do something with the capacitor. About this time Terry Hollenberg called me with what seemed like a great idea. He would take an air-variable capacitor and try to insulate it with this chemical with Teflon in it. I'd put 6 caps in, within the last 20 months - - what's one more? So, Terry and the people at Harris used a chemical called Permalon 327 by Russel Products and sent me a new cap with the rotor and stator flns coated with it. I've got it installed now and everything is working properly (knock on wood). Of course it may take a few months before an RF burn or stress becomes evident, but I've got a good feeling about this.

Thanks to Radio Guide, all the engineers who called, and Terry and his staff.

Dan Greer - WDZZ-FM - Flint, Michigan

## For Your Information . . .

A new and continuing feature of the Radio Guide, is the reader-service "coupon" located on page 12. Fill in all the information asked for, and circle any advertiser's number from which you wish to obtain more information. Along with the "coupon", feel free to send a couple of technical tips you may have lying around. We can use them!

Editor . . .

## It's Time For An SBE Town Meeting

Since it's tough to get the majority of SBE members across America in one place at one time (particularly in winter!), we're planning a national get-together on the ham radio bands. There's a way non-hams can participate too - - we'll have a telephone "request line" set up so that you can phone in your comments as the meeting proceeds. All you need to listen, is a short-wave receiver.

Here are the particulars:

**SBE Chapter 73 (Chapter of the Air)**

**Sunday nights, January 15 & February 12, 1989**

**14.205 MHz (+/- interference)**

**6 p.m. CST (7 p.m. EST, 4 p.m. PST)**

We'll have officers and board members of the SBE on hand to moderate the discussion, and we're contacting you to help us to get other opinion leaders from our industry on frequency to add their two cents worth.

I've noticed that the typical ham/broadcast engineer doesn't have the big-gun station on the band; me included. Maybe we're all too busy keeping our "real" broadcast stations going to put the time and energy into the big signal on 20 meters. In that case, maybe you can operate the station of a big gun in your market, for this occasion. If I can successfully feed 1500 Watts into a 400 foot tower, that's what I'll be using.

The topics for discussion? Well, for starters, the Executive Board will be fresh out of a meeting on January 12th, where they'll be discussing the current "hot topic" of Professional Engineer state licensing of broadcast engineers and the 1989 National SBE Convention in Kansas City. You undoubtedly have some questions or comments of your own, so why not join in.

May we also suggest that you get a group together at a local member's ham rig, or tape the meeting to play for other chapter members who can't be with us? Please help us accomplish one important task of our Society - - communication!

Steve Brown,

WLTE-FM - Minneapolis, Minnesota

SBE National Chapter Liaison Committee Chairman

## FCC Database

### ONLINE SERVICES

- 24-hour Remote Access
- AM, FM, FMTX, NCE-FM, TV, LPTV, ITFS Studies/Searches
- Terrain/Population FAA & FCC Tower Databases
- Predicted Contours
- DATAFLEX - user-specified sort/retrieval programs
- FLAG<sup>SM</sup> SERVICE - Broadcast site monitoring report

**dataworld<sup>®</sup>**  
A Service of DW, Inc.

P.O. Box 30730  
4827 Rugby Avenue, Suite 200  
Bethesda, Maryland 20814  
(800) 368-5754 (301) 652-8822

## AUDIO PROCESSING . . . hnaturally

### A-MAZE (ā-māze)



#### HIGH DEFINITION IMPROVEMENT

For any existing processing chain plus . . . separation enhancement.

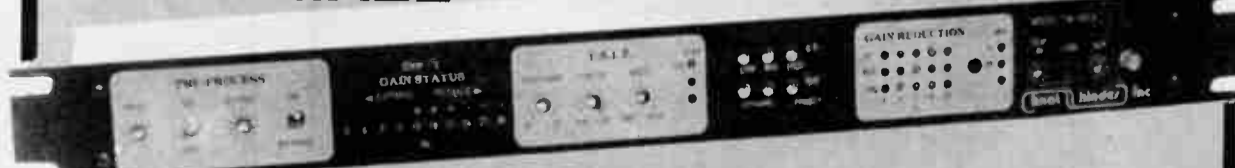
### MIC-MAZE



#### HIGH DEFINITION MIC PROCESSING

Plus . . . program gain riding; STL, AM and SCA processing.

### TRI-MAZE



FM STEREO, NRSC AM, OR TV  
THE ULTIMATE IN FLEXIBILITY AND PERFORMANCE.

**hnat hinders inc**

42 Elaine Street • R.R. 1 • Thompson, Connecticut 06277 • (203) 935-9066 • (203) 935-9242



# Robot Remote

By Robert Miller - KGWA  
Enid, Oklahoma

Need to save the set-up, "baby-sit" and tear-down times for your scheduled repeat remotes? We had four churches that rotated each Sunday's service on a continuing schedule. Economics dictated a change. We proposed that each church order a dial-up telephone line installed and we would build and install the interface to transfer the audio from their public address system to the telephone line. Advantage? Church personnel could call their telephone number at any time, other than broadcast Sunday, and check on the progress of worship service, weddings, funerals, etc. We could save the time and equipment wear and tear of repeated set-ups and tear-downs. They agreed.

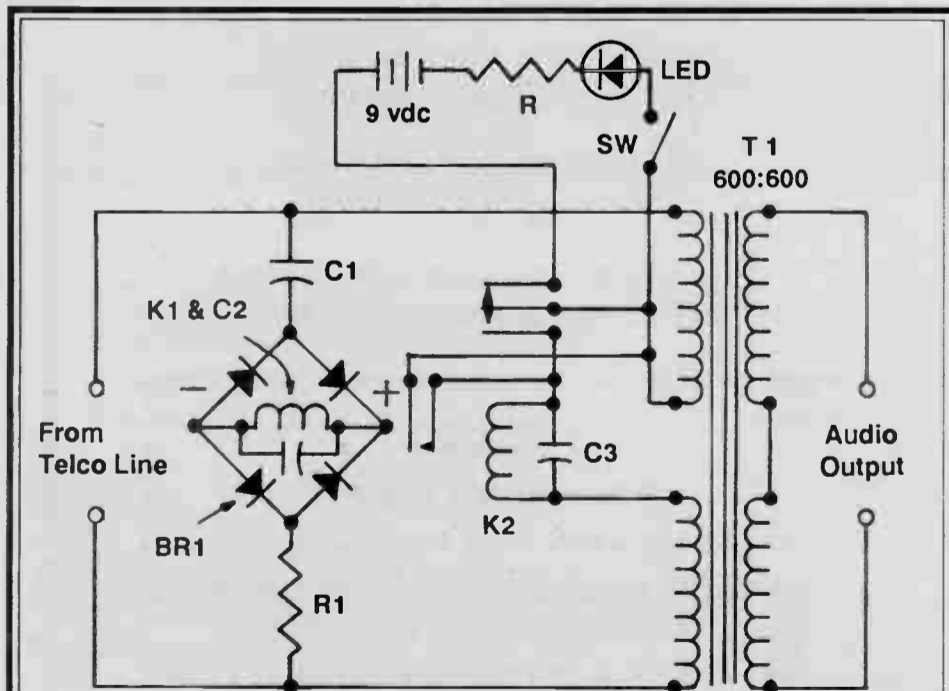
We already had a telephone coupler system wired into the board, so ... we just build an interface that would hook up automatically, when called. Here it is!

A 3 X 5 inch PC board was etched to mount all of the components except the transformer. If a Stancor A4350 cannot be found, any 600:600 split winding transformer will do. The components will mount nicely into a Radio Shack utility box. Have the telephone company install their modular jack near the PA system so that the "Robot" can easily be connected between the PA output and the telephone line.

How does it work? The ringing voltage (around 90-100 VAC) appears across C1, BR1 and R1. BR1 rectifies the voltage to DC, which appears across K1 and C2. K1 operates and is held by C2. K1 connects the upper coil of T1 to K2 and C3. The DC telephone line voltage causes K2 to operate. K2 contacts then maintain the DC flowing through K2. The ringing voltage stops because K2 "answered" the call. C2 discharges through K1, and K1 releases. C3 performs the function of audio bypass to insure that K2 remains closed by the telephone DC voltage. C3 also provides a low impedance audio path across the secondary coil split of the transformer.

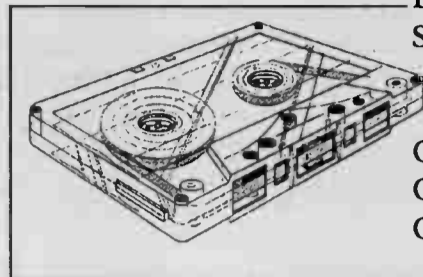
Yep, you got it! You can stick on of these things in your sports package and when the telephone line "glitches", the control studio operator waits 25 seconds and calls the sports crew back.

If you want an indicator for your remote crew, hook a 9 volt battery, a current limiting resistor and an LED in series from the normally closed contact of K2 to the armature contact of K2. When K2 operates, the LED goes out and the remote crew knows that they should be ready.



- C1 - 3.3 uF/50V (non-polarized)
- C2 - 1500 uF/25V
- C3 - .47 uF/100V
- R1 - 1200 ohm, 1/2 W
- BR1 - Bridge Rectifier (ECG 5310 or equal)
- K1 & K2 - 9 volt, 500 ohm coil (Radio Shack 275-004 or equal)
- T1 - 600:600 ohm, split windings transformer (Stancor A4350 or equal)

## Blank Cassettes... Perfect for Demo Spots



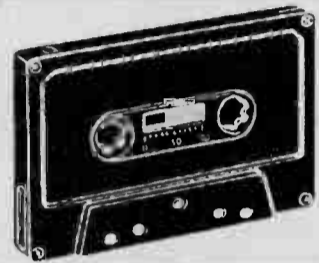
BASF Pure Chrome  
Shape Precision see-thru shell  
in quantities of:

	50	100
C-5's	\$.53 ea.	\$.46 ea.
C-10's	\$.58 ea.	\$.50 ea.
C-15's	\$.63 ea.	\$.54 ea.

*Custom lengths are also available*

BASF LHD Normal Bias  
Michelex German made shells  
in quantities of:

	50	100
C-5's	\$.49 ea.	\$.42 ea.
C-10's	\$.53 ea.	\$.46 ea.
C-15's	\$.58 ea.	\$.50 ea.



PHONE: (507) 288-7711

FAX: (507) 288-4531

Tom Jones Recording Studios  
220 South Broadway  
Rochester, Minnesota 55904

## CRL SPOTLIGHT



Noisy Audio?  
Try CRL's dynafex!



The CRL dynafex noise reduction system is the MOST effective and flexible single ended noise reduction tool you can buy. Our DX series provides more versatility than typical noise gates or companding type noise reduction units. Our UNIQUE patented combination of precise downward expansion and dynamic low-pass filtering maintains the dynamic range of your audio material. PLUS, dynafex is able to remove noise from the original source material; companding type noise reduction systems cannot. Dynafex can be used just about ANYWHERE noisy audio is a problem. Our TWO WEEK TRIAL PROGRAM lets you reduce noisy audio AT YOUR STATION!

DX-1 (MONO) \$649.00  
DX-2 (STEREO) \$749.00

Call or write NOW for details.



**CRL Systems**  
2522 West Geneva Drive  
Tempe, Arizona 85282 U.S.A.  
(800) 535-7648 (602) 438-0888  
TELEX: 350464

# Is "NFR" Real ?

*By George Yazell*

This is my fifth article in Radio Guide, and I still receive phone calls from people who think I'm a "crack-pot" or practical joker. I have just re-read the four previous articles to see where I failed to clear up any doubts as to my sincerity. I came to the conclusion that I tried to cover too many details in too short a space. Even after reviewing all four articles in one sitting, I was still confused - - and I wrote the stuff!

The 28 page booklet I've prepared does a much better job of "selling" NFR. That is what I am trying to do. I do not claim to have found the best or only way to bring Noise Free Radio to the AM Broadcast Band. But, I have found a workable method of adding frequency modulation to an AM transmitter, without eliminating your present amplitude modulated programs.

My suggestion is, order the NFR Booklet for \$12.00, shipping and handling included. Read it through. If you feel you did not get your money's worth, return it within 30 days, and I'll send you a \$10.00 refund.

Now, let me try to condense the NFR idea into a few paragraphs that make sense.

An Amplitude modulation detector in a radio receiver does not (at least it should not) respond to changes in carrier signal frequency. It will also ignore interfering signals on the carrier frequency and nearby adjacent frequencies, if those interfering signals are not varying in amplitude or are much weaker than the carrier strength of the desired signal. A signal strength ratio of 20 to 1 is usually satisfactory!

A frequency modulation detector does not (should not) respond to changes in carrier signal amplitude. It will ignore interfering signals on the carrier or nearby adjacent frequencies if the interfering signals are only slightly weaker than the desired signal. A signal strength ratio of 1.5 to 1 is usually satisfactory!

It is possible to transmit both amplitude and angle modulation simultaneously on a standard broadcast band transmitter. Motorola C-Quam Stereo does that.

In the FM Broadcast Band, channels are 200 kHz apart, and 100% modulation is defined as +/- 75 kHz deviation. The carrier may be modulated by "audio" signals from 30 Hz to 67 kHz. We are all familiar with the high fidelity, noise free, interference free service delivered to our homes by this magnificent medium.

In the AM Broadcast Band, channels are only 10 kHz apart and the FCC is proposing new rule changes that will limit the "audio" frequency range of the modulating signals to a maximum of 10 kHz. In today's AM radios, the audio frequency response is limited to about 3.5 kHz, and the noise and interference is so bad that you really have to be very interested in the program material to subject your ears to the irritating sound of an AM Radio!

Now I suggest you add NFR (Noise Free Radio) to your AM Broadcast Band transmitter. I promise that NFR will deliver an audio signal with all the high-fidelity, noise and interference free characteristics of FM, through your present AM Broadcast Band transmitter! Not only that, you can add NFR to your AM transmitter in addition to your present AM programming! No wonder some people think I'm "nuts".

If I have such a valuable idea, why don't I get a patent on it and make millions? There are two reasons. First, I have neither the dollars nor the years to complete that job. Second, everything NFR needs has already been done, or is being done now!

Early FM transmitters used phase modulated crystal controlled oscillators operating on frequencies between 102 and 125 kHz. Audio frequencies between 30 Hz and 15 kHz were applied with a maximum deviation of +/- 87 Hz (that's a modulation index of .006). That signal was MULTIPLIED 864 times, in a series of frequency multiplier stages, amplified to several kilowatts and radiated on a carrier frequency between 88.1 and 107.9 MHz. Please note that the carrier was MULTIPLIED 864 times, the amount of deviation was

MULTIPLIED 864 times, but the modulation frequencies remained the same - - 30 Hz to 15 kHz.

In a typical system, a crystal controlled signal on 117.0138 kHz was phase modulated to a deviation of +/- 87 Hz, multiplied 864 times to 101.1 MHz, +/- 75 kHz. The transmitted signal was picked up by an FM receiver, converted (heterodyned) to an intermediate frequency (IF) of 10.7 MHz, +/- 75 kHz. The IF amplifier incorporated a series of limiters which wiped off all amplitude modulation and noise impulses. The demodulator (discriminator, ratio detector, etc.) "captured" the desired signal, ignoring weaker signals on the same or nearby adjacent channels. The end result - - FM radio.

Now comes NFR! If we could apply FM to a 101 kHz oscillator, we most certainly can generate an FM signal on 1010 kHz in the AM Broadcast Band. My first model did just that. I applied audio with a frequency deviation of +/- 3 kHz (my "transmitter" was actually a Leader Function Generator).

Obviously, we need a special receiver to pick up the NFR signal. I modified an existing receiver as follows. The RF amplifier picked up the 1010 kHz, +/- 3 kHz, signal which was converted (heterodyned) to a new IF frequency of 430 kHz, +/- 3 kHz. This IF signal was then MULTIPLIED 25 times to a second IF of 10.75 MHz, +/- 75 kHz. This new signal was then injected into an existing FM IF circuit in the radio, where it was limited, demodulated and then delivered an audio signal to the speakers that was identical to "regular" FM mono audio in every respect.

I may be a little "kookie", but I'm not "nuts". NFR works and can salvage a sick AM Broadcast industry. I need your help. Read my book. Then phone or write me your suggestions as to how we can get NFR on every AM radio transmitter and an NFR radio in every home and car in the USA. Thanks!

**George W. Yazell, PE, (retired)**

**P.O. Box 8086**

**Lakeland, FL 33802**

**(813) 682-2270**

## THE "NFR" STORY

NFR is Noise Free Radio

A book covering the birth of the idea and development of a working system

A new idea for a new service for the old AM Broadcast Band

The tests that have been run and the tests yet to come

How to get in the race to be the first NFR station licensed in the USA

**\$12.00**

Includes postage & handling

Make your check or money order payable to "Noise Free Radio" and mail to:

**Noise Free Radio**

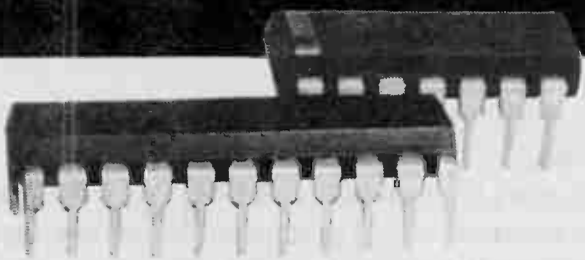
**P.O. Box 8086**

**Lakeland, FL 33802**

Be sure to include your name and mailing address!



# These 2 new ICs and RAMKO RESEARCH have just changed the whole concept of Broadcast Audio!!



## Introducing the incredible, new, xL SERIES of professional studio equipment!

### U.S. INGENUITY

Dramatic developments in analog ICs have enabled us to develop an entirely new concept of high performance, professional studio equipment: rock solid construction; performance found only in units costing 2 to 3 times more; and pricing that will leave you simply incredulous.

### FEWER PARTS/LOWER COSTS

The ICs above are two of the latest new releases from leading US manufacturers. A new quad op amp & VCA that deliver more performance and power for package size than anything previously available. Naturally, more circuitry in a single IC means: smaller product size; increased reliability; fewer manufacturing costs; and dramatically lower prices!

### PERFORMANCE & VALUE

All of the xL series deliver performance to meet the requirements of even the most demanding professional. S/N ratios of -85dB to -90dB; distortion of 0.008% or less; and +25dBm out to mention a few of the more important specs. Value? The xL series brings a new meaning to the word "VALUE" and does it in capitals! Prices unmatched by anything else in the industry-2 year warranties-performance on the cutting edge of technology-and construction that will stand up to whatever the situation demands.

### NO RISK 2 WEEK TRIAL

You're the final judge and our trial period guarantees that you get exactly what you expect, each and every time. No and's, if's or but's. Simply put, if at any time within two weeks of receiving your order (custom equipment excluded) you are not completely satisfied or have just changed your mind, return it in like new condition. Upon verification of condition an immediate refund (less shipping expenses) will be issued, for payment in full 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 20%-60% over any competitive product...Unsurpassed quality and performance...A no risk opportunity to prove to yourself that every claim we make is true. And, everything is backed by our 2 year warranty!

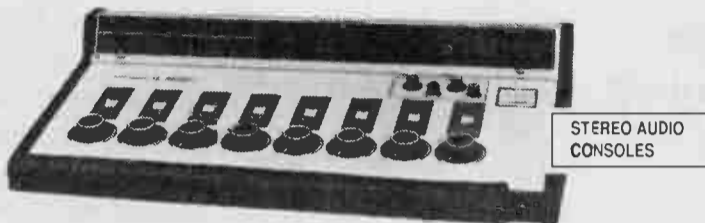
### CALL TODAY

Call RAMKO RESEARCH today or, better yet, one of our master dealers listed in this ad.. **You've nothing to lose except possibly some preconceived notions about how much quality really costs!**

## CALL TOLL FREE (800)678-1357

### RAMKO MASTER DEALERS

BARRETT ASSOC. OCEANSIDE, CA (619) 433-5600	ELECTREX CO. MIAMI, FL (305) 651-5752	SOUTHERN COASTAL MARKETING PINEVILLE, NC (800) 438-6040
BROADCASTERS GENERAL STORE OCALA, FL (904) 622-9058	PROFESSIONAL AUDIO SUPPLY FORT WORTH, TX (800) 433-7668	
CAVECO EQUIPMENT CO. ONTARIO, CANADA (416) 438-6230	R.F. SPECIALTIES PITTSBURG, PA (412) 733-1994	



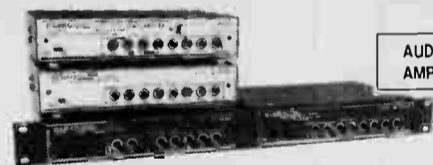
STEREO AUDIO CONSOLES

### 4, 6 & 8 MIXER, SINGLE CHANNEL STEREO-\$1295 to \$2850!

The new xL series of broadcast consoles redefine the term "solid state" From the beautiful exterior finish of Carbide Black, muted grey's and special xL white polyurethanes and the exceptionally long life (5 million operations), silent illuminated push button switches, thru the rock solid 1/10" thick aluminum control surface to the individually housed (double RF shielded) plug-in modules and bussing system, it will be immediately evident that nothing has been skimped on to bring you both the finest sound possible and construction that far exceeds anything else available. In short, a console that will stand up to years of use (and/or abuse), deliver performance that can only be found in the highest caliber production consoles, is a snap to install and program, and a dream to operate.

**HIGHLIGHTS:** Each mixer is programmable for mic thru line level on input A and high level on input B. Identical PROG1 and PROG2 output channels each individually or simultaneously selectable at each mixer. Huge 4" multi-color, expanded scale solid state "VU" meters. Long life faders driving special lutra low distortion VCAs for precision tracking and noise free operation. Overhead protected audio switching ICs that cannot be driven into clipping. Internally located barrier strips for ease of installation and future changes. Double module shielding, extensive bypassing, instrumentation "STAR" ground system, and RF beads for high level RF immunity. \*Four, six & eight mixers \*Single & dual output versions \*Mono mix outputs \*15 inputs(4 mixer), 19 inputs(6 mixer), 23 inputs (8 mixer) \*programmable mic/line inputs each mixer \*mic inputs program mable for stereo or mono feed \*programmable muting \*External 20 watt stereo monitor amp \*On air light's relays \*Plug-in modules \*Optional start/stop controls \*

□ xL41S (4 mixer, single channel) \$1295. xL42S (4 mixer dual channel) \$1450. xL61S (6 mixer, single channel) \$1795. xL62S (6 mixer, dual channel) \$1950. xL81S (8 mixer, single channel) \$2595. xL82S (8 mixer, dual channel) \$2850.



AUDIO DISTRIBUTION AMPLIFIERS

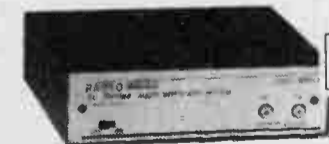
**DUAL CHANNEL, PRECISION AUDIO DA'S.** Two different units providing dual 1x4 or single 1x8 and dual 1x8 or single 1x16 operation. Individual output level controls, XLR input connectors, rear panel switch for independent or single feed. Standard barrier strip or optional quick disconnect phone jack output connectors. Optional outputs metering/phones monitoring available. Balanced in & out. +25dBm out max; .008% dist; 10Hz to 100kHz resp.; -85dB s/n. xL4s/8m-table top & single or dual 1 3/4" rack mount. xL8S/16M- table top & single 1 3/4" rack.

□ xL4S/8M-\$195. xL8S/16M-\$360. Call for option prices.



MINI AUDIO MIXERS

**6 MIXERS & UNMATCHED VERSATILITY.** Three different models with: phones monitor; master level control; expansion port; metering; phantom power; mic & line inputs on each mixer & programmable voice gating. Dual XLR & phone jack connectors on each input and barrier strip outputs. Balanced in/out. 10Hz to 20kHz resp.; .008% dist; -83dB line level & -72dB mic level s/n; +25dBm max out; UL listed supply. Table top or 1 3/4" rack. □ xL6M1(no metering or phantom pwr.)- \$190. xL6M1A (metering & 21v phantom power) - \$225. xL6M1B (metering, phantom pwr. & voice gating) - \$295 □ PS-20 (UL listed power source powers one to five units) - \$25



TURNTABLE PREAMPS

### STEREO, DUAL MONO & COMBINED STEREO IN ONE PACKAGE!

Precision performance with dual mono, stereo & combined stereo balanced outputs. Resp., 20Hz to 20kHz, 0.25dB; dist., 0.008%; +25dBm max out into balanced 600 ohms; -84dBm s/n; 300mv headroom. Table top or single and dual rack mount. □ xLSCM2 - \$154



MIC & LINE AMPS-PHANTOM POWER

**DUAL CHANNEL WITH SWITCHABLE MIC/LINE INPUTS & 21V PHANTOM POWER.** Balanced XLR inputs and balanced phone jack outputs. +25dBm max out into 600 ohms; resp., 10Hz to 20kHz, -1dB; 0.008% dist.; 72dB gain mic & 22 dB gain line; -71 dB s/nmic & -84dB s/n line. Front panel level controls. . Table top or one thru four 1 3/4" rack mount. □ xLM2L2 - \$129. PS-20 (UL listed power source powers 1 to 10 units) - \$25

\* THIS IS ONLY A PARTIAL LIST OF OVER 80 DIFFERENT PRODUCTS MANUFACTURED FOR THE BROADCAST INDUSTRY.

□ AUDIO ROUTERS SWITCHERS starting at \$1273 □ STUDIO POWER AMPLIFIERS from \$99 □ MODULAR AUDIO DA'S from \$900 □ SOLID STATE METERS □ AUDIO MATCHING AMPLIFIERS \$115 TO \$174 □ MIXERS (studio & portable); COMPRESSOR/LIMITERS; and the list goes on. Call for our new catalog or specific specifications sheets.

## RAMKO RESEARCH

3501-4 SUNRISE BLVD.  
RANCHO CORDOVA, CA 95742  
(916) 635-3600

# POWER - side™

The solution to many of AM radio's most serious technical problems

From the developers of the  
AM STEREO system  
"that isn't afraid of the dark"



425 Merrick Avenue  
Westbury, NY 11590  
(516) 222-2221

# Interfacing Transmitter Remote Status Indicators

By Michael D. Brown - Radio Broadcast Consultant  
Portland, Oregon

The phone rings... It's 3:20 a.m... The nervous voice at the other end is the new weekender the PD forgot to tell you about, and he's got a problem. "I can't hear myself on the air", he says. "Is the transmitter on?", you mumble, trying gamely not to further awaken the bed-mate groaning next to you. "How can I tell?", he innocently inquires..... As you pause to take a deep breath, you realize that you've been here before, more times than you care to admit.

When it comes to transmitter remote control, the KISS (Keep It Simple, Stupid) applies in spades. Whatever the system consists of, it must be understandable in 10 seconds or less by the entire collection of gorillas, gaggles, and short-attention-span- specialists that your station likely includes. I've found that nothing meets this criteria better than "pretty red lights" status indicators. Interfacing these at the transmitter site is where the trick begins.

The status inputs on most remote control systems require a dry contact closure to ground, floating at no more than +5 volts when in the "relaxed" mode. The dilemma, of course, is that most transmitters fail to provide external dry contacts for any function, except perhaps for overload conditions. The typical solution commonly is to either ignore the need for status indications, or to install a klugy conglomeration of relays.

# A REMOTE POSSIBILITY!



Get **LOGICONVERTER** for remote control of CD players, cassette decks, or just about *anything!* LogiConverter's opto-isolated inputs and relay outputs **eliminate incompatibility** between your console and what you're controlling. It will also create a **STOP** function even if your console has 'start-only' outputs. LogiConverter will control up to four machines . . . *easily and reliably!*

HENRY ENGINEERING  
(818) 355-3656

**We Build Solutions**

Figure 1

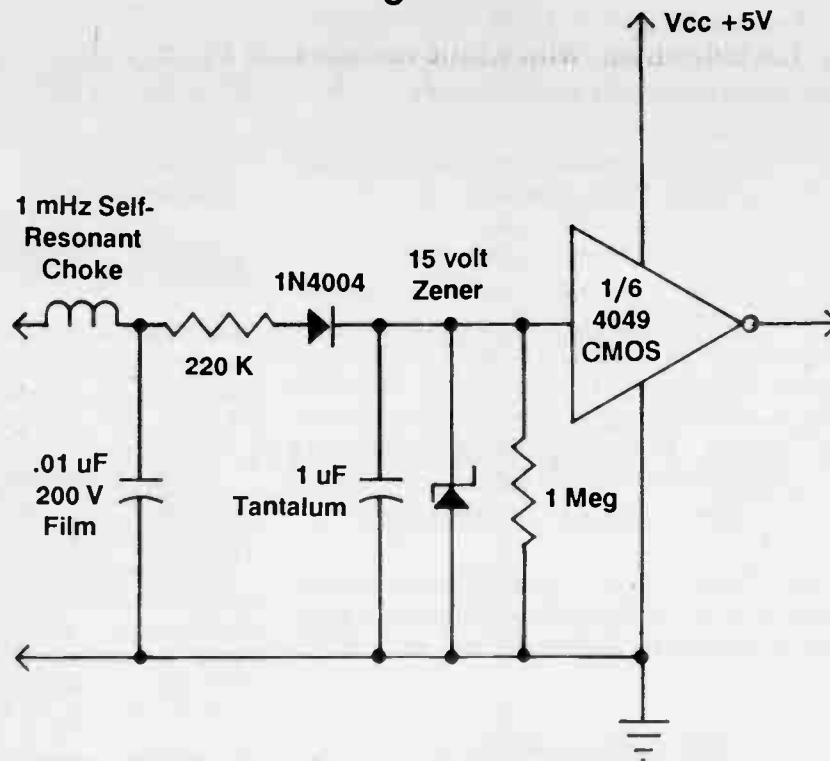


Figure 1 shows a simple universal circuit providing a "logic-low" output for any voltage input of 4 to 120 volts, AC or DC, that can be referenced to ground. And because the input impedance exceeds 1 megohm for input voltages below about 10 volts, this interface can usually be tied across metering samples without loading problems. Virtually any status indication imaginable can now be easily interfaced. (Note: The 4049 and 4050 family of CMOS buffers and inverters accept inputs of up to 20 volts, with any allowable VCC.)

Hookup for most of the indications desired is usually a simple matter. The popular Continental 315R-1 5 kW AM transmitter, for example, provides switched +28 V sources on a barrier strip (A7TB1), which were intended for external indicator lamps for filament-on, high and low power plate-on, etc.



Figure 2

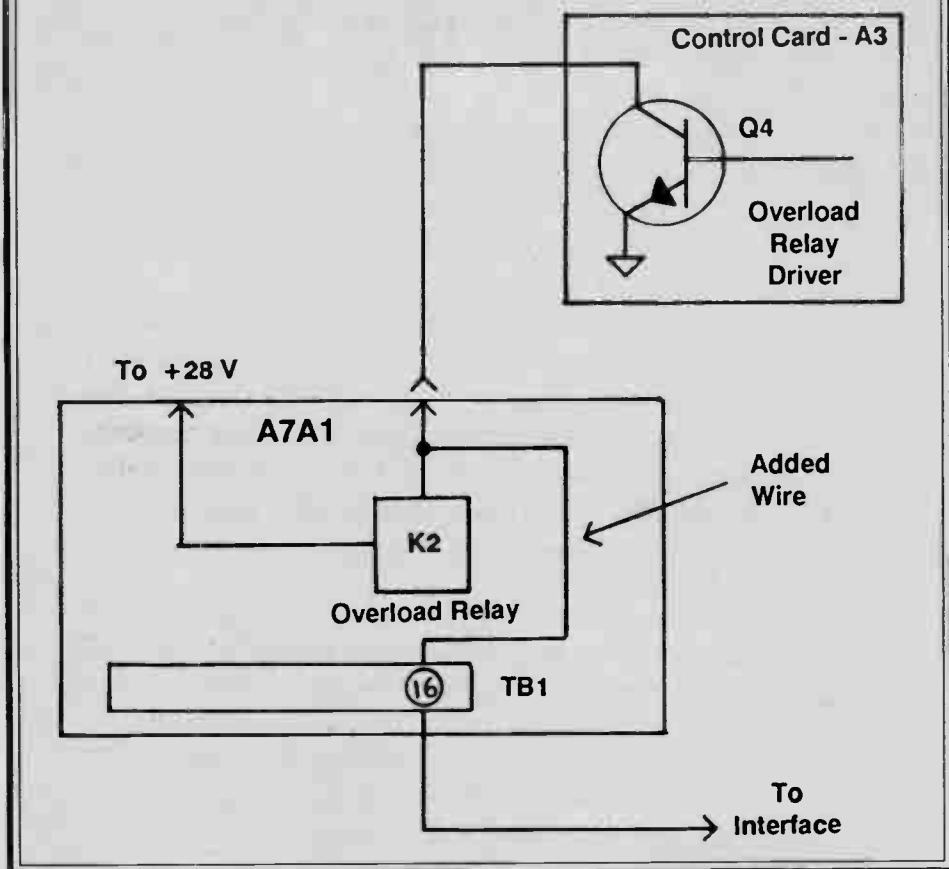


Figure 2 illustrates a simple modification to achieve a remote overload indication on the 315R-1. Overload relay driver Q4 is turned on during an overload condition, and floats at +28v during normal conditions. A wire added from the switched side of K-2's coil to the unused TB1-16 barrier strip point, provides very clean access for this indication. The sample will, however, be inverted; i.e.: the input to the status interface will be high during "normal" non-overload conditions. The "inverted" programming mode on the Moseley (and many other) remote control units will solve this dilemma. Otherwise, another 4049 CMOS section can be added to "re-invert" the indication. With a little thought (and some minor modifications), most other transmitters can be similarly interfaced.

Michael Brown is a Radio Broadcast Technical Consultant in Portland, Oregon. He can be reached at 503-245-4889. Your feedback is encouraged.

## Cart Deck Solenoid Tip

From Ray Thompson - KDKB  
Mesa, Arizona

Ray Thompson called the other day and told me of a very helpful tip on troubleshooting cart decks.

Many of the older cart decks, such as ITC Criterion, have high voltage solenoids. Ray has found that, when in operation, some of these decks will have a higher than normal hum level in the audio output. If there is a large enough ripple component on the DC solenoid supply, the solenoid will induce hum into the head - right through the air. Sort of like holding a de-gausser near a tape head, it seems.

A quick check is to disconnect the wires to the solenoid and place the deck into "play". Then manually bring up the solenoid to drive the tape. If the hum is not there, then the solenoid supply bears checking. Ray has found that a ripple of 1.5 VAC or less is usually OK; if it gets much above 2 VAC, it's audible.

Editor . . .

# ALLIED RADIO WORLD BULLETIN BOARD

Jump on! Here's what's on line right now . . .

Buying a new Denon DN950 CD/Cart Machine? Want all the low-down on interfacing remote controls to your console? Download file #191 for three users' reports. Concerned about RFR? Download files #150 and #151 for a Basic program to help figure if you need expensive measurements. Need to know operating frequencies of TV channels (for interference, etc.)? Download file #115. It's all free to radio station staff members.

Call Our Bulletin Board 317-935-0531

Modem Specs:  
8 Bit • No Parity • 1 Stop • 300-120C Baud



ALLIED Broadcast Equipment  
— A HARRIS COMPANY

EXPAND ABILITY

Expandable Digital Remote Control.

As your station metering requirements grow to additional sites and channels, the DRC190 from Hallikainen & Friends grows with you. By its inherent, modular-expansion design, the DRC190 can accommodate a single transmitter or grow to manage up to 100. Reliable firmware includes a multiple access, anti-contention data packet system, allowing any site to communicate with any other site over wire-line, subcarrier or half-duplex UHF radio. The same firmware allows expanding the system by adding additional sites or channels at any time. For a system to grow with, not out of, expand with the DRC190.

PROGRAMMABLE EXPANDABLE AFFORDABLE DRC190

## HALLIKAINEN & FRIENDS

141 SUBURBAN E4 805 / 541-0200  
SAN LUIS OBISPO, CALIFORNIA 93401-7590 USA



# Cart Deck Timer Interface

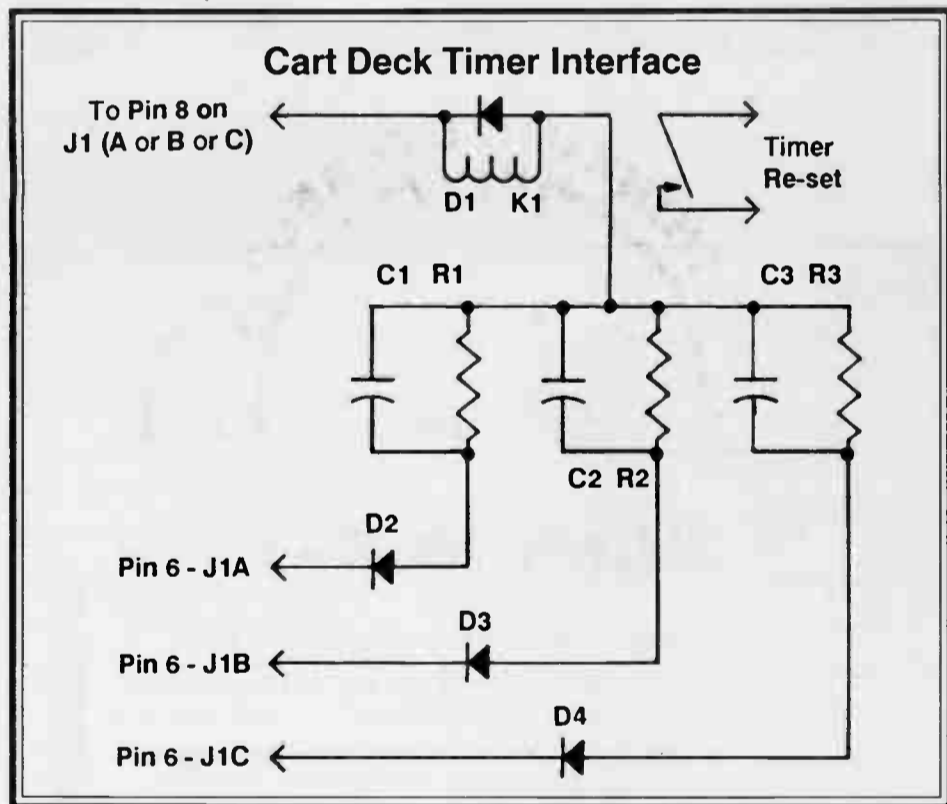
By Kevin Larke - WKYO/WIDL-FM  
Caro, Michigan

Here is a timer re-set circuit that works without remote start buttons. I have used it on three triple-decks (ITC-3D), so far. It gives a brief contact closure every time a deck is started. The brief closure ensures the exact elapsed time reading every time.

I've noticed that many stations use remote push-buttons with multiple contacts, or an SPST button controlling a multiple contact relay for remote starting and timer re-setting. This works OK, but requires more parts and if the jock holds the remote start button in for a second, the timer stays at zero for too long a time. Figure 1 is a drawing of the circuit:

K1 is a 12 Volt reed type relay available at Radio Shack. Diodes D1-D4 are 1N4002 types (actually 1N4001 to 1N4007 will work). Capacitors C1-C3 are 4.7 uF/35 Volt. Finally, the 3 resistors R1-R3 are 100K.

It's very simple. When a deck is started, its pin-6 drops to ground, charging the capacitor through the relay coil. The current, at the first instant, is high enough to close the contacts of the relay for a quick blip. When the deck stops, the capacitor discharges through the 100K resistor. The supply is 24 Volts and the relay is rated for 12, but it only receives 24 Volts for an instant so the relay won't be damaged. This circuit has been in use for a few years without a failure.



## Your Help is Needed ... and Appreciated

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.

Give me a call at (507) 280-9668 and we'll talk.

Thanks,

Ray Topp - - editor

# ECONCO



WE REBUILD POWER TUBES

ECONCO  
1318 COMMERCE AVENUE  
WOODLAND, CA 95695  
TELEPHONE 916-662-7553

OUTSIDE CA 800-532-6626 EXT. 300  
FROM CANADA 800-848-8841  
TELEX 176756  
FAX 916-666-7760

Listed below are a few examples from our price list.

3CX2500F3	.....	\$380.00
3CX3000A7	.....	\$460.00
3CX3000F7	.....	\$480.00
4CX5000A	.....	\$790.00
4CX15,000A	.....	\$1,090.00
4CX3000A	.....	\$630.00

We buy duds. Call for a quote.



## At Audio, You Get a Surprise Inside Every Box.

A lot of places sell broadcast equipment. They're all pretty much the same. But Audio is surprisingly different.

We offer the best equipment choices. And naturally the best prices. And one thing more... A special brand of warm, competent customer service. Audio's knowledgeable consultants are always ready to answer your questions, offer specific recommendations and provide speedy repair service.

Ordering is simple, easy and hassle free. Audio people make a surprising difference.

Call Audio  
Today!

The  
**AUDIO**  
broadcast group inc.

Call Audio  
Today!

2342 S. Division Ave. • Grand Rapids, MI 49507 • 616-452-1596

© 1988



# Slate Cue Oscillator

By R.F. Balonis - WILK  
Wilkes-Barre, Pennsylvania

In today's radio engineering world, sometimes it's the little things that you do that count the most. It's the things that money can't buy that will let everyone know you were there. This project is like that. For any one who does audio production, a Slating Cue Oscillator built into the production console is worth far more than the cost of its parts.

Slating is a term and practice taken, I think, from the film industry. Before each "take", a slate board with a take number written on it is held in front of the camera, prior to the shooting. In the recording industry (broadcasting too), the "slating" is a spoken "take 1" or "take 2" before each cut.

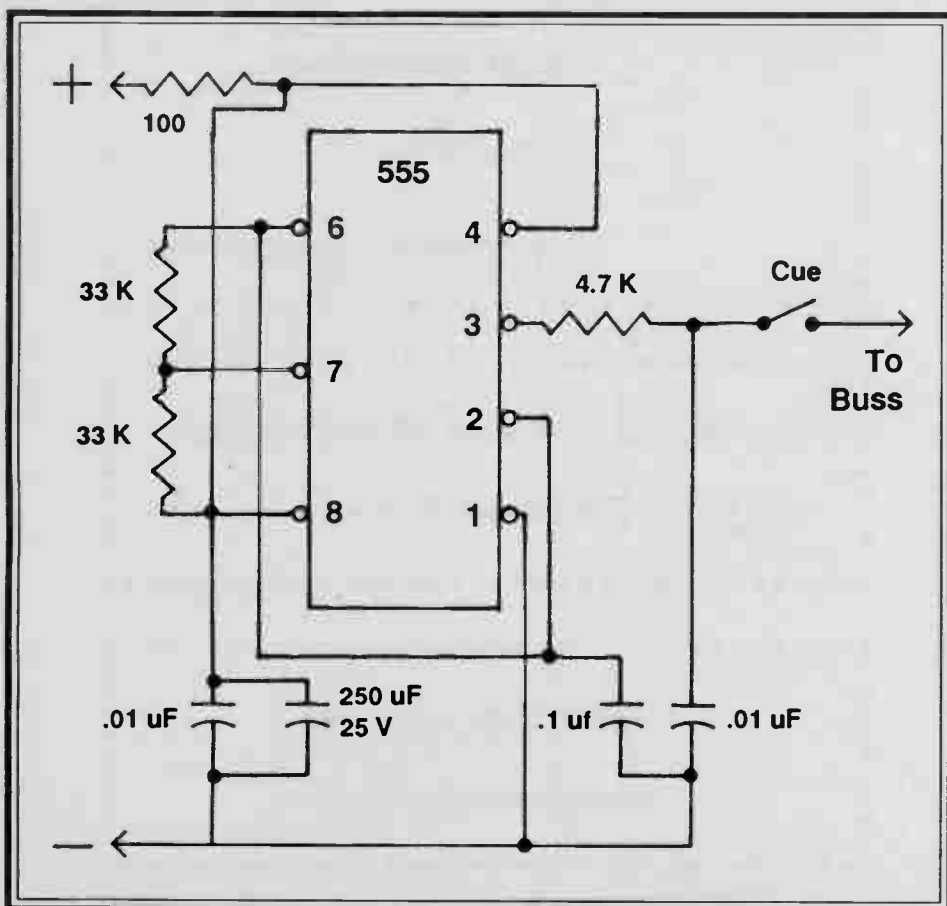
That works real good at normal playback speeds, or with few cuts on a tape. However, at fast forward or rewind, finding the talk-only slate mark can be difficult and sometimes frustrating.

That's the reason for this project. A Slate-Cue Oscillator lets the announcer (or whomever) add a harmonic rich tone to each aural slate mark. Aural slating with a short tone mark added to it, is heard as a series of high pitched tones marking the beginning of each cut, as the tape is run at fast forward or reverse. Finding a cut is simply a matter of counting the beeps.

Most any low frequency oscillator can work to generate a slate-cue tone. But I think a harmonically rich, distorted one, works better; and a built-in one for slate cue at the press of a button, best of all.

At the heart of this project is one of the standard IC building blocks, the ubiquitous 555. It is a common IC now-a-days and is in most radio station spare parts boxes. The 555 IC was originally designed for timer applications and with a minimum of parts it can function in either astable (oscillating) or monostable (one-shot) modes.

None of the parts have critical values, just about anything in the ballpark (junkbox) should work. The 33K resistors and the 0.1 mF capacitor determine the frequency. The 4.7K resistor and the 0.01 mF capacitor on terminal-3 filter the square wave a little before it's output runs thru the Slate-Cue pushbutton to tie into the console's mixing buss. 10-15 volts power is borrowed from someplace.



## FMX Stereo is here!

ON-AIR IN SMALL AND MAJOR MARKETS, HERE AND ABROAD.

As of December 15, 1988, 97 stations have committed to the FMX\* Coverage-Extension FM Transmission System. Some of these stations have been on-air in FMX Stereo for months.

FMX Stereo promises the broadcaster greater stereo coverage with the new generation of receivers scheduled for early '89 production. But there's no reason for you to wait.



Inovonics is the pioneer in FMX Stereo broadcast hardware. Our field-proven Stereo Generator, with its simple digital and patented techniques, delivers superb FM and FMX Stereo performance at a disarmingly affordable price.

And we stand behind this exciting new technology, as has been our custom with all Inovonics products since we began in 1972.

**DON'T WAIT — CONTACT US TODAY.  
FMX STEREO IS HAPPENING NOW!**

\*FMX is a registered trademark of Broadcast Technology Partners.

**Inovonics Inc.**

1305 Fair Avenue  
Santa Cruz, CA 95060

Tel: (408) 458-0552  
FAX: (408) 458-0554  
TTY: (408) 458-0557  
Tlx: 3730800



## THINK MLW-1

- Three stereo inputs, one stereo output
- Automatic switch to secondary or tertiary inputs on primary loss of channel
- Automatic switch to secondary or tertiary inputs on primary loss of audio
- Automatic loss of channel correction
- Automatic audio polarity correction
- User programmed sequence and time delays
- On-line audio monitoring and switching
- Microprocessor based
- Audio error alarms and level matching

**AND MORE... CALL OR WRITE  
FOR COMPLETE DETAILS**

**TITUS  
TECHNOLOGICAL  
LABORATORIES**

1134 Neipsic Rd., Glastonbury, CT 06033  
(203) 633-5472



## Tips From The Field

Technical Tips From Around the Country

### Modulation Peak Problem

By Carl Fletcher - WAKE/WLJE  
Valpariso, California

Recently, I came across a modulation problem with my AM transmitter; the positive peaks were 5 dB greater than the negative peaks. Since all audio stages were push-pull, I immediately thought something was wrong with the positive half of one of the audio amps, or possibly the modulation transformer. Actually everything associated with the audio portion of the transmitter was suspected.

After 5 hours of changing coupling capacitors and tubes, taking measurements and staring at schematics, I noticed that one of the RF final tubes was intermittently glowing slightly dimmer than the other tubes. "What now?", I thought, making no connection between this and my modulation problem. After a brief inspection, a loose filament connection on the tube socket was found and quickly fixed.

When the transmitter was put back on the air, the modulation problem had disappeared. The bad filament connection on the RF final had caused the problem. This experience taught me two lessons. First, rock solid pre-conceived notions can lead you a long way down the wrong path. And second, never under-estimate the value of a good thorough visual inspection.

### Fuse Tip

By Jay Mitchell - WENN  
Birmingham, Alabama

Our Harris Executive console would not work long without blowing the monitor amp fuse. One way we approached the problem, was to replace the fuse with a light-bulb, at the current and voltage rating of the circuit. When the short occurred, the bulb would light and not burn up parts or the PC board. This worked so well that you could short any diode in the bridge rectifier and the bulb would light (the amplifier would still work, with hum). This allows you to take time to work on the unit without fanning smoke out of your face. This idea should work in other equipment.

### No Audio

By Earl Fletcher - KTAN/KATZ  
Sierra Vista, California

The transmitter equipment of KTAZ(FM) consists of a Harris FM-2.5 H3 FM transmitter and a Wilkinson Series 8090 Model X FM Broadcast Exciter.

Recently we had trouble with intermittent audio. While the audio cut off, the carrier remained on the air. When the transmitter final was cut off, the audio would re-appear at the output of the exciter. Coordination with the Wilkinson (TTC) customer engineer, suggested replacement of the coaxial cable between the audio mixer module and the modulation oscillator module. The cable was replaced and the audio problem solved. It is assumed that the vibration from the PA blower motor was causing an intermittent failure of the exciter cable.

### Please-We Need Your Help!

If you have any short tech-tips, send them in or better still, call me at (507) 280-9668 and we'll talk about them. 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. Send them in - - they'll be printed in the next issue.

Editor . . .



RF Specialties of Pennsylvania

### Scotchcart II Sale

Empty	4.69	3.5 min	5.36
10 sec	4.71	4.0 min	5.54
20 sec	4.77	4.5 min	5.69
40 sec	4.82	5.0 min	5.78
70 sec	4.92	5.5 min	5.93
100 sec	5.05	6.5 min	6.22
2.5 min	5.14	7.5 min	6.41
3.0 min	5.22		



In Stock - Immediate Delivery

Minimum Quantity - 10 Carts, Single Length

### Scotch Reel-to-Reel

250-1/4-1200	7" Reel	7.10
250-1/4-2500 HPB	Hub	10.30
250-1/4-2500 R181	10 1/2" Reel	18.83
806-1/4-1200	7" Reel	6.18
806-1/4-2500 HPB	Hub	8.45
806-1/4-2500 RN	10 1/2" Reel	15.47



minimum quantity - one box

other Scotch products available - please call  
phone (412) 733-1994  
fax (412) 327-9336

RF Specialties of Pennsylvania, 121 Conneaut Drive, Pittsburgh, PA 15239

### Mailing Labels

AM, FM & TV BROADCAST STATIONS

Fast Service

100% Accuracy Guaranteed

Select by: Type of Station  
Transmitter Power  
Geographical Area  
Market Size  
Commercial / Educational

Cheshire or Pressure Sensitive labels

Total Cost: \$66.00 per Thousand Labels

Phone (800) 338-3264

Broadcast Mail Inc.



# Contract Engineers

Radio Guide will provide space here for contract engineers wishing to expand their business. To be listed here, just give me a call at (507) 280-9668.

This list is not a recommendation of any particular engineer. You will have to determine for yourself the qualifications of a particular person for the job.

Tom Becker  
Miami, Florida  
305-825-7037

Peter C.L. Boyce  
Midamerica Electronics Service  
New Albany, Indiana  
812-945-1209

James Boyd  
Boyd Broadcast Technical Service  
Tualatin, Oregon  
503-692-6074

Mike Brown  
Portland, Oregon  
503-245-4889

Lee Freshwater  
Blue Ridge Consultants  
Flat Rock, North Carolina  
704-693-1642

Chuck Gennaro  
Wisconsin Rapids, Wisconsin  
715-423-6763

Kirk Harnak  
Memphis, Tennessee  
901-529-0098

Richard A. Hyatt  
Maine Engineering Associates  
Gardiner, Maine  
207-582-4192

John Morton  
Durango, Colorado  
303-247-8734

Don Musell  
Broadcast Engineering Services  
Mouth of Wilson, Virginia  
703-579-4461

Mark Pallcock  
Marandee Broadcast Engineering  
Chatsworth, California  
818-882-9475

Ransom Y. Place III  
Danbury, Connecticut  
203-798-9395

John Ramsey  
West Hartford, Connecticut  
203-243-4703

Christopher Scherer  
Miami, Florida  
305-667-5918

Lee Soroca  
Soroca Electronics  
Syracuse, New York  
315-468-5123

Tom Toenjes  
Signal Specialists  
St. Mays, Kansas  
913-437-6549

Dave Wrenn  
Aiken, South Carolina  
803-649-1663

Brad Johnson  
Central California  
209-526-6277

Scott Dean  
Dean Engineering  
Fresno, California  
209-434-2358

Gary Smith  
Advanced Technical Svc.  
Abilene, Texas  
915-672-5149

James A. Chase  
Electro-Labs  
Angola, Indiana  
219-665-6427

Gary Reardon  
Ware, Massachusetts  
413-967-6156

James Droege  
Electronic Engineering Service  
Beatrice, Nebraska  
402-228-0780

Michelle Hunt  
Denver, Colorado  
303-469-1293

Tim Pozar  
Broadcast Engineering Consultant  
San Francisco, California  
415-695-7727

Mark Bohach  
Columbus, Ohio  
614-385-7583

Bob Ladd  
Bellevue, Ohio  
419-483-2511

Dave Hebert  
Pasco, Washington  
509-545-9672

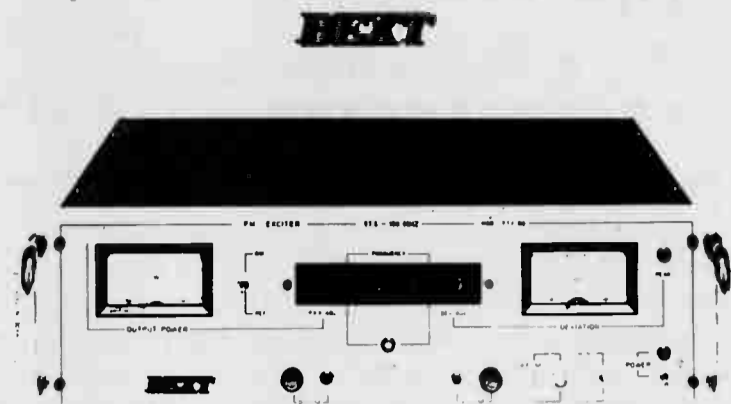
Dave Biondi  
The Radio Service Company  
Houston, Texas  
800-444-2301

Anyone Else ?

## Broadcast Computer Bulletin Boards

Broadcast Computer Database  
7 days a week, 24 hours a day  
All Baud rates (8 data, no parity, 1 stop)  
Specializes in on-line engineering programs  
David Armstrong (sysop)  
(713) 937-9097

Network Communication System Broadcast BBS  
300/1200 Baud rate  
Specializes in technical tips and schematic graphics  
(601) 373-0160



### HIGH PERFORMANCE AT AFFORDABLE PRICES

#### FRONT PANEL PROGRAMMABLE PLL FM EXCITERS:

10 W, \$1,995	20 W, \$2,795
30 W, \$3,495	80 W, \$4,495

#### FM SOLID STATE AMPLIFIERS:

100 W, \$3,495	250 W, \$3,695
500 W, \$5,995	1000 W, \$11,995

#### FM TUBE AMPLIFIERS:

800 W, \$6,995	1500 W, \$8,995
2000 W, \$9,995	5000 W, C.P.

CALL BEXT FOR A DISTRIBUTOR NEAR YOU

BEXT INC., 739 FIFTH AVE. STE. 7A, SAN DIEGO, CA 92101  
TEL (619) 239-8462 FAX (619) 239-8474

## CRL SPOTLIGHT

Upgrade Your  
FM Stereo Generator  
... with the CRL SG-800A



Your stereo generator is an important part of your overall on the air quality. Older generators can often color your audio because they can not handle dynamically processed audio very well. The digitally synthesized CRL SG-800A produces a flawless composite baseband signal. Our unique low distortion pulse amplitude modulator ensures maximum stereo separation (60 dB typical). The SG-800A is also available with two low-pass filter options, including the new CRL DSP-1 digital low-pass filter. The price of the SG-800A starts at \$1595. Our two week trial program will let the SG-800A prove itself to you. Call or write us for details.



**CRL Systems**  
2522 West Geneva Drive  
Tempe, Arizona 85282 U.S.A.  
(800) 535-7648 (602) 438-0888  
TELEX: 350464



# Transmitter With a Heart

By **Walter Bolinger - KJCR**  
Keene, Texas

At KJCR we operate a Continental 1 kW FM transmitter in stereo. The studio is a couple of blocks from the transmitter site and a Marti STL gets the signal to the transmitter. Recently, one of the on-air operators called me and said that there was a funny sound going over the air. By the time I could get to the station, it was no longer present. Some time later, I was called again. This time I could hear it, but only during the gaps in program audio.

They called it a "heart-beat", and it did sound a little like listening to the heart with a stethoscope. It was a low frequency, repetitive sound and my first thought was that it was motor induced. I checked the various motor driven equipment in the studio, but no change. I decided that the problem would have to be run down when the station was off the air.

The next morning at 2:00 a.m., I got up and went to the studio. The sound was there, even when the station was off the air. We do keep the filaments on all the time, and this keeps the exciter on too (great for frequency stability). The STL operates continuously, so I turned it off and the "heart-beat" was still there. I had noticed that the blower motor on the transmitter had gotten noisier lately, so I began to figure that the trouble might be related.

I went to the transmitter site and lubricated the motor, but no change. I turned the exciter off and the noise stopped. With the exciter back on, I started wiggling the cards in the exciter and shortly, the noise was gone. I turned the exciter off and gave all the contacts on the cards a cleaning. Now, several weeks later, the "heart-beat" has not returned. I figure that some of the contacts were a little dirty and the vibration from the blower was enough to modulate the signal and produce the noise.

## Radio Guide

January, 1989 Volume 2 - Issue 1

Mail to: Radio Guide 511 18th Street SE  
Rochester, MN 55904

Fill out the information below, and then circle the number of any manufacturer from which you would like additional information.

- |                                 |                                       |
|---------------------------------|---------------------------------------|
| 1 - Data World                  | 11 - Audio Broadcast Group            |
| 2 - Hnat Hindes Inc.            | 12 - Econco                           |
| 3 - Tom Jones Recording         | 13 - Inovonics Inc.                   |
| 4 - CRL Systems                 | 14 - Titus Technological Laboratories |
| 5 - Noise Free Radio            | 15 - RF Specialties of PA             |
| 6 - Ramko Research              | 16 - Broadcast Mail Inc.              |
| 7 - Kahn Communications         | 17 - Bext Inc.                        |
| 8 - Henry Engineering           | 18 - JRF Magnetic Sciences            |
| 9 - Hallikainen & Friends       | 20 - Data for Small Systems           |
| 10 - Allied Broadcast Equipment | 21 - Stanley Broadcast Engineering    |
|                                 | 22 - Northern Magnetics               |

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_ Phone \_\_\_\_\_

FCC's Engineering  
FM and TV Data Bases  
for your P.C.

Call today to request a free sample

Data for Small Systems

Suite #236  
2020 Pennsylvania Ave. NW  
Washington, DC 20006  
(703) 276-9442

**SBE** STANLEY BROADCAST  
ENGINEERING

James S. Stanley  
Engineering Consultant

P.O. Box 24601

Tempe, AZ 85282

(602) 264-8752

**NORTHERN**  
MAGNETICS

CERTIFIED TAPE HEAD SERVICES

Northern Magnetics is an industry leader in the supply and service of tape heads and tape head products.

Phone: (612) 333-3071

Telex: 1561238 MPS UT

P.O. Box 16409

Minneapolis, MN 55416

FAA Repair Station # C14-57

Optimize — **JRF**  
don't compromise: **MAGNETIC SCIENCES**

If you demand optimum performance from your tape recording equipment... you need our services!

JRF maintains a complete lab facility insuring precision relapping and optical alignment of all magnetic recording heads and assemblies. Worn unservicable heads can be restored to original performance specifications. 24-hour and special weekend service available.

- Broadcasting
  - Mastering
    - Recording Studios
    - Tape Duplicating

New and reconditioned replacement heads from mono to 24-track... Many in stock.

For repair or replacement, we're at your service!

Call (201) 579-5773

**JRF/Magnetic Sciences, Inc.**

Kennedy Road • P.O. Box 121 • Greendell, NJ 07839 • Telex: 325-449