January, 1972 / 75 cents

BROADCAST ENGINEERING

the technical journal of the broadcast-communications industry

A HOWARD W. SAMS PUBLICATION

Digital logic basics see page 16

Cable Engineering

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Circle Number 1 on Reader Reply Card

January, 1972 • Volume 14, No. 1

BROADCAST ENGINEERING

The technical journal of the broadcast-communications industry

in this issue...

ABOUT THE COVER

Ampex engineer E. Stanley Busby, Jr. winds up his series on digital logic. The cover picture is a blowup of one of the latest readout devices in use today. Part 4 begins on page 16. Cover picture courtesy of Ampex.

DEPARTMENTS

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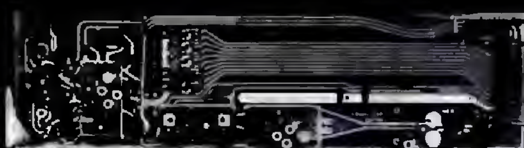

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(Continued from page 4)

Plans Advance For the New Chicago Frequency Center

After considering comments from both the broadcast and land mobile industries (See Sept., 1971 D.C.), the Commission has decided to proceed with plans for its Chicago Regional Frequency Spectrum Management Center will administer frequency allocations in an area of 96,000 square miles centered generally on Chicago, in the states of Illinois, Indiana, Iowa, Michigan, Ohio and Wisconsin.

Broadcast remote-pickup licenses in the following frequency groups will come under the jurisdiction of the new Center:

Group D (MHz)	Group E (MHz)	Group F (MHz)	Group G (MHz)	Group H (MHz)	Group I (MHz)	Group J (MHz)	Group K (MHz)
26.15	26.17	26.19	26.21	26.23	26.11	26.13	152.87
26.25	26.27	26.29	26.31	26.33	26.45	26.47	152.93
26.35	26.37	26.39	26.41	26.43			152.99
							153.05
							153.11
							153.17
							153.23
							153.29
							153.35

FCC Form 425 has been adopted to replace the present form (FCC 313) effective April 1, 1972, for all applications for new, modified, or renewed licenses. In addition, licensees in the Chicago region must file Form 425 as follows:

Indiana by June 30, 1972
Michigan and Ohio by September 30, 1972
Illinois and Wisconsin by December 31, 1972
Iowa by March 31, 1973

Short Circuits

A report by the Commission's Chief Engineer's office concludes that elimination of UHF "taboos" in the New York City area would provide only a minimum number of additional channel assignments--Canada's Department of Communications (DOC) reached a similar conclusion in the Toronto area . . . FCC Broadcast Bureau Chief Wally Johnson has urged outside engineers to contribute suggestions for improvements in broadcast technical regulation . . . Shorted winding: a California group calling itself the Institute for Social Research and Law has requested the Commission to issue rules or regulations prohibiting the use of sex, violence, or appeals to vanity in television and radio advertising.

States Can Demand PE Licenses

Dear Editor:

There has been much discussion in your Letters to the Editor column about the title and definition of an engineer.

Below is a summary of an article from the Louisiana Engineer of June 1971 by the attorney of the Louisiana State Board of Registration for Professional Engineer's and Land Surveyors. This information directly concerns those who represent themselves as consulting engineers to radio stations. The court ruling in Louisiana is very specific and will probably apply in most other states.

I have been a registered professional engineer since 1937 and have seen many examples of unqualified and unscrupulous persons claiming to be engineers. A case in point was found by an FCC engineer in a routine inspection trip who found audio proofs of performance on file at two different stations both on the same date. The problem was that the stations were over 300 miles apart.

Ben Akerman
Chief Eng., V. Pres.
Radio Station WGUN
Decatur, Ga.

Editor's Note:

The material the writer enclosed was a review of a court case involving a man who offered his services as a consulting engineer although he was not licensed as a professional engineer.

This man had, for a number of years, designed radio and TV stations and had submitted appropriate applications for construction permits. The complaint in this case was not that the man had promised more than he could deliver or that he had—through engineering practices—deceived station representatives.

The Louisiana court ruled against this man because in that state he had not complied with the regulatory statute that required him to be a registered professional engineer before he could offer his services. In fact, the FCC makes no such distinction. If his engineering data

(Continued on Page 8)

(Continued from Page 7)

in support of an application were in order and technically correct, his efforts would be acceptable. And while the defense brought out this point, the court claimed that Federal rules—such as those of the Federal Communications Commission—do not displace the Louisiana statute governing the practice of professional engineering.

The key to this ruling was that this man was covered by the state statute in two ways: (1) the data and exhibits submitted require and/or imply individual engineering practice and knowledge; (2) in several instances this man had checked a box on FCC forms, indicating that he was a "Consulting Engineer". Any Comments from the gallery?

Professionalism First, Titles Don't Really Matter

Dear Editor:

I have been following the letters in your magazine regarding the correct or incorrect usage of the term engineer, and thought I might add my two cents.

Personally, I think too many people are stuck on this title thing. Why is it so necessary for some people to have a title, such as engineer, hanging on the end of their name? A college diploma does not make an engineer, nor do years of experience in the field. It is the man himself and his abilities to do the job that make him what he is. I have known many degreed engineers who couldn't find their way past their diploma and many non-degreed, so-called engineers, who wouldn't know if the schematic was upside down or not. In this respect, the title means nothing.

I don't care what people call me. My ability to do the job, my knowledge in my chosen field of endeavor, my professional reputation among technical and non-technical people will determine whether my name is spoken in jest or with serious respect to my profession. These factors will also determine my future growth and renumeration for my services. And these things will happen whether there is a diploma or not. From my standpoint then, people may call me what they wish. My performance to my employer and my personal pride in my chosen profession will be the determining factors in what people think of me as an individual and as a professional in my field.

Norm Smith
(CE or whatever you will)
KTLK Radio
Denver, Colo.

Editor's Note:

Kudos for Norm Smith! He may be the last angry man, but he thinks of broadcast engineering as a profession. In that context, he wants to be known first as a professional.

There may be a mystique that goes with some titles, but if you're looking for respect, it's better to be known as a professional. Undoubtedly, several states have recognized this. What they seek is a licensed title that insures those seeking professional services that people bearing the title "Professional Engineer" have it. But even these rigid state tests, backed by Federal tests cannot insure integrity.

Warped LP Letter Goes To Press

Dear Editor:

I read with interest the letter from R. Dennis Alexander of Radex Productions in which he asked information about straightening out warped LP's (November, 1971, **BE**).

I've had the problem a couple of times before and my solution is a little strange, but it worked for me. I took the warped album from its jacket, but left the paper sleeve on, to keep the LP from being scratched. The album is then placed on top of the clothes dryer in my home, over the place where the pilot light keeps the top at a nice even heat. Also, place a flat object on top of a fairly heavy weight.

There is just enough heat, with the weight, to straighten the LP without damaging the quality of the record grooves.

Donald Corey
KSWE Radio
St. Louis, Mo.

JANUARY, 1972

Cable Engineering

in this issue...

 By Leo G. Sands

CAFM Is A Natural Cable By-product

Long before there was CATV, there was wire distribution of audio programs. In the United States, audio programs were transmitted through telephone lines to restaurants, factories, etc., by music service companies such as Muzak. Later, RF signals were transmitted through wire and cable to radio receivers in foreign countries where radio reception was poor. And, for more than 20 years, television signals have been transmitted through coaxial cable to receivers that do not have to depend upon a local antenna for signal pickup. Now that television reception can be extended to almost every habited area of the United States, television has become our most potent communications medium.

However, a great many people listen to radio more hours per day than they watch television. Many of these people are "audiophiles" with expensive FM-stereo receivers who demand, but do not always get, flawless reception.

A survey conducted by an FM station in the San Francisco Bay Area indicates that 75 percent of homes have FM receivers and that 79 percent of these were either consoles or stereo system component type receivers. The survey also indicated that the average listener spent 3½ times as much time listening to FM than to AM and television combined. This last sentence points up the fact that in terms of listener hours, FM radio is the most used communications medium—at least in the large metropolitan areas where there are numerous FM stations.

FM Potential

But, what does this mean to the CATV system operator? It means that the FM radio listener is a potential CATV subscriber. It also means that existing CATV subscribers will get more for their money if CATV also provides superior FM reception.

Good FM reception often requires more than use of the compromise antenna built into many FM receivers. FM reception can often leave a lot to be desired even when a good outdoor antenna is used. As in television reception, there is the "multipath" problem. The audiophile is often quick to note distortion resulting from multipath reception—most often not being aware of the cause.

Optimum reproduction of FM-stereo programs requires a strong signal not marred by multipath signal propagation. For good synthesized quadraphonic reproduction, it is even more important. And when true four-channel (quadraphonic) broadcasting begins on a regular basis, an even cleaner signal will be required.

Since many CATV systems already transport the signals of FM broadcast stations, don't these systems already satisfy the requirements? No! The typical CATV system equipped for transportation of FM radio signals employs an FM band amplifier at the head end. This amplifier provides essentially equal amplification of all intercepted signals within the 88-108 MHz FM band.

This means that at the subscriber outlet, the FM signals are available at various levels. Some may be strong enough to fully saturate the receiver limiters—some may be almost down to the noise threshold. It's not the same as television signals which are usually delivered at some reasonable facsimile of equal levels.

Since a radio receiver has wide dynamic range, why is this so important? It is important because FM receivers are far from near-perfect, regardless of price, with very few exceptions (if any) and, for good reasons. A tunable FM receiver must be able to receive any station within the 88-108 MHz band—a 20-MHz spread—compared to the 1.06-MHz spread of the AM band. It should have a bandpass of at least 210 KHz to avoid clipping of significant FM sidebands. At the same time, it should be selective enough to

Introducing... Cable Engineering

With this issue of Broadcast Engineering *magazine, we are opening a newly designed special monthly section—*Cable Engineering.

Broadcast Engineering *has always carried articles that appeal to several areas of the communications spectrum. That's why we are known as "the technical journal of the broadcast-communications industry".*

But because of the continued growth of the Cable and Closed Circuit industry and ever increasing coverage in BE, *we think Cable TV should be the major focus of a separate section. As in the past,* BE *will continue its wide communications coverage. And* Cable Engineering *will bring you comprehensive Cable technical and association news, the state-of-the-art and practical techniques that affect signal quality.*

This special emphasis is designed to give you a concise monthly update on your industry. Meanwhile, we look forward to continued Cable participation in the Letters to the Editor and Engineer's Exchange columns.

Sincerely,
Ron Merrell, Editor

select stations whose carriers are 200 KHz apart. Its IF should not drift appreciably. And, it should "capture" a signal that is at least 6 dB stronger than interfering signals. If these tunable receivers do not achieve near-perfection, it is understandable.

Their performance would be excellent if the signal level of all stations tuned in were almost equal and if they were adequately spread apart in frequency.

For optimum FM reception, a fixed-tuned receiver is required. It may be fixed-tuned to one FM channel or switchable to any of a number of channels, preferably the former.

The alternative is reception of FM stations with a tunable receiver whose desired input signals are at essentially the same level. This can be done in two ways: (1) utilization of an outdoor antenna and a preamplifier whose gain is automatically or manually adjustable or (2), feeding the receiver from a CATV outlet—when the CATV system head end is equipped with individual FM channel amplifiers.

Feeding the Receiver

This article is about the latter alternative. When a CATV system employs a single amplifier for all FM band signals, the output levels of the FM channels differ drastically as illustrated in Figure 1. On the other hand, the output levels can be made essentially equal by employing individual FM channel amplifiers at the head end.

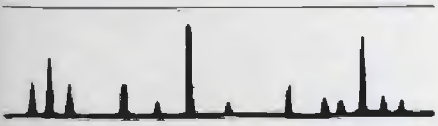

Fig. 1

Instead of picking up and transmitting all of the available FM signals, including noise and spurious signals by utilizing an 88-108 MHz amplifier, only the signals of selected FM stations are picked up, amplified and transmitted into the CATV system. As shown in Figure 2, only a single FM receiving antenna is required. When necessary, however, two or more antennas can be used.

Head end amplifiers designed for this purpose are available. The Catel FMRM, for example, has a rated sensitivity of 3 micro-volts for 30 dB of noise quieting. AGC maintains output level constant at the present level as input level varies over a wide range, as shown in Figure 3. Image rejection is rated

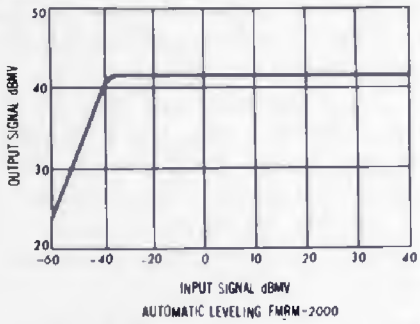

Fig. 3

at better than 90 dB. The resulting output signal levels of all of the channels processed in this manner, are uniform as shown in Figure 4.

Fig. 4

Using this technique, it is possible to import the signals of only those FM stations whose programs are of interest to the communities served. Because of the superior location of the head end antenna system, reception of stations beyond the range of a home antenna is often possible. For example, within a reasonable distance beyond the New York City metropolitan area where good reception of New York City stations is not possible, it would undoubtedly be possible to provide good reception at these stations through a CATV system. To serve good-music buffs, the programs of WQXR-FM, WTFM, WRFM, WPAT-FM and other

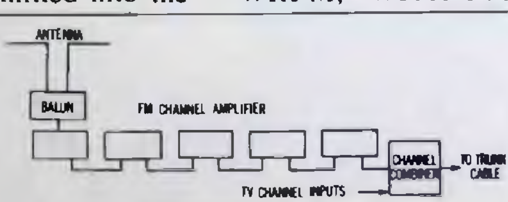

Fig. 2

stations could be imported. For the rock audience, the signals of WOR-FM and other in-crowd stations could be imported.

Transportation of the signals of AM standard broadcast is also feasible. It is possible to provide a translator at the head end that will intercept all signals within the 540-1600 KHz band and translate this band to another band of frequencies above 50 MHz for cable transmission. This will require the use of a converter at each subscriber location to translate the signals back to their original frequencies.

This converter can have output terminals to permit direct connection to receivers (such as AM/FM-stereo receivers) that are designed to be used with an external antenna. Receivers employing a loop antenna or ferrite rod antenna can be inductively coupled to the converter output. This can be done by running a wire loop within the home and placing the receivers close to the loop. Or, the converter output can be fed to one or more small flat loop antennas on which the receivers are placed.

While this technique will work, it has its limitations and drawbacks. The noise picked up by the broadband input device will be amplified and fed into the cable system. Since the AM station frequencies are translated back to their original frequencies, but not exactly because of oscillator frequency error at the head end translator and at the subscriber-location converter, a receiver is apt to pick up the signal directly and via the cable system at the same time, causing heterodyne beats to be produced.

A better way is to demodulate selected AM signals at the head end and feed the resulting audio signals to FM modulators. The AM stations can be received with an FM receiver tuned to a vacant FM channel. The same technique can be used for transporting signals of international short wave broadcast stations.

How About Four Channel?

In addition to transportation of FM and AM broadcast station signals, an FM weather channel and a time signal channel can be provided. Head end equipment for these purposes is also available.

The origination of monaural, stereophonic and even quadraphonic audio programs is now feasible because of the availability of suitable off-the-shelf head end equipment. It has been customary for many CATV systems to provide a monaural music channel, either on the aural carrier frequency of an unused or weather television channel or on an FM channel. Now that stereo FM modulators are available. the stereo-listening subscribers can be more adequately served. The programs can be played back from recorded stereo tapes by an automated tape player system.

These stereo programs can be reproduced monaurally with a mono-FM receiver, stereophonically with a stereo-FM receiver and viewers owning a quadraphonic adaptor or a quadraphonic-FM receiver will be able to reproduce stereo programs as synthesized four-channel stereo programs.

True four-channel quadraphonic programs can be transmitted by two stereo modulators, each operating on a different channel and both fed by a four-channel tape or disc player. The listener with only one FM-stereo receiver could tune in on the main FM stereo channel to hear the left and right channels only. Those with two FM-stereo receivers can tune one receiver to hear the left and right channels and the other to hear the left-rear and right-rear channels, as illustrated in Figure 5. While this might seem an awkward way for a subscriber to provide means for hearing true quadraphonic programs, there are undoubtedly many who would do so until true quadraphonic broadcasting standards are established and compatible receivers become available.

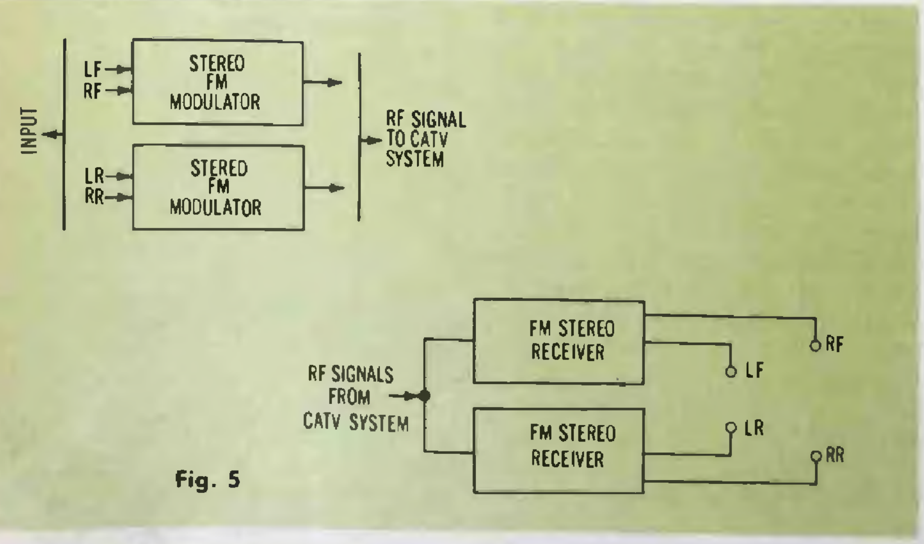

Fig. 5

How About Profit?

What economic incentives there are for CATV system operators to provide these improved radio reception services must, of course, be weighed. Even when the CATV company normally connects its outlets to television receivers, but not to FM receivers, subscribers can buy and install splitters so both television and FM receivers can be fed by the CATV system. This makes it difficult to exact an additional charge for FM service.

On the other hand, providing high-quality FM signals can attract additional subscribers—those who aren't excited about watching television, but who are dedicated music listeners. They can represent significant additional income. By adding to the scope and quality of services, the CATV system operator might be able to convince the franchising authority that a rate increase is warranted.

Local-origin music program channels can produce income by transmission of commercials. To avoid alienating the audiophile who wants music with a minimum of commercials, discretion should be used in regard to the types of commercials transmitted. This is the audience sought by the local record dealers, hi-fi shops and deluxe car dealers.

When using tapes as the music source, the mechanics are simple. The commercials can be spliced or dubbed into the music program. This reduces manpower, costs, and simplifies cablecasting procedures.

Practicing The Practical

By Ron Merrell

There have been a great many ideas flooding the market on "sky blue" uses for CATV. In fact, if you listen to some forecasters, cable TV can be the answer to everything needed in 20th century communications.

Nobody has bothered to mention to a great many operators just how they will get the money to invest in such a myriad of possible offerings. Those who entered the industry seeking something less than the fountain of potential may, understandably, never seek the kind of maximum service some forsee.

From time to time there have been services added that lack the "Gee Whiz" approach, and so they are bypassed or soon forgotten. And, of course, singled out, few new ideas are responsible for economic success or failure or total system quality signal consistancy.

With this in mind, let's take a look at what two systems have done to increase listener/viewer interest. Neither innovation involved extensive investments in time nor money...and both are in use today.

Have you ever thought of turning on a TV set to watch a radio show? They're doing it in St. Cloud, Minnesota!

WJON radio, who held the cable TV franchise for the St. Cloud area, had an extra TV channel and they weren't sure what to do with it. Finally, they decided to put a TV camera in the radio studio and let the TV viewers watch the announcer do his thing.

"To the best of my knowledge we're the only station in the country doing anything quite like this," says station manager Andy Hilger.

Viewers hooked into the cable system, along with a choice of TV stations pumped in from communities across Minnesota, can tune in WJON's Channel 3 to see and hear the DJ as he reads news and weather, plays records, and so on.

As a matter of fact, they even get to see him drink coffee, scratch his head, talk on the telephone, hunt through piles of albums, and plug in tape carts.

But it has caused some problems. "For example," says station program director Mike Dime, "until we started to watch it we had

cases where an announcer would be drinking a well-known brand of soft-drink on TV while he was reading a commercial for their biggest competitor on the radio." The radio signal also serves as the sound for the cable TV signal. Most of the time, however, station personnel just ignore the camera.

The regular 5 o'clock radio news show is aired before live closed circuit cameras, which gives cable subscribers a different perspective of local radio and of their cable system.

In the foreground of the news reporting picture is a St. Cloud State College student manning the camera. Students built this set.

Above, DJ as he appears on WJON studio monitor. Below, even program director Mike Dime gets in on the act when he enters the studio.

They even turned out in numbers to assist in reporting on a local election.

The idea could improve interest in radio and cable TV at the same time...even though a system may not be owned and operated by a radio station. But music shows are not the only possibility. It could be used with stations that present talk shows, and talk-panel shows.

Then There's CAFM

Another view is taken by a cable system that has added FM to its outlets.

Two Suburban Cablevision systems have added FM mono and stereo signals to their subscriber offerings.

The systems, located in Marion, N. C. and Culpeper, Va., pipe a number of FM signals to the subscriber's drop where an FM tuner is added to select the FM stations. In this way, the subscriber can receive FM signals from a number of directions at acceptable signal levels without using any external antenna.

The Marion system will receive 9 stations, while the system in Culpeper will pick up 10.

For More On CAFM
See Page CE-2

Cable Engineering Invites Your Comments And Your Ideas.

Address Correspondence To: 1014 Wyandotte Kansas City, Mo. 64105

"LADY, 'CATV' DOESN'T MEAN WE TELEVISE PET CATS!"

Understanding Zoom Lenses

Part 2 of a 2-Part Series By Frank Bemish

Optimum performance can only be achieved from a lens when it is set up properly. Since there are many variables in a color camera optical system, it is necessary to pick some starting point from which to work. The lens is a good starting point since the entire camera optical system is referenced to the lens.

After the lens is mounted on the camera, the lens should be set in the 1.0x position (no range extender). (Figure 1) If the lens is equipped with a vernier back focus adjustment, this should be set to the center of its travel so that the lens will move freely throughout the full range of adjustment. Lock the lens at this point.

To assure proper focus tracking throughout the zoom range, the camera tubes (back focus) must be adjusted at infinity. This should be as far away as possible and in no case less than 25 feet from the lens. The iris should be set wide open and there must be glass in the filter wheel to insure the proper glass path. Clear or filter glass will serve this purpose.

Zoom tight and focus the lens on an object 25 feet or more from the front of the lens, then zoom wide and adjust the green tube focus in the camera. (Figure 2) Repeat this procedure until the lens track focuses throughout the entire zoom range.

It should be noted at this point that improper adjustment of the infinity focus setting will affect the ability of the lens to focus track in close working situations. When the green channel tracks, repeat the procedure for the other channels.

Since a zoom lens design may make several compromises to achieve maximum operational flexibility, it may be necessary to make a slight compromise in one color channel adjustment in order to insure focus tracking. This will not be evident in either the monochrome or color picture but will assure the most uniform operation from your lens.

Range Extender

Adjustment of the range extender back focus should only be made after the basic lens is setup. It should not be necessary to adjust the tubes when the range extenders are used. The back focus adjustment on the range extenders should be adjusted to match the basic lens. (Figure 3.) This is accomplished in the same manner as originally used to set up the lens to the camera tubes. However, the range extender adjustment is moved instead of the tubes to achieve infinity focus.

When properly set up, the lens will track focus from the minimum objective focus distance to infinity.

When setting up the lens, make sure that the cable drives are properly engaged and thoroughly tightened. The cable path from the control to the lens should not contain any sharp bends and, in general, should be as straight as possible. A smooth zooming action cannot be achieved when there is excessive slop or drag in the control cables.

Increasing Lens Usefulness

A basic lens operation review should be unnecessary but here are some operational tricks that will increase the usefulness of your lens.

The range extender is widely used in the field and sporting applications for it brings the subject closer to the viewer. The extender also has great application in the studio for close up work. A zoom lens will still retain its minimum focusing distance, and infinity focus when a range extender is used. The lens just becomes a longer focal length lens that will focus to the same near distance. Example, an 18 to 200mm zoom lens that normally focuses to 28″ will become a 36 to 400mm when a 2.0x range extender is used and will still focus to 28″.

Using a range extender for close ups has several advantages over a close-up adaptor for this work. Chances are you will have a much

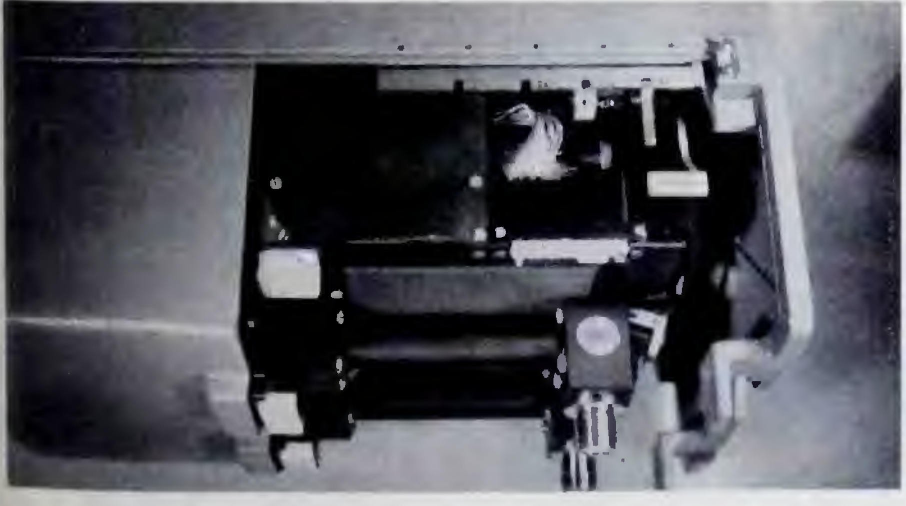

Fig. 1

Fig. 2

wider range of shots available and will be able to frame much tighter than you could with only the basic lens and a close-up adaptor. With a range extender, the lens remains further from the subject, and this reduces lighting problems. The range extender also retains infinity focus, which is lost when a close-up adaptor is used. This means that

Fig. 3

the operator could pan from an extreme close up to a subject more than 25 feet away and still retain focus tracking on the zoom. This may not be the case when a close up adaptor is used.

Getting The Ants Eyebrow

When a close up of an ants eyebrow is required, a combination of both a close up adaptor and range extender may be used. (Figure 4) Generally, the light loss through this combination is not critical as the subject area is small enough to light properly without problems. The major operation problem likely to be encountered is the extreme shallow depth of field found with this setup.

Lens Care

The overall performance of a lens can be kept at a high level by periodic maintenance. The front and rear elements should be carefully cleaned periodically. *Caution:* When removing or replacing lens caps, avoid touching or hitting the glass surface as this may result in scratches. Never touch the coated optical glass with your fingers as body oils and acids will damage the optical coatings. Do not use acid, denatured alcohol or other strong solvents, harsh or linty cloths, dollar bills, cigarette filters, etc. to clean lenses. They will damage the optical coatings. Be sure to avoid excessive cleaning and excessive pressure when cleaning. To clean a lens, the following procedure should be used:

1. Remove all loose dust with a soft lint free cloth, lens tissue or anti-static camels hair brush.
2. Wipe the surface of the lens with a wad of lens tissues using a soft circular motion. (The optical glass and coatings are relatively soft so care must be taken to avoid scratches.)
3. Persistent dirt particles may be removed by applying a few drops of lens cleaning fluid and rubbing with a wad of lens tissue in a circular motion.

Cleaning fluids that leave a residual film such as denatured alcohol will increase the susceptibility to flare. (Figure 5) While several excellent cleaning solutions are available on the market, I have found nothing beats 100% pure alcohol. Since this is not readily available without a government license. (A good grade vodka such as Smirnoff will produce excellent results! Vodka is pure alcohol cut with water.) Other mild cleaning solutions such as Windex will produce satisfactory results and will not harm the optical coatings.

The control cables should be cleaned and lubricated periodically. Remove the "C" washer from one end and (pull the center shaft through the casing. Clean and relubricate with a light weight grease. The moving lens parts that can be reached also should be greased using a light weight, high temperature coefficient grease having a consistency similar to Vaseline.

The best policy is to return the lens periodically to the manufacturer or authorized repair service for a complete interior cleaning and adjustment. I have seen lenses with so much internal dirt built up that the light transmission increased one half or more f stops with cleaning.

Fig. 4

Cable Engineers Set Regional Meet For March 3

The North Central Chapter of the Society of Cable Engineers will hold a regional meeting March 3 and 4 in Lincoln, Nebraska at the Cornhusker Hotel.

The program will include seven technical sessions, a panel discussion on vital industry topics, and a tour of the programming facilities of TV Transmission, Inc. For further information, contact Loyal Park at 402-477-0670, in Lincoln.

See 1971 Index For Reference To BE Cable Articles

"MISS KILLY, ABOUT THESE CUE CARDS YOU PRINTED IN SHORTHAND.... !"

Try Using Plate Glass On Warped LP's

Dear Editor:

In reply to R. Dennis Alexander, Radex Productions, (November, 1971, BE) asking how to restore warped LP's. One method I have found useful in restoring warped records is to place the damaged disc between two sheets of plate glass and place this in warm sunlight or on top of a warm oven. Four to eight hours usually renders the disc playable.

As for storing discs, they should be placed vertically on a shelf and they should be packed snugly so that they rest on the edge of the jacket and do not lean to one side. I might also add that they should be stored in a cool dry atmosphere when possible.

George J. Kereji, CE
WAYN Radio
Detroit, Mich.

A Warped Sandwich

Dear Editor:

I am writing in response to Mr. Dennis Alexander's letter in the November issue of BE.

Place the warped record "sandwiched" between two sheets of clean glass. Place this on a warm equipment console (a large television cabinet also works). The record will slowly straighten itself.

If the glass is not available, leave the record in the jacket and stack books, tapes, telephones, anything with weight on the jacket. Leave this on the warm console. In just a few hours the record will be as good as new. The important thing to remember is to use clean surfaces when "straightening" records.

If it is necessary to store LP's, stack them. Make sure they are in a cool, dry place. Keep them from heat. This not only protects the LP's but also the jackets. Save those paper inserts. The LP's will last longer and sound better.

Dale Bernelle
KXKW Radio
Lafayette, La.

Send Your Industry News To Broadcast Engineering For Better Coverage

No. 100

Circle Number 14 on Reader Reply Card

INDUSTRY NEWS

Commission Authorizes CATV Exclusivity Experiment

Hampton Roads Cablevision Co., operator of a Newport News, Va. CATV system, has been authorized by the Commission to carry the signals of Richmond television stations WWBT, WTVR-TV and WXEX-TV until March 1, 1972, in order to experiment with an FCC cable proposal on program exclusivity, by providing run-of-the-contract exclusivity for all televised motion pictures on request from local television stations in its area.

The Commission's program exclusivity proposal was contained in its "Letter of Intent" (FCC 71-787, 31 FCC 2d 115), outlining proposed new CATV rules.

On June 29, 1971, the FCC ordered Hampton Roads to cease and desist from carrying the Richmond television signals in violation of the distant signal provisions of Section 74.1107(d) of the rules. Hampton Roads' appeal for a stay of the order was denied by the United States Court of Appeals for the District of Columbia Circuit and, on October 31, 1971, the cable company stopped carrying the disputed signals.

On October 26, 1971, Hampton Roads filed a petition stating that, effective November 1, 1971, it was waiving all subscriber fees until its requests had been acted on; it wished to experiment with the program exclusivity proposals outlined in the "Letter of Intent"; unless it received relief, it would stop its cable operation on December 31, 1971; and if relief was granted, it would dismiss its pending legal action.

Hampton Roads stated that it was losing about $7,000 per month before deleting the Richmond signals and that without the Richmond signals or adequate replacements, it would lose 75 percent of its subscribers.

Hampton Roads serves approximately 1,000 subscribers in Newport News, ranked 44th among the top 100 television markets. The Richmond television stations place at least a predicted Grade B contour over Newport News. Without the Richmond signals, Hampton Roads now provides its subscribers only with the signals that can readily be received over-the-air in its area, those of WAVY-TV, WTAR, Norfolk, WVEC, Hampton-Norfolk and WYAH, Portsmouth.

The Hampton Roads petition was opposed by WAVY Television, Inc., licensee of station WAVY-TV (NBC), Portsmouth-Norfolk-Newport News, Va., one of the local stations carried by the CATV system.

The Commission noted that it had said in its "Letter of Intent" that it planned to put forth new cable rules with an effective date of March 1, 1972 and that Hampton Roads had stated that the new rules would allow sufficient signal importation to make its cable system viable without the special relief it had requested. "It does not seem appropriate to allow a cable system to fail a short time before new rules are adopted," the Commission remarked.

In authorizing the experiment, the Commission specified that Hampton Roads may not serve more than 2,500 subscribers during the experiment and must provide the Commission with written progress reports every 30 days.

FCC's Torbet Asks NAB To Appoint Rules And Procedures Committee

John M. Torbet, executive director of the Federal Communications Commission, has suggested to the Small Market Radio Committee of the National Association of Broadcasters that NAB appoint a working committee to examine FCC rules and procedures and make suggestions for improvement.

Torbet told a meeting of the Committee that FCC rules "were thrown like a blanket over the whole industry and the time has come to consider radio's problems separately."

He said that his experience with the National Industry Advisory Committee (NIAC), a technical industry-government advisory body, convinced him that such industry-government cooperation could be fruitful.

Responding for NAB, President Vincent T. Wasilewski said the Association would "be quick to accept any proffer of a working committee" and that he certainly will pursue the matter.

In another action, the Committee unanimously passed a resolution urging all broadcasters to support NAB's effort to bring license renewal legislation into effect.

The resolution reads:

"Realizing the prime importance at this time of the issue of license renewal legislation, it is hereby moved that the Small Market Radio Committee encourage all broadcasters in the United States to support the efforts of NAB to bring sound legislation into effect regarding license renewal changes as proposed by the NAB Task Force.

"This Committee further commends the actions of NAB President Vincent T. Wasilewski in this effort for all broadcasters in such a vital area."

The Committee also requested that Chairman Clint Formby, president and general manager, KPAN, Hereford, Tex., write Clay T. Whitehead, director of President Nixon's Office of Telecommunications Policy, and FCC Chairman Dean Burch urging them to support a license term increase from 3 to 5 years.

The Committee feels this particular provision of the license renewal legislation is of great importance to small market broadcasters and cited the present "undue hardship in paperwork" that license renewal preparation entails.

In another action, the Committee suggested that the NAB staff investigate the possibility of hold-ing a separate half-day meeting on radio management problems during the NAB Fall Conference. NAB members could register for one or both meetings.

In addition to Chairman Formby, other Committee members are: Harry E. Barker, general manager, KQMS, Redding, Cal.; Ross E. Case, general manager, KWAT, Watertown, S. D.; George Crouchet, Jr., president and general manager, KPEL, Lafayette, La.; Dick Painter, general manager, KYSM, Mankato, Minn.; Al Rock, general manager, WSMN, Nashua, N. H. and Walter L. Rubens, president and general manager, KOBE, Las Cruces, N. M.

SMPTE Gives Conference Dates

The Sixth Annual Winter Television Conference of the Society of Motion Picture and Television Engineers (SMPTE) has been scheduled for Feb. 4-5, at the Sheraton Dallas Hotel in Dallas, according to K. Blair Benson of EVR-CBS, SMPTE's Vice-President for Television Affairs.

Leonard F. Coleman, Eastman Kodak Co., Dallas, is Program Chairman; he will be aided by Benson and SMPTE's Editorial Vice-President Richard E. Putman, General Electric Co.

The two-day program is in the process of being put together. The main thrust of the meeting is to be the production of color commercials on film and videotape, although other aspects of color television will be considered if time on the program is available.

Heading the arrangements committee for the meeting is Franklin R. Reinking, Eastman Kodak Co., Dallas.

Registration fees for the meeting are $25.00 for SMPTE members and $35.00 for nonmembers. Additional information on the Conference may be obtained by writing to The SMPTE Winter TV Conference, 9 East 41st St., New York, N. Y. 10017.

The dates of both 1972 SMPTE Technical Conferences have recently been changed. The new dates are:

111th SMPTE Technical Conference and Equipment Exhibit, New York Hilton Hotel, April 30-May 5, 1972.

112th SMPTE Technical Conference and Equipment Exhibit, Century Plaza Hotel, Los Angeles, Oct. 22-27, 1972.

FCC's Dr. Hilliard Is Re-elected Chairman Of The FIMC

Dr. Robert L. Hilliard, Chief of the FCC's Educational Broadcasting Branch, has been re-elected chairman of the Federal Interagency Media Committee for 1971-1972.

Founded by Dr. Hilliard in 1965, the Committee's purpose is to develop cooperative information exchange and projects among Federal agencies with communications responsibilities, in order to achieve the most efficient use of time, funds and personnel, and to provide the most effective service to the public. The FIMC currently has a membership of twenty-six Departments and Agencies.

Elected to the Executive Board of the Committee were Thomas R. Cook, Department of Justice; Ann Erdman, Department of Health, Education, and Welfare; Mercer Jones, Equal Employment Opportunity Commission; Dr. James McPherson. Office of Education; Michael Neben, Office of Education; and Dr. A. Nicholas Vardac, Department of Interior.

"GUESS WHAT, DEAR! THEY'VE COMPLETELY AUTOMATED THE STATION, TODAY!"

OTP Director Sounds Off On Programming And Renewals

The Office of Telecommunications Policy (OTP) is fast becoming a major influence in the broadcast-communications industry. And this is largely due to its Director, Dr. Clay T. Whitehead.

Dr. Whitehead has been touring the association and convention schedule and speaking out loud and clear. In order to give further insight into what Dr. Whitehead and the OTP are doing these days, we're including here a portion of his December address before the Arizona Broadcasters Association meeting in Phoenix.

Clay T. Whitehead

"Let's turn now to license renewals. Ever since the days of the 'Blue Book,' the FCC has told its licensees what type of programming is in the public interest. In the 1960 Programming Statement, it was refined into 14 program categories, featuring public affairs, news, religious, educational and station-produced programming of virtually any sort. Informally, the signals go out through the jungle-drum network of regulators, lawyers, and licensees, and you get the message as to what kind of programs the FCC wants from you. With the Cox-Johnson 5:1:5 standard, the Commission has also flirted with minimum percentages for the most favored program types. The flirtation has almost become outright seduction, as the FCC now seems ready to adopt percentage standards for determining 'superior' performance when an incumbent's renewal application is challenged.

"These are disturbing developments—for the public and the broadcaster. If value judgments on program content are unavoidable in the present context of broadcast regulation—and they may be—they should be made as much as possible by the public served by the station and as little as possible by government bureaucrats. As things stand now, hypocrisy prevails, and lip service is paid to local needs and interests while the Broadcast Bureau's concerns and forms really call the tune.

"It is largely our regulatory policy, not the broadcaster, that is hypocritical. The theory is that licensees should be local voices, that they should investigate the needs and interests of the public they serve and reflect them in their programming. Government has created a set of incentives for you, but when the results aren't what the regulators think are in the public interest, they try to fight the system they have created and tell you and your audiences how much of what kinds of programs are best.

"If the public, through the government, doesn't like the programming the broadcasting system produces, they ought to change the incentives rather than encourage the government to make the programming decisions. To provide you with the right incentives, I suggested that we eliminate all government-conceived program categories, percentages, formats and other value judgments on specific program content. Then let the Commission strictly enforce a meaningful ascertainment requirement—hopefully not in the incredible detail of the *Primer*—let them judge you by your audience's

Industry News

(Continued from page 13)

criteria rather than their own. If this means that New York City stations will have no agricultural programs, and Phoenix stations will have Spanish-language public affairs programs, so be it. And if it means one channel in a large market carries little news while others provide a lot, who are we in Washington to impose our judgment and say no?

On Second-Guessing

"Although the FCC will still be second-guessing the licensee in order to give content to this 'good faith' standard, we will have shifted the focus and purpose of government supervision to enforcement of the local needs and interests requirement in programming. This alone is an effort worth making.

"As part of my renewal proposal, I also suggested that the leisure period should be lengthened and that the FCC should consider new applicants only when the incumbent's license is not renewed or is revoked. This was seized upon as evidence of my support for broadcasters' present legislative efforts on renewal policy. But that represents a highly selective view of what I said. I share your concern about the stability of the licensing process, for I think that is a key part of the public interest in broadcasting, but I specifically emphasized that the proposals are closely related and should be evaluated as a package. Let me tell you why.

"In evaluating any plan to change renewal procedures, you should be highly skeptical of a change that enhances government review of program content, measured against national standards and percentages. In your current mood you may not be inclined to inspect gift horses very carefully, but you must if you care about your longer range future. I sense that your attitude is one of compliance: 'Just tell me what I have to do by way of fairness, access, and programming and I'll do it—I'll even be superior to anyone the FCC wants me to be superior to, just tell me who it is. Let's not rock the boat with Whitehead's unrealistic proposals.'

"I don't think my proposals are unrealistic. Things have been getting worse for broadcasters and they will continue to do so. The battle lines are being drawn tighter every year between you and dissatisfied elements of your public. If I were a true revolutionary, I would watch this trend and say the worse it gets, the more sense my proposals make. But I do not have this revolutionary vision; I want to start now to stop the trend to make the licensee an agent of the government for programming purposes."

"The social and economic forces that are causing this unhealthy trend are not going to go away. You are not seeing a temporary madness in the body politic, you are seeing the times change. There is no easy way out. It's more difficult to be private licensees with public responsibilities than it is to be "gate-keepers" for a government-controlled broadcasting forum of communications. It's harder to be free and to exercise that freedom responsibly. I know you want the latter approach. So do I and I'm convinced the public does too."

Radio Club of America Elects Officers

Fred M. Link has been re-elected president of The Radio Club of America for a two-year term. Also re-elected for two-year terms were Samuel N. Harmatuk as vice president, Francis H. Shepard as secretary and David Talley as treasurer.

Elected as a new member of the board of directors for a two-year term was Edgar F. Johnson. Directors re-elected for two-year terms were Ernest Amy, W. G. H. Finch, Frank A. Gunther, Harry W. Houck, Jerry Minter and Jack Poppele.

The club is the world's oldest existing radio-electronics technical society with approximately 500 members throughout the world.

NAB Names PR Head

Robert E. Hallahan has been named director of the new Broadcast Bureau of the National Association of Broadcasters' Public Relations Department.

Digital Logic Basics

By E. Stanley Busby, Jr.*
Part 4 of a 4-part series

One of the advantages of a digital logic system is its ability to manipulate variable quantities (once they are in digital form) without error. A simple comparator (discussed in last month's article) which tells that two quantities (now numbers) are the same, or which one is larger is often inadequate. Sometimes it must be known *how much* bigger one is than the other.

What's The Difference?

Where broadcast equipment uses electrical arithmetic, it is likely to involve subtraction rather than addition. Servo systems, for example, generate a corrective influence which is proportional to the *difference* between what is and what ought to be. Those who service video recorders are familiar with "error voltages." Used in this sense, the word "error" is not the same as "mistake," but means a departure from the ideal . . . a *difference*.

It is not the purpose of this article to attempt explanation of how a computer finds roots and logarithms, but the simplest of any arithmetic, addition and subtraction, is now in such wide use in commercial equipment that you need to understand it.

One and One Are 10

Since there are only two numerals (1 and 0) in the binary system, its arithmetic is at least five times easier than that of the decimal system. The multiplication table is absurdly simple:

1. 0 times anything = 0
2. 1 times 1 = 1

To make things even easier, we never bother to add a long column of figures a la third grade. If you want to know the sum of A+B+C +D, you add A and B, then add C to their sum, then add D to *that* sum, etc. Lots of wives do their check stubs this way.

Binary addition works exactly like any other scheme . . . start at the top of each column of numerals, beginning with the least significant column. Add the column. If the sum gets bigger than one "digit," write down the least significant

*Engineer, Ampex Corp., Redwood City, Calif.

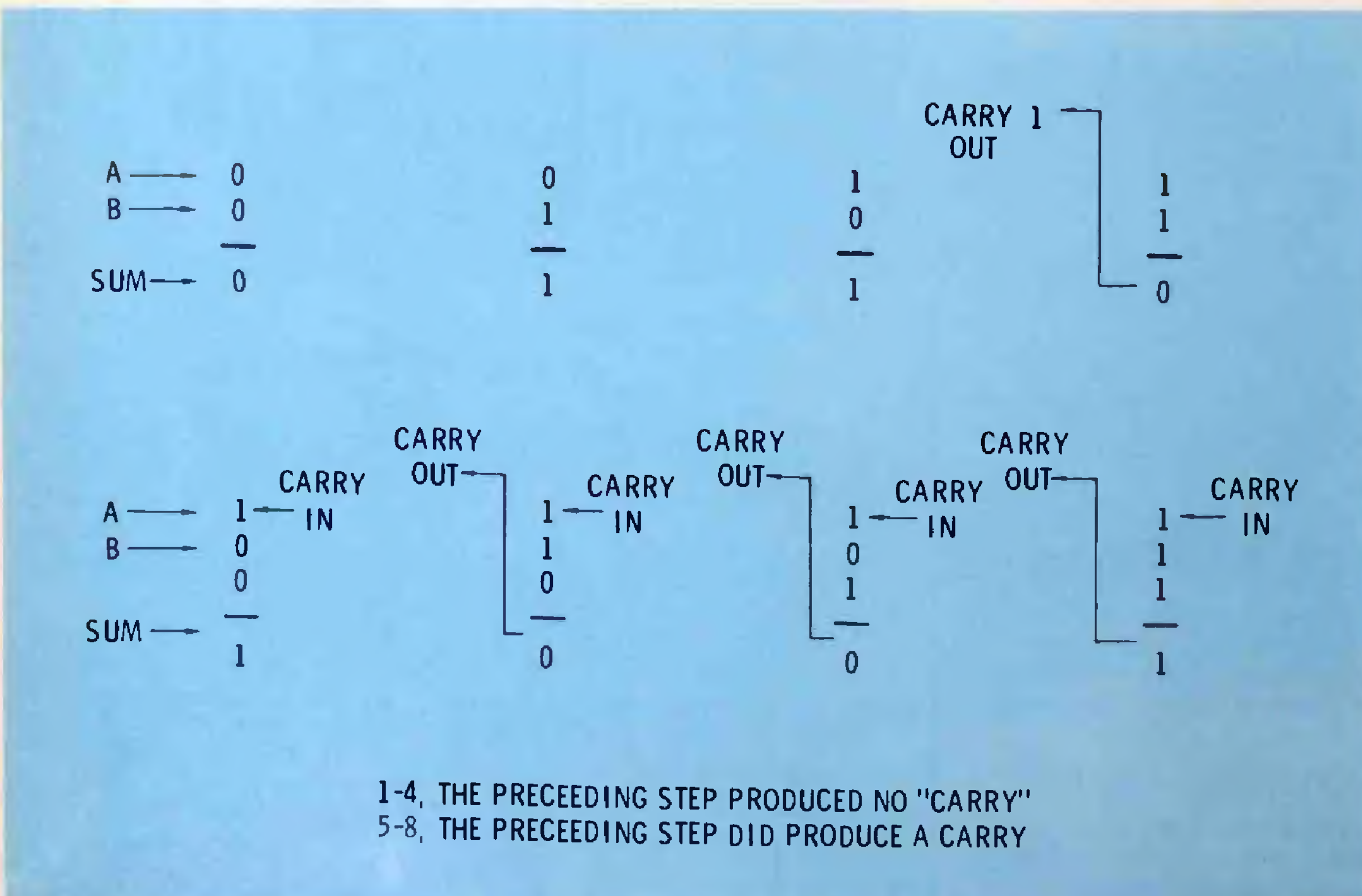

Fig. 1 The eight possibilities of binary addition.

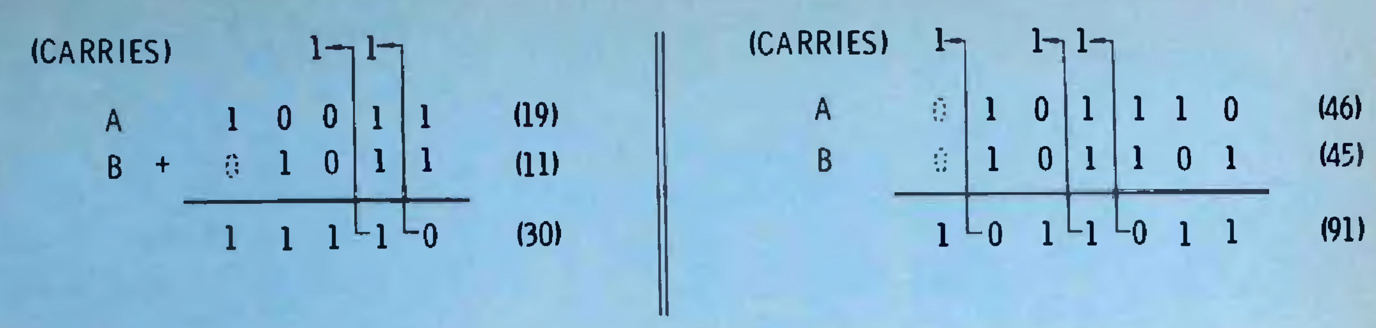

Fig. 2 Two examples of binary addition.

digit of the sum (which will be a "1" or a "0") and "carry" the rest (also a "1" or a "0") to the top of the next column and repeat.

Since we are concerned with only two numbers, no column can be more than three numerals deep . . . number A, number B, and maybe a carry. Study Figure 1 before going further.

The table in Figure 1 can be reduced to four easily remembered sentences:

1. If a column has no "1's" in it, the sum is 0.
2. If a column has one "1" in it, the sum is 1.
3. If a column has two "1's" in it, the sum is 0 and carry a 1.
4. If a column has three "1's" in it, the sum is 1 and carry a 1.

Figure 2 shows two examples of binary addition.

100 Take-Away 1 Equals 11

An old rule of grade-school arithmetic says: to subtract, change the sign; then add. Changing the sign of a binary number is simple. Change all the 1's to 0's and all the 0's to 1's. This is called "complementing" the number. For example:

VALUE	8	4	2	1
0	0	0	1	1
1	0	1	0	0
2	0	1	0	1
3	0	1	1	0
4	0	1	1	1
5	1	0	0	0
6	1	0	0	1
7	1	0	1	0
8	1	0	1	1
9	1	1	0	0

"EXCESS THREE CODE"
"XS3"

TO CONVERT ORDINARY BCD TO XS3, ADD 0011 (THREE)

VALUE	4	2	2	1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	1	0	1
4	0	1	1	0
5	1	0	0	1
6	1	0	1	0
7	1	1	0	1
8	1	1	1	0
9	1	1	1	1

ONE FORM OF A 4-2-2-1 CODE

THERE ARE OTHERS

Fig. 3 Two other forms of BCD.

0101 (five) *IS THE SAME AS* 0101
minus 1100 (twelve) plus 0011
NO CARRY 1000
1000 complemented is 0111 (seven)

Note that if the addition in the most significant column creates a "carry" it is added to the least significant column. This is called an "end-around" carry.

Sometimes the number being subtracted is larger than the one being subtracted from. Whenever this happens, there will be no carry from the last column. The answer, which is obviously negative, will have its ones and zeros reversed and must be re-complemented before it can represent a true magnitude. For example:

1100 (twelve) *IS THE SAME AS* 1100
minus 0101 (five) plus 1010
carry 0110
1
0111 (seven)

Fig. 4 The nixie tube read-out display.

The rule for subtraction can be stated in three easily remembered sentences:

1. Invert (complement) the number to be subtracted, then add it.
2. If there is an "overflow" (a carry from the last stage) the answer is positive, and one (the carry) must be added to the sum.
3. If there is *no* carry, the answer is negative and must be complemented.

When numbers are present in Binary-Coded-Decimal form (BCD) some tricky circuitry must be employed if binary adders are to be used. Alternatively, the BCD numbers can be converted to pure binary, added, (using readily available binary adders), then reconverted to BCD. MSI circuits are available which convert BCD to binary and vice versa.

There's BCD And There's BCD

In previous articles, only one form of BCD was mentioned. In it, each "decimal place" was "worth" twice as much as its right-hand neighbor. It is sometimes called "8-4-2-1" BCD. There *are* other forms. This is possible since there are only ten decimal numerals and sixteen combinations to choose from. Two popular forms are tabulated in Figure 3.

Each of the two forms shown in Figure 3 have two characteristics in common:

If you were to serially transmit all ten of the decimal numerals, you would have transmitted twenty "ones" and twenty "zeroes." This equality is an advantage in some transmission systems.

Each pair of numerals that add up to nine are "mirror images" of each other. This is very useful when performing BCD arithmetic.

There are many other special-purpose BCD "codes."

Show And Tell

The BCD format (usually the 8-4-2-1 kind) is widely used in conjunction with numeric display devices (read-outs). Two types of number display devices have already found wide application in broadcast equipment, and another fairly new type is coming into use. They are:

1. The "Nixie" tube. (See Figure 4.) This is a gas discharge tube (remember the VR-105?). It has one anode, returned to a 200 Volt (approximately) positive supply through a current limiting resistor. There are ten cathodes, each one made of thin wire and shaped like a numeral. One cathode at a time is grounded and the others left open circuit. The ionized gas immediately surrounding the wire of the grounded cathode glows an orange color and forms a highly visible numeral.

MSI devices are available which accept BCD input and have ten outputs...one for each cathode. They are designed to withstand the voltage to which the open cathodes rise (about 70 Volts).

2. The "seven segment" display. (See Figure 5.) This display can also be made of seven gas discharge elements, but usually uses incandescent filaments. MSI devices are available for these, also — BCD in, seven lamp driving outputs, and logic to light up the right ones.

3. The light-emitting diode array. The diodes in the array operate from the typical +5 Volt supply used with DTL and TTL logic devices. Similar ones are available having a full 35-diode array (7 tall by 5 wide), with which they can portray not only numbers, but the letters of the alphabet and punctuation marks as well. The version shown in Figure 6 is a partial array and can form only the numerals, a minus sign and a decimal point, but inside the dual-in-line package along with the diodes is a gated four-bit memory and the necessary logic to turn on the right diodes. The input is BCD, of course. Like the seven segment display, all parts of the display lie in the same plane. Like the Nixie tube, the numerals approach the shape of normal printed numerals.

Memories

Electrical arithmetic is complex enough that it is economical to *store* numbers somewhere, fetch them when needed, perform the arithmetic, and *store* away the answer until it is needed. When we wish to see a number displayed, our eye must see it long enough to recognize it. The display device is usually fed by some sort of memory which contains the result of arithmetic performed some time ago. Meanwhile, the arithmetic circuits are busy with another problem.

The important characteristics of a memory device are these:

1. Volatility. It is volatile if it loses its mind when the power is turned off.

It is non-volatile if it doesn't.

Examples: flip-flops are volatile.

Delay lines are volatile.

Magnetic cores are non-volatile.

Punched paper tape is non-volatile.

2. Read-out — destructive or non-destructive. Read-out is destructive if in the course of finding out what is in the memory you must erase it.

Examples: Destructive — most magnetic core memories.

Non-destructive — almost everything else.

3. Access — random or serial. Random access is like that of a pigeon-hole desk — one "reach" fetches any one item. Serial memory is like a lazy-Susan serving

tray. You *may* luck out and find what you want in front of you. Then again, you may have to turn it all the way around. Random access is faster. Serial access is cheaper.

Examples: Magnetic cores are random access.

Most flip-flop arrays are random access.

Various kinds of tapes and punched cards are serial access.

A track on a magnetic drum or disc is serial access.

A shift register, like a delay line, is used as a memory element by connecting the output to the input and pumping the contents around and around. To enter a new bit, the output-input connection is broken when the old bit appears at the output, the new bit allowed to enter the input, then the connection re-established. To keep track of where a bit is, a counter may be used to count shift pulses.

Shift register memories are of two types—dynamic and static. The static type essentially consists of a number of J-K flip-flops connected in tandem. Each clock pulse shifts everything one step along the chain. Information can stay in place as long as power is applied. The dynamic kind stores information in the form of capacitive charges which are shifted along by clock pulses and "re-charged" in the process. If the clock stops, the information will die away. Like an airplane, it must operate above some minimum speed.

The "Read-Only" Memory

A read-only "memory" is a memory only in the sense that it remembers how it was arranged at the factory. Imagine a tic-tac-toe grid having 32 x 32 lines. There will be 1024 cross-points. Initially each cross-point is conductive. The customer specifies which of the 1024 bits shall be ones, and which zeros. The manufacturer then selects the specified bits and carefully zaps them open. The "memory" then contains a permanent bit pattern. Read-only devices are capable of great density, currently as many as 8196 bits in one dual-in-line package. They are very useful in situations where the logic required is unchanging, as in code conversion, character generation, desk calculator instruction sequences, look-up tables, etc.

Fig. 5 The "seven segment" display. All numbers look square.

Fig. 6 The light-emitting diode array.

Transmission

Digital information is seldom sent (for more than a few feet) using a wire for each bit. For distances up to a few thousand feet, a well-terminated twisted pair might be used, serially transmitting one bit at a time. For longer distances, for transmission over telephone circuits or for recording on a single track of a tape recorder, data is "encoded," or modulated on a carrier. Amplitude modulation of a tone has been used for years. Pure FM, sometimes called FSK (frequency shift keying), is almost as old. A number of phase-modulation methods have come into use and three popular ones are outlined in Figure 7.

One common characteristic of serial transmission schemes is the use of a unique progression of bits, which never occurs and *cannot* occur during the transmission of data. This progression, or "pattern," marks the boundary between one "word" and the next and is used to synchronize receiving equipment.

The Society of Motion Picture and Television Engineers has recently proposed a "code" for the digital recording of time (in hours, minutes, seconds and TV frames), as well as 32 bits of extraneous information.[1] The "synchronizing interval" is this progression: 0011111111111101.

The data is arranged so that twelve ones never happen *except* in the sync interval. Receipt of twelve ones followed by 01 indicates forward tape travel. Twelve ones followed by 00 indicates reverse motion.

The time is encoded in eight 8-4-2-1 BCD digits, utilizing 32 bits. The 32 "spare" bits may be used in any manner the user desires. All told, there are 32 "time code" bits, 32 "spare" bits, and 16 bits in the "sync interval," which totals 80 bits. The modulation format used is bi-phase mark. The highest *frequency* developed in the process of encoding is 80 x 30 = 2400 Hz (2000 Hz in 50 Hz countries), easily accommodated on the cue track of VTR's or other recorders. One complete "word" is encoded and recorded each TV frame.

A unique feature of this time code is that it may be used to encode the proper time of day even though the frame rate is locked to a color sync generator, whose frame rate is *not* 30 per second, but is 0.1 percent slow. To correct the time count, the time counter (clock) may be caused to "skip over" two frame counts each minute, except each tenth minute. The Europeans are lucky...their color frame rate turned out to be *exactly* 25 frames per second.

"Frame numbers" recorded on a tape permit it to be controlled by today's complex tape editing equipment.

The transmission of data from machine to machine, often over telephone lines, has created the need for standardization of transmission format. The American Standard Code for Information Interchange (ASCII) is a standard transmission format.[2] It consists of eight data bits. Seven of these (permitting 128 combinations) are used to identify all the numerals, upper and lower case letters of the alphabet, the common punctuation marks, and some non-printing instructions or commands, like "who are you?" and "rub out." The eighth bit may, if desired, be used to cause the total number of "ones" to be consistently either an odd or even number, so that the received "word" may be checked for accuracy. Checking for accuracy of transmission in this manner is called a "parity check."[3] If *one* bit is altered by noise or other disturbance a parity check will reveal it and warn of error. *Two* bits in error in the same word (or any even number) would not be revealed. It is very unlikely that two bits in the same word will be so affected.

Logic devices are no longer the exclusive domain of the computer people. They are now finding application in broadcast equipment, manufacturing machine control, desk calculators, and are even used in some toys. The two-way capabilities of Cable TV opens the possibility of remote meter-reading and home-owner access to large central computers. The TV receiver can image letters and numerals just as well as it can image a bar of soap. You can be sure that when these products of the "data age" intrude into everyday life, the man who is *already* familiar with the techniques used can command a premium.

Much has gone on and much is still going on. That which has gone on for a while can be found in books. That which is still going on is reported in magazines. Read both.

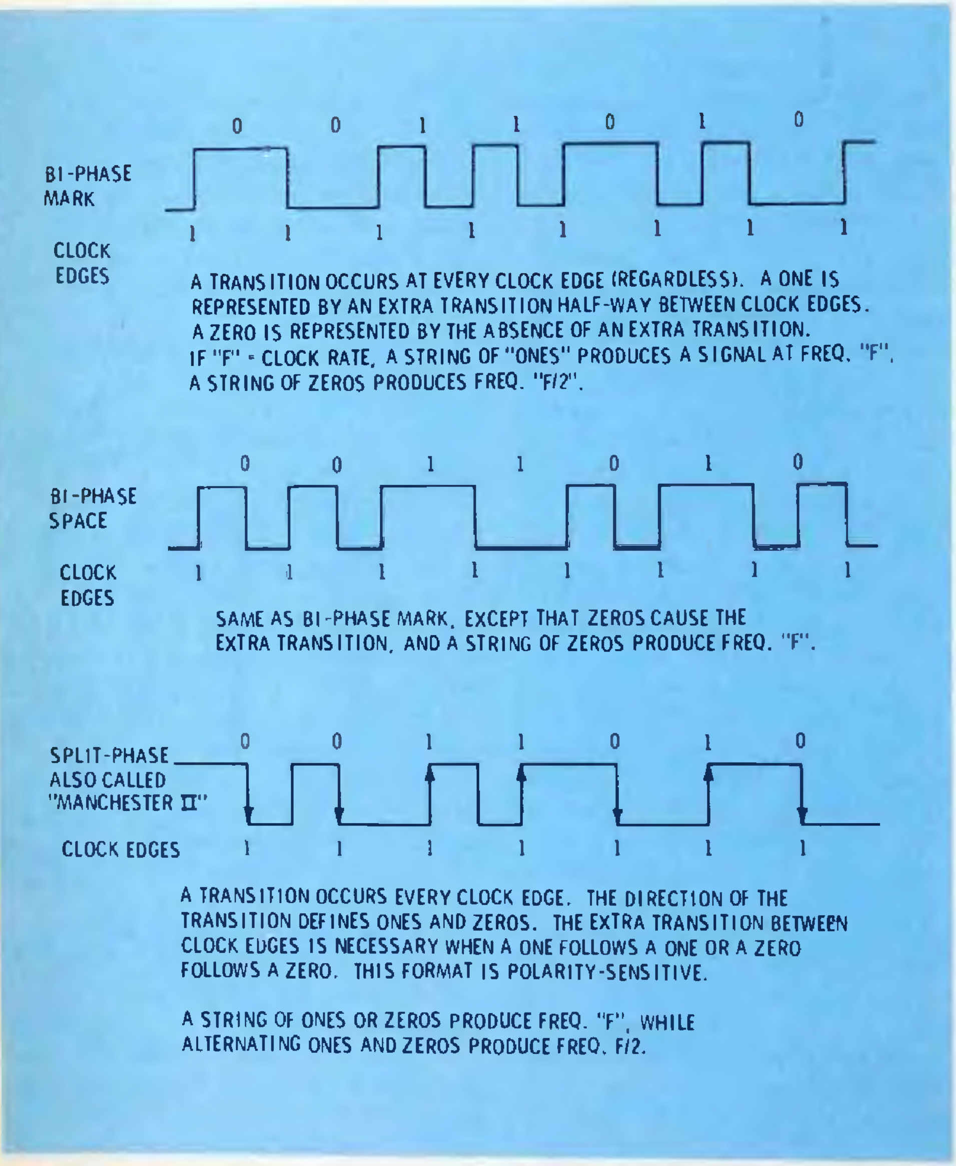

Fig. 7 Three phase modulation formats for data transmission. These are examples of "self-clocking" formats, because a transition always occurs at "clocktime". This is an advantage when demodulating a signal of variable rate, such as playback of a tape during high speed search.

Figure Correction: The RTL configurations in Figure 5 of the second part of this series (November issue) showed "bubbles" on the RTL flip-flop circuits. All logic symbols are shown and explained on pages 25 and 26 of the September Issue. Cross out the bubbles in RTL circuits on Fig. 5.

Footnotes

1. "Standardization for time and control code for video tape and audio recorders," Ellis K. Dahlin; *SMPTE JOURNAL* Vol. 79, No. 12, Dec. 1970, p. 1086-1088.
2. American Standard Code for Information Interchange, ANSI X3.4 – 1968 (AMERICAN NATIONAL STANDARDS INSTITUTE).
   Also see "Data Communication," A. J. Boyle, *THE ELECTRONIC ENGINEER*, Aug. 1971, p. DC-9.
3. a. "Generalized parity checking," Harvey L. Garner, *IRE TRANSACTIONS ON ELECTRONIC COMPUTERS;* Vol. EC-7, No. 3, September 1958, p. 207-213.
   b. "Error Detecting Codes," R. W. Hamming, *BELL SYSTEM TECHNICAL JOURNAL*, Vol. 26, April 1950, p. 147-160.
   c. "Error-correcting Codes," W. W. Peterson – Wiley, 1961.

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"Ultrasonic delay lines used to store digital data," A. H. Meitzler, Bell Labs Record, Vol. 42, No. 9, Oct. 1964, p. 315-319.

"A magnetorestrictive delay line shift register," L. E. Hargrave, *IRE TRANSACTIONS ON ELECTRONIC COMPUTERS*, Vol. EC-10, No. 4, Dec. 1961, p. 702-708.

"Digital Computers – Storage and Logic Circuitry," H. W. Sams, #20131.

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BROADCAST ENGINEERING

1971 Annual Index

KXRO
speeds up power changeover

Fig. 1 The author is shown operating the panel. By pressing the appropriate button for power and mode change and then pressing the plate voltage reset button, the changeover can take place in less than one second.

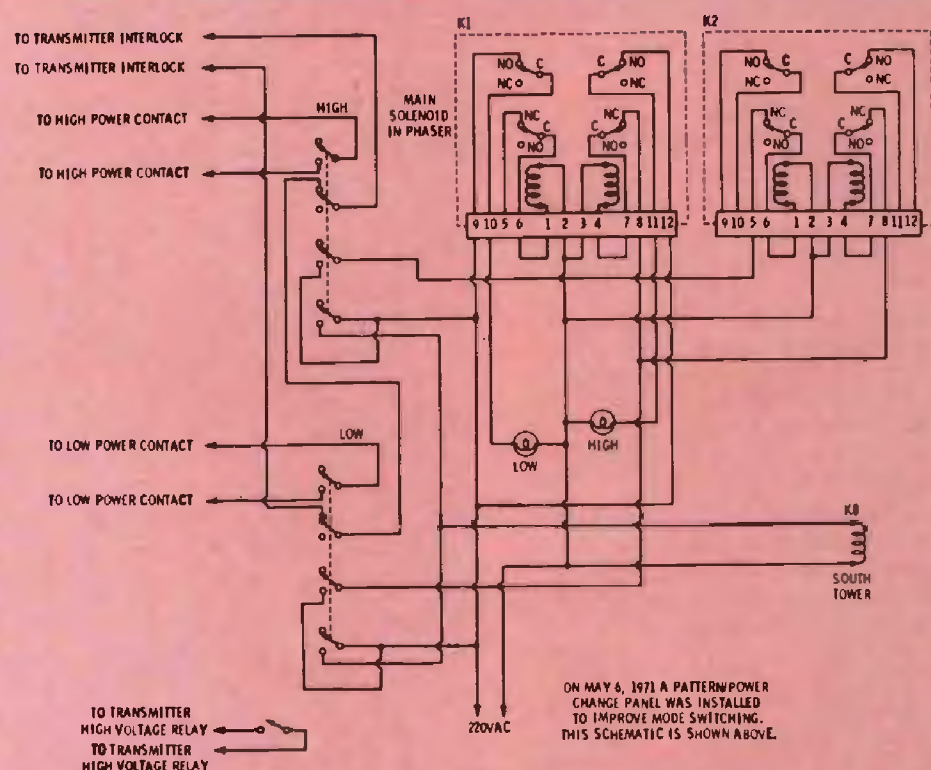

Fig. 2 Schematic of the KXRO changeover panel.

By Dave Hebert*

☐ Over 42 years, KXRO has undergone quite a few power increases, beginning with 100 Watts in 1929, up to our present 5,000 Watts. In about 1949, the station increased power to 1000 Watts, DA-N, and a system for pattern change was incorporated into the "new" Raytheon transmitter and phasor.

In 1965, the power was increased to 5,000 Watts, 1,000 Watts at night with a directional antenna. This power increase brought with it some interesting switching problems.

*CE, KXRO, Aberdeen, Wash.

At the time of the 5,000 Watt installation, it was decided to retain both 1 kW antenna couplers and the existing phasor. The application for a construction permit specified an installation as shown in Figure 1.

Relay Switching

Relay K1 is our main switching from Directional to Non-directional. Since the phasor is adjacent to the transmitter, this relay is located inside the phasor cabinet. Relay K2 is located at our north tower, which is used for non-directional operation, and this relay is used to switch between the two antenna couplers in the tower shed. Relay K3 switches the south tower into the circuit during directional operation. This tower is "floating" when we're non-directional.

The previous pattern change installation consisted of a DPDT light switch (to switch relays K and K2) and a momentary-contact push-button switch to operate latching relay, K3. Actual power change was accomplished on the transmitter itself.

The main disadvantage of the previous method was the relative ease of putting 5,000 Watts into very weak 1,000 Watt directional system. Secondly, the station had to leave the air for about four seconds to allow for the necessary switching procedures. Also, ther was the problem of having 220 VAC on the coils of K1 and K2 continuously: the coils are designed for pulse operation only. In short, something had to be done.

We sat out to make our new operation as fast, simple and reliable as possible. The entire panel, which would house the three push-buttons necessary to change the power/pattern modes, was custom built in the same style and color as our Gates transmitter, and was installed in our RF monitoring panel.

Since the transmitter indicator lamp coding is red for full power and green for low power, we used red and green skirted 4PDT push-buttons. The phasor also has a red lamp for full power switching and a green lamp for low power switching.

Switching Requirements

An analysis of what is to be switched reveals that our switching panel must accomplish the following: 1. Remove high voltage in the transmitter; 2. Actuate the power change solenoid in the transmitter; 3. Change the positions of K1 and K2; and 4. Actuate K3.

Then, we must have a separate switch to restore the high voltage in the transmitter. So, the entire panel consists of three push-button switches: 5,000 Watts non-directional, 1,000 Watts directional, and plate voltage "reset".

Referring to Figure 2, it can be seen that essentially both the high power and low power switches perform identically. Section "a" performs the appropriate switching for the power change in the transmitter. Section "b" is wired in series on both switches. When either button is depressed, the circuit is opened, thus removing the high voltage in the transmitter.

Section "c" of the switch is used to change the positions of K1 and K2. The fourth section, "d", operates K2. This section is wired in parallel in both switches so the pulse is sent to the south tower in every operation. The tower is switched in and out of the circuit on each alternate pulse. Lamps 1-1 and 1-2 indicate the positions of K1 and K2. Again, the red lamp is for high power and green for low power.

On the schematic, Figure 2, the numbers 1 through 8 indicate connections from the panel to the transmitter. Also, the letters A through E indicate connections from the panel to the phasor. The letters in parenthesis indicate duplication; thus, jumpers may be used in lieu of additional wiring.

The cost was surprisingly low for this project. The 4PDT push-buttons were about $12.00 each. The plate-voltage "reset" switch was about $4.00. As we had a consulting engineer assist in the project, the additional charges amounted to $75.00, which included his work to have the actual panel built and painted. It is urged the #16, 600 Volt wire be used on the installation. (Be sure to purchase plenty of wire. We bought 130 feet and had none left over.) The cost of the wire and terminal strips for the panel varies with the type used and source of supply.

The power change is now accomplished merely by depressing the switch for the mode to be changed to, and the plate-voltage "reset". We have finally installed something that doesn't surpass the average intelligence of most board-men.

Actually, our only problems stem from not depressing the buttons far enough, thus not actuating all the switching functions. The switches we used have some rather stiff springs, but we feel that the additional thumbwork saves us leg work—and we're only off less than one second to change power.

Eliminate that RFI in your Audio Circuits

Once the symptoms are understood, RF in your audio circuits can be eliminated. Here is your guide to symptoms and cures.*

Fig. 1 The terminal connectors shown here are crimped to the wires. This is an especially hazardous practice if the wires are copper. Creeping corrosion inside the clamp is possible.

Fig. 2 A disc capacitor is shown here with minimum possible leads. It is a good practice to keep all leads short and to trim excessive wire protruding through connectors after soldering.

Written by the engineering staff of Sparta Electronics and edited by Paul Gregg.

Radio frequency interference, or RFI, is always a possibility when audio equipment is operated in the presence of RF fields. It can be particularly troublesome in solid-state systems containing low-level program lines and high-gain preamplifiers because less RF voltage or current is needed in such systems to cause interference.

With properly-designed audio equipment, particularly that intended for use by radio broadcasters, the incidence of RFI is relatively low when proper installation practices have been followed. But RFI does occur in even the best of installations because of its virtually unpredictable nature. It does not necessarily require a strong field for RFI to result, and it is not uncommon for an audio system to be unaffected by a nearby high-power transmitter, yet be ridden with RFI from a distant source at a different frequency.

The obvious question, of course, is "Why can't audio equipment be made RFI-proof?" The answer, unfortunately, cannot be so obvious. Although normal gain and frequency response of an amplifier can be limited to the audio range, this is not the case for individual components and conductors. Capacitors, resistors, inductors, wires and transistors continue to function as such at frequencies far beyond the bounds of the audio spectrum; the wire that is a simple conductor at audio frequencies may become a highly efficient antenna or inductor at radio frequencies; the insignificant stray capacitance at audio frequencies can become a very effective coupling or tuning capacitor at radio frequencies: the semiconductor junction that is a linear control element at audio levels will become an excellent diode detector or modulator if sufficient RF energy reaches it.

The task of RFI suppression, then, is just that – suppression rather than elimination. No matter what pains are taken at the design and manufacturing levels to minimize susceptibility to RF, the possibility will still exist simply because there is no way to force a component (such as a semiconductor) to recognize the difference between a change of voltage or current at audio frequencies and a similar or greater change at some higher frequency.

Fortunately, there are many effective preventive measures that can be taken, and the ultimate solution to RFI becomes that of providing reasonable suppression during initial design and manufacture followed by additional effort during subsequent installation if required by an unusually severe environment. It is well to note that the best of built-in suppression can be undone by improper or careless installation.

RFI Symptoms

The symptoms of RFI are varied, depending upon the strength of the field, how it is entering the system, where and how it is being detected, and what kind of modulation it carries. An AM carrier may enter a system, be partially or completely detected by a non-linear element (more on this later) and produce the modulation superimposed over the normal program. If the two programs are different, the intruder is usually recognized as such quite readily. If they are the same, the symptoms may appear as hum, noise, raspiness or similar distortion. Also, if the RFI is strong enough, the result may be a completely blocked amplifier stage with only noise or perhaps silence as a symptom.

An audio system normally does not contain the necessary elements for FM detection, so when the intruding carrier is frequency modulated the symptom is usually that of an un-modulated carrier: hum, noise, distortion of the normal program, or again the silence of a blocked amplifier stage. If the offender is a VHF FM carrier, however, it will often enter the audio system via a conductor or cable that is resonant or "tuned" at or near the frequency of the interfering carrier, quite literally a tuned antenna. In such a case the FM can be converted to AM by riding the slope of the tuned element and subsequently be detected by a non-linear element so as to exhibit the symptoms of AM RFI.

When RFI is caused by a TV transmitter, the symptoms will most often, though not always, be characterized by a raucous 60 Hz buzz due to the AM frame-rate sync-pulse. Since two carriers may be involved, one AM and one FM, the symptoms may also become involved, even to the extent of including those of a completely separate carrier from another source.

No matter how complex the symptoms, however, there are two factors common to all forms of RFI. First, RF energy is entering the system by a path or paths that can be located and interrupted. Second, the RF is being detected by a non-linear element or rectifier that can be located and suppressed.

The process of eliminating or suppressing RFI, then, involves two basic steps: preventing or minimizing the transfer of RF into the system, and preventing detection of the RF. The first step is simplified considerably by identifying the source and particularly the frequency of the interfering carrier, and the second requires locating the point at which it is being detected.

Suppressing Entering RFI

When considering the means whereby RF energy can enter an audio system, one must be constantly aware that stray capacitances may be excellent conductors for RF and that any wire or metal structure will be resonant at many different frequencies. The most prevalent example, of course, is the twisted pair shielded audio cable feeding a console which may act as a quarter-wave stub antenna at one frequency and as a multi-wavelength long-wire antenna at a much higher frequency. Of nearly equal importance are instances where turntable tone-arm leads act as VHF antennas – particularly troublesome because of their locations in very low-level, high impedance circuits – and AC powerlines, which can be very efficient longwire antennas at the lower radio frequencies.

Problem Cables

The search for the route of RFI is generally a process of eliminating, one by one, the connecting cables by which RF may be entering the system. At the same time, judicious use of operating switches and potentiometers will provide positive clues as to the source. For example, if reducing a turntable mixer control to zero will stop the interference it is a near certain indicator that both injection and detection are taking place in that channel and prior to the mixer control, perhaps in another part of the system.

If a connecting cable is found to be an offender, the first step is to examine the connections at both ends and particularly the way the shield is connected. In most instances best operation will be obtained when the shield is connected at the load or console end and left open at the source end. This is because the equipment at each end of the connecting cable will always have some sort of return to a common ground, and connecting the shield at both ends completes a loop which quite often will respond to magnetic fields. There is no hard and fast rule, however, and it is wise to try various combinations.

When the interference is in the VHF range, it will often be found that shortening *or* lengthening a cable will eliminate RFI by "detuning" it. Also, it may be found that simply moving or re-routing will accomplish the same effect. In such cases it is often true that touching cables or connections will result in a change of level or symptoms of the RFI. Obviously, con-

Here are eight problems that cost you money

no control
track

bad electronic
edit

control track
out of phase

head not
locked to video

unstable
capstan

non-synchrono
switches

60 cycle drum
error

low-band color
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AMPEX

The monitor picture shown below is an unretouched photo taken directly from a color monitor; shown here on a standard AVR-1. A color monitor is available as an option.

AVR-1
the third generation recorder

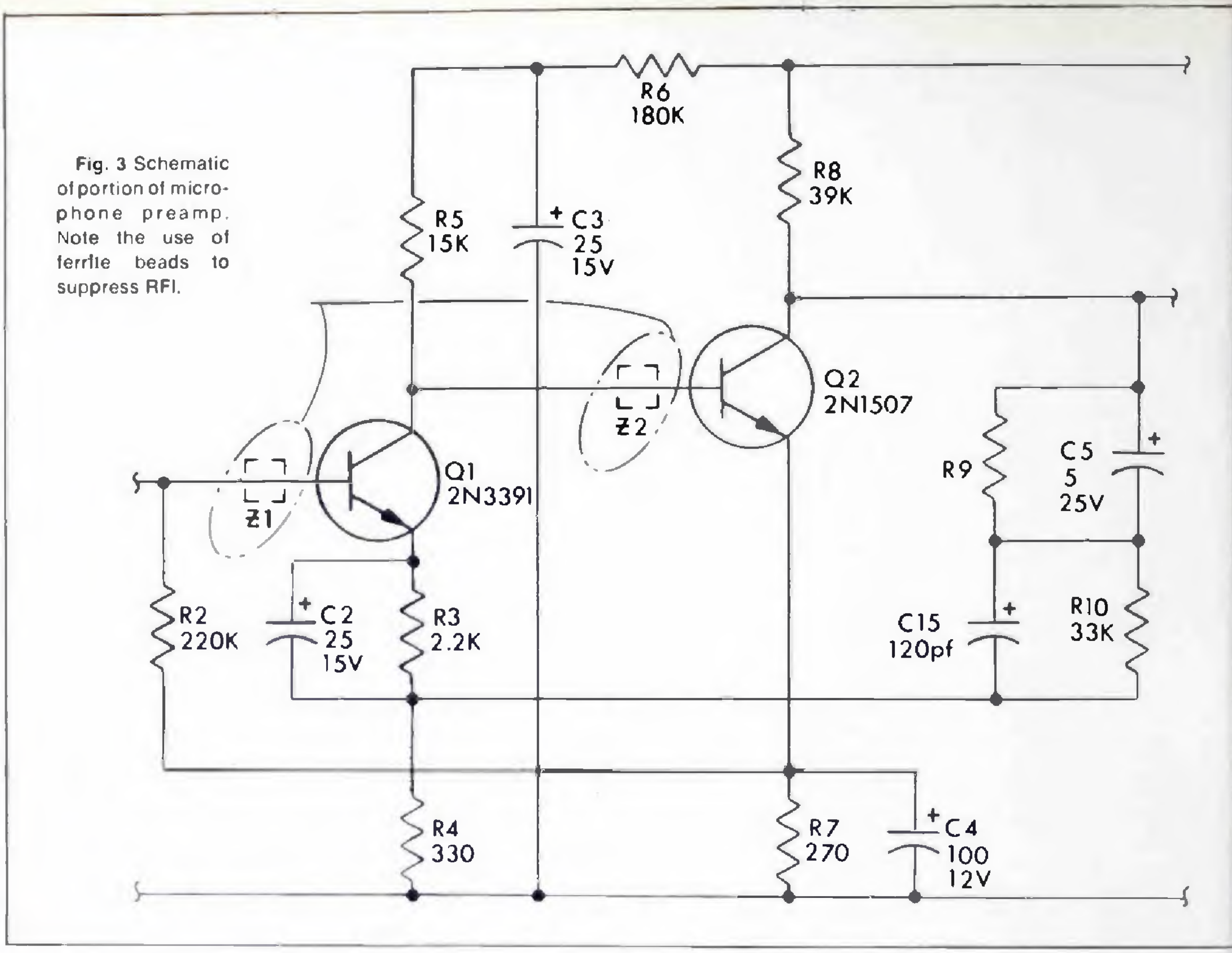

Fig. 3 Schematic of portion of microphone preamp. Note the use of ferrite beads to suppress RFI.

necting cables should never be coiled and tied in loops. If one must be shortened but not cut, fold it back and forth upon itself and tie it securely.

Using Capacitors

If cable-dress and shielding techniques are insufficient, bypass program-carrying conductors to ground or shield terminals with suitable capacitors. Since the reactance of a capacitor decreases as frequency increases, the procedure is to choose a capacitor value which will have no significant effect at program line impedances and frequencies, yet form a low reactance shunt path to ground for the radio frequencies. For the typical 600 Ohm system, a value of 0.001 mfd to 0.002 mfd is nearly ideal since the reactance is about 5K Ohms at the higher audio frequencies, falls to 100 Ohms at the middle of the AM broadcast band, and is close to 1 Ohm at the middle of the FM-TV bands.

The capacitors used should be low-inductance types, such as disc ceramics. Lead-lengths should be kept short, otherwise, the capacitor and leads could become resonant at a frequency which could add rather than cure RFI. The preceding given values can be extrapolated to other impedance levels simply by following the reciprocal relationship: if the audio line impedance is higher, the capacitor should be proportionally smaller, and vice versa.

RF Chokes

In severe circumstances, RF chokes may be inserted in series with the audio lines, and with bypass capacitors to ground at each end a very effective filter section will result, if lead lengths are kept short. The Ohmite Z-50 and Z-144 chokes are typical and quite popular for suppression at the higher frequencies. Alternately, passing audio leads through ferrite beads is very effective and space-saving at VHF frequencies. Chokes are generally not too practical at AM broadcast frequencies, however, since those with high enough reactance usually have enough DC resistance to affect audio levels in low-impedance lines. When filtering AC power lines, 0.01 to 0.1 mfd, 600 Volt capacitors may be used, although it may be simpler and more effective to employ a commercial filter designed for the purpose.

RF Detection

The suggestions so far have dealt with means of preventing RF from entering the audio system. Of equal importance and often the most effective approach is to isolate and suppress the point of detection. Even though it may require going into the circuitry of equipment in the audio system, it often requires less effort than adding multiple filters to prevent the RF from entering in the first place. As an aid in locating points at which RF can be detected, it will help to consider some circumstances that can result in a non-linear junction, or rectifier.

Considering one of the earliest known forms of an RF detector, the galena crystal and cat's whisker, we can see the effects of RF detection resulting from point-contact of two dissimilar metals. The significant factor is that a junction of any two dissimilar metals or metal compounds is a potential detector. Now, we cannot prevent such junctions in an audio system because they exist virtually every time a connection is made. What we can do, however, is assure that every connection is secure and tight so there is no possibility of introducing a voltage-drop—audio *or* RF.

Turntable RFI

In this context we must also consider a very common cause of RFI in turntable systems. Connections to the tone-arm cartridge are made with small push-on clips because soldering to the cartridge pins directly would likely destroy the cartridge. The combination of a loose clip, particularly if oxidized, plus the tone arm lead (an excellent VHF antenna) and the following high-gain amplifiers is an excellent invitation to RFI. Also, the usual tone arm with plug-in cartridge-shell and plug-in connecting cable provides two additional sets of contacts at which RFI detection can take place.

Transistor RFI

Within the circuitry of individual equipments of an audio system, the most common offender is the emitter-to-base junction of a transistor. This junction is a forward-biased diode, with bias set so that a change of base current with signal will produce a linear but amplified change of collector current. Should RF energy reach such a junction, the bias could shift to a non-linear area and result in distortion of the normal program material. If the RF is amplitude modulated, it is likely that partial or full detection would take place, resulting in audible recognition of the AM component along with normal program. A sufficiently high level of RF, however, could completely block a transistor, causing complete loss of any audible symptom. It becomes quite necessary to allow for varying symptoms with varying levels of interference when attempting to locate an offending junction.

Once the point of detection is determined, the solution is much the same as earlier described; shunt capacitors with short leads, and series inductors in severe instances. It is usually easiest and most effective to add a capacitor directly across the emitter-to-base junction. The most effective capacitor value will vary with particular circuit parameters, but a value of 100 pf is a good starting-point. As a general guide, the capacitor should be as large as practical without causing a loss at the highest audio frequencies.

The input impedance at the base of a transistor is usually measured in thousands of Ohms, and the signal current is generally quite small. If it is found that a capacitor reduces but does not adequately suppress the RFI, it will often suffice to then add a series resistor of perhaps 100 to 1 K Ohms in series with the signal path immediately preceding the shunt capacitor, and substitute an inductor for the resistor in particularly severe instances. These latter extremes are rarely necessary, since most audio equipment designs include equivalent suppression at the most-likely points of RFI detection.

Exit RFI, Stage Left

We can conclude that RFI is always a possibility in an audio system and can appear unexpectedly when a change or addition is made to the system or when another transmitter goes on the air. We can also conclude that RFI suppression is a logical process of eliminating or minimizing RF paths into the audio system, or locating and suppressing the points at which detection is taking place, or both. ▲

Audio equalization review

By Pat Finnegan*

When Do You Compensate and how much is needed? The price you pay for going overboard may be reduced signal quality.

■ One would not have to search very far before coming upon one of the many audio equalizers in use in a broadcast station. These serve many useful purposes and solve many problems in the area of frequency response. Equalizers will be found not only in incoming and outgoing Telco broadcast lines, but also in tape recorders, turntables. for special effects, just to mention a few locations.

In a broad sense, there are four main reasons that equalizers are used: (1) to overcome intrinsic response problems; (2) to make a unit or system conform to a specific standard response curve; (3) to correct general response problems: and (4) to shape the response in various configurations to produce special effects.

Consider the Problems

Many devices and circuits have response limitations even at their most optimum performance. This is due to the physical properties of the devices and their circuits. In the tape recorder, aside from amplifier design, the focal point of response limitation is the tape/head area. The natural properties of the magnetic materials. residual magnetism, reluctance to change fields, gap between the pole pieces, the load impedance the head offers to the amplifier, all combine to produce a definite limit to the audio response across the band. This calls for external correction. The record and playback heads, while containing many of the same features are different in that the record head must carry more current and is the amplifier load. The playback head is loaded by the amplifier.

In disc recording and playback, the major limiting area is the cutter head and the playback head. These are electro-mechanical devices which not only have some of the magnetic problems but also include mechanical inertia of the stylus.

The optical sound system in a film camera is another electro-mechanical device. The recording amplifier drives a Galvanometer, an electro-mechanical shutter device in accordance with the audio signal. The playback on the projector has both optical and light limitations to further limit the response.

These problems and devices might be considered as transducers; that is, converting energy from one form to another. The microphone also is a transducer where response limitations are present. In all these and similar devices, there is a natural response limitation, even at the most optimum circumstances, so that the response across the band is not flat. In most cases it is the high frequency end that is affected, although, in some cases, the low end may also be affected.

Next to transducer limitations, comes electronic circuit response limitations. This will be determined by the quality factor of the components, the resistance, capacitance and inductance in the circuits that the signal must cross. For the system response to be flat across the band, the impedance presented to each frequency must be identical. If at any point in the system, the impedance is identical for each frequency of equal amplitude passing it, each frequency will produce an equal voltage and current at that point and the system response at that point will be flat.

Any point in the system should produce the same results whether it be input or output, interstage coupling or wherever. When the impedance is not identical, the response will suffer. As we well know, no capacitor or inductor would be so obliging, and even resistors have been known to show non-linearity at times. Thus, these component reactions, circuit design, and physical parts placement will combine to present a natural limit to the audio response. At some frequencies, the values of resistance, capacitance and inductance may be in such proportions as to become resonant, both series and parallel.

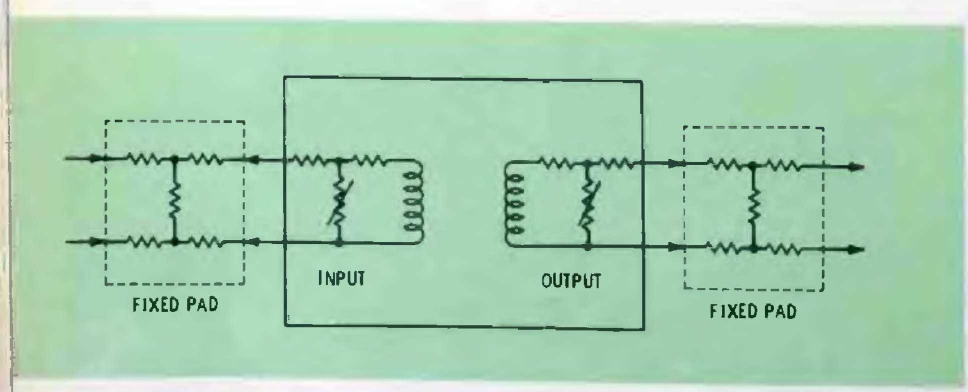

Fig. 1 Variable "T" type attenuators can cause response problems when inserted at the input and output of the amplifier as gain controls and when operated at an extreme end. External fixed pads should be used to bring the controls within mid-range.

*BE Maintenance Editor

Equalization vs. Design

Ordinarily, we don't think of amplifier or system response in terms of equalization, but rather as a design problem. It is both. A designer is actually using built-in equalization throughout the amplifier to overcome basic response limitations. He does this by the use of feedback circuits, impedance matching transformers, cathode and emitter bypass capacitors (or the lack of them), etc.

When Telco lines for broadcast are under discussion, the thinking most generally turns to terms of equalization. Telco lines have the same basic components of resistance, capacity and inductance to limit the response, just as an amplifier. The wire size and length will contribute resistance, the length inductance, and there is capacity across the wires. These factors will limit the frequency response as will the components in an amplifier.

Compensating will, of necessity, take different forms as only the input and output of the line is available for correction. The basic components will at the same time be different for different remote locations as the circuit path will be different. One cannot consider airline distance from the studio to the remote site and come up with even an approximate consideration. For example, the remote pickup may be only two blocks from the studio, but the circuit path may be several miles in length in its route to the central test board and back to the studios. Thus, estimating the circuit distance can only be a guess.

Over Correction

As we just discussed, systems have intrinsic limitations and these must be overcome if the response across the band is to be flat, or at least acceptable. And, these limitations hold even when the systems are optimum.

Many problems are not a matter for equalizers. Equalizers will generally overcome the intrinsic response limitations and often with enough reserve to spare so that overcorrection is possible. But there are many cases when problems actually need correction, not equalization.

Overcorrecting with equalizers can be a temptation when one does not feel like rooting out the real problem. For example, a tape recorder problem. Improper head alignment will cause poor high frequency response. The equalizers in the tape machine can be overcorrected to attempt compensation for some of the lost response, but seldom will full compensation be obtained. Overcorrection can cause other problems of amplifier stage overload and distortion, boost of high frequency noise, and even oscillation. Even the playback equalizers can be overcorrected to attempt solving the original misalignment. The overall tape recording when made and played on this machine may sound presentable. Anything so recorded, however, is not standard, and if played on a machine that is standard, will give very poor results.

Load Matching

Load matching is another common area of response problems that calls for correction, not equalization.

Many amplifiers have input and output transformers with various impedance taps. It sometimes happens that amplifiers get shifted in the system and the impedance requirements may be incorrect for the amplifier so substituted. Unless the taps on the amplifier are changed to match the new requirements, there will be load problems and most likely, response problems.

Ease of substitution is a very

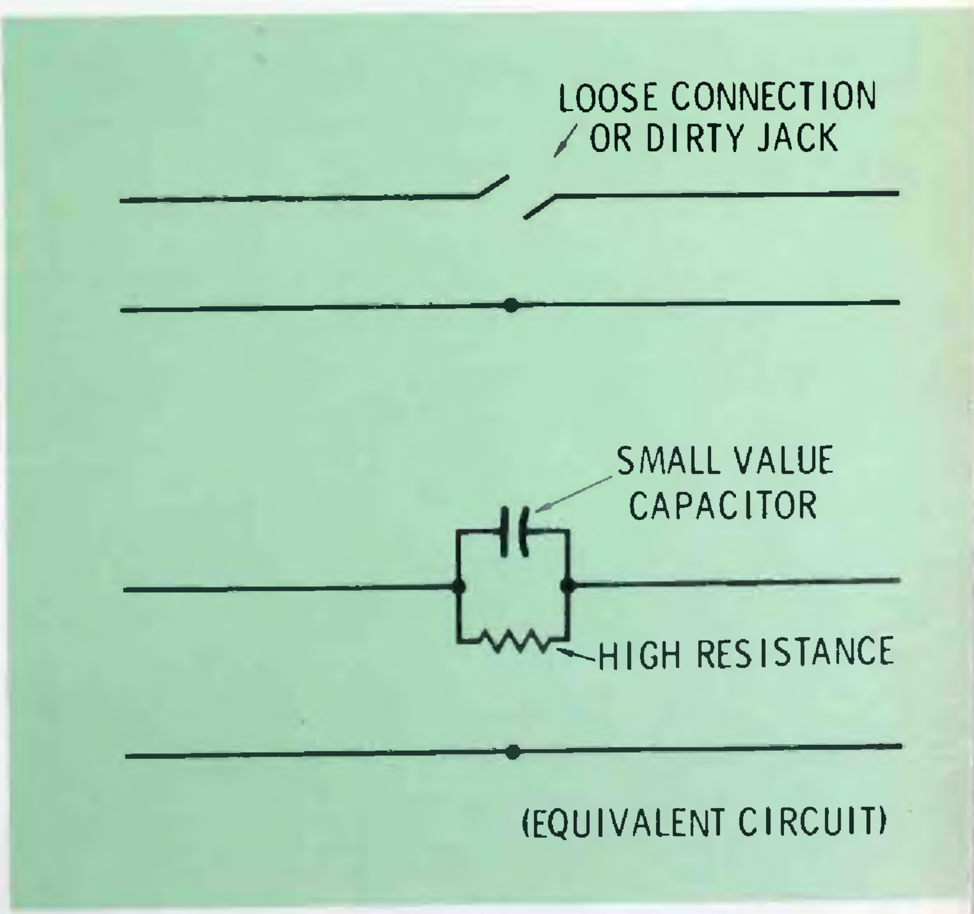

Fig. 2 A dirty or loose connection can have the effect of inserting a high resistance and small value capacity in series with the line. This will affect the low frequency response.

good argument for standard system impedances. A standard system impedance will allow substitution of amplifiers without concern for mismatching. If an amplifier must be a bridging connection, the transformer or resistors can be external to the amplifier, so the amplifier itself can incorporate the standard impedance, and thus be moved from one location to another with ease.

Using "T" Pads

While discussing amplifier loads, here is another possible trouble spot. Some amplifiers have "T" type variable input and output pads. These pads are not very linear in impedance at the extreme ends of the control, so they should be operated at midrange. At the ends, they become non-linear enough to cause response problems. If the levels are so high the pad must be run at one end, add a fixed pad ahead of the "T" pad so the control can operate in midrange.

An FM Problem

Although not directly an audio problem, there is one area where frequency response may be poor and improper equalization may be blamed when it is not at fault. This is the FM exciter in the FM transmitter. Some exciters have high Q tuned stages following the modulator. These must be tuned broad enough so that adequate bandpass is obtained. If these are mistuned so that the bandpass is very narrow, the recovered high audio frequency response will be poor. When making Proof measurements, the engineer may attempt to overcorrect by the use of equalizers, which is an error technique. The basic tuning problem should be corrected by proper wideband tuning.

The audio signal must pass through many contacts as it proceeds from input to output of the broadcast system. There may be many soldered connections, many jack fields. At any one of these points, there may be a poor connection or contact. It may be a loose connection, poor solder joint, or a dirty or sprung jack. Such a connection is often intermittent. If there is nothing to disturb it, the connection may not be intermittent, and thus there may be no evident clue. This type connection can present a high resistance, low capacitance contact. It is the equivalent of adding a small value capacitor in series with the lead. This small value capacity will discriminate against the low audio frequencies and cause poor response.

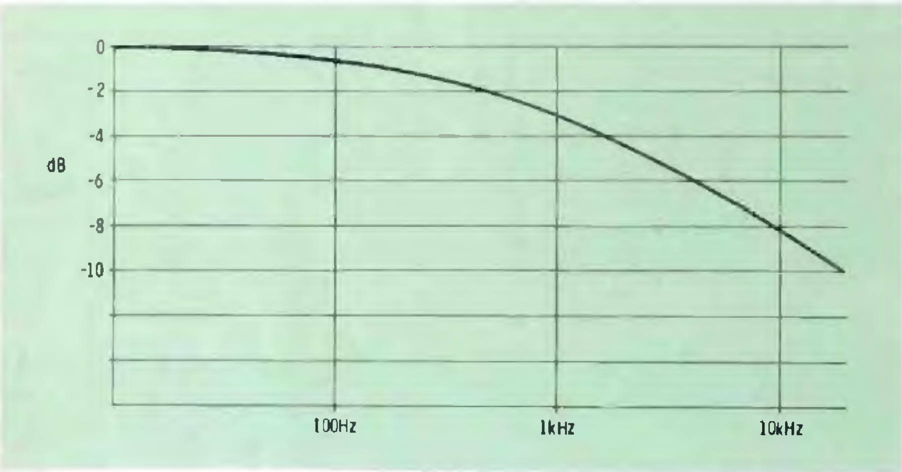

Fig. 3 Typical response of one mile of telco line.

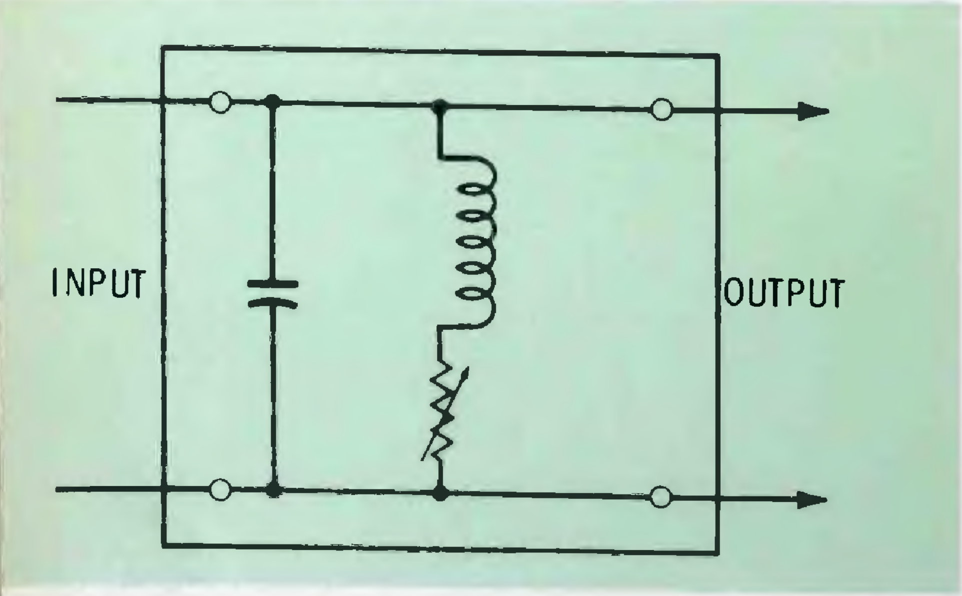

Fig. 4 Circuit of a commercial equalizer that is simple in construction and operation. Adding resistance to the coil dampens resonant response curve and broadens the skirts, causing the least amount of equalization.

The Equalizer

Since the problems that call for equalization are many and varied, so are the equalizers designed to correct the problems. Equalizers may be rather simple RC circuits, or variable units containing several components of resistance, capacitance and inductance that may be added to a circuit, or they may be complicated units containing a variety of circuits. Some equalizers are passive units, that is, components only, while others have an integral amplifier built into them to overcome losses caused by the equalizer. Some equalizers are built into the amplifier or unit they are to correct, such as a tape machine,

to all recording and broadcast studios

THE SANSUI QSE-1 IS *ALL* YOU NEED TO ENCODE 4 FULL-FIDELITY CHANNELS —AND NOTHING ELSE.

Just add it to your existing equipment for instant conversion and here's what you have going for you:

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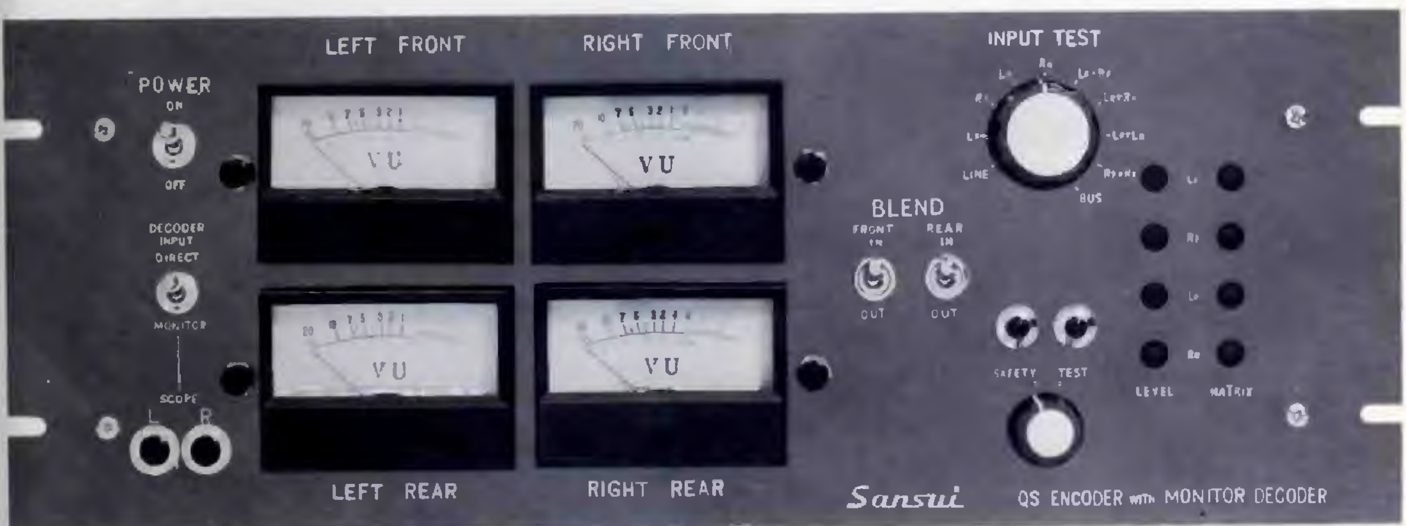
Its ingenious ±"J" phase shifters completely eliminate the signal dropouts and shifts in sound-source location that plague other matrix systems. Its symmetrical treatment of all four channels can **accurately** pick up **and relocate in reproduction** any sound source over a full range of 360°—so there are no limits to total free-



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Can you afford **not** to make this simple addition? Experiment with one right now. Learn what other recording and broadcast studios everywhere, now working with the QSE-1 Encoder, are finding out for themselves. Confirm their astonished conclusions.

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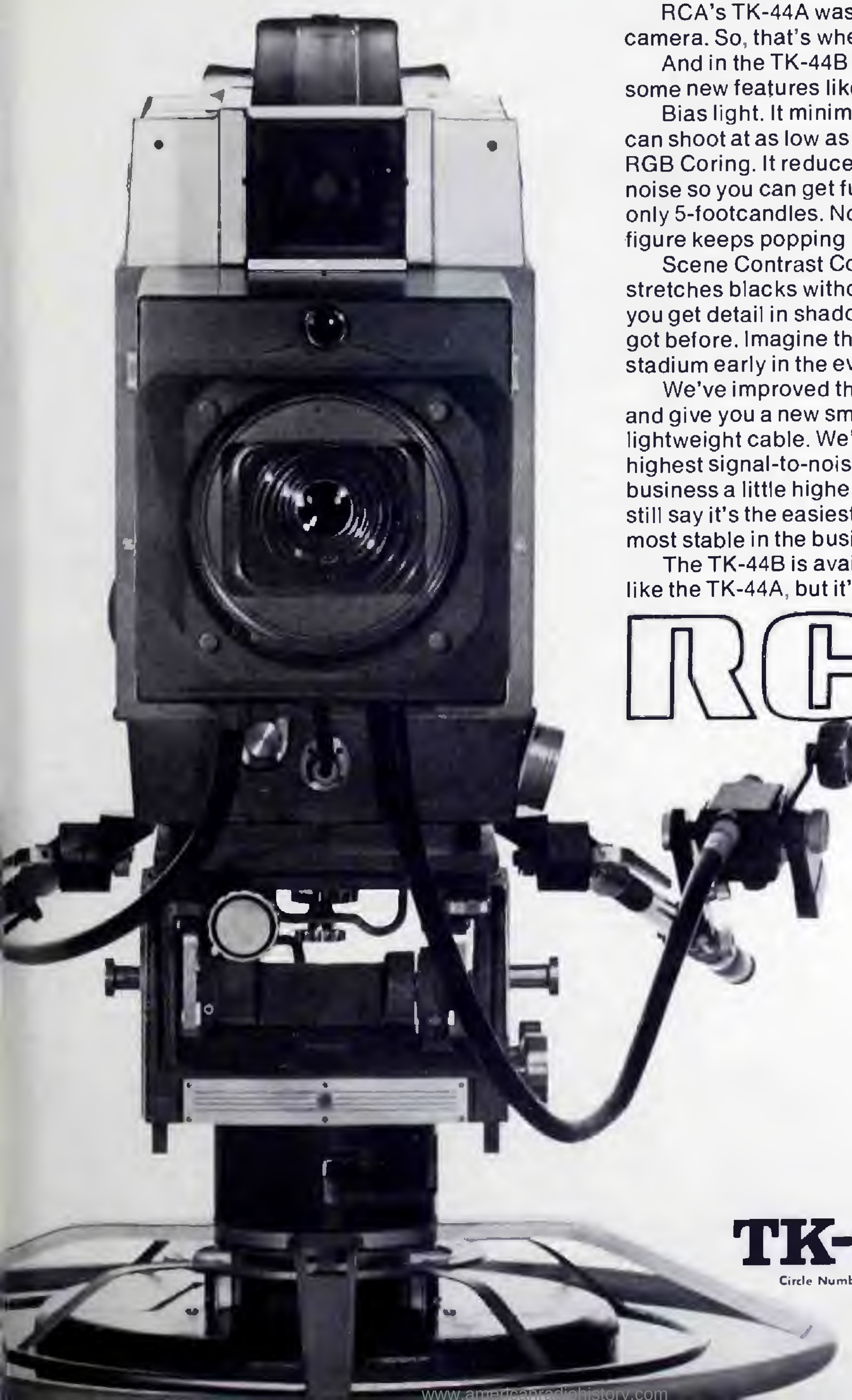
Circle Number 42 on Reader Reply Card

After "A"

TK-44A

comes "B" for Better.



RCA's TK-44A was a great color camera. So, that's where we started.

And in the TK-44B we're including some new features like . . .

Bias light. It minimizes lag so you can shoot at as low as 5-footcandles. RGB Coring. It reduces high-frequency noise so you can get full level video at only 5-footcandles. Notice how that figure keeps popping up.

Scene Contrast Compression. It stretches blacks without color shift. So you get detail in shadow like you never got before. Imagine that down in the stadium early in the evening.

We've improved the connectors, and give you a new small diameter, lightweight cable. We've made the highest signal-to-noise ratio in the business a little higher. And customers still say it's the easiest to set up and most stable in the business.

The TK-44B is available now. It's like the TK-44A, but it's a little better.

RCA

TK-44B

Circle Number 47 on Reader Reply Card

WMCA Goes Ultra Modern

WMCA Radio began broadcasting from its ultra-modern new studios at 888 Seventh Avenue (57th Street) November 1, at 6:00 a.m., according to an announcement by R. Peter Straus, president of WMCA and Straus Communications, Inc.

The new WMCA broadcast center is the most modern radio facility in New York and the only one in the country designed specifically for a listener-participation talk format. It will open one year after WMCA introduced "Dial-log Radio 57," the only such format now aired in New York on a 24-hour basis.

Four separate studios are built on a room-within-a-room construction plan, in which walls, ceilings and floors float on springs and cork to completely isolate the studios from outside noise. The entire studio area is then surrounded by an outer core to provide extra insulation from street noise and to accommodate public viewing rooms for each studio.

The studios are all equipped with special acoustical glass windows and microphones selected specifically for their response to conversational tones. The rest of the broadcast area is constructed on Liskey "raised pedestal floors," which allow five to fifteen inches of under-floor space, with removable panels to facilitate special wiring.

Taking a cue from the U.S. space program, V.P. Kanner has provided the new WMCA broadcast center with a complete set of back-up systems for all technical facilities, any of which an engineer can activate simply by flipping a switch.

In addition to special lines provided by Con Edison, the station will have its own emergency stand-by generator to provide power for the entire studio area in the event of a blackout. The telephone company's newest multi-line call director is backed up in case of failure with a complete second set of call-in lines. Even the air-conditioning has its own back-up system.

while some are portable or patchable units to be used in many situations.

When selecting equalizers, the application and range should be considered. Equalizers designed for Telco line correction, for example, will have features primarily designed to overcome line response losses, while the equalizer designed for a tape machine will be designed to overcome that specific problem.

When sophisticated response shaping is desired, passive equalizers are available that will divide the audio band into three segments, and there are those that split the band into many small segments. One commercial equalizer available that splits the band into low, medium and high requires three separate units. The low band covers frequencies below 1 KHz, the mid range covers 300 Hz to 3 KHz, the high range covers above 1 KHz. Not only is a roll-off possible, but several dB of boost also is available.

Some equalizers are designed to shape the response curve to a definite standard curve. While many of these have some adjustable elements, they are not considered operational adjustments, but rather basic maintenance adjustments. Such equalizers, for example, would be found in a tape recorder. The adjustable elements are intended mostly for a "trim up" adjustment. On the other hand, equalizers designed for special effects would be an operational unit designed to be operated and adjusted at will, even during the program.

Curing the Problems

Correction, of course, will depend upon the application and the equalizer in use. A highly capacitive circuit, for example, may have inductance added by the equalizer to resonate or neutralize the capacity. If the circuit is tending to resonate, resistance may be added to lower the circuit Q by the equalizer. As far as effect is concerned (and this is our primary interest), the equalizer presents an opposing response curve to the curve presented by the circuit in question. The curve may not be identical in the opposite direction, but generally it will be.

An unloaded Telco line, for example, will show a roll-off from 50 Hz on up, becoming more pronounced above 1 KHz. For approximately 1 mile of line using #26 wire, the response can be down 2dB at 1 KHz, 6 dB at 10 KHz, 9 dB at 15 KHz. (Unloaded line means that the line does not have series loading coils at intervals in the line.) The equalizer will, in effect, roll-off the low frequency response of the line, bringing it down to the point at which the equalization is desired, say 10 KHz. This is the action of the general "line" equalizer. More sophisticated units operate differently and can provide a boost as well as roll-off, although more equalizer sections will be required.

One simple commercial equalizer designed for line equalization is a parallel resonant circuit made up of a capacitor, inductor and a variable resistance in series with the inductance. The circuit is resonant above 15 KHz. By switching various values of resistance in series with the coil, over 30 dB of equalization is available at frequencies below 100 Hz, become progressively less as frequency moves closer to the resonant frequency. Thus, with 30 dB at 100 Hz, 1 KHz will have 17 dB available and at 10 KHz, only about 1 dB. The resistance is dampening the Q of the circuit and broadening the skirts of the tuned circuit response curve.

Loss In Levels

Correction for response deficiencies has its price, and this is usually paid by loss in levels. The first payment is the *insertion loss*. This loss varies, but it can be as much as 10 dB, usually rated at 1 KHz. This means that even with the controls set for minimum or zero equalization, there will be a loss across the bandpass of 10 dB. The loss may vary a small amount across the bandpass. As different amounts of equalization are added into the circuit by adjustment of the equalizer, there will be additional loss. This additional loss will vary with frequency.

When the catalog sheet for the equalizer states "up to 40 dB equalization," this generally means 40 dB at the extreme frequency sensitive end, while other frequencies will have differing losses which will be less than the maximum as stated.

Any circuit that makes use of an extensive amount of equalization will require postequalization amplification to return levels to their

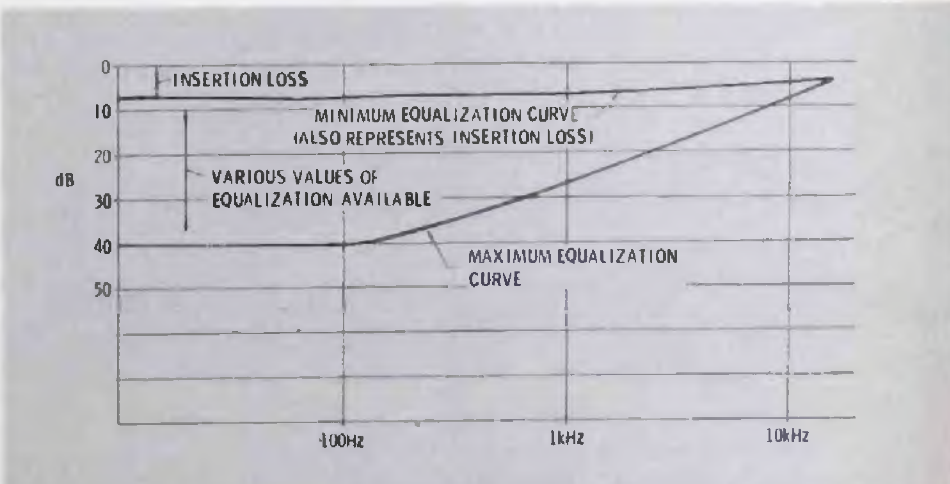


Fig. 5 Typical equalization curve of a small commercial equalizer. There is an insertion loss of about 7 dB. About 35 dB equalization is possible at the low end.

original value. If this amplification is not added immediately after the equalizer, there is the possibility of noise and crosstalk entering the signal. For example, a poor remote line may be equalized just as it enters the building. The output from the equalizer may be −40 dB. The signal is now a low level signal, but the routing is through the normal high level circuitry of blocks, jacks and cables with levels of perhaps +8 dB adjacent. There can be many opportunities for hum, crosstalk and other noise pickup. Once these foreign elements get into the signal, they will be amplified right along with the signal. However, if the amplification is applied immediately following the equalizer, the output level will be a normal high level signal and no problems will be encountered.

Standard Curves

Some equalizers are designed to produce a standard response curve, such as those in a tape or disc recorder. The playback curve in each case is complementary to the recording curve. That is, it is exactly opposite the recording curve in effect. Because a curve is standard does not mean it is of necessity a smooth roll-off. The NAB standard disc recording curve is actually a combination of three different curves added together. The first curve has the characteristic impedance of a parallel RC circuit whose time constant is 73 μ sec. The second has the impedance of a series RC circuit with a time constant of 318 μ sec., and the third has the impedance of a series RC circuit with a time constant of 3180 μ sec.

The NAB tape recording curve is a combination of two curves for one range of tape speed, and a combination of another pair of curves for another range of tape speeds.

The low speed combination of curves is a 3180 μ sec., and a 90 μ sec., while the high speed is a combination of 3180 μ sec. and 50 μ sec.

Telco Equalization

The quality of local Telco lines for broadcast varies, but for general pickups, the local equalizer can improve the quality so that it is presentable. If the remote amplifier has a built-in tone generator (many do), this will make the job easier. There will usually be three tones available: 100 Hz, 1 KHz, 5 KHz. It is impractical to expect more than 5 KHz response from the line unless equalized lines are ordered from the Telephone Company.

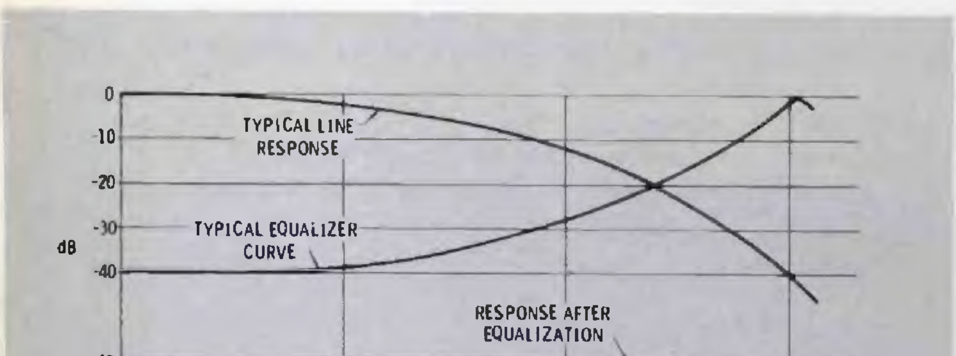


Fig. 6 Typical telco line response curve and typical equalization curve added to it. The response after the equalization is shown on the bottom curve. Note that while response is relatively flat out to 10 kHz, the overall levels are now at −40 dB. The insertion loss of an equalizer must be added to this level figure, so actual levels are down to about −50 dB. It is now a low level circuit after the equalizer.

As a first check on the quality of line you pulled, have the remote operator send the three tones available, one after another, maintaining the output at zero level on his VU meter. At the studio, the Control operator should set his console VU to read zero on at least one of the tones, reading the other two against this first as a reference. This will give a fair idea of what must be done to improve the line quality.

For example, if 100 Hz was set to zero on the VU, but 5 KHz on the console reads −8 dB, that much correction must be added to the circuit if the line and program are to sound reasonable. Have the remote operator send 100 Hz, setting the console VU to zero (the remote VU also at zero), then add equalization without changing any levels until the reading at 100 Hz drops to −8 dB. Up the console level to again read zero VU. Next, have the remote operator send 5 KHz at zero. The console meter should be reading somewhere close to zero. Touch up the equalization a bit more if needed. In most cases, a perfectly flat response out to 5 KHz will not be obtained, so settle on a compromise that will give the best equalization with the least amount of equalization.

What happens if the remote amplifier does not have a tone generator? Set the equalizers by ear. Have the remote man send program material of some type, talk on whatever is to be broadcast. A poor line will sound very boomy, with strong bass sounds, and the voice will sound dull and flat. Adjust the equalizers until the material sounds less bassy and the voice becomes more crisp. Levels will need adjustment as equalization is added. This type equalization can be done even while the program is on the air. However, adjustments should be made in small amounts at a time while keeping the levels up to par. To rack the equalizer controls from one end to another will cause the levels to go through wild gyrations and disturb the listeners.

Tape Equalizers

Tape machine equalizers, although often adjustable, are not often adjusted. All heads are not identical, so if any adjustment must be made, it will be a small trim-up adjustment.

The playback machine should be done first, playing a standard alignment tape. The head adjustments and any other adjustments made first and optimized before touching the equalizers. The equalizers should be done last, and only if one is certain these need adjustment.

It is possible the new head that is defective, or possibly a record head was installed instead of a playback head. If the response is very poor even with everything adjusted and optimized, unless the equalizers have been adjusted before, the head probably is defective. Try another head. Usually, a new head will bring the response to within a dB or so of normal, assuming the amplifier and equalizers are normal.

One can trim the equalizers if one or 2 dB off normal bothers him, but in all probability the minor loss of response can't be detected in the program anyway. The danger comes from a willingness to quickly jump to adjusting equalizers (as in the case of a bad head). The equalizers may be adjusted so far from normal that it is difficult to restore the adjustment to a standard curve.

If equalizers have been badly misadjusted, it is best to replace the head with an audio tone generator, maintaining the proper impedance match between generator and amplifier. Many instruction manuals will describe a setup for a particular machine. Readjust the equalizers to the normal curve.

Some tape machines do not have adjustable equalizers in the playback amplifier. Small amounts of trim-up equalization can be obtained by adding loading resistors across the head, thus changing the match between head and amplifier. Head impedances will run somewhere between 600 to 1,000 Ohms. This is a cut and try method, and only small amounts of equalization will be obtained.

Microphones

Microphones can sometimes use equalization in the system to compensate for poor room acoustics or poor microphone placement. The room may have too much reverberation so the program sounds off with too much echo effect. Or, the mike may be so far from the voice pickup that it sounds very bassy. An equalizer can be used to tilt the system response curve to make the pickup sound better. A general equalizer can be used to roll off the low frequency response, or one of the special effects equalizers can be used to reshape only the bass part of the response curve. Whatever equalizer is used, it should be inserted only in that section of the system carrying that program, such as the input from the remote line, or from the subcontrol room from that studio. If the filter or equalizer is placed down the system away, it can affect other program sources such as tape machines and turntables that will be used to add local commercial announcements.

Running motors or other low frequency vibrations can be picked up on a microphone. These sounds can come from air conditioners or vibrations through a wall. The special effect equalizer can be used to notch out this low frequency rumble without affecting the voice pickup quality very much. Again, the equalizer should be placed only in the offending section and not further down the system.

Summary

Various types of equalizers are necessary to overcome intrinsic limitations, affect a standard response curve, or create desired effects. Those designed to shape a standard curve should not be adjusted indiscriminately. The price of equalization is often a loss of levels which must be made up. Equalizers should not be overcompensated to attempt correction of faulty operation or problems that need correction in other ways. ▲

Annual Index

(Continued from page 21)

MAINTENANCE

(For selected maintenance short subject features, see titles under Engineer's Exchange.)

SOLID STATE

(Also see selected short subjects under Engineer's Exchange.)

TELEVISION

(Also see selected short subjects under Engineer's Exchange, Direct Current, and Industry News.)

ENGINEER'S EXCHANGE

Pictures Can Aid Record Keeping

Ever walk into a station and find that the equipment circuitry has little similarity to the original design? Then when units break down, troubleshooting is a nightmare!

We have been testing the Polaroid CR-9 camera and we think it can help solve this problem and a number of others that rise out of keeping records.

Since the camera will take pictures of schematics, the CR-9 can help you keep modifications straight. And it can be used to document actual circuit modifications. In fact, there are cases where pictures of circuit boards and/or wiring would improve communications with the equipment manufacturer when you needed to discuss a unit problem or suggest a modification.

The body of the Polaroid CR-9 Land resembles the "Big Swinger" Polaroid camera. Seven lens openings from F5.6 to F45 and shutter speeds of 1/125, 1/60, and 1/30 seconds plus "B" (for time exposures) are provided. Packed with the camera is a pistol grip which has a shutter release trigger and cable.

Also included are eight light shields of various round and rectangular sizes designed to fit the CRT mask of almost any oscilloscope. The length of each light shield is such that, when the shield is attached to the front of the camera and then held firmly against a scope screen, the lens-to-CRT screen distance is at approximate focus. Focus is not adjustable, so for best sharpness the "F" stops with the larger numbers should be used.

Type 107 Polaroid film packs (8 exposures) are normally used.

Color film pack 108 also fits the camera, but the slow film speed and high cost would prevent its use for most applications.

Camera Preparations

Try the various light shields to find the one which best fits your scope. Or if you have several different models of scopes, select and label a shield to fit each one. Changing shields takes only a few seconds. Better light trapping is obtained, if the shield fits around the outside of the rim of the scope mask. However, we have taken pictures of 10 seconds time expos-

Fig. 1

ure with a light shield which had pieces removed and then patched to make it fit inside a round mask. No fogging from light leaks appeared.

If you have never used a camera to photograph scope waveforms before, you will need to experi-

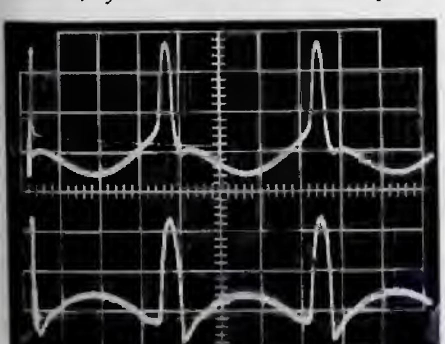


Fig. 2

ment to obtain the correct exposure, because a scope trace emits a very small amount of light. Polaroid Type 107 film is rated at Exposure Index 3000, which is extremely fast compared to most films. Yet some fast rise-time waveforms might require several seconds of exposure.

Operation And Results

Adjust the scope as you normally do, adjust the camera according to the brightness of the scope waveform and its duration, hold the camera shield firmly to the CRT mask as shown in Figure 1 and squeeze the shutter trigger. For time exposures on the "B" shutter position, hold the trigger for the amount of time necessary, then release. No shutter cocking is needed.

Remove the camera, pull the two tabs on the film, count off 15 seconds and peel off the print. The print should be coated for permanence, although this does not have to be done immediately.

Those of you who are camera buffs will understand about depth of field (or depth of focus). Depth of acceptable focus is very shallow when close-ups are being made. The smaller the lens aperture (larger the "F" number) the less critical the focusing and the sharper both the waveform and the graticule markings will be. "F" stops of F16, F22 and F32 give sharpest results.

Imitation Double Trace Waveforms

We asked ourselves if the camera could be used to give the visual effect of a dual-beam or dual-trace scope. The answer is, yes. The CR-9 will double-expose.

Figure 2 shows two different waveforms from a horizontal sweep circuit. The upper waveform and graticule markings were shot at F22 for about 7 seconds, the trigger was released and the camera removed while the scope was shifted to the second circuit and the beam positioned. Then the camera was held to the scope screen, the graticule illumination was turned out (in case the two pictures were not in perfect register), and a second exposure of 6 seconds was made before the film was pulled. External sync on a triggered-sweep scope was used to eliminate all phasing error except the slight one of camera positioning.

Several uses are possible at the broadcast station. One involved photographing a part of a TV screen. Figure 3 shows the vertical blanking bar (including the Vertical Interval Test Signal) photographed from the screen of a not-very-sharp television receiver. The exposure

Fig. 3

Fig. 4

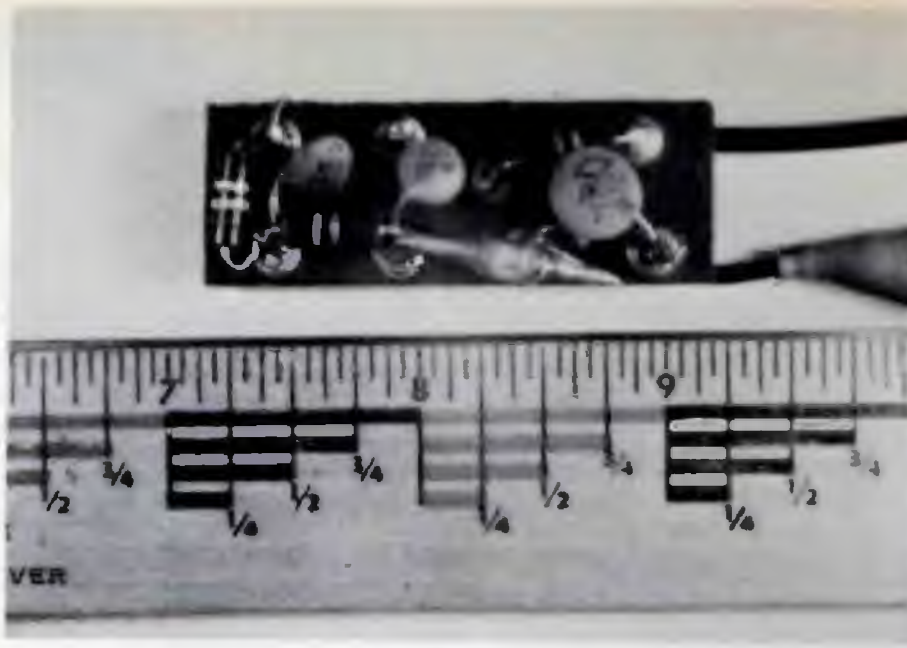


Fig. 5

was 1/30 second at F16. For best sharpness, there should not be too much space between the picture tube and the safety glass.

It should be possible to photograph any reasonably flat object that was positioned at the end of the light shield in the thin area of good focus. However, the light shield blocked the light from such objects. One of the light shields (a size which fitted none of our many scopes) was altered by use of a pair of scissors so light could enter from two sides. A couple of high-intensity lamps were positioned to light the paper, and sections of printed material were photographed.

Meter scales which are not too far behind protective glass or plastic can be photographed, also. The calibrations and pointer shown in Figure 4 were nearly ½ inch from the end of the light shield on the camera, yet the picture sharpness is satisfactory.

One final suggestion is that small etched boards or electronic subassemblies can be photographed by use of the altered light shield. One example is shown in Figure 5. Exposure can be determined by a camera light meter.

Use F22, F32 or F45 to extend the depth of focus, when you photograph objects which might not be in the best position.

Additional uses for the camera are contained in the Polaroid instruction booklet. For example, a standard PC connector is provided for use with electronic flash, or for applications where you might want to start a transient by completing a circuit through the internal flash contacts so it is synchronized with the camera exposure.

Carl Babcoke
BE Tech. Editor

NEW PRODUCTS

(Use circle number on reader service card for further information)

Broadband Down-Converter

Introduction of a solid-state, broadband down-converter for 2500 MHz instructional television fixed service (ITFS) has been announced by **Emcee Broadcast Products.**

According to the company, its new model MC-2500 Down-Converter provides the user with optimum reliability and temperature stability over a wide range of environmental conditions. Incorporation of special low-noise transistors and Schottky-Barrier mixer diode result in low noise figure (7 dB typical, 8½ dB max.) and high gain (20 dB typical, 18 dB min.). Frequency range is from 2500 to 2690 MHz, and stability is ±50 kHz.

The Model MC-2500 is encased in a strong aluminum, weather-sealed casting and is designed to operate under temperature extremes from –40° F. to +140° F. Advanced power supply utilizes an integrated circuit voltage regulator for excellent line and load regulation.

Circle Number 60 on Reader Reply Card

Solid State 17-Inch Monitor

A new solid state 17" video monitor with 800 line horizontal resolution has been introduced by **GBC Closed Circuit TV Corp.**

Designated model MV-17, the new 17" CCTV monitor utilizes silicon transistor circuitry, a unitized chassis and plug-in printed circuit boards for reliability and ease of servicing.

Switchable external synchronization makes the MV-17 ideal for use as a studio program monitor. GBC also expects it to be used widely as a monitor in high resolution industrial applications.

A built-in regulated power supply keeps the new GBC monitor stable, even if AC line voltage varies. Sweep geometry is linear within 3% of picture height.

Other features include a 440AB4 integral implosion type picture tube and a 60 dB signal-to-noise ratio. Video bandwidth is a full 10 MHz, providing better than 800 TV lines at the center of the picture.

The MV-17 is a cabinet model, but simple adaptors are available for 19" rack mounting.

Circle Number 61 on Reader Reply Card

Audio-Video Routing Switchers

International Nuclear Corp. is introducing a new series of audio/video routing switchers designed to provide high-speed electronic switching of multiple video and/or audio input signals to any combination of multiple outputs.

The BRS-V-2000-X Series routing switcher provides economical selection and distribution of video and/or audio signals for the professional in the broadcasting, instructional and closed-circuit fields. It is designed to professional standards of performance for both color and monochrome signals.

The new switchers are modular in concept and form a family of compatible subassemblies from

(Continued on page 43)

Move Pays Off For WBAP

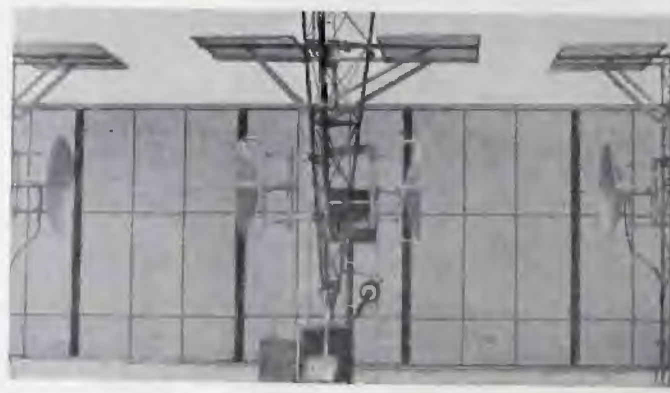
By Rupert Bogan

What at first appeared to be a curse may be a blessing for WBAP Radio in Fort Worth, Texas.

When it was discovered that the station's transmitter was in the direct flight path of the Dallas/Fort Worth airport now under construction, WBAP was forced to move to a new location. The move resulted in the erection of one of the most modern transmitting facilities anywhere.

Recently the station began transmitting from a $1,200,000 plant located in Coppell, between Fort Worth and Dallas.

The unique plant employs an STL receiving technique, worked out by WBAP's engineering department. A dish mounted on a tower 300 feet up points southwest to the Fort Worth studios of the clear channel station. Energy feeds down the tower via coaxial cable to a parabolic reflector mounted at the base and is transmitted to a parabolic reflector which faces it. This dish, in turn, feeds the signal to an STL receiver.



The results of this unique set-up are quite satisfactory, exceeding all parameters for proof of performance measurements, WBAP's engineering department has found.

Another unusual feature of the WBAP transmitter is the laboratory where the measurements are made. In order to block out effects of the 50,000 watts of energy, engineers have shielded the room with expanded copper, covering the floor, ceiling and all four walls.

A 120 ton air conditioner cools the sophisticated equipment and in summer, maintains a constant 80 degrees temperature and 78 per cent humidity.

In its previous location, the WBAP transmitter had a 653-foot tower. However FAA restrictions have reduced the height to 500 feet at the present site. In order to achieve the same field strength engineers have employed top loading by running a skirt of cable attached to the guy cables 110 feet down from the top of the tower.

Collins Radio, main contractor for the entire plant, arranged with Continental Electronics to supply 317 C transmitters which form the main and the alternate main transmitter for WBAP.

Round the clock, engineers man the transmitter which is located in 5,500 square-foot structure with pre-cast cement exterior with embedded natural rock.

(Continued from page 41)

which a wide variety of system configurations can be generated.

Other features of the BRS-V-2000-X Series include solid-state, plug-in audio and video switch crosspoint modules and input-output amplifiers; computer compatibility; and video only, audio only, or audio-follow-video.

Designed to meet exacting demands of broadcast color reproduction, the BRS-V-2000-X Series switchers are available with a battery-operated stand-by power system, vertical internal switching, and a number of control methods ranging from mechanical interlocking switches to BCD computer control.

Circle Number 62 on Reader Reply Card

Mike Isolation Stand

The problem of "hollow" sound quality often associated with attempts at distant sound pickup is greatly reduced by the use of a new microphone isolation stand introduced by **Shure Brothers Inc.**

These so-called "hollow" sounds are caused by direct sound waves and reflected sound waves cancelling each other. Shure has found that this phenomenon can be effectively counteracted by locating the microphone as close to the floor as possible without actually touching. In this way, the two paths of direct and reflected waves coincide to deliver the same natural quality of sound associated with close microphone pickup.

The Shure Models S53P and S55P Distant Pickup Microphone Isolation Stands put this principle to work while at the same time providing excellent shock isolation from floor vibrations. They suspend a microphone approximately ⅛-inch above floor level. The Model S53P is specifically designed for the Shure SM53 Microphone. The S55P is designed for use with Models 545, 548, and SM57.

Circle Number 63 on Reader Reply Card

Transcription Tone Arm

Gates Radio Company, a division of Harris Intertype Corporation, has introduced a new transcription tone arm designed especially for AM and FM broadcasting.

The Gates' TA-12 transcription arm, which tracts with as low as one gram pressure without skipping, faithfully reproduces stereo records by minimizing the effect of the tone arm on sound reproduction and by reducing excessive wear.

Precision manufacturing, extensive quality control and testing procedures are guarantees that this tone arm will meet broadcasting's critical tracking requirements for fine groove stereophonic recordings.

Because of the advance design of the tone arm, resonance is less than 15Hz, well outside the oper-

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ating frequency range of the system. Distortion due to tracking error in the arm and pickup is reduced to a minimum by separate horizontal and vertical pivots.

Accurate tracking pressure is further achieved by rearweight adjustment with a calibration of approximately one gram per revolution. This reliable tracking allows for lower pressure on the stylus adding to the record and stylus life.

Gates' TA-12 transcription arm features an arm rest with a lock which considerably reduces accidental damage to the stylus. The arm is fabricated with rugged simplicity from nickel plated steel which provides excellent RF shielding.

Designed for modern cartridges, Gates' TA-12 tone arm incorporates mechanical features which permit easy installation and rapid cartridge and shell change.

In the kits only category, **Heath Company** is offering its IM-58 harmonic distortion meter and its IM-48 audio intermodulation analyzer.

The IM-58 will measure harmonic distortion as low as 1% as a full-scale reading in a frequency range of 20 to 20,000 Hz. The meter scale is calibrated in volts RMS, percentage of distortion, and dB.

The IM-48 combines the functions of AC VTVM, wattmeter, and intermodulation analyzer. It includes built-in high and low frequency sources for intermodulation tests, and load resistors hit 4, 8, 16, and 600 ohms.

Output terminals from both units allow scope monitoring. The IM-58 is a $65 kit, and the IM-48 is listed at $69 in kit form. BE built the IM-58 and found that it meets or exceeds manufacturer's specs.

Microphones

Smooth response, light weight, a slim silhouette and high resistance to shock are features of **RCA's** new BK-14A and BK-16A microphones for broadcast, recording and public address applications. Newly-designed shock and isolation filters assure high quality, noise-free speech and music pickups. The BK-14A is recommended for outdoor as well as indoor use, and has special screening against wind and pop noises.

Both microphones are omnidirectional dynamic types with replaceable cartridges and provision for stand mounting. They are styled in non-reflecting satin-nickel housings 8 inches long by ¾ inches in diameter. A swivel mount with 30-foot cable and connector is supplied with each microphone.

Tape Tightens Format

Station KUDL has tightened their format in a semi-automatic process that relies on five cart machines and nearly all music on tapes. Chris Martin is shown below taping a top 40 number which another DJ, Andy Barber, will plug into the rack for later use.

This system eliminates record problems, not the least of which is those that disappear. And by using sequenced cart machines, the TT is used mainly for LP's. The DJ then has more time to accomplish other tasks, because record cueing has been eliminated.

On air DJ pulls tapes sets up machines.

Martin monitors the taping of another new record.

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bookreview

Lighting Handbook

Broadcast Engineering will be giving you some article coverage of Lighting this year, but meanwhile Sylvania Electric Products Inc. has their fourth edition of the **Lighting Handbook** off the press. This paperback condenses the essentials of lighting for television theater and professional photography.

The paperback version is available through: GTE Sylvania Advertising Services Center, 70 Empire Drive, West Seneca, New York 14224.

Workshop In Solid State

Harold Ennes, long on broadcast engineering and writing experience, is the author of a unique approach to solid state. In his book **Workshop In Solid State,** Ennes follows his chapters with self tests that show the reader immediately what he missed, misunderstood, and where his knowledge is correct.

Ennes has compiled in this "must" text for those learning solid state a rich mix of theory and practice. The reader should come away with theory, design, and testing knowledge.

Main chapters include: Do You Really Know The Diode?; Understanding The Transistor; Basic Transistor Parameters and Stabilization of Parameters; Basic Linear Circuit Analysis; Practice Problems in Solid State Amplifier Circuitry; Switching and Pulse Applications; Special Applications and Special Transistors; Oscillators and RF Amplifiers; Logic Circuitry and Applications, Power Supplies; and Basic Testing and Servicing Techniques.

This book is available as book #20735 through the Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Ind. 46206.

Audio Amplifiers

Transistor Audio Amplifiers was first published in Great Britain and is now available in the U.S.

The design of audio amplifiers requires a thorough understanding of transistor characteristics and their various circuit possibilities. And since a design is usually a compromise between several factors, it is important to understand the basis of the performance requirements. This book considers these aspects of design in detail.

Particular attention is given to extensive use of direct-coupled audio amplifier circuits and noise and acoustic roughness due to non-linearity.

This text, written by P. Tharma, is available through Van Nostrand Reinhold Company, 450 West 33rd Street, New York, N. Y. 10001.

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CARTRIDGE TAPE EQUIPMENT—Completely rebuilt and reconditioned. Tapecaster and Spotmaster Record/Playbacks $375.00. Playbacks $250. 30-day money-back guarantee. AUTODYNE, P. O. Box 1004, Rockville, Maryland 20850 (301/762-7626). 11-71-tf

USED EQUIPMENT—Pay Cash for FM/AM transmitters, antennas, consoles, etc. Contact: Electrónica Fernández, Box 415, Hato Rey, Puerto Rico 00919, Tel.: 767-3500. 11-71-4t

KTR-1000 COLOR TV MICROWAVE LINKS—NTSC Color TV plus program audio microwave links for studio-xmtr. CATV, etc. Rack mounted. Mfr. Raytheon. 25 sets in stock, as new condition. Radio Research Instrument Co., Inc., 3 Quincy Street, Norwalk, Conn. Tel. 203-853-2600. 12-71-4t

FOR SALE — 2 IVC 800 Series 1" Color VTR's. Excellent condition—Priced to sell —Call (402) 477-0533 or write T-V Transmission Inc., P.O. Box #81304, Lincoln, Nebr. 68510. 12-71-2t

RCA 77-DX MICROPHONE with stand and boom. Like new. $170. WDNG. P.O. Box 1290, Anniston, Alabama 36201. 1-72-1t

CARTRIDGE TAPE EQUIPMENT—KRS model SB6AP 6-deck playback unit and model SB6AR single-deck record/playback unit. Both in current use. Price: including 330 carts, $2500. WAML Radio, Box 367, Laurel, Miss. 39440. ph. (601)-428-5601. 1-72-1t

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MICROWAVE ENGINEER. Microwave maintenance engineer wanted to maintain 450 miles of Lenkurt 76 TV in Nevada. Must be familiar with video baseband equipment, and audio sub-carriers. Company car and benefits. Salary open. Send resume to Personnel Department, Donrey Media Group, P.O. Box 1359, Fort Smith, Arkansas 72901. 12-71-2t

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To supervise operation of a two-way, 26 channel system in major television market. Salary in high teens or low 20's, depending on experience and capability. Reply to Box 258, Broadcast Engineering, 1014 Wyandotte Street, Kansas City, Missouri 64105. 1-72-1t

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CHRISTIAN TV production group needs a remote truck. Also CCTV equipment. Can be a tax write off to you. Write Evangel Ministries, 1950 Thomasville Road, Tallahassee, Florida, 32303. 1-72-1t

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