January, 1970/75 cents

Broadcast Engineering®

the technical journal of the broadcast-communication's industry

A HOWARD W. SAMS PUBLICATION

Transmitter maintenance

From nuts & bolts to IC's

Amps for remote monitoring

WELF— a station for the 1970's

page 26

IT ALWAYS SEEMS THAT 3M PROVIDES A COUPLE OF FEATURES THAT OTHER PRODUCTS DON'T

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The 3M Brand Color Encoder has two unique features not obtainable elsewhere. The color bar generator is one. It is **completely** digital, not partially digital. Simplifies setting up procedures, and maintains accuracy between encoders. Affords precision without adjustments. With digital you **know** it is accurate.

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January, 1970 • Volume 12, No. 1

Broadcast Engineering

The technical journal of the broadcast-communications industry

in this issue...

ABOUT THE COVER

WELF is nearly all solid state and much of its operation is automated. The consulting engineer and the WELF staff have worked these features into their new facility, producing what might well be a typical design for the 1970's. For details on this unique station design, see article on page 26.

DEPARTMENTS

BROADCAST ENGINEERING is published monthly by Intertec Publishing Corp., 1014 Wyandotte Street, Kansas City, Missouri 64105. Telephone: 913/888-4664.

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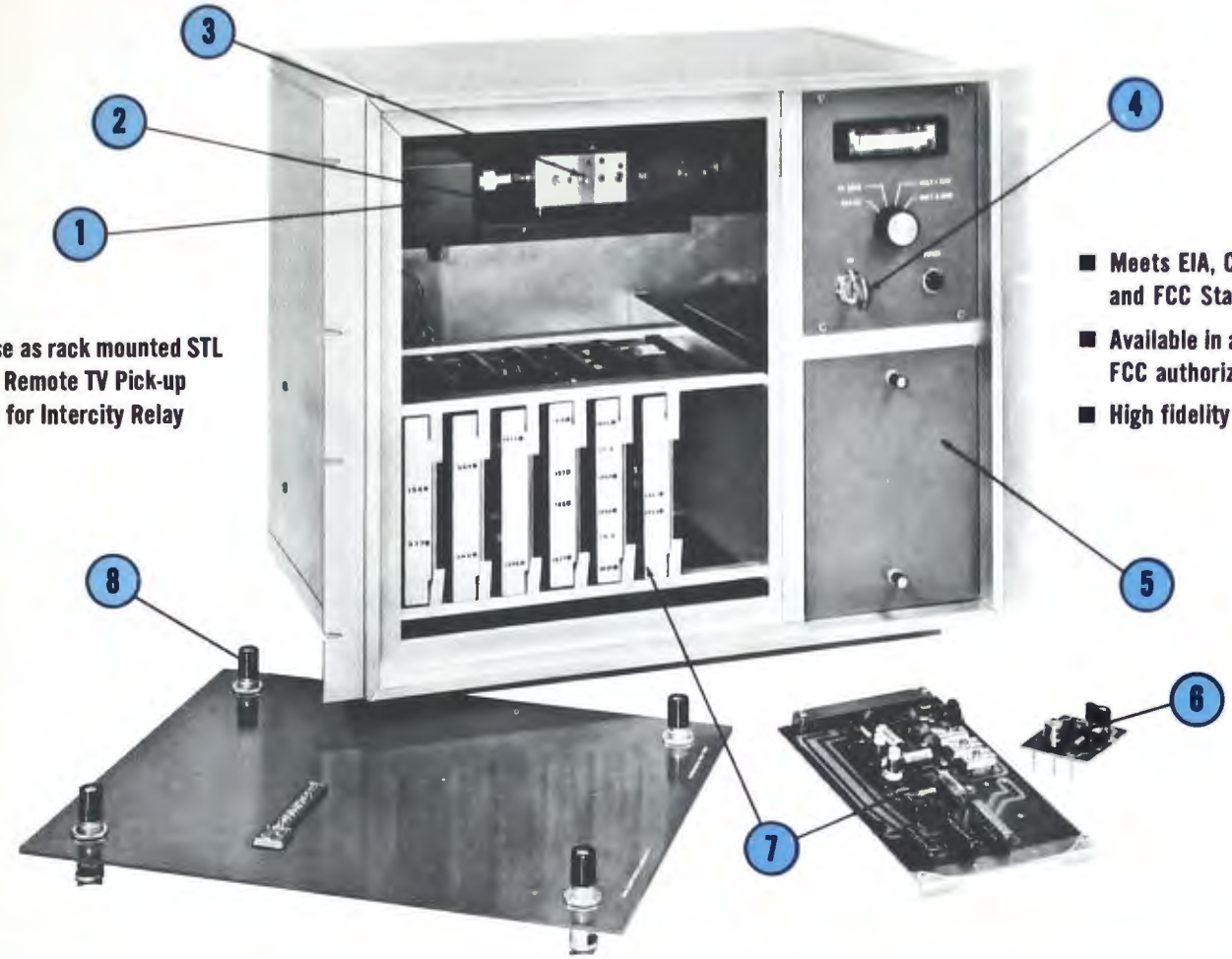

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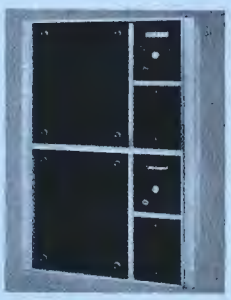

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DIRECT CURRENT FROM D. C.

January, 1970

By Howard T. Head

Commission Expands Microwave For CATV Use

Following up on its determination to encourage and even require local organizations by CATV systems (See Dec. 1969 D.C.), the Commission has moved to make microwave frequencies more freely available to CATV systems. First of all, the Commission has authorized the use of Community Antenna Relay Systems (CARS), previously restricted to the transmission of broadcast signals, for the purpose of carrying all types of CATV program originations. These include links between studio and headend, remote pickup circuits, and service from mobile units.

In essence, the service to be permitted on these channels by CATV systems parallels that now permitted to television broadcast stations. CARS channels in the frequency band from 12.7 to 12.95 GHz are to be employed, and CATV operators are to be limited to a maximum of three channels.

CATV systems proposing to substitute microwave service for existing cable links will be required to make a showing as to the reason for employing microwave instead of cable. At least one leading CATV supplier has indicated that existing facilities can be converted to two-way operation employing presently available equipment.

In addition to this type of operation, which is essentially for studio use, the Commission has also established a local distribution service (LDS) operating in the same band as a substitute for trunk cable in underground conduits and on surface telephone poles. A frequency assignment plan is provided which would permit 38 TV channels for non-repeater operation and 18 channels for multiple hop operation. The Commission notes that this is more than the number of signals usually carried by CATV systems.

Comments Invited on Land Mobile Studies

The Commission has invited comments from the industry on reports prepared by the Stanford Research Institute (SRI) of the results of monitoring of the land mobile radio services in New York, Detroit, and Los Angeles (See Oct. 1969 D.C.). These studies (which showed that although considerable congestion was present on some channels others showed little or no usage) have been the subject of charges and countercharges by land mobile and broadcast interests. The land mobile organizations have emphasized the instances where congestion was found, while broadcasters have pointed to large areas of presently-assigned land mobile spectrum which were the SRI found were in little use.

(Continued on page 6)

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(Continued from page 4)

The Commission has proposed to share the lower seven UHF TV broadcast channels with the land mobile services, and, following tests which showed the sharing of VHF TV channels to result in considerably less interference to television than expected, proposals have been made for regular sharing of VHF TV channels.

The Commission is under heavy pressure from Congressional committees to provide additional frequency spectrum for land mobile services. Best guesses are that the Commission will act to authorize some form of sharing early in 1970 . . . whether or not the facts show the additional land mobile spectrum to be needed.

TV Receiver Industry Opposes Radiation Restrictions

In response to the Commission's proposal to tighten radiation limits on the local oscillator of UHF TV receivers (See Dec. 1969 D.C.), both the broadcasters and receiver manufacturers have followed predictable patterns. The broadcasters have pointed out the potential interference to TV reception resulting from high levels of local oscillator radiation, since the EIA standard IF results in a local oscillator frequency 41.25 MHz above the aural carrier of the station to which a receiver is tuned. This places the interferring oscillator signal in a UHF channel seven channels higher.

The receiver manufacturers continue to insist that the requirement for reducing local oscillator radiation would be a burden, although they have had 17 years to meet quite generous requirements. The broadcasters have found an unexpected allay in the land mobile interests, who point out that one of the technical factors requiring large amounts of spectrum space for UHF TV requirements is the system of "taboo" requirements, one of which calls for a 60-mile separation between two UHF stations separated by six channels.

Short Circuits

Hearings are now scheduled to get underway this month in which various groups, including the NAB, will oppose AT&T higher tarrifs. These tarrifs include not only intercity service, but also local bridging connections for both radio and television service, which, although ordinarily intrastate in nature, are subject to FCC regulation because they connect directly to the intercity network lines . . . The Commission has made further changes in its proposal to reduce all standard broadcast directional antenna studies to computer terms. Many consulting engineers regard this proposal, in light of the "AM freeze" (See Nov. 1969 D.C.), as an example of flogging a dead horse . . . CB stations may now transmit traffic reports.

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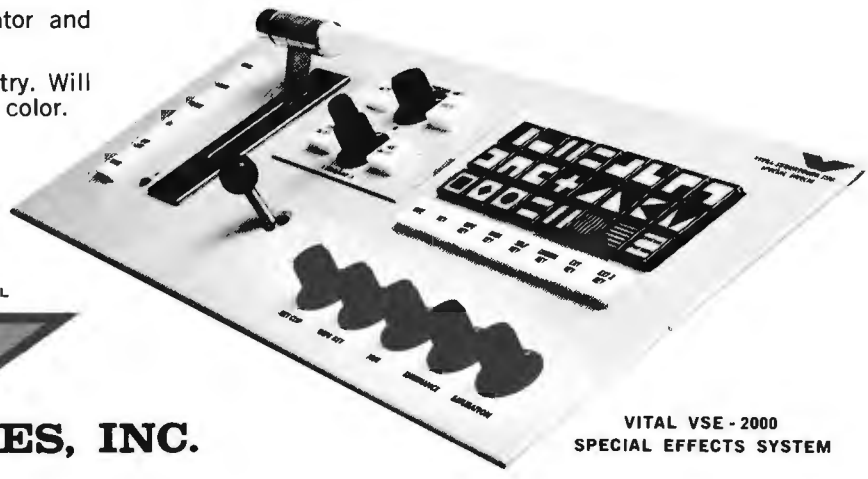

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Circle Number 7 on Reader Reply Card

LETTERS TO THE EDITOR

Remotes:

One, if by Land Two, if by Air

Dear Editor,

I would like to object to statements made by Mr. Talley in his article about equalizing telephone circuits for remote pickups. He says that wireline facilities are used primarily for remote radio pickups. I think he is about twenty years behind the times. Here at WBCO and WBCO-FM, we use one remote pickup transmitter in the 26 MC band, three in the VHF band, and we are working on equipment for UHF, for which we are licensed. We also used microwave for remote transmitter control and program transmission to our transmitter site. We originate a minimum of two programs a day by radio link, and some days as high as four or five.

Remote radio pickup is both feasible and economical to use. We broadcast about 30 football and 30 basketball games a year, by radio link pickup. We have done games over 40 miles away by remote radio pickup. The only two telephone pickups used are for two once a week programs, everything else is by radio. I know of no stations in Northern Ohio that rely very much on remote telephone circuits.

Fred Clinger
Chief Engineer
WBCO-WBCO-FM

Going Up and Up

Editor's Note:

We have no figures to back either Fred Clinger or David Talley's statements as to the number of stations radio or wireline remoting. But even without the figures, Fred is on the right track. Radio remoting is very much a way of life at many stations.

What Talley was saying in Part 1 of his series (Oct., page 59) is that remote operation must be approved and that economy is a consideration. But he erred in not including the 26 MHz remote band.

The fact that Talley did suggest higher frequencies does show that he is not 20 years behind the time. Rather, he is looking at the shift that has been taking place. Currently, 161.70 is a popular operating frequency. And there is another growing group who prefer the 450 MHz band. The movement upward is based on the interference factor that exists in some areas of the country on 26 MHz.

As for the question of operational economics, anyone standing on either side of the street will find themselves in lots of traffic. Purchase price vs. line rates in any dialog is complicated by number of remotes, type of programming on remotes, availability of quality lines, proximity of station and event, management decisions, and the budget.

Since **Broadcast Engineering** magazine is in favor of equipping for emergencies, we do favor the movement to radio remotes.

Light on the Subject

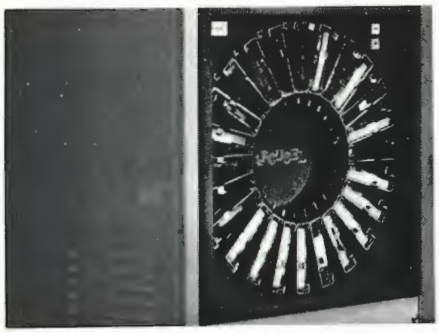
Dear Mr. Anderson,

I recently had the pleasure of reading your article "A Redundant Remote Control Loop For TV Transmitters"; which was printed in the June, 1969 issue of Broadcast Engineering Magazine.

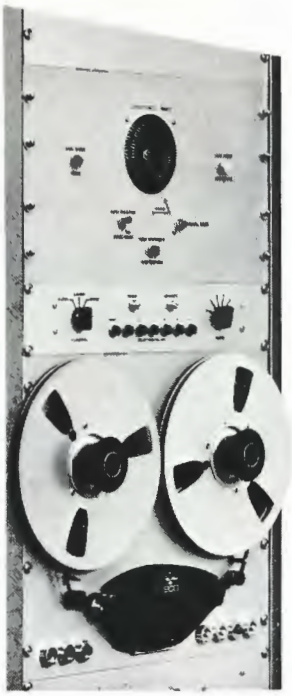
An experienced telephone engineer helped me solve the same problem with one of our remote control radio stations. I simply installed a small Neon Bulb across the loop. The bulb will be activated before the fuses are blown. If you should blow Neon Bulbs, simply use several bulbs in parallel. I later saw commercial equipment for sale in a catalog from Buckeye Telephone Supply Co. of Ohio. In our case we never blew another telephone line fuse or a Neon Bulb.

Paul F. Rex
Chief Engineer
Butler
Broadcasting Co., Inc.

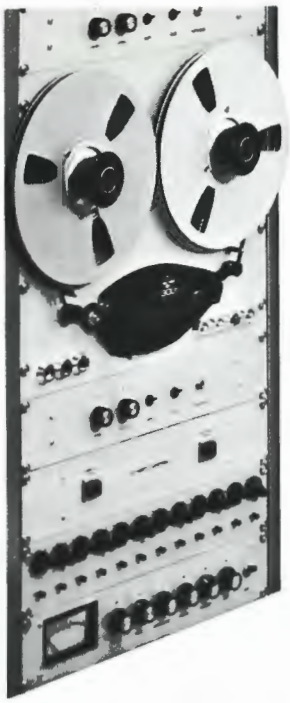
THE TAPE-ATHON 5000 SYSTEM

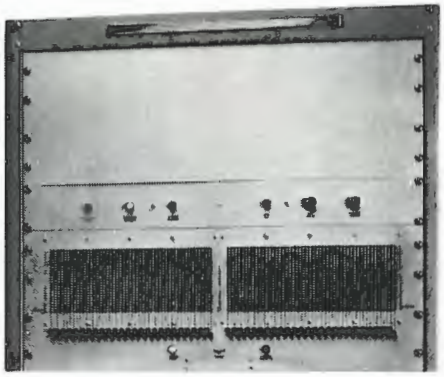


IS DESIGNED AND PRICED TO GET *ANY* STATION INTO SOPHISTICATED AUDIO AUTOMATION



By incorporating a "building block" engineering concept and using high quality mass produced equipment, Tape-Athon can deliver a sophisticated audio automation system for ⅓ less than comparable units. Starting with standard "Carousel" cartridge decks (from one to eight per system) we add **our own** tape transports (up to 9 if you like) and our logger/recorder (optional). The Tape-Athon master timing control and solid-state intersperser permit a wide range of music sequencing.





The ultimate in programming of course is provided by one or more of these switchboards which allow an infinite variety of music/announcement ratios and timing.

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INDUSTRY NEWS

IEEE To Sponsor Cassette Recording Update Program

A new program, entitled "Cassette Colloquia" has been inaugerated by the Institute of Electrical and Electronics Engineers. This program is designed to fill an existing gap in techniques used by the Institute to keep its members abreast of rapid changes in technology, while simultaneously augmenting many of its present programs.

This continuing series will stress tape recordings in Cassette form of special seminars, workshops, sessions, and the like conducted by IEEE the contents of which appear to have immediate value to a wide audience, and for which most likely no other permanent record will exist.

The first offering in this continuing series is a recording of a workshop entitled "Industrial Programming Languages" or IPL-'69. A group of distinguished panelists, led by author and contributor Eric Weiss, took a hard look at the current status of languages for process control and suggested numerous ways in which improvements could be made in both specifying languages and designing new systems.

The IPL-'69 Cassette uses electronic speech compression (a technique which, in effect, "speeds up" the delivery of the speaker without changing the pitch of his voice). The formal presentations by each panelist were compressed using this technique. The question and answer session that follows was kept at "normal" delivery rate. This approach in conjunction with editing, permitted the "packaging" of approximately 2½ hours of material into about 75 minutes of final Cassette.

In addition, the Institute plans to offer a coordinated package of taped commentary and visual material. Current plans include offerings to be made in conjunction with the IEEE 1970 International Convention and Exhibition. Selected subjects from the technical program will be recorded during the Convention, and offered, shortly thereafter, in conjunction with a complete set of authors' visual material as published in the Convention Digest. Other possibilities are also under review.

"Cassette Colloquia" has been initiated by the Educational Activities Board of IEEE as part of its Continuing Education Services. The Cassette IPL-'69 was produced jointly by the EAB and the IEEE Group on Industrial Electronics Control Instrumentation.

Cassettes are available from IEEE through Cash Receipts IEEE, 345 East 47 Street, New York, N.Y. 10017. Price: $6.00 per copy for members. $10.00 per copy for nonmembers.

Continuing Education For Practicing Engineers

A Student Branch of the Institute of Electrical and Electronics Engineers (IEEE) has scored a significant first in a field of major interest to all engineers today—continuing education for practicing engineers. The students, all of whom are enrolled at the University of Waterloo, Ontario, Canada, have organized an eight-week course for all members of the technical community, to present "The Principles, Operation and Applications of Semiconductor Devices."

A team of consulting experts has been recruited from the University of Waterloo, McMaster University, and the Canadian Westinghouse Company's Integrated Circuits Laboratories in Hamilton. They will coordinate and teach the course, for which a registration fee is charged to cover expenses and lecture materials.

For the finest in solid state amplifiers ...look and listen to Gates

AUTOMATIC GAIN CONTROL AMPLIFIER

The most flexible unit you can buy! Features include: Selective "fast, medium, slow" recovery times; a better than 30:1 compression ratio; up to 15 dB expansion; separate expansion and compression disable switches; separate input and output attenuators. All silicon solid state and field tested. Model No. 994-6629.

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Instant peak control! Features include: 30 dB extended control range; fast attack time; low distortion; selectable "fast, medium, slow" recovery times; a higher than 30:1 compression ratio; separate input and output attenuators; readily accessible circuit components; unique dynamic recovery circuit. All silicon solid state and field tested. Model No. 994-6631.

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Peak limiting without clipping! Features include: 3 to 5 micro-second attack time; 30:1 compression ratio allows 99.5% negative modulation without over-modulation; automatic phase reversal with asymmetrical limiting and positive peak modulation levels of 110% or 120% with negative peaks limited to 100%. Completely solid state and field tested. Model No. 994-6543.

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Rules Changed For Determining AM Station Operating Power

Amendment of Part 73, Subpart A of the rules dealing with the determination of power of standard broadcast stations has been adopted by ther Commission, effective December 18, 1969 (Docket 18607). The changes amend the rules concerning the indirect measurement of power of AM stations, the Commission stated, greatly expanding and modifying the rules in Section 73.52 with respect to procedures specified for the determination of the efficiency factor used in computing power by the indirect method.

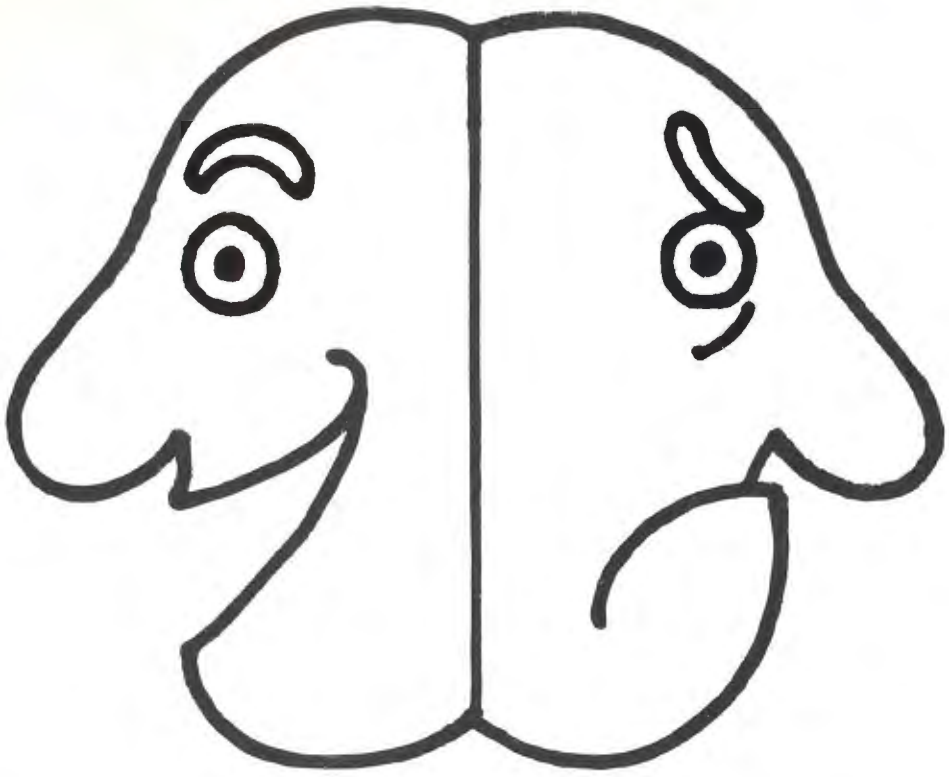
The Commission issued a Notice of Proposed Rule Making in this proceeding, adopted July 15, 1969. Four parties filed comments generally supporting adoption of the proposed changes—Association on Broadcasting Standards, Inc., Collins Radio Company, and E. Harold Munn, Jr., and Charles E. Strain, both consulting engineers. Several suggestions by Munn and Strain were incorporated into the amended rules.

Operating power is to be determined on a temporary basis by the indirect method in an emergency, where the authorized antenna system has been damaged by causes beyond the control of the licensec or permittee; pending completion of authorized changes in the antenna system; if changes occur in the antenna system, or its environment, which affect or appear likely to affect the value of antenna resistance; or if the antenna current meter becomes defective. Prior authorization for determination of power by the indirect method is not required, but an appropriate notation is to be made in the operating log.

Operating power is to be determined by the indirect method by applying an appropriate factor to the plate input power, in accordance with a specific mathematical formula. The value of the efficiency factor applicable to each mode of operation is to be entered in the operating log for each day of operation, with a notation as to its derivation. The product of the plate current and plate voltage, or alternatively, the computed operating power, is to be entered in the operating log under an appropriate heading for each log entry for plate current and plate voltage.

If a station has not previously been in regular operation with the power authorized for the period of indirect power determination, if a new transmitter has been installed, or if, for any other reason, the determination of the efficiency factor by the mathematical formula specified in the amended rules is impracticable, the efficiency factor is to be obtained from the transmitter manufacturer's letter or test report retained in the station's files, or by reference to a table in the amended rules. The table lists several efficincy factors and the method of modulation, maximum rated carrier power, and the class of amplifier for each. The amended rules also specify how antenna resistance and reactance is to be determined.

ARE THERE TWO OF YOU?



Love your neighbor

Business is business.

Get while the getting is good.

It's dog eat dog.

If I don't, somebody else will.

Why do so many of us think and act one way on weekends and another way when we go back to work on Monday? It's one world, you know. And it can become a better one only when a little bit of your better side starts rubbing off on the rest of the week.

RELIGION

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EIA Supports Broadband Systems Future

Broadband communications will open a whole new world of services in the next decade and should be regarded as a "national resource" the Electronic Industries Association's Industrial Electronics Division said in a filing to the Federal Communications Commission.

Because much of the equipment and most of the applications of this equipment in connection with broadband communications networks are still in early developmental stages, the EIA urged that the Commission not specify industry standards at this time but instead keep the door open for new innovations and service concepts.

"We visualize the services for all broadband communication networks that in aggregate will far transcend current entertainment television via cable in importance to the American public, business, and industry," the EIA Division's filing said. It was made in connection with FCC Docket 18397, Part V, which inquires into the development of communications technology and services and has to do with the Commission's rules and regulations relative to community antenna television systems.

In order to render services to meet a wide range of modern-day needs, EIA recommended that FCC provide a regulatory environment that will allow the development of two types of broadband communication networks. A video telephone system with the ability to act as a video output terminal with limited keyboard access to computers and be able to transmit and receive facsimile information at the rate of one second per page.

And a network that would in effect be a minimum 300-megahertz bandwidth "pipe" to provide many information services for home, business, and the government such as broadcast video, first class mail, educational material, transportation information and entertainment.

"Broadband communications is the tool not only to provide a means for new styles in human settlements, but also to rebuild, in a sociological sense, the crowded inner core of major cities," the EIA said. "Broadband communication systems using cable can be structured to promote small, self-determining communities within the massive megalopolis. Through these, city dwellers can find order, identifiable territory, community pride, and opportunity to participate and vote on matters that can be of local option —education, cultural pursuits, recreational interest, and the like.

TV Van In Heavy Traffic

Four sister-television stations will make use of a new television van. Based at Station KSL-TV, Salt Lake City, the van will be used for remote recording by sister stations KIRO-TV, Seattle, Washington, KID-TV, Idaho Falls, Idaho, and KBYU-TV, Provo, Utah. KBYU-TV is an educational station licensed to Brigham Young University. All four stations are owned by the Church of Jesus Christ of Latter Day Saints.

KEMO-TV Jumps Power To 5 Million Watts; Directional Antenna

KEMO-TV San Francisco has installed new transmitter and antenna equipment which increases its effective radiated power to 5 million watts, the highest allowable by the FCC for any television station. The installation has begun operation, thus making the channel 20 outlet one of the two most powerful stations in the country (and the world), and the highest powered in the West.

The installation employs a new 110 kilowatt transmitter (TT-62 A/B), the first in service anywhere, coupled with an RCA antenna (TFU-30JDAS). The antenna is directional—unusual in television—directing the signal to the north, east and south. This in effect, harnesses the entire five megawatts of power to extend the signal into populated areas, at the expense of coverage of the Pacific Ocean.

Thus, KEMO-TV's signal has a planned distribution to help fill the nulls in the Bay Area which have plagued UHF and VHF stations alike.

IVC Plans To Market Educational Videotapes

Plans to create and market a diversified library of educational videotapes in conjunction with Stanford University and the Association for Continuing Education (ACE) have been announced by International Video Corporation.

Donald F. Eldridge, IVC president, said IVC, through its newly formed affiliate International Video Institute (IVI) will offer videotapes of courses originated by ACE, an industry-managed adjunct of Stanford University's Instructional Television Network. The curriculum offered will consist of college level courses ranging from graduate engineering to professional business management.

"We will offer companies throughout the country a variety of leasing packages, some including a complete videotape playback system. Tapes will be made available for companies using major brands of videotape recorders, including IVC.

a full range

of remote controlled pan & tilt heads

for broadcast and closed circuit (educational & industrial) TV

CCTV 30 lbs. max.

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...to accommodate leading monochrome and color TV cameras

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As recognized specialists in the remote control of TV camera equiprnent, we offer a superior line of pan and tilt heads for a wide variety of applications. These include all manner of industrial and educational uses as well as hospital or medical applications, traffic control, security and surveillance, and a host of others.

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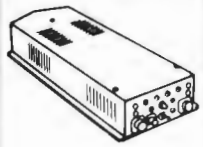

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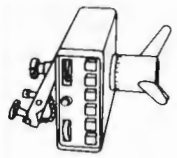
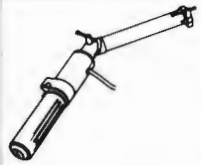
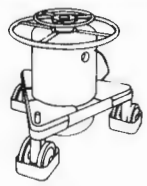


Shot Box

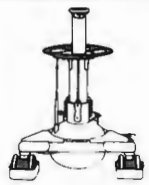


Zoom Control

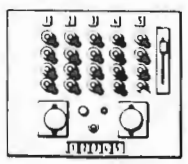
Steerable Tripod



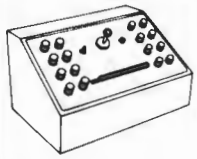
TVP Camera Pedestal



TVP Pneumatic Hi-Lo Pedestal



Broadcast Control Panel



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EDUCATIONAL BROADCASTING

Looking Inside Non-Commercial Broadcasting

By Mike Smith

NAEB Reflects on Responsibility

The 45th annual convention of the National Association of Educational Broadcasters got underway in Washington with "Educational Broadcasting and Social Responsibility" as its theme.

The theme was well covered by challenging speakers such as Myrna Mannes, John Macy and Dr. James E. Allen, Jr. But while the exhibit areas were crowded, many of the sessions were not. And missing from the lineup were technical sessions designed to meet the needs of the educational engineering staff.

Marya Mannes, journalist, author and social critic, in a keynote address at the convention stated that a strong non-commercial network is essential for American life and it deserves top priority in national affairs. "The inability or rather the refusal of the Congress to recognize this is quite simply a national tragedy," she stated. "And the reason for this tragedy is that public broadcasting has not yet managed to penetrate the public consciousness. If it had, the Congress would reflect it."

Miss Mannes submitted that what the Congress sees is "a seedy begger with the cultured voice approaching, cap in hand." Public broadcasting will get the money it needs when it forces itself on the public attention and captures it," she said.

She defined a "lack of imagination coupled with a managerial timidity" as the two major flaws in educational broadcasting. She urged delegates to face that lack squarely and overcome it by using techniques successfully demonstrated in commercial broadcasting. "You can't tell a man anything if he doesn't want to listen and you can't show him anything if he doesn't want to look. The commercial broadcasters know this. We don't. They know how to hook . . . You can borrow a number of their techniques, most of which are showmanship using the form while drastically changing the content." She suggested the continuing story of familiar groups could be used by public broadcasting "to say more about the different attitudes and conflicts in our society than a year of panel programs and weighty ana-

lyses," and recommended that noncommercial broadcasters make better and more imaginative use of their station break time.

She stressed that educational broadcasting must be bold, innovative and aggressive in its programming to provoke strong reactions so that "you will become really public: the hub of a major controversy with passionate defenders as well as opponents across the land. People who never turned to your channels before will turn to see what on earth you're going to do next."

Other NAEB Action

Educational Broadcasters were assured by John Macy, President of the Corporation for Public Broadcasting, that the CPB intends to conduct its portion of the industry's business "in a frank and open fashion with emphasis on receiving as well as sending information and advice." The relationship between educational radio and television and the CPB is so fragile that it could be readily destroyed by a lack of understanding, he warned.

"I think we should anticipate and welcome the opportunity to exchange opposing points of view which are bound to arise. The one thing we must both realize is that the measure of the success of our joint efforts will be determined very largely by the manner in which we handle our differences," Macy stated.

In a speech at the convention, Dr. Allen stated that "we have only begun to realize the potential of TV for instruction in helping to eliminate deficiencies and to compensate for deprivation." He stated that there will be more money available in the future for educational broadcasting, "but we must be realistic and understand that the amount of future support is going to be determined by the hard case we can make for the educational effectiveness of the medium. On that score I view the situation as increasingly promising. This proof-of-the-pudding requirement is one of the motivations behind **Sesame Street.**"

Production of program tapes for affiliated radio stations of the National Educational Radio Network has increased by more than 25 per cent since NERN operations were moved from Urbana, Ill. to Washington, D.C. six months ago, according to Lucinda Landreth, NERN manager.

Warren Kraetzer, executive vice president, WHYY-WUHY Philadelphia, and Karl Schmidt, associate director of radio, University of Wisconsin, Madison, were elected chairman and vice chairman respectively of the Executive Board of Directors of the National Association of Educational Broadcasters at a Board meeting during the convention. Kraetzer succeeds Dr. George Bair, director of television, University of North Carolina, Chapel Hill.

The Board passed a resolution stating that the NAEB staff and membership identify means by which radio and television can deal with matters of major national priorities. The resolution stated that "we are concerned primarily with the need for greater public awareness and commitment to resolving important issues concerned with the natural environment and with the man made conditions that jeopardize it and we are concerned as well with the critical deficiencies in education and the inadequacy of traditional means for dealing with them effectively."

CPB, BELL Working On Interconnect For Program Transmission

CPB is presently negotiating with the American Telephone and Telegraph Company on charges for non-interruptible interconnection service to be provided by the Bell System to CPB for television program transmission.

Noting that CPB and AT&T have not been able to reach agreement on a level of charge that CPB feels is within its ability to pay, although AT&T has proposed rates substantially below those of its tariffs for commercial users, the Commission said it is important to the future development of public broadcasting that the question of these charges be resolved promptly, and stated that it is prepared to enter into informal proceedings to facilitate an early resolution of the question, at the request of either AT&T or CPB; if this fails, the Commission said it will consider appropriate formal action.

In response to a request by the Corporation for Public Broadcasting (CPB) for a declaratory ruling on aspects of free or reduced rates interconnection for educational broadcasting, the FCC has ruled that any provision for interconnection permitting pre-emption or a lower priority for public broadcasting is contrary to the requirement of law that interconnection service be comparable "in all material respects" with service furnished commercial users.

The Commission also ruled that the public interest requires that free or reduced rate interconnection services be provided for public broadcasting, and that all costs for this service, including the cost of new construction, be included in the carriers' total interstate rate base and operating expenses; that carriers proceed "expeditiously" to equip themselves with facilities to fulfill the needs of the Public Broadcasting Act; and that interconnection service be made available to public broadcasting on the same facility basis as service for commercial interests, including, where necessary, the equal allocation of facilities for as long as is needed by the carriers to equip themselves with adequate facilities to meet all requirements.

KUON On Wheels At Fair

Navigating safely among crowds as large as 120,000 scattered throughout 265 acres is no easy task. It's even more difficult when you are transporting a television camera and crew. Finally, the task is additionally complicated by the proximity of displays indoors and out and the festive atmosphere of a state fair.

But crews of KUON-TV of Lincoln, Nebraska, accomplished it all with aplob, crediting the useful versatility of three light industrial vehicles with making the job possible.

The assignment was to cover the multitude of activities at the 100th annual Nebraska State Fair, an event that drew a record crowd of 465,000 in seven days.

KUON, the parent station of the Nebraska Educational Television Network, used a crew of 50 and spent 113 hours filming the activities.

The station's schedule for fair week called for two hours of live programming each evening for eight days, but leaving the schedule open-ended allowed the coverage to run to three hours, two of those nights.

The live evening broadcast was made from the coliseum during the pony judging contests. "Since there was quite a bit of time between events, we inserted filmed highlights of the day during those periods—up to 23 in one night," explained Production Co-ordinator Burnie Clark.

Three seven-man production teams, plus six directors, ten talent personnel and 13 assistants, worked at a hectic 15-hours-per-day pace to record all the highlights of the huge exposition.

Three Cushman flatbed Haulsters were employed for maneuvering the bulky and expensive camera equipment quickly and safely through the immense crowds on the grounds and in the aisles of the exhibition buildings.

Marconi Mark V black and white cameras were mounted on the decks of two of the Haulsters, while the third carried an Auricon sound-on-film camera. The State Fair Board loaned the vehicles to the station.

Tripods were firmly wired to the decks, although Clark said holes would be drilled and the tripods bolted down if the station owned the vehicles.

Operating with generator power from the KUON mobile unit, each camera could range up to the length of a 750-foot cable.

SCANNING THE CATV SCOPE

By Harry Etkin

Telcos Remain Under Fire

There was a time when CATV systems grew almost unnoticed. But even during that period in the evolution of communications, the Telcos saw the potential of this new industry. And so it was that, also nearly unnoticed, the Telcos began building their own systems, systems meant for lease-back purposes.

With both interest groups classed as carriers, it was obvious to some that they inevitably would lock horns. Eventually, the Telcos would become a major influence in the new industry.

Why didn't it work out that way? Try telling system operators today, "We may be the only phone company in town, but . . . " CATV was not without initiative. But Telcos were in a position to squeeze operators until June 26, 1968. On that day the FCC handed down a decision that said the telephone companies represent "an interstate communications undertaking." The FCC required that common carriers obtain Section 214 certificate authorization before building or extending CATV systems for lease-back purposes.

Under the 214 application ruling, the telephone companies must file 214 applications for certificates of convenience and necessity for operation of CATV systems. The FCC also stated that "the telephone company is in a position to preclude from or substantially delay an unaffiliated CATV system in commencing service and thereby eliminate competition."

The struggle over CATV Telco regulation shifts emphasis back to the FCC and Justice Department. What action the Justice Department, Congress, FCC, NCTA and Telcos will take is slowly beginning to take shape.

NCTA on Telcos

The National Cable Television Association has now filed comments before the FCC, recommending that any telephone company which refuses to grant pole attachments be barred from CATV operations. This would include most General Telephone system companies and practically all United Utilities system companies.

The Commission should develop measures for effectively curbing such Telco practices as:

1. Telco delays in approving plans, rearranging poles and establishing changeout costs.

2. Establishing favorable tariff charges on lease-back while periodically raising pole-attachment charges.

3. Overbuilding franchised independent cable operators facilities in order to drive the CATV operator out of business.

The basic questions for the FCC is whether or not it should prohibit Telcos from engaging in CATV activity. Should it adopt a policy prohibiting 214 certificates to be granted in any case where the customer is a wholly-owned subsidiary or Telco related company? If so, why?

Justice For Justice

The Justice Department has stated to the FCC that there is a "serious danger that the existing local monopoly positions of the telephone companies as communications common carriers may prevent the development of an independent community antenna television industry. The significant competitive risks involved in extensive telephone company ownership and/or operation of CATV systems calls for affirmative action by the Commission."

Regulatory authority should be applied by the FCC to require all Telcos to offer pole space to all applicants on an equal basis and it should prohibit Telcos from restricting use of cables by CATV operators, provided it did not violate the technical aspects of the communications network. Telco monopolization will become less of a problem as the FCC and Justice Department keep a tight lid on overreaching utilities.

Telco Abuses

The FCC began to face the Telco abuses by having the FCC's CATV Task Force take separate action concerning the urgency of the Telco problem.

In the Bloomginton-Normal, Illinois, market, the TeleCable Corp., has charged General Telephone and Electronics with anti-competitive activities in attempting to extend General Telephone of Illinois' monopoly position into the communities cable distribution facilities. The FCC CATV Task Force, in action directed against GT&E and its subsidiaries (GT&E Communications, Inc., and GTI) concluded that a Telco-related CATV system should be required to apply for Certification of Convenience and Necessity under Section 214 of the Communications Act. In the Illinois action the General Companies were to show cause why they should not be ordered to cease construction of CATV facilities in the Illinois towns. This was the result of a TeleCable petition based upon GTI's refusal to grant pole line attachments. The FCC also added that the Telephone Company would have a tough time getting certificates from the Commission later because of "anti-competitive conduct."

In another related Commission action responding to questions raised in a complaint by Better TV Inc. of Duchess County, New York, nine New York Telephone Company 214 applications were designated for a consolidated FCC hearing. Better TV petitioned for denial of the Telco's application for CATV facilities in Hyde Park, New York, and also asked for an investigation of the Telco and its parent AT&T relative to furnishing CATV

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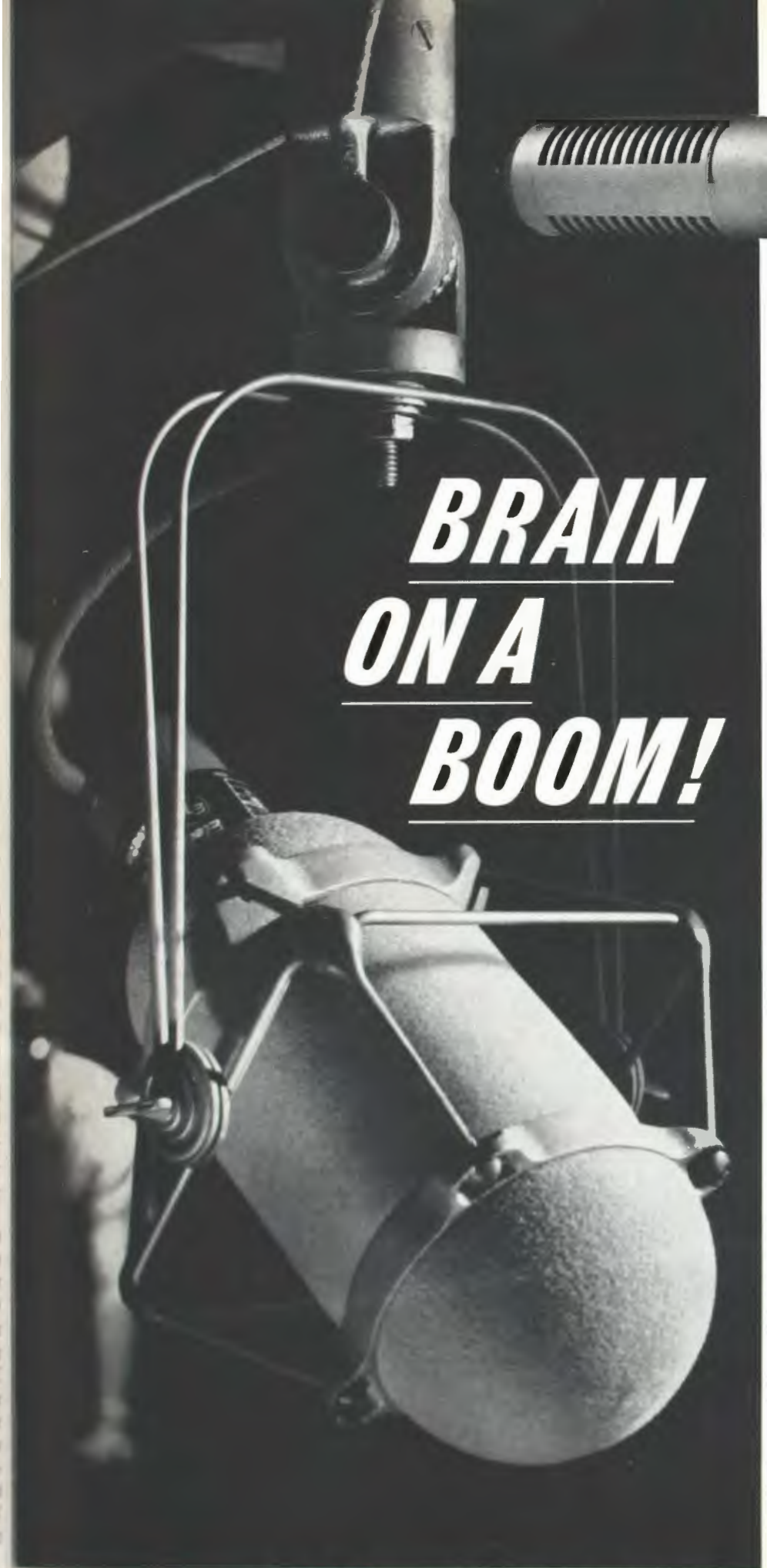

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(Continued from page 20)

leaseback service and pole line attachments to CATV systems and for deferral of all Bell 214 applications until after the investigation.

You will note from these facts that the FCC Task Force is certainly bogged down with CATV operator complaint petitions pertaining to Telco operational abuses. Due to the usual delay in reviewing and FCC judgment of the petitions, the Telcos involved in some cases construct and lease-back the CATV distribution facilities to the CATV operator of their choice before the Certificate of Public Convenience and Necessity under Section 214 of the Communications Act has been issued.

Telco Reaction

The Bell System, General Telephone & Electronics Corp., and United Utilities, Inc., have asked the U. S. Supreme Court to review and reverse the decision of the U. S. District Court for the District of Columbia to uphold the FCC's policy of requiring Telcos to file 214 applications when offering to lease-back CATV systems. The Telcos contend that the common carrier facilities used for this service are similar to, and in some instances are identical to, other facilities long used by the carriers to provide similar services. They claim that FCC approval under Section 214 has never been required. Therefore, lease-backs are either intra-state or come within an exception to FCC jurisdiction and the Commission does not have jurisdiction or authority to require the Telcos to get Certificates of Public Convenience or Necessity.

The Bell System, General Telephone & Electronics Corporation, and United Utilities, Inc., in their appeal to the U. S. Supreme Court claimed that lease-back is either intra-state or out of the FCC jurisdiction. Therefore, Section 214, being applicable to inter-state service, does not pertain to CATV lease-back.

Recently the U. S. Supreme Court upheld the FCC's right to require Telcos to file Section 214 applications when offering to lease-back CATV systems.

Operators vs. Telcos

The Continental Telephone Corporation, Continental Transmission Corporation, and Farmers Union Telephone Company have been directed to show cause why they should not be ordered to Cease and Desist from construction, operation and offering of CATV facilities in Sussex Borough and Wantage Township, New Jersey, in violation of Section 214 of the Communications Act. Garden State CATV, Inc., has petitioned the Commission to issue the show cause order.

Garden State alleged that it had for some time sought pole attachment agreements from Farmers Union, but that such attempts have proven unsuccessful as a result of Farmers Union policy to construct CATV facilities for lease-back purposes. CATV plant facilities are currently being constructed by an independent contractor on behalf of Transmission, subject to a pole attachment agreement between Farmers Union and Transmission, and that such construction is without prior Section 214 certification by the Commission.

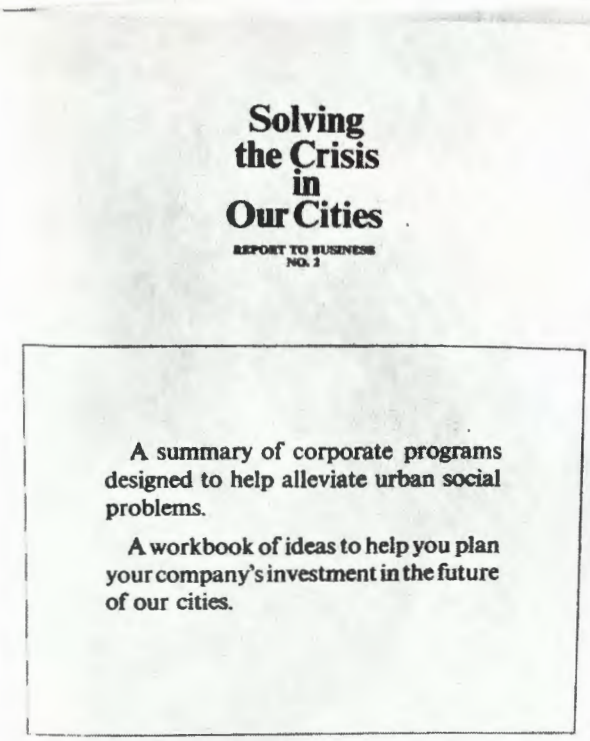
High tariff charges and poor public service were among the complaints lodged against Rochester Telephone Company by Warsaw Television Cable Corporation. The CATV system operator raised objections to the telephone company's application for 214 certification. Warsaw Cable, through its petition, said it had been forced to accept lease-back arrangements against its will and that the Telco reversed its position and denied Warsaw Cable any access to pole attachments.

A New Direction

American Telephone & Telegraph Company in its comments on Part V of FCC's CATV rulemaking proceeding, stated that the state of the art is simply not sufficiently advanced to make decisions which may be irrevocable as to the public interest considerations involved in determining which services should be offered, and how they should be provided. Sound public policy requires that the Commission permit common carriers maximum flexibility to innovate and experiment.

In a related development, after the U. S. Supreme Court upheld the right of the FCC to regulate Telco activities in carrying cable TV signals, AT&T reversed its previous CATV policies. It was understood

TRAINING THE UNSKILLED MINORITIES ISN'T JUST FOR GIANTS



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Oxford Chemicals feels a smaller firm like itself is in a better position to attract and train hard-core unemployables because they feel it is hard to compete within a large corporation. Oxford finances its own training program, sending employees to school at night. Each trainee is assigned to a trainer of the same ethnic group.

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(Continued from page 22)

that the Bell System proposes to let cable television operators and others attach their own cables on AT&T telephone poles and through its underground ducts and conduits almost without restriction.

The FCC viewed the change as a major concession by the nation's biggest telephone system. In a letter from William Ellinghause, AT&T's vice president for marketing and rate plans, to the Chairman of the FCC, said that past policy of its Bell Telephone System allowed: only one cable TV system attachment to a pole; barred outside systems TV cables from underground conduits; and agreed to carry only cable TV signals taken "off the air" or originated locally for entertainment or education. This was to protect its service from interference.

The Bell System promises that it will make reasonable efforts to provide pole attachment and conduit space to all legally qualified applicants at appropriate charges. This change to the restrictive Telco CATV practices are due to the Telco CATV policies which have come under strong pressure from the Commission, the Justice Department, and the direct result of NCTA's efforts.

Cable TV must play a decisive role in changing the CATV-Telco policies. CATV has an obligation and an opportunity. The obligation is to serve the information and expression needs to the subscribers. The opportunity is one which may mean revolutionary changes in American communications.

With its recent declaration, AT&T offered a vehicle for securing a compromise for the CATV-Telco controversy. Regulatory recommendations should be proposed in the CATV-Telco rulemaking which provide the answers to this and other CATV-Telco communications problems.

The FCC should require all Telcos to offer space and to prohibit Telco pole-attachment contract restrictions, provided they do not interfere with technical integrity. Telcos should be prohibited from offering direct CATV service and also Telco CATV affiliates from operating CATV systems in the Telco service area. The FCC should not allow a repeat of Telco monoply patterns.

Ed. Note: The CATV editor invites readers' comments on this and other issues of interest to CATV operators. Address your letters to: Harry Etkin, CATV Editor, Broadcast Engineering Magazine, 1014 Wyandotte, Kansas City, Mo., 64105.

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All in all, close up or at a distance, the Shure SM58 solves the kind of ever-present perplexing problems the audio engineer may have felt were necessary evils. The SM58 might well be the finest all purpose hand held microphone in manufacture today. And, all things considered, it is moderate in cost.

Other features: the complete pop proof filter assembly is instantly replaceable in the field, without tools. Filters can be easily cleaned, too. Stand or hand operation. Detachable cable. Rubber-mounted cartridge minimizes handling noise. Special TV-tested non-glare finish.

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Automated and Solid State . . .

A STATION DESIGN FOR THE 1970's

By Robert A. Jones and Bruce Micek*

■ Solid state equipment. Automated gear. These are familiar terms, but when applied to small stations they take on new meanings and increase the flexibility of the total station design. The planning and designing at WELF is an example of what can be accomplished when solid state equipment and automated gear are combined with unique facility design.

*Robert Jones is a Consulting Engineer in LaGrange, Ill., Bruce Micek is an engineer at WELF.

With this in mind, let's take a look at a station that is all transistorized, except for its RPU receiver, two tape transports and one tube in the transmitter.

WELF Floor Plan

The beginning point and major restriction in all compact stations is the floor plan. Figure 1 reveals the floor plan we designed for WELF. The basic design of a compact station demands that the studios and offices be combined at the transmit-

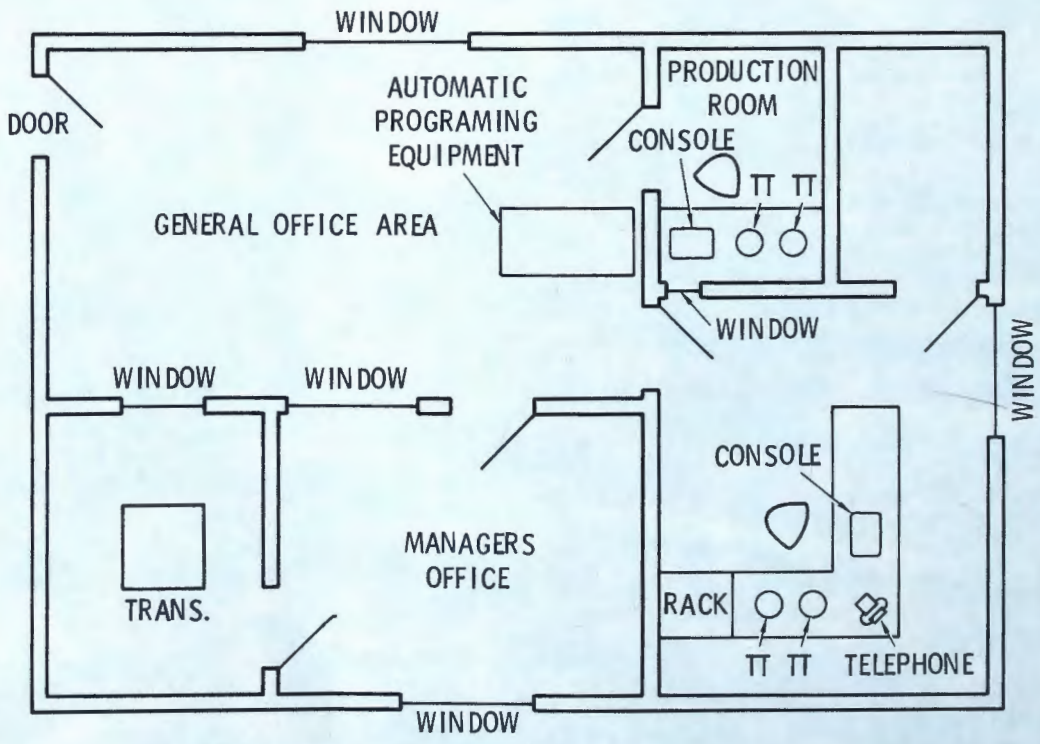


Fig. 1
Floor plan of station WELF.

ter site. Since WELF is a non-directional station, this further simplified the space and equipment requirements.

The front entrance leads directly into the general office area. Two desks are placed there to accommodate the WELF "girl friday" and the WELF sales staff. This area also doubles as a reception room. A unique feature here is the placement of the Vangard transmitter. It is located in a separate room, but can be viewed directly through a window from the office-reception area by visitors to the station.

The advantage of isolating the transmitter in its own room is that the temperature and air flow can be more closely controlled. Proper temperature and dust control are important to the operation of the equipment and to reduction of mainenance time required.

The WELF transmitter is operated by remote control, since it can not be viewed directly by the operator on duty in the control room. This may seem odd, since the transmitter is in the same building and only about 20 feet from the operator. But to fully comply with the FCC Rules, Section 73.92(a), remote conrtol is necessary. This section states that the transmitter shall be clearly visable to the operator at his normal operating position and that the operator be able to control the transmitter's basic functions. And this keeps the transmitter out of reach of would-be knob twisters.

The general manager's office is located between the transmitter room and the office area. This arrangement was made because the general manager is also the chief engineer. The remainder of the building gives space for the control room, the production studio and the rest room-storage area.

Control Room

The control room is used for all "live" programs and for primary control when the operation is automated. Nothing unique was used in the layout of the console or turntables. We realize that each station operator has his own ideas in this area. We chose an "ell" configuration. The elongated desk provides space for a second mike. This permits interviews or group discussion programs to be aired. The console is a solid state unit by Sparta. This was chosen because of its small size and its simplicity of operation.

The turntables are mounted to the right and slightly lower than the console (The right side was used since all our operators are right-handed). Adjacent to the turntables is a single 19-inch relay rack. The remote control meters for the transmitter, the solid state limiter, a single reel-to-reel tape machine, an FM receiver, a remote pickup receiver and a single cartridge machine fill this rack.

Next to the console we mounted control switches to permit the operator to start or stop either turntable, the reel-to-reel tape machine, or to step the carousel cart machine in the automation equipment.

Production Studio

The production studio is quite compact. Another small, solid state console is used here. This is identical to the one used in the main control room. It was decided to use identical units since it would provide a complete backup in case of equipment failure. The other equipment in the production studio includes two turntables.

No cartridge machines are located in this room, but this was not an oversight. Originally we did have two cartridge units. However, when WELF switched to partial automation of its programming, these two cartridge units were relocated in the ATC racks. This creates no problem for the operator who has to cut some spots. The ATC racks are located just outside the door to the production room. (See Figure 2.) It is a simple job to open the door and insert or withdraw a new cart. Remote control buttons have been installed in the production room to operate these two cartridge machines, as well as one reel-to-reel machine. In addition, buttons were added to insert the proper tones for use of the produced carts with the automation unit.

As noted, we selected, primarily, all transistor equipment. These is no doubt that today's transistors are good. They have proven highly reliable. Also, most engineers recognize that with transistor equipment there is considerably less heat. Remember that heat is a big contributor to the deterioration of component parts. Heat has a way of raising maintenance time required, and certainly equipment breakdowns.

Electronics

Figure 3 is a block diagram of the basic design of all equipment employed at WELF. We have not shown types and model numbers of each piece of equipment, since each reader has his own preference. The dashed lines represent the boundaries of the transmitter room, con-

Fig. 2 The ATC racks are located near the production room door

trol room, production room and the automation program area. As noted previously, the only equipment located in the transmitter room is the solid state transmitter. This room has controlled air flow to maintain the transistors and circuit boards at a constant temperature. An opening has been provided in the floor directly behind the transmitter to bring in cool air. An exhaust is also provided in the ceiling directly above the transmitter. This is used to exhaust directly to the outside during periods of high temperature, or can be used to return warmed air to the heating system of WELF during cold weather.

The monitors, both modulation and frequency, are located in the control room along with the limiter which supplies the program audio to the transmitter. The output of the transistor console feeds the limiter. All programs and program originations pass through the control room console. Inputs to this console (with switchable position) include four possible mike inputs, one cartridge input, two turntable inputs, one reel-to-reel input, one FM off-air receiver input, one remote pickup (160 MHz) receiver input, the telephone beeper input, inputs from automtaion equipment. The manufacturer of the console, does not claim this much can be done, but we did it, and it works extremely well. This was in keeping with our original concept of getting the maximum use out of the minimum of equipment in a compact, efficient facility.

The production room has an identical solid state console. This duplication of equipment provides less confusion to the operators, a 100 percent back up in the event of failure of one or more of the printed circuit boards in the main console, and the fact that the spare boards and components on hand to repair the main console can also be used as replacements in the production

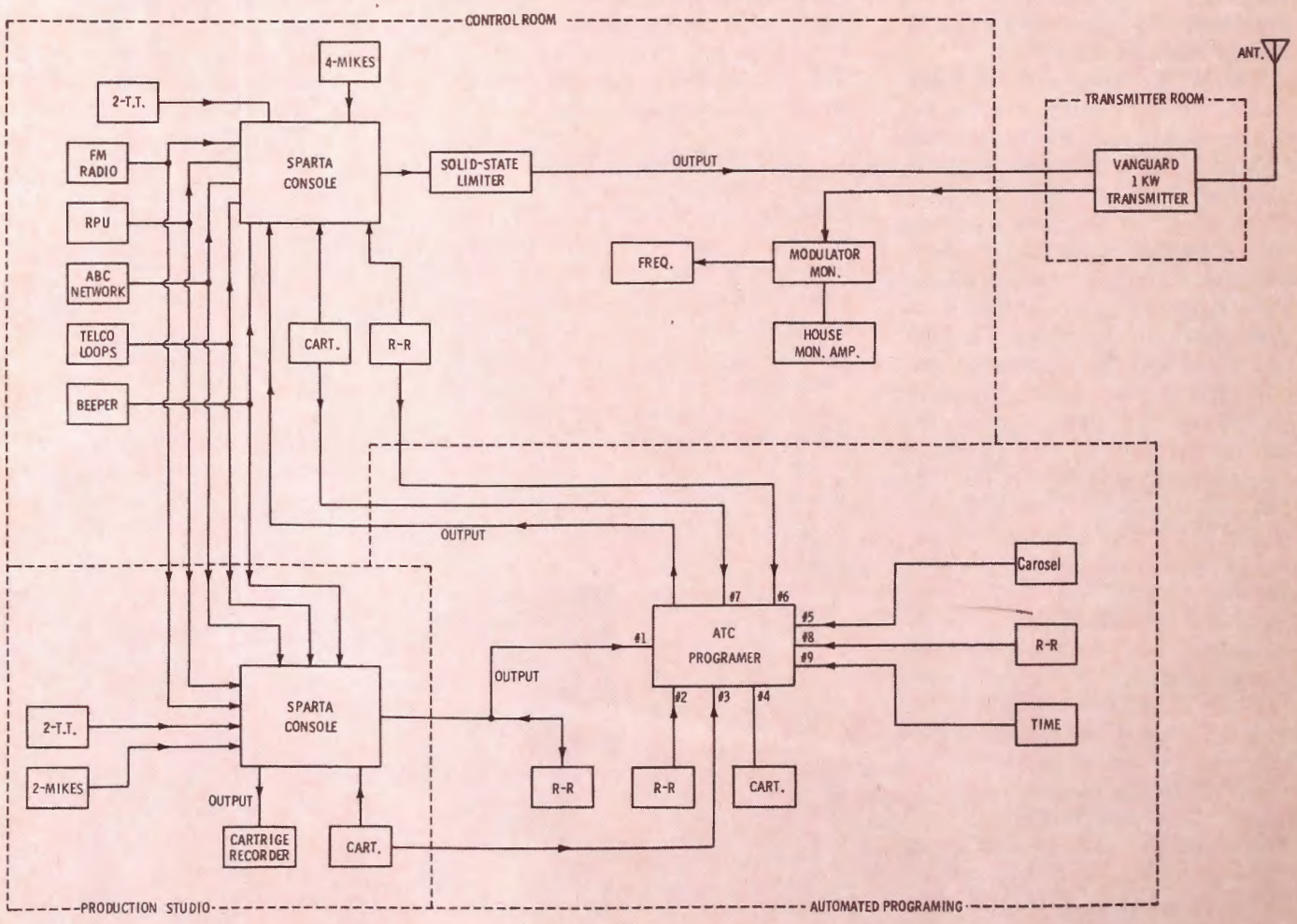


Fig. 3 Block diagram of the basic design of all equipment employed at WELF.

console. This cuts down the number of spare parts that must be stocked by WELF.

The inputs to the production console consists of two mikes, two turntables, the off-air FM receiver input, the remote pickup (160 MHz), the telephone company beeper, the other local telephone loops, and one cartridge machine. The outputs from this console are numerous. The finished product can feed a cartridge recorder, a reel-to-reel tape machine, the automation equipment, or go directly on the air.

Automation

The final element in WELF's solid state equipment in its automation gear. In our case we used a basic Gates-ATC unit, and then added to it to meet the specific needs at WELF. The basic programmer is given a choice of nine separate inputs. These are as follows: Input 1 is a reel-to-reel tape recorder used mainly to feed music; Input 2 is a similar reel-to-reel tape recorder used for the same purpose; Inputs 3 and 4 are single play cartridge playback units used for weather reports, delayed news, etc.; Input 5 is the carousel cartridge tape machine for all spots; Input 6 is used for spare or utility purposes and it connects to the reel-to-reel machine in the control room; Input 7 is the cartridge machine in the main control room for station breaks or other general purposes; Input 8 is another reel-to-reel machine used for delayed programs; and Input 9 is the time announcer. As you will note in the block diagram, automatic programming controls every tape machine in either studio, both cartridge and reel-to-reel, taking maximum advantage of all equipment.

Maintenance

Several comments should be made with regard to maintenance procedures for an all transistor station. First, as noted at the outset, we designed WELF for a minimum of maintenance time. The two main factors necessitating repair or preventative maintenance are heat and dust. The WELF transmitter was installed in its own room, permitting absolute control of air flow and temperature. There is a separate fresh air (filtered) input for this room. The exhaust can either be directed outside or inside. This is not uncommon procedure for a station operating in the northern climate. The only maintenance follow-up is to change or clean the air filters regularly, and to clean the inside and outside of the transmitter at least once a month.

Fig. 4 Console, turntables and rack as shown in lower right area of Fig. 1.

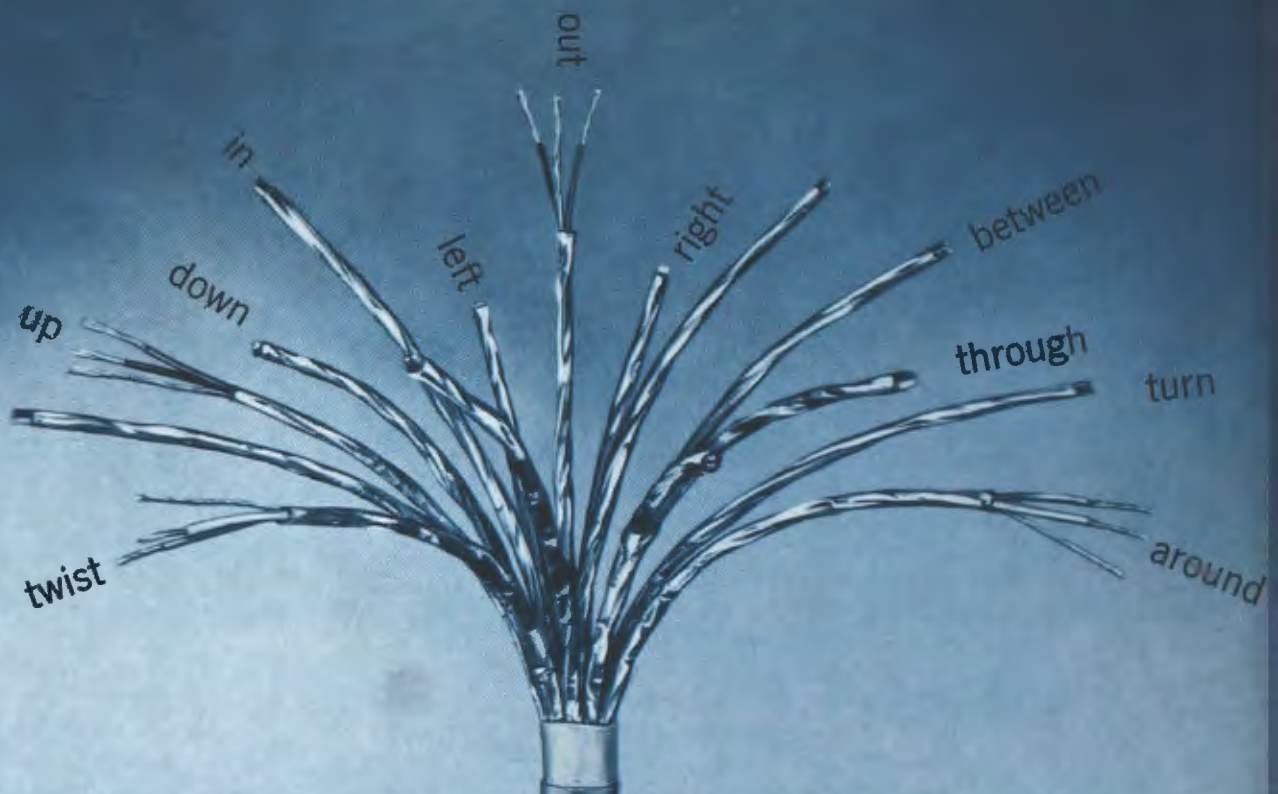
The studio equipment is located in the portion of the building that is air conditioned; therefore, all temperatures are controlled. Regular maintenance here also includes thorough unit cleaning once a month. The heads of each cartridge machine and each tape recorder are cleaned every other day. The average time required to pull a complete maintenance schedule each month is about two hours. In almost twelve months of operation, WELF has had no major breakdowns or technical problems. We must conceed that part of the reason for lack of failure or component breakdown may be due to the fact that WELF started with all new equipment.

One distinct maintenance advantage we have with solid state equipmen is that in the event of part failures, a new board can quickly be substituted and the equipment returned to service. Where tubes are used, this freedom is not available. With tube type equipment, unless the fault is a tube, the unit normally must be unplugged, disconnected, and then removed to the work bench for servicing.

To service and repair transistor boards and amplifiers one must take a few precautions, but these have been discussed by others in articles previously published in **Broadcast Engineering,** and in a current series, Transistor Service Tips, written by BE's technical editor. We trust that the ideas of physical design and electronic circuits will be of help to the reader. The WELF operation can serve as a guide to those considering a transition to automation and more use of solid state equipment.

Editor's Note: The WELF plan can open new doors for commercial and educational FM stations. Efficiency is important in all stations, but here is an operation that is especially applicable to stations whose budget, space and staff is limited.

Feel Free To Flex



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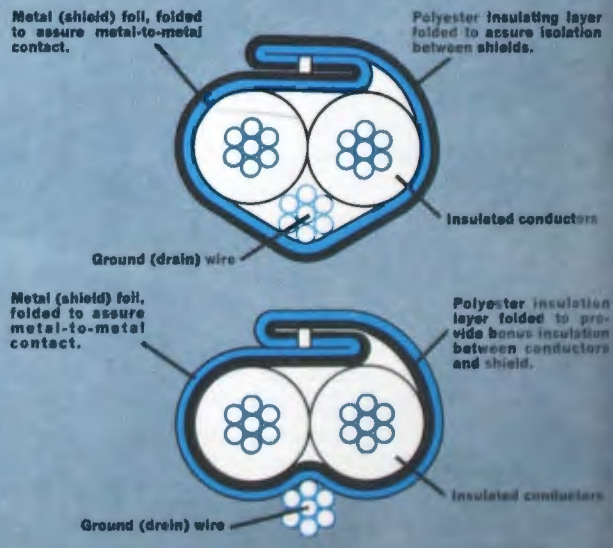

A NUTS AND BOLTS PROCEDURE

General Transmitter Maintenance

By Patrick S. Finnegan*

Whether it be a modern cabinet in decorator colors that blend well with the new control room decor, a growling monster out in a back room, or a mysterious device locked up in solitary confinement out on a hill somewhere, the transmitter is the unit that puts the word "Broadcast" in the term Broadcast Station. It is often ignored by other departments in a station, and all too often by the lesser technically inclined operators—until it quits. Without the transmitter a Station is out of business. This means the transmitter must work reliably all the time. And this takes maintenance.

Classes Of Maintenance

Maintenance can be classified into two types: preventative maintenance and catostrophic maintenance. Preventative maintenance is the care, cleaning, inspection of connections and contacts, oiling blowers, and logging of day to day meter readings. Each is done to keep the normal wear and tear from advancing to the point of failure. Catostrophic maintenance is necessary when the transmitter quits because of a tube or component failure.

Progress has been made in modern transmitters in the areas of reliability and stability. Consequently, they need little routine operating attention, and those on remote control need checking only once a day during the required inspection period. The improved reliability and stability is good, but this often leaves operators with little opportunity to gain knowledge of their transmitter. When a catostrophic failure does occur, some tend to hit the panic button.

The only way to avoid the panic button is through confidence by the engineer. This comes from knowledge of his transmitter. Much knowledge can be gained through the regular routine maintenance and inspections and by reading the transmitter manual. As an engineer works with transmitters, he soon realizes that all transmitters have many basic things in common.

Over Confidence

Confidence and familiarity with his transmitter is one thing. Over confidence and to use an old saying "familiarity breeds contempt" are something else. Contempt for high voltage circuits is something an engineer must guard against. These circuits can range up to 20,000 volts. Such voltages are not only unhealthy, but are downright lethal. Alertness, caution and a healthy respect for high voltages is an absolute must!

To work alone or with an assistant is an age old question where high voltage is concerned. Whenever possible, an assistant is advisable. He should at least know how to turn off the main circuit breakers and use whatever emergency procedures may be called for. As a practical matter, the engineer generally finds himself working alone.

Regardless of whether or not the engineer has an assistant present, he

With this issue of **Broadcast Engineering,** Patrick S. Finnegan will begin a series of articles dealing with maintenance. And while the title of Maintenance Editor may be new, Pat certainly is not new to the magazine or the industry.

His long record of service spans 26 years, interrupted only by three years in the Air Force during World War II. Even then Pat was doing communications work in a radar company.

During his career as a broadcast engineer, Pat has been involved in AM, FM and full time stereo station construction. And this includes one station that used a six-tower directional antenna. Of course when television made its appearance on the commercial scene, he was on his way from stereo to VHF and then UHF. In fact, his book **Planning The Local UHF-TV Station** (Hayden Press) went on sale in 1965.

Pat's work as an author didn't end with that book. He became a consulting author for **Broadcast Engineering.** On the article writing side, he has had 19 technical articles published.

After having held administrative, maintenance and operational positions, Pat is now the Engineering VP of the Tri-City Radio Corporation. They operate WLBC-AM, WMUN-FM, and WLBC-TV in Muncie, Indiana.

Pat's major contribution to the magazine in 1969 was his series of articles on Proof of Performance. We think you'll be interested in following his work during 1970.

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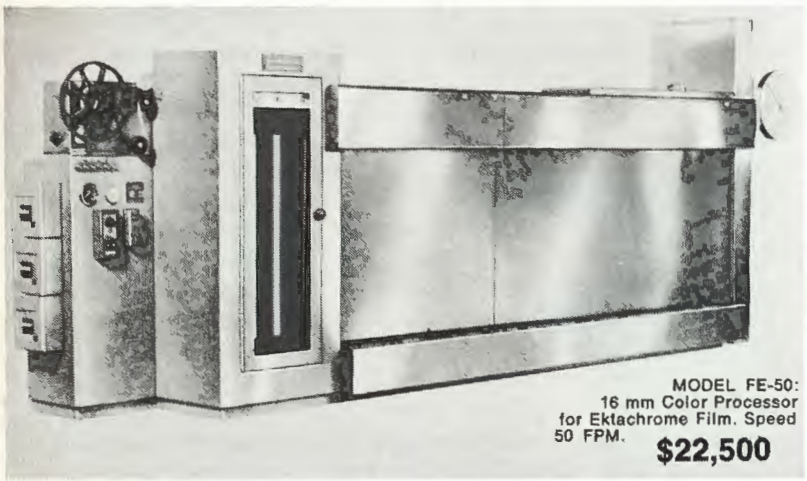

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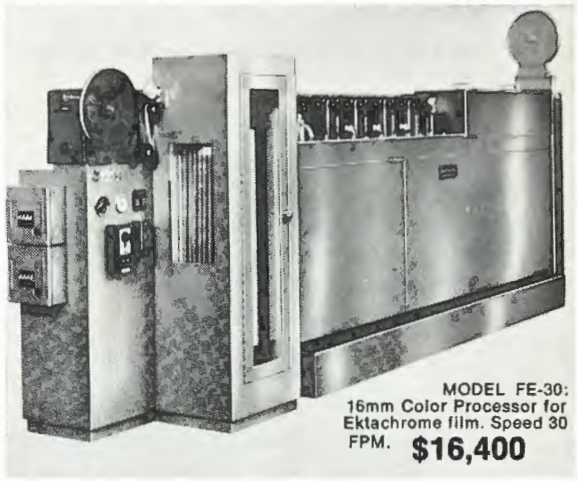

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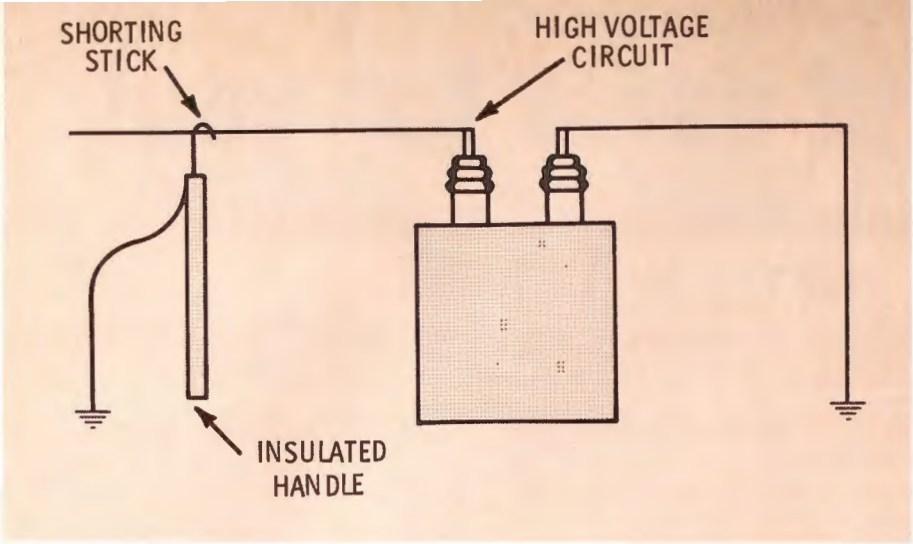

Fig. 1 Hang a shorting stick on the high voltage circuit, leave it there until your work is finished.

should learn to rely upon himself. He should turn off the switches, short the circuits and be certain high voltage is not present. A misunderstanding of signals with his assistant can cause the engineer to touch a live circuit or one that was not bled.

Basic Divisions

Transmitters operation on AM, FM, low or high band, VHF TV or UHF TV will present their own special service problems. However, all transmitters have points in common which can be divided into four general divisions: mechanical, electrical, electronic and monitoring.

Mechanical includes such things as the cabinet, doors, physical mountings, cavities, insulators, blowers, air filters and water pumps.

Electrical includes main AC power circuits and breakers, control ladder with all its various relays, transformers and low and high voltage power supplies. The processing of power line power is converted as efficiently as possible into an RF carrier.

Electronic includes all the RF and intelligence circuity, such as crystals, tubes, multipliers, tuned circuits, modulators and filters necessary to generate the RF carrier and impress upon it the intelligence to be transmitted.

Monitoring, as considered in this article, is the metering that samples various circuits within the transmitter to indicate its performance.

Mechanical Maintenance

Air blowers and the amount of air moving will generate both noise and vibration. Heating and cooling of the parts and cabinet will cause expansion and contraction of parts. The effect of this process is a tendency to loosen the nuts, bolts and screws in the transmitter.

Checking and tightening around those components that require maintenance should be part of a routine check. Experience with a particular transmitter will indicate those parts which tend to come loose.

Loose hardware on RF shields can cause feedback problems and unwanted radiations. In one case a UHF transmitter suddenly developed severe multiple ghost images in its transmitted picture. The problem was traced to a small glass, through-the-wall tuning capacitor in a multiplier next to the visual mixer/modulator. The hold down nut, which was also a ground connection, had worked loose. RF from the power stages coupled back into the mixer through this capacitor. Tightening of the nut cleared it.

Blowers also require maintenance. They should be oiled or greased as per the manufacturers instructions. This can be overdone as well as neglected. Once a bearing has been allowed to run dry higher vibration and a shorter life can be expected.

Blower belts should be maintained at proper tension and replaced when they start to fray. The use of a belt dressing is optional. A loose belt will reduce the amount of air flow. In addition, squirrel cages and fan blades should be kept clean. Dirt will adhere to these and build up so that the air flow is further reduced.

Most transmitters that require a high air flow to cool tubes and seals will sample this air flow and interlock it. If the air flow is not enough, the transmitter will shut down.

Air filters need to be inspected and cleaned or changed often, depending upon the environment of the transmitter. A clogged air filter will also reduce air flow.

The water cooling systems require constant maintenance. Water flow is sampled and interlocked as is air. The joints must be leak proof and the filtering system and pumps regularly inspected.

Cleanliness is always difficult to maintain. In spite of air filters and tight cabinets, dust will get inside. And high voltage will then attract dust. All high voltage insulators should be kept clean, as dust will provide a lower resistance path for the voltage, especially during periods of high humidity. An arc-over can cause a carbon path that is difficult to remove. If this happens, the insulator must be replaced. Ceramic insulators should be cleaned with alcohol or clorothene. Minor cleaning can be done with a damp cloth and tap water. Make sure the insulator is dried before applying power. Other insulators, such as polystyrene, should be cleaned only with a damp cloth. Care must be taken when using cleaning fluid so it does not dissolve the plastic or leave any residue than can conduct.

Electrical Maintenance

Control ladders generally operate on 120 or 220 VAC. This voltage is routed through various relays whose contacts are plated and shaped to carry current.

Relay contacts should be treated with care. Cleaning should be done by dusting and polishing the contacts with a piece of paper or burnishing tool. Do not file contacts indiscriminately. If arc-overs do occur, pits and hills will develop on the contacts. These require strong measures. Use a point file to even the contacts and clean off the carbon with alcohol. This will help, but burning will occur more often

Fig. 2 A hot and/or swelling capacitor case are warning signs of an impending failure. Also, watch for oil leaks around insulators.

after filing and the contacts will need to be replaced. Remember, each filing will widen the contact gap.

If primary AC circuits are properly installed, they require little maintenance. An occasional measurement of the current flowing in each leg of a three-phase system is recommended to make certain the lead is balanced. If one or more phases suddenly drop, it may be an indication that one of the main breakers is going bad. Another check on the phases is a voltage check across each (during the daily inspection) with the transmitter panel meter. The daily inspection should include a check of the temperature of the breakers. Feel the front of the breaker. If properly rated they should not run warm.

Proper size AC cables should not run warm either. The primary cables are large metallically and will conduct heat. A cable that is at normal temperature, but running warm less than a foot from the connector indicates that the connector is heating. These cables carry high currents and the connection must be of a very low resistance. In a circuit carrying 100 amps, for example, even 1 ohm is too much resistance. Cables that are heating will eventually cause the insulation to harden and become brittle. The wire at the connection will change character, harden, and eventually fall apart.

Filament power supplies may be either AC or DC, but both carry high current. High current requires very low resistance connections. Keep filament connections clean and tight. One UHF transmitter uses a filament supply that delivers 1500 amps to the final tube. A loose connection here and one has an arc welder on his hands.

Because most high current filament supplies are low voltage, the engineer may get careless. Caution should be taken when working on the supply when it is on. Do not wear rings on your fingers. If the ring should short across the supply, it can weld to the supply in an instant and the ring finger could be burned.

High voltage supplies usually have an automatic device to short out the capacitors when the power is turned off. Never rely on these devices to do the job. (See Figure 1). Always use some shorting device, such as a shorting stick, and leave it hanging on the circuit until the work is finished.

Heating is again a sign that high voltage capacitors are going bad. (See Figure 2.) Oil filled capacitors can swell up or oil leaks may develop near the insulators. When any of these conditions are present, trouble is brewing and the capacitor should be replaced.

High voltage capacitors should never be checked with an ohmmeter. The high voltage will polarize the oil molecules and even though the capacitor is shorted, once the short is removed, a voltage will again build up on them. When a capacitor has been removed from service, whether placed on the shelf or discarded, the terminals should be shorted together with a small piece of wire.

Grounding relays can become highly resistant from too much voltage being shorted. These contacts should be kept clean. A quick test to see if these relays are doing their job is to observe the plate voltmeter. When plate voltage is turned off the plate voltmeter should drop to zero instantly. If the relay is not shorting the supply, the plate voltmeter may drop off slowly to zero.

Electronics

Control of RF energy is not an easy matter. When given even the slightest chance RF will leak out of its circuits and get into other circuits. Maintenance calls for keeping the shielding and joints around RF boxes clean, tight and completely shielded.

The leads into RF boxes are often a source of exit for RF. Ordinarily these leads are by-passed with feed-through capacitors. Some transmitters have shown up in the field with paint on the chassis under these capacitors. Such a problem can be most difficult to find, especially when such capacitors are

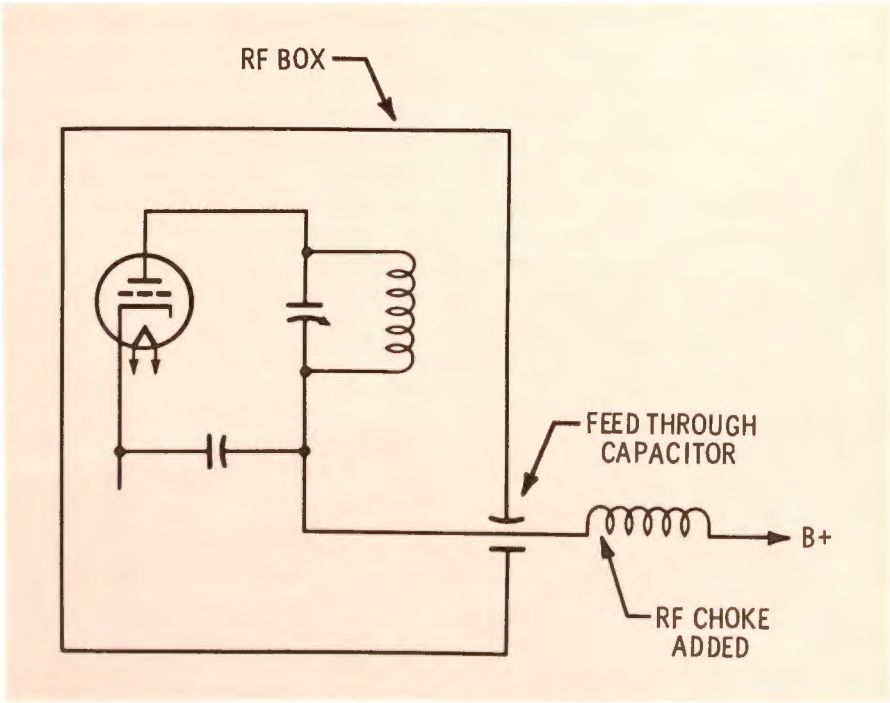

Fig. 3 Mounting a small RF in series with a lead to insure against leakage getting past the feed-through capacitor.

physically difficult to get to.

Feed through capacitors are not always sufficient to keep the RF inside the box. (See Figure 3). Small prepackaged RF chokes can be installed in series with the lead outside the box. The choke should be selected for the frequency involved and should be able to carry the current of the lead.

Neutralization

Direct feedback is a serious problem when it occurs within the same stage. This can be caused by improper neutralization. Any transmiter that has one or more stages that require neutralization will describe the method in the instruction manual. Conventional circuits used in AM and FM require a different method than that of a cavity stage.

Here is a technique that can be used for conventional stages when the neutralization is only slightly off. First, peak the tuning of the grid circuit of the stage in question. Observe the grid current and plate current meters of the stage while tuning the plate circuit through resonance. In a stage that is properly neutralized, the grid current will hit peak at the same instant the plate current hits the bottom of its dip. If this is not the case, the neutralization should be touched up.

A stage that is slightly out of neutralization may be unstable, causing the tuning to constantly drift. For a cavity stage, remove the plate voltage from the stage. Measure the voltage across the cathode resistor so as to keep the drive within bounds. After the plate power has been reapplied, observe the power output meter. Adjust the neutralization control to a minimum. The small amount of power being coupled through the stage will be amplified by the upper stages and is easier to see. Measure the cathode voltage with a regular voltmeter. Without plate voltage the tube acts as a rectifier. This measurement cannot be made while programming.

Multipliers

Multipliers, if carelessly tuned, can become oscillators. This is particularly true of those stages where the tuning is very sharp. One may tune past the correct point. One UHF transmitter I've seen had a medium power stage where this could happen. This oscillation could be tuned up and the transmitter appeared to be working normally. The frequency monitor was very unstable and the aural monitor gave out some peculiar noises. The oscillating stage, however, would only last a few minutes before the tube blew.

One technique you can use to be certain that no stage "has gone into business for itself" is to either switch out the crystal or pull it out of the circuit. Without the crystal driving the transmitter, the grid current and plate current readings should drop to a lower value or to zero. The antenna current and power output meters should drop to zero immediately. If they do not drop, a stage is oscillating.

Unwanted radiation in UHF and VHF TV transmitters can be a headache. As the wavelengths get shorter they find their way out of containment easier, particularly the power stages. The engineer can build a little device to detect RF leaking from these power stages called an "RF sniffer". This is a small neon lamp, such as an NE-51, with a resistor in series to control its sensitivity. When plugged into the AC power, this can be run along seams, door edges, cables and other spots around power RF cavities. RF will cause the lamp to change from its normal orange color to blue or purple.

RF Efficiency

Efficiency of all RF stages is another concern, especially the power stages. The greater the efficiency, the less the stage has to work, and the less power is wasted in heating up components. This will also contribute to longer life for both tubes and components.

Good, clean, tight RF contacts are the first step in this area. RF will burn loose contacts quickly, and the higher the frequency the quicker they burn. Since RF travels on the surface of conductors they must be kept clean.

If contacts on large air coils of AM transmitters are burned they should be cleaned. If the spot on the coil cannot be cleaned thoroughly, the contact should be moved to an adjacent spot and the difference made up with other adjustments. If the strap should break, replace it with a clean copper strap.

The upper VHF and UHF transmitters use partial to full cavities. These require a different approach as the contacts are generally spring or finger contacts. Such contacts should be clean and firm. They should not be too tight, since tuning over a period of time will cause the contacts to wear grooves in the cavity walls. This can mean an expensive replacement. On the other hand, the contact should not be so loose that arcing occurs. Tuning a cavity under full power should be done cautiously as the RF can burn off the contact.

Cavity RF surfaces are silver plated and will tarnish after a time, but this probably will not effect their performance. Whenever a cavity is opened for cleaning or repairs, it is best to clean these surfaces with silver polish. The polished cavity seems to perform more efficiently.

Tube life and efficiency depend upon proper voltages, efficient cooling and proper tuning. Connections to the tube must be clean and tight or the tube will not work properly. Burning of tube contacts, or breaking off a tube contact, can cause loss of tube functions, although the tube elements may still be good.

And don't forget that heating and cooling of the filaments affects tube

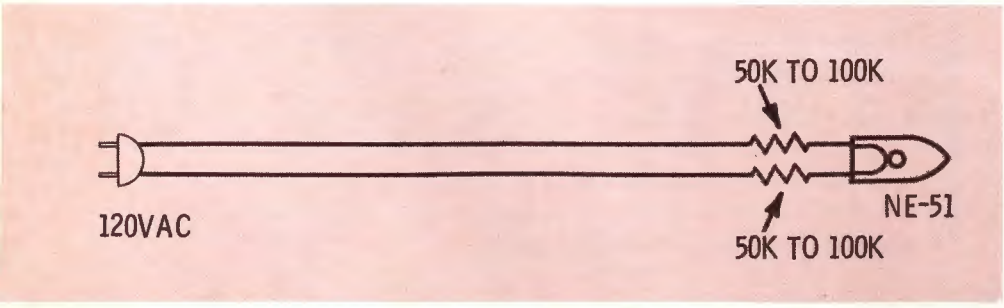

Fig. 4 The RF sniffer. The resistors should be of such value that the neon lamp barely lights.

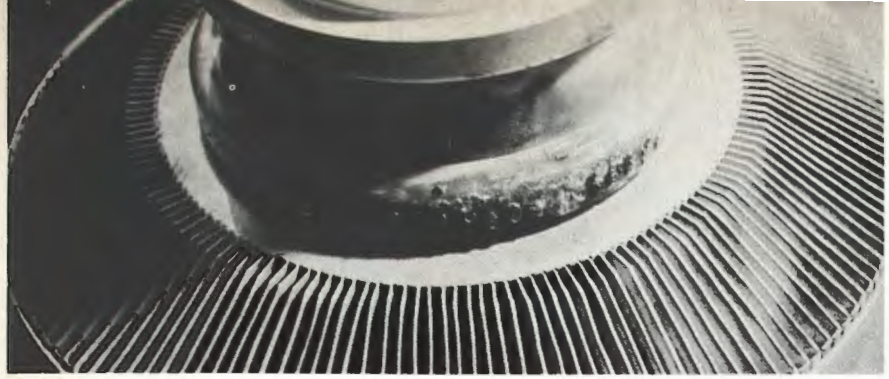

Fig. 5 A UHF power tetrode showing the damage that can be caused by a poor plate spring contact. The tube shown here is damaged beyond repair.

life. One technique is a slow start-up and slow shut-down. On start-up, run the filament voltage at half value without other tube voltages for five minutes, then five minutes at full value before applying plate and other voltages. Shut-down is the reverse. Plate and other voltages should be off, run the filaments for five minutes (blowers running), five minutes at half voltage, then five minutes with no voltages but with the blowers still running.

Another technique is the use of only enough filament voltage to get the required power output. This will generally be less than the normally stated filament voltage. In UHF transmitters the RF bombardment of the cathode will supply the additional heating required to get the full electron stream flowing.

Adjusting filament voltages as a life extending technique will depend upon the transmitter. Some transmitters tap off the filament AC voltage and feed to the grid circuit as a hum-bucking technique. In that case the filament voltage will need to be maintained as required, otherwise the hum-bucking will be ineffective or overdone.

Modulators

AM high power modulation transformers have ball gaps so that high voltage peaks will arc across and protect the transformer. These gaps should be cleaned often and properly spaced. If arcing occurs too often, the modulation level should be decreased rather than changing the ball gap spacing. Separating the gaps to prevent arcing negates their purpose.

Tubes in push-pull modulators should be a balanced pair. A tube with a short number of hours can be balanced with a new tube, but one with many thousand of operating hours should be taken out and kept as an emergency spare. When trying to balance a very old tube with a new one, the controls are all adjusted so as to decrease the efficiency of the new tube to match the old one. This is a poor practice.

The same technique holds for other balanced pairs of tubes in RF stages, whether they be push-pull, paralled or diplexed. More efficient, stable results can be achieved by matching the tubes as nearly as possible.

Monitoring

Metering throughout the transmitter gives a good view into the condition of the individual circuits. When a transmitter is first installed and properly tuned up, a complete set of readings should be recorded. These will change as the equipment ages in, but they will be close. Later modifications can also change some of the original readings. Such changes should be entered into the master set. During the daily inspection, the current readings can be compared against the original readings. This will indicate trouble brewing when abrupt changes occur or reveal a gradually changing condition.

Typical readings are usually shown in instruction manuals. One should not be overly concerned that the readings on his transmitter do not exactly match the typical readings. As long as the transmitter is set up properly and adjusted properly, the first set of readings taken will be its typical reading.

Many things can cause a particular transmitter to vary from the published typical readings. On a particular channel the stages may work differently, or a stage may work as a tripler instead of a doubler on that channel.

One major fault in modern transmitters is the tendency to install a meter with an arbitrary scale of 0-100. Many circuits are switched into and read on this meter with some arbitrary figure. It would be preferred that proper shunts and multipliers were installed so that the reading would indicate a direct relationship to what is measured. For example, if a stage is drawing 200 ma., the meter should indicate in milliamps and not some arbitrary figure. To gain a better understanding of what is happening in the circuit compare the actual readings against the published tube specifications. You may want to make a conversion chart for your master set.

The main meters, and especially those for the FCC readings, should be accurate. If the accuracy of the meters is questionable, they should be replaced or checked against a meter known to be accurate. Before tossing a meter out, however, it is best to check the mechanical zero of the meter. If the zero is off, the meter reading will be off. This may seem a minor point, but there are many cases of misadjustment of the mechanical zero.

To adjust the mechanical zero make sure all power is turned off. Some circuits feed a bucking current which may be read on the meter without the circuits being active but with some voltages applied. If the mechanical zero is not set to compensate for this, the actual reading will be in error.

The final practice to apply after any period of maintenance is to turn the transmitter on and into the antenna. It needs to be on long enough to make sure it is working properly. Someone may have accidentally left a switch turned off, a plug disconnected or the transmitter still feeding the dummy lead.

Shut-Down

This article has given the basic techniques applicable to all transmitters. If these are taken care of on a regular basis, the fine adjustments of signal processing according to type of service will require less maintenance. Most of these techniques contribute to the reliability and stability of the transmitter.

To sum up, keep it tight, keep it clean, maintain good electrical and RF contacts, and watch the meter readings from day to day. ▲

Exchanging Nuts and Bolts For IC Concepts

By Norman Crowhurst*

To most of us who were raised before the advent of the transistor, let alone all the wonderful changes now taking place, the whole area of integrated circuit application seems a little mysterious. We used to think about what happens to tube current when the grid moves positive or negative. Then, after a little effort to think more in terms of current than voltage, we translated that to transistor circuits.

Now we are faced with little black (or are they white) boxes, with lots of terminals. We read articles about these IC's that make no attempt to explain their inner working, as we would like to see. Instead, they merely tell us that IC's contain so many AND, OR, NAND, or NOR gates, flipflops, or something. Then they proceed with the logic algebra, to explain how to use these things for a specific project.

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Economics

All this somehow offends our innate desire to know all the details. "What if it doesn't work," we think to ourselves, "how is anyone to know how to fix it?" If we think a moment, the answer is simple: these little IC's are so tiny that you couldn't 'fix' one that went wrong. The only thing you could do would be to junk the whole thing and put in a new one.

To those of us accustomed to replacing tubes, transistors, resistors, capacitors, etc., that procedure seems like an enormous waste, especially when we realize that one of these tiny things may have a dozen transistors and diodes in it, with goodness knows how many other circuit elements. If one of the little transistors popped, shouldn't we be able to replace just that transistor?

Really, that is an economic question—just assuming that, with the aid of a powerful microscope, we could make the replacement. Promotion for the less expensive IC's tells us that, at say $2 apiece, we are paying only a few cents per gate, and possibly even less than that per transistor, if it's a transistor-containing unit.

New Philosophy

Then there's one more thing that rubs us the wrong way about this whole new thing: we like to know how things work—not only what it does, but how it does it. We aren't easily satisfied with knowing that a certain combination of input pulses, and that combination only, will produce the desired output pulse.

This new way of thinking is only an extension of something we had already started to do, to help ourselves think things out, long before IC's came on the scene. I refer to the use of block diagrams of a studio installation, to explain how its system works.

When you look at such a schematic, it has blocks for amplifiers of different kinds, equalizers, mixers, compressors, limiters, monitors, all the rest. If each of these items had all the details of its electronic circuit drawn in down to the last resistor and capacitor, it would take days to follow the schematic of a studio installation.

We accept that the amplifier amplifies, within certain specifications, and that each of the other components does what it's supposed to do. We can pull the amplifier schematic if we're interested, but how often do we?

The very reason for employing IC's—making such a lot of circuitry go into such an extremely small space—is that the systems in which

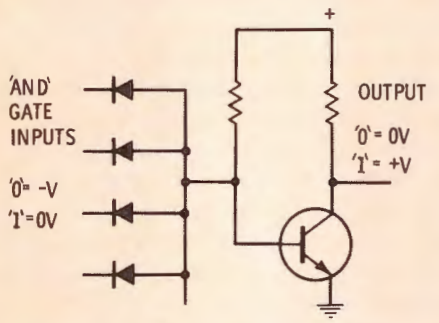


Fig. 1a AND gate only passes on its designated output signal when each of its inputs is activated.

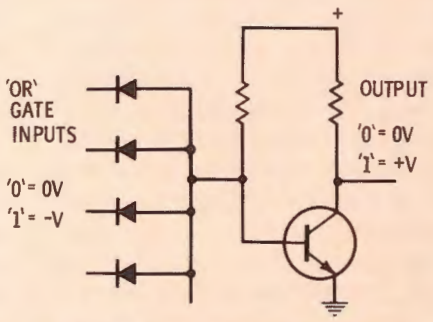


Fig. 1b OR gate passes on a signal only when any one of its inputs is activated.

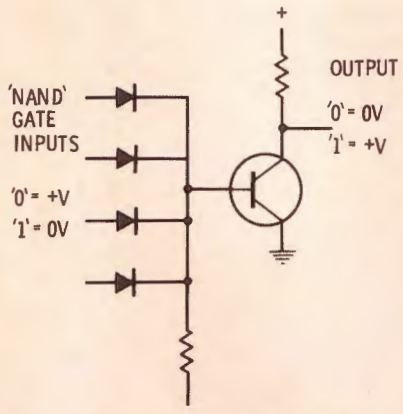


Fig. 1c NAND gate passes on a signal when there is an absence of signal voltage at any one of its inputs.

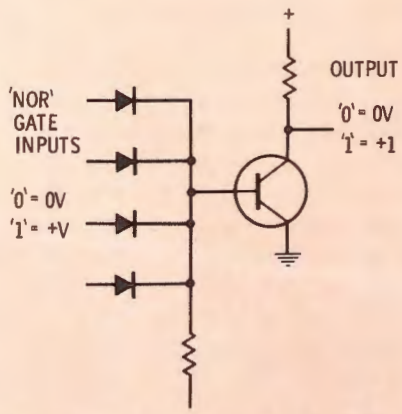


Fig. 1d NOR gate passes on a signal only when none of its inputs are activated.

they are used are so complicated: far more complicated than a studio installation, for example. The advent of the IC is a step toward eleminating all the smallest detail thinking, so we can more readily think in concepts than in 'nuts and bolts'.

Varieties of IC

Integrated circuits come in two main kinds, digital and linear, with subdivisions in each. A digital IC is concerned with binary logic circuitry, as used in computers. A linear IC is used for analog computers, and can be applied to high-linearity audio and other applications more familiar to our readers. We will discuss the two kinds separately.

Digital

A computer using binary logic handles input, output, memory, performs various calculations, reaches decisions based on prescribed parameters, all on the basis of a tremendous number of yes-or-no facts. It does the same as a mechanical or electrical computer, but infinitely more quickly. It also occupies an incredibly small space, for what it does.

Consider the computers used on space program work. They must compute courses in 3-dimensional extra-terrestrial space, forces, accelerations, changes of direction, and come up with directions for action, involving calculations that would take several men years to perform (using older methods and possibly making mistakes!). And they must have these answers in moments. The digital IC is essential to computers for this kind of operation.

TABLE 1.

Some Codes, Using Binary Digits, to Convert the Decimal System.

Decimal Numbers	Basic Binary	Excess 3.	2421	4221	Grey	STR
0	0000	0011	0000	0000	0000	00000
1	0001	0100	0001	0001	0001	00001
2	0010	0101	0010	0010	0011	00011
3	0011	0110	0011	0011	0010	00111
4	0100	0111	0100	0110	0110	01111
5	0101	1000	1011	0111	0111	11111
6	0110	1001	1100	1010	0101	11110
7	0111	1010	1101	1011	0100	11100
8	1000	1011	1110	1110	1100	11000
9	1001	1100	1111	1111	1101	10000
10	1010)					
11	1011)					
12	1100)	Redundant numerals in basic binary.				
13	1101)					
14	1110)					
15	1111)					

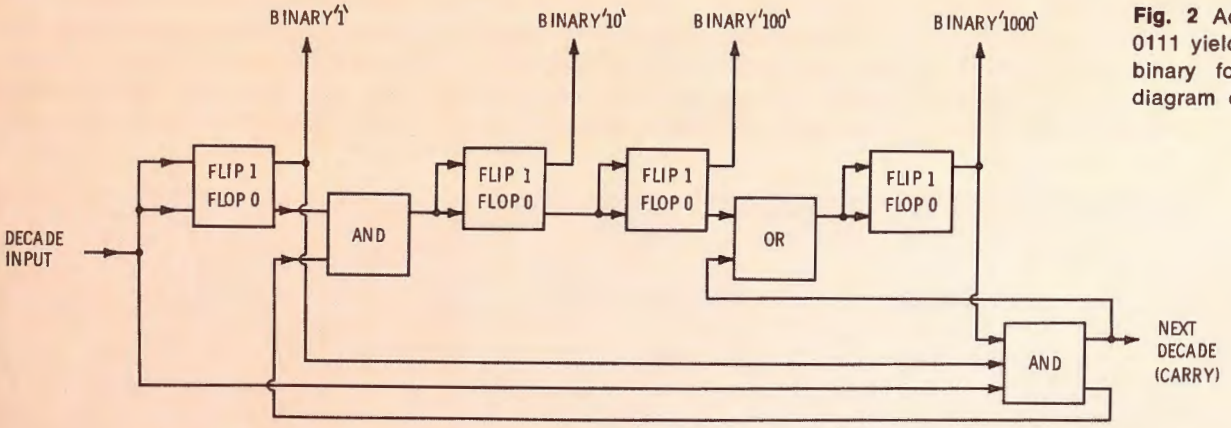


Fig. 2 Adding '1' to 0111 yields 1000, the binary for 8. Block diagram of circuit.

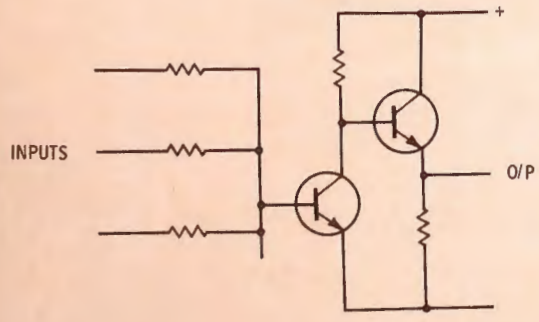


Fig. 3 Resistor-transistor logic (RTL). Resistors provide the signal coupling elements, while transistors provide isolation.

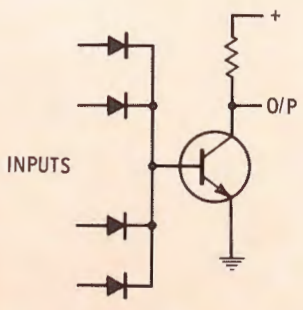


Fig. 4 Diode-Transistor logic (DTL). Diodes provide the coupling function.

Coding and Decoding

Merely to transmit, store, or read out facts in the decimal system (which all our coordinates basically are), such a computer must translate every decimal number into a binary one, or vice versa, and do so faultlessly, or be capable of detecting its own mistake, if it does goof. The newer telephone systems using this technique, will go even one better and report faults so precisely that the repairman knows exactly what to do.

How is a decimal number converted to binary? A decimal digit corresponds with at least 4 binary digits. The first, or basic conversion, starts at 1 and converts numbers in decimal to numbers in binary, used as a simple counting system in each case, one a one to one basis.

Converting this to logic, the last binary digit tells whether the decimal number is odd or even; the second from last whether or not dividing by 2 gives an odd number, the third from last whether or not dividing by 4 yields an odd number, and so on with successive powers of 2. Four digits are required to describe numbers up to ten: odd or even; odd or even multiple of 2; odd or even multiple of 4; and whether 8 or over.

If the number is over 8, it can also be 10 or over. But the numbers 10, 11, 12, 13, 14, 15 in the decimal system don't have single digits. So the binary conversion from the decimal system requires 4 binary digits per decimal digit.

This leads to certain possibilities for error detection. Do you remember the systems of checks for multiplication or division by different numbers, such as 3, 4, 5, 9 or 11? The one for 9 is called "casting out the 9s." Then there's the fact that multiplying by 5 results in a number whose last digit is either 5 or 0. These are ways some of use learned to detect our mistakes in school.

The computer can be designed to use similar methods of finding its mistakes and either report or correct them. But this involves utilizing redundant numbers, and then setting up an alarm system so that the most likely mistakes will produce redundant numbers, and any redundant number will trigger 'recycling' of the computer.

The first step in this process is to align the binary symmetry with the decimal. Instead of making the last digit tell whether the number is odd or even, the first digit tells whether the number is from 0 to 4, or from 5 to 9. From there on, different procedures can be used, each of which had advantages in different systems. Table 1 shows the equivalents for decimal digits in several systems.

Each system needs a little different logic package to convert each digit of decimal to its brand of binary, and can use a further logic circuit to provide error detection and initiate recycling or correction.

Mathematical operations, like addition, subtraction and their compounds, multiplication and division, are added by further logic circuits, each of which turns out accurate answers for the combination of inputs —data and instructional.

In case some readers may be unfamiliar with AND, OR, NAND and NOR designations. Here are their definitions: an AND gate only passes on its designated output signal when each of its inputs is activated; an OR gate passes on a signal when any one of its inputs is activated; a NAND gate passes on a signal when each of its inputs is not activated; thus failure of action of any one activates the output; and a NOR passes on a signal only when none of its inputs is activated. Figure 1 shows one interpretation of these functional relationships.

Examining the codes of Table 1, which are only some of the possibilities, the ones identified as 'Excess 3', 2'421 and 4221, are derived from the binary code directly. The Grey code is designed so that any step representing an addition or subtraction of 1 on that decade, requires only the addition or removal of one digit in the code.

The STR, which stands for "Swing Tail Ring" counter, has the feature that alternation of digits ('ON' to 'OFF' and back again) during a code group is avoided.

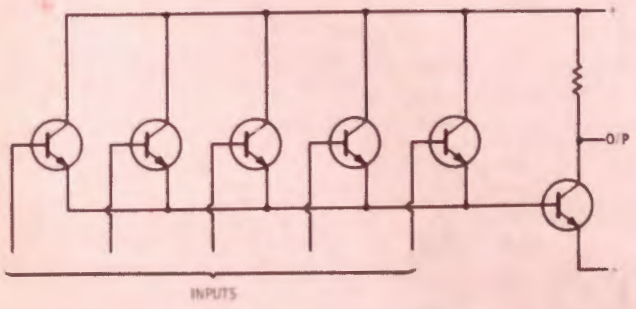


Fig. 5 Transistor-transistor logic (TTL). Transistors are used here for coupling and other functions.

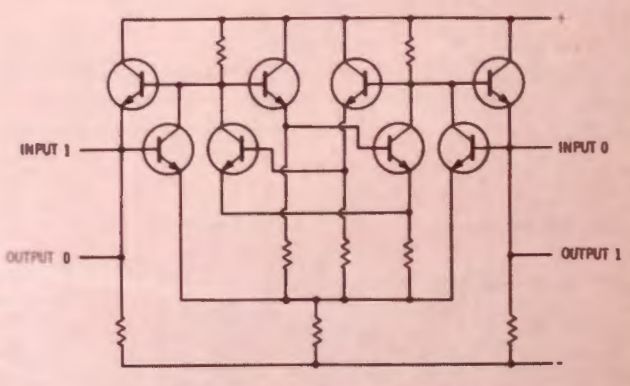


Fig. 6 R-S flipflop, essentially an astable multivibrator.

This gives a speed advantage for some applications. The binary code for 5, for example, requires alternation between 'up' and 'down' between every binary digit, in transmission. With the STR code, the 'up' and 'down' only occurs once during a ligitimate 5-digit group, enabling greater speed to be applied, without 'confusing' the system.

In each system, the digits of the code set the logic for receiving further 'information'. In the basic binary, applying a '1' input to a digit presently in a '0' state, changes it to a '1'; applying a '1' input to a digit presently in a '1' state, changes it to a '0' and passes a '1' input to the next higher binary digit.

Thus, adding '1' to '0111' (in decimal, adding 1 to 7) changes the last digit to '0' and passes '1' to the 2nd digit, which is already '1', so it changes to '0' and passes '1' to the 3rd digit, which also is already '1', so it changes to '0' and passes '1' to the 4th digit, which presently is '0', so that changes to '1' and ends the operation, yielding '1000', the binary for 8 (Figure 2).

At the condition for the binary equivalent of 9 (1001), adding 1 should reset this binary counter to 0000 and pass a pulse to the input of the binary group for the next higher decade. This requires an AND gate that accepts inputs from 4th and 1st digits, along with the input pulse.

The operation can be made quicker by logic that tells each digit group (representing a digit in decimal numbers) what to do when specific further 'information' is received. Using decimal numbers to illustrate, because they're easier for most of us to think in, the logic presets the action so that adding 1 to 999 immediately initiates changing the fourth place zero to a 1, and the other three digits, presently 9's, back to zero.

Using this method, each unused combination of the binary set for the decimal digit can also use an AND gate to trigger recycling.

If the number added to 999 were 17, still using the decimal system to do our thinking, although the computer would actually use binary for each digit of the decimal, the logic 'tells' the fourth digit place to change from 0 to 1, the third digit place to change from 9 to 0, and the remaining two places to change from 99 to 16—one less than the number added. All this happens simultaneously in a system of advanced design.

This is the way anyone fast at mental arithmetic usually thinks it out "in his head." The computer merely makes use of all possible 'short-cuts', previously programmed into its logic.

Without going into all the details —since this article is about IC's, not computers—it is evident that the logic circuits must make a tremendous number of interconnections and be ready to apply any new combination on an instant.

If you don't believe it, try drawing out a schematic for a machine to do the job, using the requisite gates, and without bothering to think out how the gates will do their jobs. You'll soon see why data processing engineers don't want to be bothered with such trivia.

There are many ways of achieving the various gate in flipflop effects from which all basic digital logic can be built. For example, and OR gate could isolate all inputs by diodes so that any one of them will pass on the needed trigger pulse, without interfering with the circuits connected to the others.

Varieties of Logic

This is easier to do with transistor combinations than merely with diodes. So we find that whole families of logic IC systems have developed. Distinguishing between them can get difficult, because of the different terms of reference used. For example, if you read about "current mode logic' you'd expect to find a 'voltage mode logic' as an alternative to it. But that is not the point of distinction intended by he definition 'current mode logic'.

All logic circuits are referenced to voltage changes: one voltage at input or output represents '0' in the binary code, another represents '1'. The logic merely controls how the state of successive elements of the

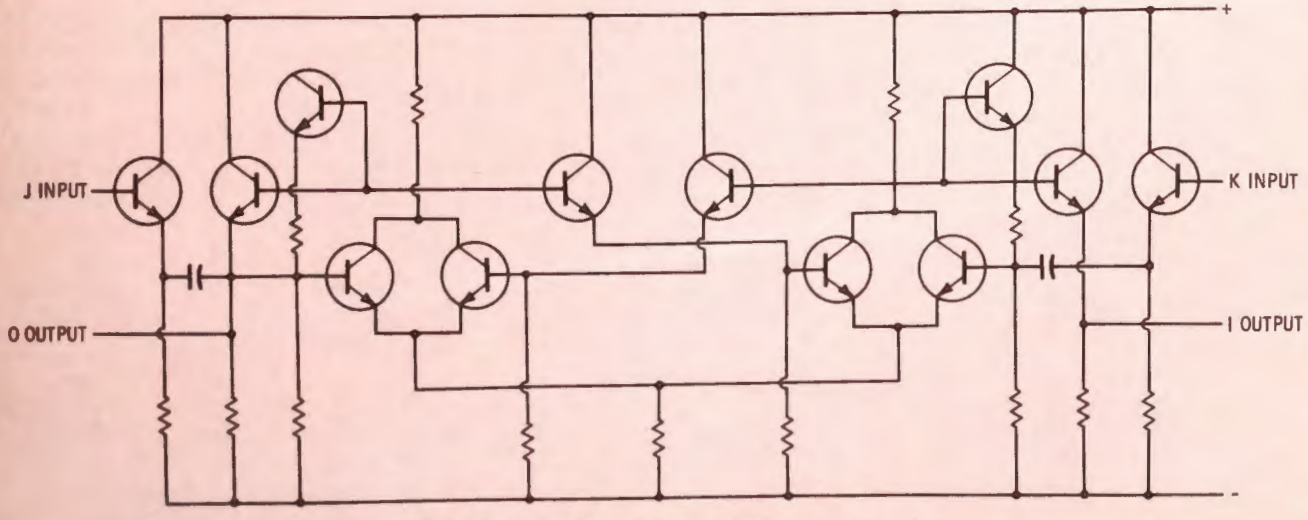


Fig. 7 The J-K flipflop changes state for each input.

system changes, to conform with the intended operations.

'Current mode logic' refers to a system that does not operate between directions of conduction and nonconduction, but which utilizes the forward voltage drop of a silicon diode or transistor as an elemental voltage. At less than this voltage, rather than reversal of voltage, the diode does not conduct current; at more than this forward voltage drop it does conduct.

This mode of operation results in faster change of state than is possible using the same devices with voltage reversal to change their state. The same system may also be called 'emitter coupled logic', because the changing voltages utilized are coupled through the emitter circuits of transistors.

Another term of reference names the circuit elements involved. Thus we have 'resistor-transistor' logic (RTL), in which resistors provide the signal coupling elements, while transistors provide isolation, change of state, signal reversal and so forth (Figure 3). Or 'diode-transistor' logic (DTL), in which diodes are responsible for the coupling function. (Figure 4) This is faster than RTL. Then there is 'transistor-transistor' logic (TTL or T^2L), in which transistors are used for coupling, as well as the other functions (Figure 5).

In integrated circuit design, each little package unit contains a whole functional set. So many inputs arranged as one of the gates referred to above, to give one or more outputs (representing a differnt kind of gate, for example AND combined with NAND) according to the rules of the gate.

Or it may hold a state until a valid command reaches it, in which case it is called a 'flipflop' (Figure 6). This type is essentially an astable multivibrator, with trimmings, such as extra gates and interlocks. The R-S flipflop shown in Figure 6 has set and reset inputs, each of which changes the output state, when it is applied differently from the last input injected. Repeated application of the same input does not change the state.

Another variety of flipflop, known as the J-K flipflop (Figure 7) avoids an ambiguity that occurs with the R-S, unless more complicated external circuitry is used. If the two inputs of an R-S flipflop are tied together, so both receive any input, the output is indeterminate. The J-K flipflop changes state for each input, under these circumstances. Multiple inputs enable this unit to change state for every input from one source, or to change only in a specific direction for inputs from other sources.

For our discussion, the point here is that the 'innards' of an IC package get too complicated to bother with exactly how they work, every time a designer uses one. What he is concerned with is the most economic way of achieving the logical process needed for his project, and possibly achieving it at the maximum speed.

Economics may be a matter of using the minimum number of packages, or of doing the job with the least overall cost. The time factor can also enter the economic picture, because the faster a system can work, the more work it can handle in a given time.

From these basic elements, designers build up bigger packages, which these complex systems in turn view as blocks in an overall diagram. Thus IC's are to a memory, a calculating unit, an adder, a coder, decoder or transfer unit what tubes or transistors were to our more simple devices, like amplifiers, limiters, compressors, and equalizers.

The early computers were extremely bulky, because of the vast amount of parts they contained. IC's have changed all that, by putting what would at one time have taken a whole 19" chassis, onto a single IC chip, ¼" square, and of negligible thickness. That's microminiaturization. And it brings with it a whole new way of thought—philosophy—of design.

Linear IC's

All that logic stuff uses two-state condtions. A voltage is 'up' or 'down' and a circuit conducts or does not. There is even a variable threshold logic system that allows

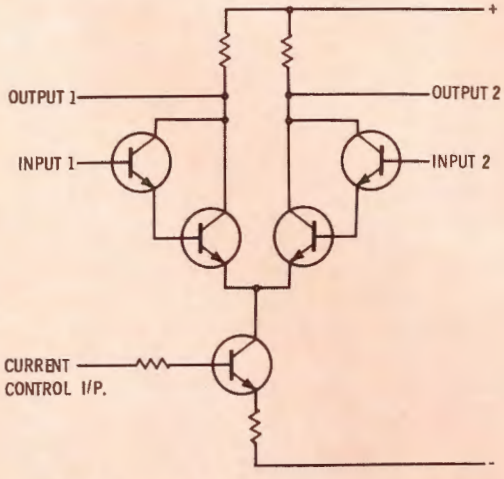


Fig. 8 Internal circuit of one IC differential amplifier.

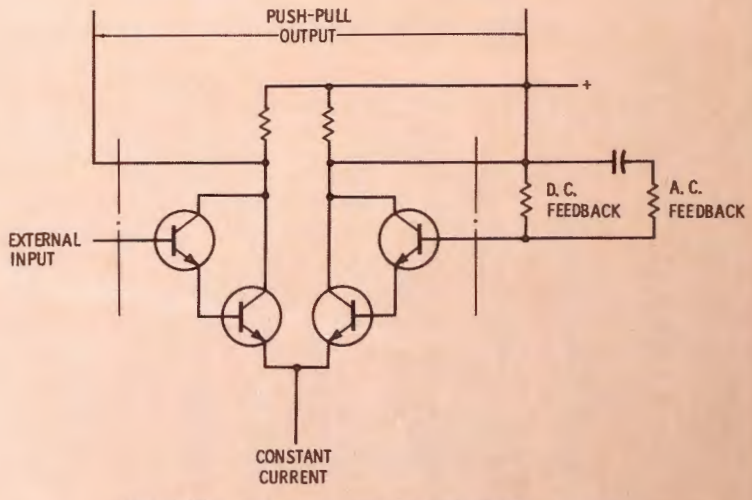


Fig. 9 The feedback may be AC, DC, or a combination of the two.

adjustment for system noise, so the best sensitivity to signal can be used, while preventing spurious triggering of the system by random noise.

Linear amplification and signal handling is something different. And by 'linear' the IC systems designer is talking about something far more linear than we have considered for audio or broadcast work. That this is so can be seen by the number of significant places used in analog to digital conversion. If the analog part was not far more linear than we would be quite satisfied with, accuracy would vanish after a few places.

The big items in linear IC's are the 'op amps'—operational amplifiers. Because they are functional—have to handle all kinds of functions—the basic unit is a differential amplifier: it handles a difference between two signal inputs, rather than one signal to ground. To make such a unit handle a single signal, it is only necessary to ground one of its two inputs.

The extremely high degree of linearity is achieved by using tremendous amounts of gain, with corresponding built-in stabilization, both of operating points and differential gain.

As with digital IC's, because they become so complex internally, these too are regarded as little boxes that do a job.

Figure 8 shows one configuration of a differential amplifier's internal circuit. It consists of two compound, or Darlington-connected, transistors using common emitter connection and separate collector resistors. In the common emitter connection is another transistor, which again could be compound, if necessary, wired to produce a constant current condition.

This means that whatever the relative voltages on the two input transistor bases, the total collector current is held constant at a value controlled by the transistor in the common emitter circuit. As the collector resistors are matched, the collector voltages are a perfect phase-reversed image of one another.

A simple resistor connection from one output to the corresponding input results in precise gain control from the other input, as a transimpedance function (output voltage for input current).

The feedback may be AC or DC, or a combination of both (Figure 9). The fact that the common emitter 'load' is a constant current device means that, provided the two input bases move their voltage together, the DC voltage at the bases does not affect output. What controls the output voltages is the relative current input to the two bases.

Such a differential amplifier, at a cost of the same order as a single transistor and having about the same space requirement, can provide an extremely stable and linear device with a great deal of versatility. The operation of this one can be traced in terms still familiar to us. Such a unit can be built into an audio amplifier, or used, with variations, as a building block in a whole system.

For more complicated devices, with greater variety of input combinations, it would take a clever engineer to figure out how it all works—in fact it isn't necessary for even its 'designer' to do so any more. For the device was not even designed by an engineer, in the basic sense.

Now that computers can perform such complicated calculations, they are "smart enough" to design integrated circuit components of this nature, once they are programmed with the finished component's requirements. The computers can further program the production details.

This is why the latest developments are being referred to as second or third generation products. Men designed the first generation from the ground up. Now we are reaching the stage where machines design machines and program the building of them. So they are truly regenerative. Men have to supply the raw materials, and the programming.

From that you could draw the conclusion that some of the science fiction stories, about machines "taking over" and using humans as serfs, are coming true. Not quite. What problems will the machines solve? This is still something that men must program into the computers.

Viewed this way—and this is the important view, about which too little has been heard—modern computerization is taking the chore out of work, leaving man more truly free for more advanced creative "brain" work than ever before in his history. To know IC's is to understand them. Once you understand them, prepare to use them.

A Chopper stabilized amplifier for remote location metering

Gene Hostetter, Engr. Dept., California State College; Richard Smart, CE, KOL, Seattle. **By Gene Hostetter and Richard Smart**

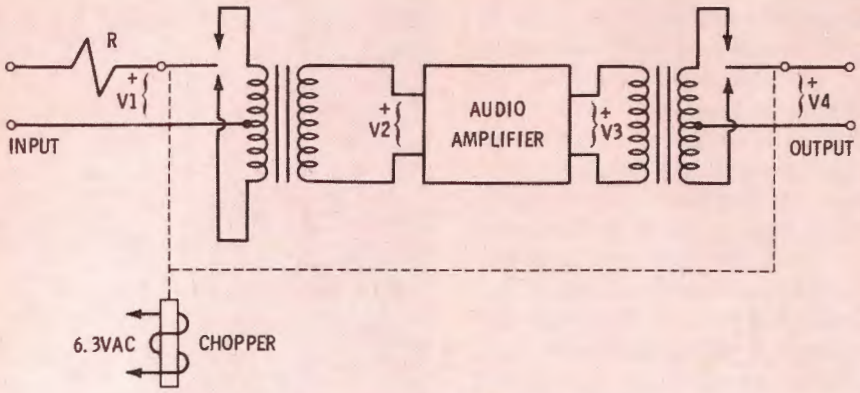


Fig. 1 The chopper stabilized DC Amplifier.

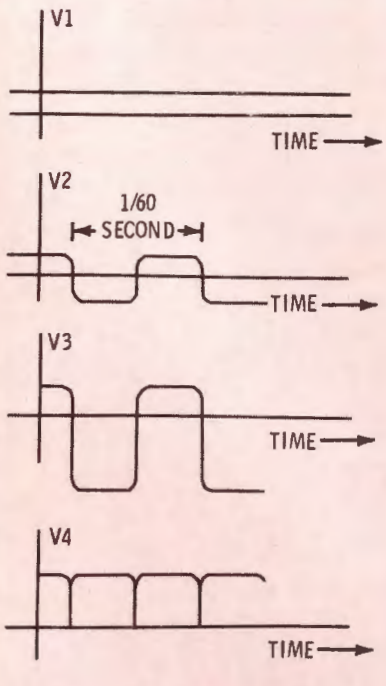


Fig. 2A Typical voltages for positive input voltage.

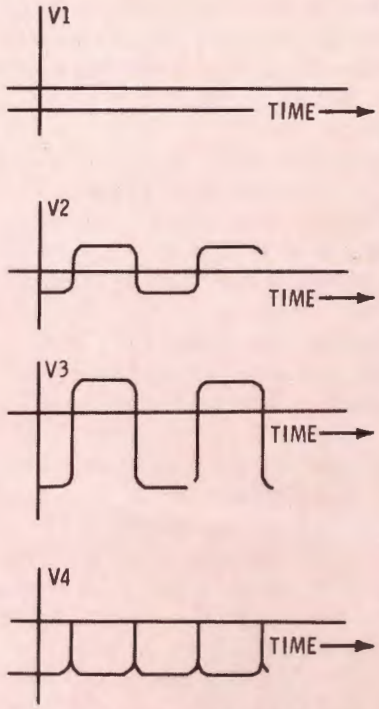


Fig. 2B Typical voltages for negative input voltage.

Voltages which are to be monitored by remote control or recorded by an automatic transmitter logger are sometimes too minute to be used directly. The internal impedance of some phase monitors are so high as to make a remote reading far too dependent upon the intervening circuitry, which often includes a length of telephone line. Also, the metering of some parameters such as FM frequency deviation from certain monitors involves excursions of millivolts superimposed upon hundreds of volts.

The arrangement to be described was chosen after a period of trial and error with more common DC amplifiers such as those found in oscilloscopes. For its intended uses at relatively low frequencies, it has the advantages of good gain stability, negligible drift of the zero voltage point in the output and simple non-critical construction. The input and output of the device are each "floating", there is no common connection between the two and no ground connections are required on either input or output.

The heart of the DC amplifier, Figure 1, is a two-pole double throw mechanical chopper which is driven from the 60 cycle per second power line. The chopper is, in effect, a high speed relay which is capable of operating fast enough to respond, back and forth, to the power line current like an AC buzzer. One section of the chopper alternately reverses the polarity of the voltage applied to an ordinary audio amplifier. The second section of the chopper reverses the polarity of this amplified AC signal in synchronization. Figure 2 shows the idealized voltages v_1, v_2, v_3 and v_4 under the conditions of positive and negative input voltage. Of course, the actual waveform of the output voltage contains some ripple because of the frequency response limitations of the transformers, chopper and amplifier. Although a ripple filter on the output could be used, there is no need for it if the device is to drive a DC meter movement.

None of the components are critical. Inexpensive surplus choppers which will give long and good service have been available for years. If a double pole chopper cannot be found, two nearly identical single pole choppers may be substituted with slightly more output ripple. The amplifier and transformers together should have the same gain and power handling capabiilties as if they were to be used to amplify 60 cycles per second AC signals of the same voltage as the DC signals at the input and output. A turntable or microphone preamplifier is ideal for converting millivolt signals to voltages suitable for transmission down a telephone pair.

Without the resistor R, the input impedance of the device is quite low for a DC input and varies slightly as the chopper alternates contacts. This may have a detrimental effect upon the equipment to which it is connected. Any value of R may be chosen up to several megohms (with a corresponding decrease in system gain) to increase the input impedance and swamp any effects of the chopper on the input.

The device in use at KOL has been in operation for over three years without maintenance or adjustment. It is used to drive an automatic transmitter logger with an FM frequency deviation signal in the presence of strong AM fields. An inexpensive Shure high impedance stereo preamplifier is used for the amplifier. The chopper was found at a surplus store and cost about five dollars. The transformers are UTC "A" series: 50K to 500 ohms stepdown in the input and 50K to 500 ohms stepdown on the output. These particular transformers and ratios were used only because they were handy and gave a suitable gain. Ordinary low current power transformers would have been just as good and much less expensive. R in our design is 50 K. A balancing control for the output was found to be unnecessary, but the circuitry remains simple and easy to duplicate.

Directional Installations

Expanding the Impedance Bridge

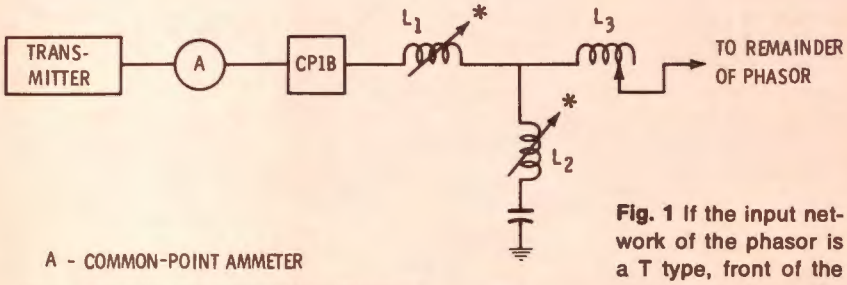
By J. G. Rountree*

The development of the Operating Impedance Bridge has given broadcast engineers and technicians a very useful tool in the adjustment and maintenance of antenna systems, particularly directional antenna systems. It is the purpose of this article to discuss a means of expanding the usefulness of the bridge in directional installations.

*Consulting Engineer, Austin, Texas.

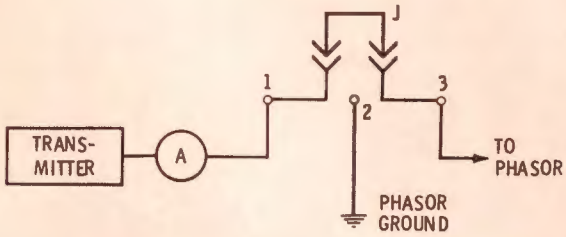
The bridge is available in two general forms: a portable instrument which can be moved from place to place within the system as needed, and a panel-mounted Common-Point Impedance Bridge designed to be permanently mounted in the phasor cabinet to permit checking of the common-point impedance at any time. The common-point bridge is of particular value in new phasors, and it is the recommendation of the author that all new phasors include such a bridge, together with front-of-panel controls for common-point impedance and reactance.

Such front-of-panel controls can be provided if the phasor is designed so that the input network is a T network with variable input and shunt coils (See Figure 1). In such a design, if the coils are properly shielded or oriented, the input coil will vary the input reactance only. The shunt coil (with its associated capacitor) will vary input resistance and reactance both. Thus, the shunt coil is adjusted for the desired common-point resistance, and the input coil is adjusted to remove the undesired reactance.



A - COMMON-POINT AMMETER
CP1B - COMMON-POINT IMPEDANCE BRIDGE
L1 - INPUT REACTANCE CONTROL
L2 - INPUT IMPEDANCE CONTROL
* - DENOTES FRONT-OF-PANEL CONTROL

Fig. 1 If the input network of the phasor is a T type, front of the panel controls can be provided when the network uses variable input and shunt coils.



A - COMMON-POINT AMMETER
J - METER JACK WITH SHORTING PLUG
1 - RIGHT-HAND TERMINAL (ON FEED-THROUGH INSULATOR) AS VIEWED FROM FRONT OF PHASOR
2 - CENTER (GROUND) TERMINAL
3 - LEFT-HAND TERMINAL

Fig. 2 Wiring diagram of the meter jack with shorting plug. See See Figure 3 for physical details.

The common-point impedance bridge is of limited value for use in existing phasors, however. In order to avoid upsetting adjustment of the phasor because of stray capacitance, the common-point bridge would have to be mounted externally. Few older phasors are equipped, or can be conveniently modified, for front-of-panel control of input impedance.

Nevertheless, it is of value to be able to measure the common-point impedance while the directional antenna is operating. It is often quite revealing to do this during a rain, sleet, or snow storm! Such measurements can be made without interrupting broadcast transmissions if a suitable arrangement is made. This article will describe one such arrangement.

Figure 2 indicates the wiring diagram and Figure 3 is a photograph of the physical arrangement of feed-through insulators and a meter jack which permits the insertion of an Operating Impedance Bridge at the common point of input of a phasor. Figure 4 shows such a bridge in place and connected.

Certain precautions must be taken in installation of the jack. To

avoid the possibility of accidental contact with the "hot" RF wiring, the arrangement is placed on top of the phasor cabinet, far enough back from the front edge to allow the Operating Impedance Bridge to be placed in front of the jack. Figure 5 shows a plan view of one possible physical arrangement.

As viewed from the front, the input lead is on the right-hand side of the bridge, hence the lead from the common-point ammeter goes to the right-hand feed-through insulator. The lead to the phasor circuitry goes from the left-hand feed-through insulator. The necessity for keeping all RF leads as short as possible influences the exact location of the jack arrangement.

The feed-through insulators for the "hot" RF leads msut have low capacity to ground. The E. F. Johnson type 135-52 feed-through insulator, which mounts in a hole 1-7/32 inches in diameter, is eminently suited for this use.

It will be noted that the RF ground lead also is brought through a stand-off insulator. This is done in order to provide the most direct path to ground. Frequently a manufacturer of RF coupling equipment will bring all RF leads to an uninsulated bolt on the inside of a closed cabinet, with the end of the bolt protruding outside, to be connected to the station ground system. Such an arrangement provides a good DC or 60 Hz AC ground, but overlooks the fact that, because of skin effect, RF current will not pass through the bolt. Instead, it will flow along the inside surface of the cabinet until it reaches a hole through which it can pass, then it flows along the outside surface to the ground connection point. Such an arrangement increases losses.

The ground lead inside the phasor cabinet should be a copper strap, two inches or more in width, connected to the ground strap of the phasor circuitry by as short a path as is consistent with routing the strap immediately adjacent to the inside of the phasor cabinet.

Obviously, this jack arrangement has other advantages. It is useful for connection points in making the usual bridge measurements to support application for direct power measurement, and it provides a

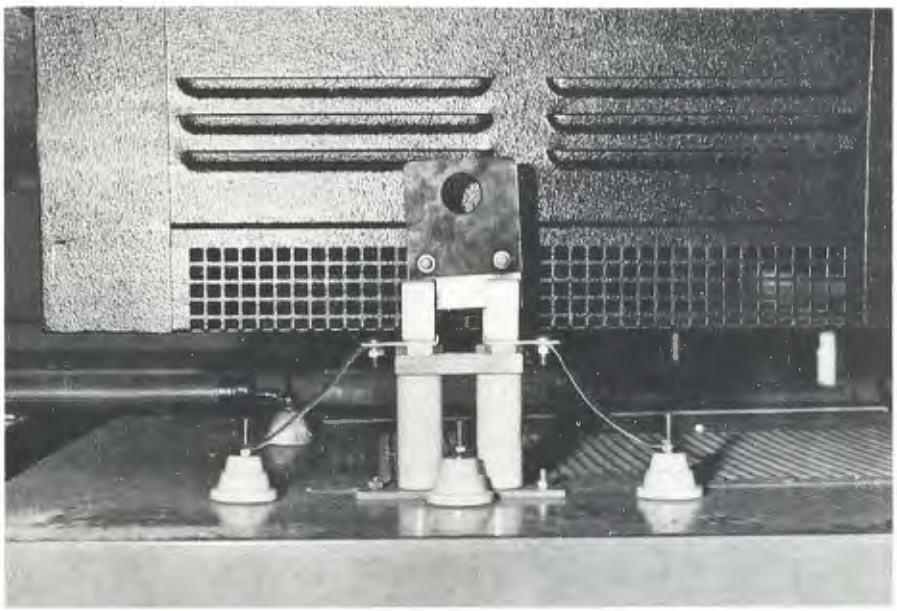


Fig. 3 Physical arrangement of feed-through insulators and meter jack.

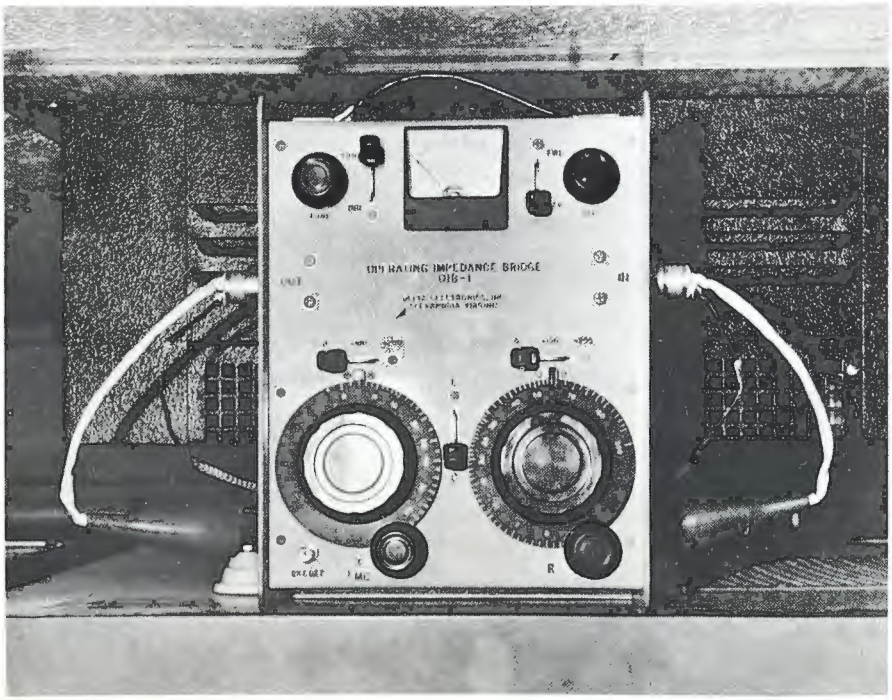


Fig. 4 Operating impedance bridge in place and connected.

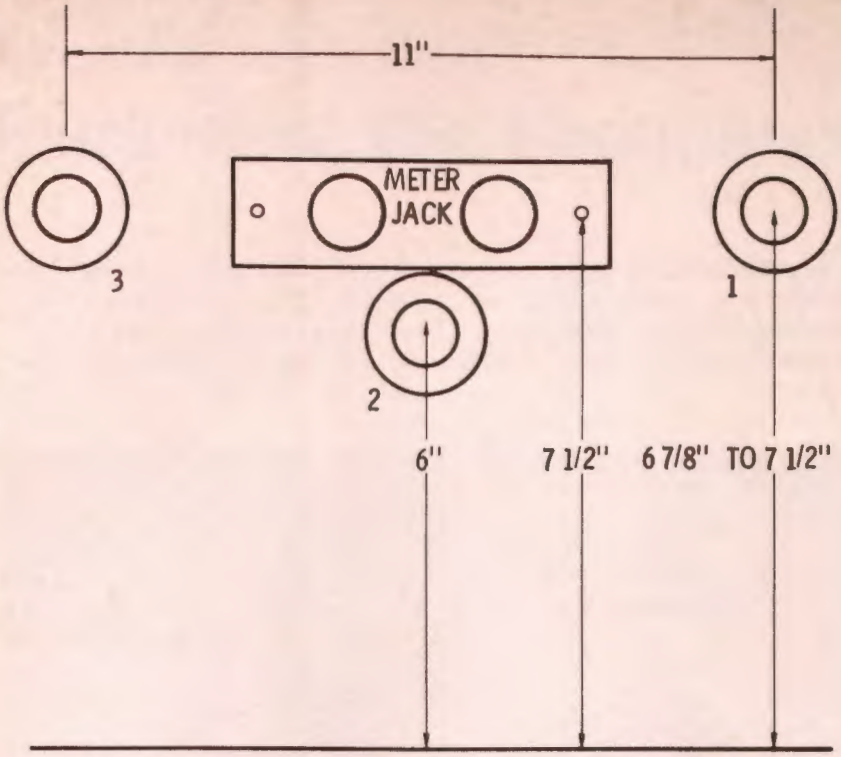


Fig. 5 Layout measurements and feed-through insulators numbered to correspond to wiring shown in Figure 2.

ready arrangement for placing other meters in series with the common-point meter so as to compare their readings.

In using the Operating Impedance Bridge, it will be found that the apparent sensitivity will be greatly increased if a well-shielded receiver with an S meter is used as a detector. Since the bridge operates in a strong RF field, it cannot be emphasized too strongly that the receiver must be well shielded. The power cord must be adequately bypassed for RF and the S meter must be shielded, or, if mounted externally, its leads must be bypassed. Stray RF pickup by the receiver can result in a false null indication and thus an inaccurate reading.

The use of a selective, well-shielded receiver as a null indicator has another advantage: If there is another radio station in the vicinity, the signal from that station, picked up by the antenna system being measured, will not permit obtaining a deep, sharp null with the meter of the bridge itself. The S meter of the receiver will however, give a clear, sharp, null indication. ▲

READER SERVICE CARD Broadcast Engineering

FOR ISSUE OF JANUARY, 1970

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A

Metal capacitor clamp on tone arm rest prevents arm bounce during transport. Too often the portable console is planned only for operation. Look for ways to secure all standard units.

Ronald Pesha
Chief Engineer
Station KFKA
Greely, Colo.

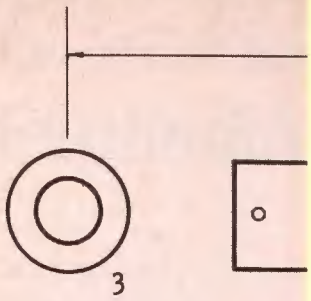

Fig. 5 Layout measurement
respond to wiring shown in F

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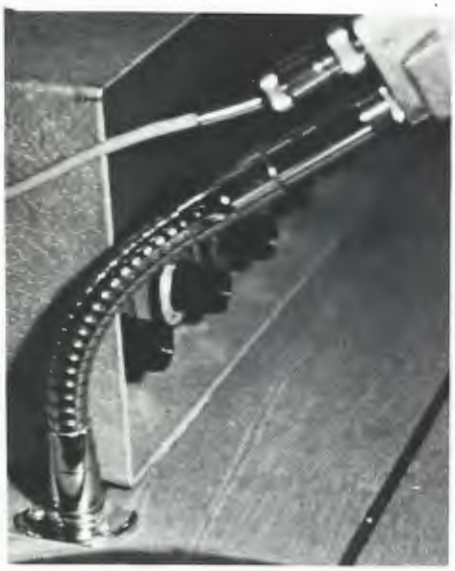


At left, inexpensive transistor radio gets cues from station. Radio mounted below console surface. At right, gooseneck and flange mount keep mic stable during transport and use.

Metal capacitor clamp on tone arm rest prevents arm bounce during transport. Too often the portable console is planned only for operation. Look for ways to secure all standard units.

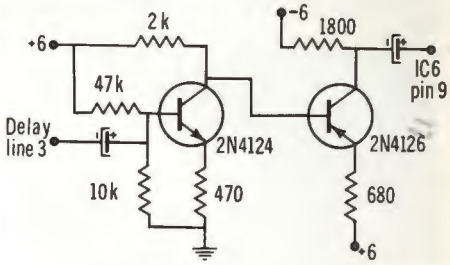
Ronald Pesha
Chief Engineer
Station KFKA
Greely, Colo.

Chroma Keyer Revisited

Dear Editor,

We have built and are using the Solid State Chroma Keyer from the August issue of **Broadcast Engineering.**

However, to improve performance, I made a change in Q2's circuit. As drawn, Q2 loads the delay line and also the frequency response of Q2 with a 15K load. This is bad because it rounds off and widens the keying pulses.



Here is a circuit I designed for a replacement of R49, R50, R51, and Q2. Also, for R9A and B I used a IRC-CTS, and two type 4W Base Elements W11-100X, one type 4W multi-section Kit WM, and one SK4 Kit for WPK.

Victor I. Castens
KOAM-TV
Pittsburg, Kansas

NAB Opposes Coded Identification On Video Tape And Film

The National Association of Broadcasters has asked the Federal Communications Commission not to adopt a rule which would permit the transmission of coded identifying information on video tape and film.

The Commission has been petitioned to allow such transmission by the International Digisonics Corp. (IDC), which stressed the need for a monitoring service that could provide verification of the number of times a TV program or commercial has been broadcast.

The NAB objected that such a rule is not in the public interest, and that it would have a deterring effect on future refinement and development of television receivers. Consideration of any coded monitoring system should be considered along with other test devices now under study and review.

NEW PRODUCTS

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

Sound Control Slave

The **Switchcraft** 12-station model 640 Sound Control Center has been modified into new models which permit literally thousands of input, amplifier and output combinations to handle the equipment in the largest demonstration display room a distributor might require.

In the model 640B, the 12th station becomes a control station for the slave unit, designated model 640C. Station 12 of the 640B unit is push-lock push release on all three rows. Depressing a row button deactivates the row function on the 640B and switches in the components controlled by the same row on the 640C slave unit.

In combination, the 640B and 640C allow the comparison of 22 inputs, 22 amplifiers, and 22 sets of stereo speakers. Thus, 10,648 comparisons of hi-fi and stereo combinations in all can be made.

Circle Number 50 on Reader Reply Card

VSWR Watchdog

CCA's new VSWR Watchdog protects the Broadcast and Communication facilities from problems associated with icing, humidity or any other malfunction of transmission line and antenna systems. The CCA VSWR Watchdog, when used

in conjunction with a conventional directional coupler provides instantaneous protection against any malfunction in antenna and transmission line systems. Thus, broadcast and communication stations can confidently use their high power transmitters. If a fault should occur, the Watchdog will protect the system from disasterous consequences.

The VSWR Watchdog contains front panel controls for adjusting protection levels and built-in visual and audio alarms. The equipment can be reset from either a local or remote location.

Circle Number 51 on Reader Reply Card

Motion Picture Conditioning System

A new and unique motion picture film conditioning system for TV stations offers the television industry and all users of motion picture films a heretofore unavailable means of automatically cleaning, coating, lubricating and conditioning film in one economical, time-saving operation. The system, manufactured by **Lipsner-Smith Corporation,** in Chicago, is known as the CF2 Ultrasonic Film Conditioning System.

Company president Jerry Lipsner states that through the system's use, "any film can be improved to give full brilliance, resolution and clarity, wtih a minimum of film defects appearing on the screen." The benefits are many, and are obtained simply by running the film through the CF2 Ultrasonic Film Conditioning System prior to projection.

The first advantage is cleanliness. Employing a specially developed ultrasonic cleaning principle, the CF2 completely and thoroughly removes all contamination from the film. Scratches and abrasions, in which dirt tends to accumulate, are also cleaned out, and the subsequent coating fills them in, preventing further dirt buildup. This results in brilliance and clarity approaching "when-new" quality. Film emerges static free, precluding attractions of dust particles and other contaminants.

Circle Number 52 on Reader Reply Card

Reversal Print Film

A new reversal film, Eastman Ektachrome R Print Film 7389, intended for making color prints from original made on Ektachrome EF and MS films, was introduced by **Eastman Kodak Company** in a special presentation before the 106th Technical Conference of the Society of Motion Picture and Television Engineers.

The new film, which will replace Ektachrome R Print Film 7388, has the capability of producing a silver optical sound track on 16mm release prints. If desired, a sulfide sound track, similar to that of its predecessor, can also be produced on 7389.

The silver sound track significantly increases the sound quality on 16mm release prints being made for business, industry and government use. In addition, the silver sound track also increases laboratory efficiency in handling the film. A conventional negative sound master is used, and sound track production is virtually the same as on other films.

Sharpness and exposure latitude also have been improved in the new film, and its sensitivity to variations in laboratory handling has been significantly decreased. The new film will be available for sale early in 1970.

Circle Number 53 on Reader Reply Card

Digital Clock

The new BPC-101C digital clock from **Broadcast Products Company, Inc.** provides a low cost, all solid-state instrument for use as a clock,

stop watch, or elapsed-time indicator in various commercial applications. The unit provides a direct, easy-to-read six digit display in hours, minutes and seconds. High reliability is assured through the use of integrated circuits.

The BPC-101C is also available with a number of optional features. These include a 24/100 hour display to tenths of a second, rear projection display, facilities for remote function control, readout and direct BCD output, plus battery operation with an internal time base. A solid-state switching matrix is also available to permit minute-by-minute control of external circuits. Nominal

power required is 115 VAC, 60 Hz, 6 watts (50 Hz optionally available). Standard time base is 60 Hz with an accuracy of ±2 seconds; but a 100 KHz internal crystal time base is also available as an option.

Circle Number 54 on Reader Reply Card

Educational TV Mobile Unit

A compact color TV mobile unit that brings the same picture quality obtainable in studio program production to broadcasts and video tape assignments in the field has been demonstrated by **RCA** for educational broadcasters.

The trim, 24-foot vehicle, carrying RCA's most advanced color TV originating equipment, was a feature of the company's exhibit at the National Association of Educational Broadcasters convention in Washington.

E. C. Tracy, Division Vice President, Broadcast Sales, said the new unit offers educational stations a means of covering news, features and other events as they occur, with the advantage of full-fidelity equipment. "The mobile unit puts wheels under the studio," Tracy commented, "and the entire community becomes a laboratory for the educational broadcaster, to be explored by the probing eye of the color camera."

Besides the color camera, the basic mobile unit is fitted out with camera controls, picture monitor, a "high-band" video tape recorder and audio facilities. Microwave equipment can be added to relay "live" programs back to the home studio.

Convention-goers saw a demonstration of the camera's contouring circuits that produce well-defined and virtually noise free color pictures. Camera engineers explained that the circuits in effect "comb away" picture noise as contouring is increased.

To illustrate camera sensitivity, light on the exhibit studio set was reduced to only 15 foot candles as the TK-44A continued to make pictures of broadcastable quality. Engineers credit this capability to a new light-splitting prism of unmatched efficiency, and other improvements.

Circle Number 55 on Reader Reply Card

Automated Design Service

Collins Radio Company is now offering to customers the capability to procure the automated design of MOS/LSI arrays by remote input of logic equations or Fortran statements. Collins officials described

this as the most significant addition to the process services offered by the Company through its C-System.

Collins' Automated Design and Process System, controlled by Collins C-8500 processors, makes customized MOS/LSI digital arrays practical for low volume applications at low cost. This process capability, in use by Collins for its own production for the last 17 months, is now being made available to other manufacturers. Sixty-day turnaround on prototype arrays is typical.

The customer, in effect, commands Collins' entire automated MOS process during design and production. He shares the highly computerized system as if it were his own in-house facility. His instruction to the system may be input from remote terminals located in Collins facilities or he may elect to install a terminal in his own plant with a communication link to the Collins system.

Circle Number 56 on Reader Reply Card

Random Access Audio/video System

A new random access audio/video system employing "touch-tone" type remote control with digital addressing was introduced at the NAEB in Washington, D.C. by **Visual Electronics Corporation.** This new system represents the first standarized design using computer techniques for the total control of audio /video information systems.

This system is designed for application in universities and schools.

Here for example, at any one of a large number of student positions, one may call up not only a specific audio or video tape machine, but can select within a given tape, a particular segment or lesson which might be recorded there under its own address number. The machine besides being selected remotely, can be controlled (start, stop, rewind, etc.) from this remote station using digital cotnrol techniques over a common control circuit. In addition to tape machines, the video sources can be film and slide projectors used with TV cameras.

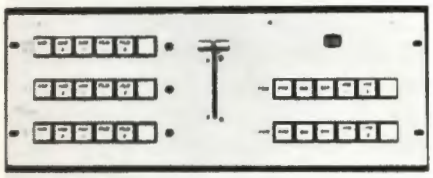
All stations on the system are interconnected with a single common cable. The system is so modularized that it can expand from a very small system to one as large as a 1000 sources feeding as many as 1000 individual stations. Each source can be called up within one-third of a second without the possibility of busy signals.

Circle Number 57 on Reader Reply Card

Video Switcher

Alma Engineering, Inc., announces the new model 6531 production switcher. Designed especially for educational CCTV, the Alma 6531 also meets requirements of the broadcast industry for a back-up taping switcher.

Versatility is provided by six preselectable, composite/noncomposite



inputs to the MIX/EFF and PVW/KEY busses, plus three composite inputs to the program and preview busses. The preview buss can be used for taping while a program is being broadcast. Reliability and servicing are enhanced by the solid-state, modular plug-in construction. Additional features include timing of all signal paths for color, remote control, and momentary contact pushbuton switches.

Circle Number 58 on Reader Reply Card

VT Recorder

The lowest priced videotape recorder that allows high quality assemble editing of any monochrome video signal has been placed on the market by **Ampex Corporation.**

The VR-5100E was demonstrated for the first time at the National Association of Educational Broadcasters' (NAEB) convention November 10-12 in Washington, D.C. It is designed for use in educational, business, industry, government, medical and other closed circuit applications where precise editing of tapes is required. Assemble editing allows a user to add picture and sound information to the end of an existing recording without picture or sound disturbance at the transition.

Circle Number 59 on Reader Reply Card

Rear Controlled Zoom Lens

A new four time zoom lens which can be controlled from the rear of a viewfinder camera has been introduced by **GBC Closed Circuit TV Corp.**

Designated Model RC-ZL1, the new unit is designed for ETV, CATV training and other studio applications. It enables the camera operator to adjust both zoom and focus from the rear of the viewfinder camera while he watches the monitor.

The four time zoom lens has a focal length adjustable from 22.5 mm to 90 mm. It utilizes 15 hand coated lens elements and provides F stop apertures from 1.5 to 22, with click stop settings. The rear control is made of anodized aluminum. Since all moving parts utilize teflon bearings for smooth, easy movement, no lubrication or maintenance is required. The RC-ZL1 can easily be attached to any viewfinder CCTV camera with two mounting screws. It carries a full year, 100% unconditional guarantee.

Circle Number 60 on Reader Reply Card

VSWR/Wattmeter

The first VSWR meter of a new series, combined with a THRULINE® RF Wattmeter has just been introduced by **Bird Electronic Corporation.** To measure VSWR accurately under power requires either a sloted line—which is impractical outside the lab—or a high-directivity coupler, power level instrumentation and calculation.

Using a coupler with 20dB directivity (i.e. relative isolation of 100:1 between reflected and forward power), a 1.3 VSWR reading, for instance, can be more than 100% in error. If, additionally, VSWR under power is indicated on

a single scale meter (e.g. from 1.0 to ∞), as was common until today, low VSWR values are not readable. Most important, however, was the unreliability of such instruments even as relative indicators of minimum VSWR conditions, since the probable errors shift and often transpose minimum and maximum points.

The new THRULINE VSWR/Wattmeter has two expanded scales, one for 2.5/ ±0.2 and the other for 1.3/1 ±0.06 VSWR full scale. The tight limits of accuracy are the result of special high-directivity coupling elements (better than 3000 to 1) and precision calibration potentiometers.

The forward power meter is designed for a 6 full scale ranges from 25 watts to 1000 watts and three frequency ranges from 100 to 1000 MHz. Model 3121 VSWR/Wattmeter is equipped with "QC" (Quick-Change) Connectors available in all common RF cable series, as well as 7/8" and 1 5/8" EIA line.

Circle Number 61 on Reader Reply Card

Pulse Delaying Amplifier

The 912 is a solid state, regenerative, bridging pulse amplifier incorporating a continuously variable pulse delay, from **Grass Valley Group, Inc.**

It will accept any of the pulse sequences used in television, remove up to 100% hum and other low frequency disturbance and deliver a clean, uniform and identical train delayed a minimum of 0.3 μsec and a maximum of 5.0 μsec. The delay is screwdriver adjustable from the front panel, or can be remotely controlled via a line carrying only DC. The trailing edge and hence the width of the output pulse can be independently varied about ±0.5 μsec at maximum delay, with proportionately smaller width variations as the delay is decreased.

The 912 operates without the use of conventional delay lines. The leading and trailing edges of the

incoming pulse are selected and shaped, and each fires a delay multivibrator. The two multivibrators are designed so that their pulse widths are accurately controlled over a 20 to one delay range by an appropriate voltage variation, with a tracking error of less than 0.05 μsec. The trailing edge of each variable width pulse is selected and shaped, and is used to trigger a set-reset output circuit. The output is then a replica of the input, delayed in time by the width of the monostable pulse.

The circuit is designed to be jitter free, there being no visible leading or trailing edge time displacement when viewed on a scope with a 20 ns/cm sweep.

Circle Number 62 on Reader Reply Card

Audio Distribution Amp

Broadcast Electronics offers their all solid state audio distribution amplifier, the Spotmaster AD1A. Designed specifically for broadcast stations, the AD1A distributes audio channels via five separate output channels (up to 25 with the addition of AD1A extenders), and incorporates a front panel VU meter and monitor jack to permit visual and aural monitoring of the incoming signal at the output of the line amplifier.

Response of the AR1A is said to be essentially flat from 40 to 20,000 Hz, with low distortion and noise, 60 dB channel isolation and 12 dB peak factor. Write direct to Broadcast Electronics for more information.

Circle Number 63 on Reader Reply Card

Tape Recorder

Roberts, a division of **Rheem Manufacturing Company,** has added another tape recorder to its present line. This new unit, the model 800X, described as "professional studio-type sound equipment," boasts of 40 watts, has automatic reverse which provides playback in both directions for extra hours of uninterrupted playing time. It has a 3-speed hysteresis synchronous capstan motor plus two 6-pole eddy-current reel motors.

Other features are sound-on-sound which adds sound to a prior recorded sound, on a separate track, without erasing the prior recording. The tape lifter protects heads from wear in fast forward and rewind

operations. The 800X includes solid state integrated circuit amplifiers, four-track stereo/mono recording and playback, four-digit index counter with reset button for precise editing, cueing and tape indexing, and switched equalization which automatically balances tone characteristics for each speed.

Circle Number 64 on Reader Reply Card

Portable Camera

Telemation now manufactures nearly every item necessary for a complete ITV/ETV studio. Among the studio facilities TeleMation exhibited at the NAEB Convention this year were the TMC-2100 Television Camera. The TMC-2100 camera is a small, very portable camera which can be equipped with plug-in modules for 2:1 interlace sync, EIA sync or crystal drive, with 800 lines resolution guaranteed in any mode. Broad-type features, including automatic beam alignment, wide-band video amplifier, automatic target control and perfect picture geometry; its availability with or without viewfinder; and its use as either a self-contained unit or in a multi-camera system has led to widespread acceptance and use of the camera in ITV/ETV systems. TeleMation recently began marketing the TMC-2100 equipped with a lead-oxide, or Plumbicon*, tube, as well as the original vidicon model.

*(Trademark, N. V. Philips)

Circle Number 65 on Reader Reply Card

Video Distribution Amp

Applied Electro Mechanics has available a model BUDR-1 balun amplifier that accepts balanced or unbalanced signal voltages, provides hum-free transmission, and eliminates frequency interference.

This solid state video distribution amplifier has two outputs balanced at 124 ohms and two outputs unbalanced at 75 ohms. And the BUDR-1 gives common mode rejection up to 50 dB and a frequency response from 10 Hz to 10 MHz. The unit automatically cancels generated unbalanced voltages and eliminates power hum and other spurious interference frequencies.

Circle Number 66 on Reader Reply Card

Solid State Wide Band Scope

Leaders latest entry into the solid state oscilloscope field is the LBO-32B. The 3″ scope has a bandwidth of DC to 7 MHz. Input circuitry stabilizes the DC level so that power line fluctuations have no effect on the position of the CRT display. This enhances the instruments input sensitivity of 10 mv/cm. The horizontal and vertical amplifiers are easily balanced so the instrument adopts itself to use as a vectorscope.

The line sweep position makes a usable frequency comparator using the lissajous technique. The calibration voltage is set at 0.03v p-p at line frequency. The sweep circuit has a frequency range of 1 Hz to 200 kHz in six steps and automatically locks to the horizontal video pattern of the TV signal.

Power is 105-125 volts 50/60 Hz at 55 VA. Size is 9″ H x 6¾″ W x 10½″ D and weighs 17.6 lbs.

Circle Number 67 on Reader Reply Card

TECHNICAL DATA

For further information, circle data identification number on reader service card.

100. **AMERICAN ELECTRONIC LABS, INC.** — A new technical data sheet describing the Model APX-1293 in its series of Crossed Planar Log Periodic Antennas is now available. The APX-1293 covers the frequency range of 1-12.4 GHz and was designed for applications where polarization and broadband frequency diversity are necessary. The APX-1293 is a completely randomed Crossed Planar Log Periodic Antenna featuring simultaneous horizontal and vertical polarization, high isolation between polarizations, and lightweight rugged construction. The data sheet gives general description, features, and specifications.

101. **BARRY RESEARCH** — Technical papers describing Barry's newest product line including the PM · PM Multiplex Teleprinter System, Phase Modulator TPM-2, and the Teleprinter Converter TCT-2 is now available. The PM · PM technique produces no interference with the normal AM program material nor reduces the effective area coverage of the AM broadcast. The economics offered in equipment costs, operator time and frequency spectrum requirements make this system attractive for many applications. The papers give application, features, and specifications of each line.

102. **BROADCAST EQUIPMENT** —A new catalog No. 46A is now available. The catalog gives price list and descriptions of AM Transmitters, 81M Phasing Equipment, AM Transmitter Accessories, FM Transmitters, FM Antennas, Audio Equipment, Remote Equipment and others.

103. **BUCHANAN ELECTRICAL PRODUCTS CORP.** — Crimping tools for a wide variety of applications, including Class I and Class II specifications of MIL-T-22520, are detailed in a new Catalog T103. A separate section of the loose-leaf catalog explains crimp tool phraseology and lists better crimping techniques. An assortment of crimping tool kits is also offered.

104. **BY-BUK CO.**—A catalog of pressure sensitive printed circuit drafting aids, featuring thousands of time saving basic shapes and conductor line tapes required in the development of printed circuit layouts and master artwork is now available. The catalog, No. P-45, covers a complete selection of individually die cut pads, elbows, trees, corners, fillets and symetrical shapes. Shapes and sizes covered by military specifications are also included.

105. **CHERRY ELECTRICAL PRODUCTS CO.** — A new 44-page catalog describing Cherry Precision Switches is now available. The catalog includes photographs, cutaway illustrations, descriptions, detailed specifications and application data for the hundreds of standard switches and variations manufactured by Cherry. The largest single section of the catalog deals with Cherry Coil Spring Snap-Action Switches.

106. **COLUMBIA ELECTRIC MANUFACTURING CO.** — A new Catalog TT-969 describes in detail each of the 10 Tong Test Model ammeters. The catalog indicates maximum conductor size that each model will accomodate as well as available ampere

scale ranges. It also describes the operating principle that permits the measuring of current in an AC phase or DC circuit by snapping the tongs of the instrument around the cable or bus bar.

107. **COMPUTER PRODUCTS**—A six-page bulletin describing the PM700 Series Regulated DC Power Supplies is now available. The bulletin describes the 16 models in the PM700 Series and gives necessary specifications, prices and delivery information. This series of power supplies is packaged on plug-in printed circuit cards and has higher power than the PM400, 500, and 600 series.
108. **ELCO CORP.** — A revised and expanded 36-page manual contains complete design information for back-panel connector arrays. The manual defines the Variplate metal plate interconnection concept and its associated terminating technique, automatic wire wrapping. It discusses, in detail, the voltage/ground plane and bus bar techniques of power distribution, connector grid pattern, plate size, layout dimensioning, material, and finish. A typical plate blueprint is included as a design aid.
109. **GREIBACH INSTRUMENTS**—A new catalog on Greibach instruments includes galvanometers, microammeters, millivolt meters, watt meters, and others. The catalog is broken down into two instrument sections, analog and digital. Photographs, model numbers and names of the devices are given. Instruments listed in the catalog include galvanometers, microammeters, millivoltmeters, true RMS meters and voltmeters, wattmeters, voltammeters, ammeters, meters for VAW DC current, selective expansion, differential, deviation, expanded scale and digital multimeters.
110. **GENISCO**—A new series of data sheets describing the Technology GF50 series of subminature RFI/EMI filters is now available. The data

sheets cover a choice of five current ratings, from 0.1 to 10 ampheres, and three voltage ratings—50, 100 and 200 volts. Also included and key specifications, dimensional configurations, and graphs showing typical insertion loss curves of various circuit configurations.

111. **HALLICRAFTERS CO.**—A new manual on the Communications Receiver Model SX-122A is now available. The manual gives operating and service instructions for the Model SX-122A. Also discussed is general discription, installation, functions of operating controls, operation, and alignment.

112. **HEWLETT PACKARD**—A brochure on Hewlett Packard products is now available. The brochure includes Model 5268A Frequency Multiplier plugged into a 5245-series Electronic Counter, Model 8554L/8552A Spectrum Analyzer, Model 10514C Double-Balanced Mixer, and others. Also included are prices, photographs, and descriptions of the products.

113. **KISTLER INSTRUMENT CORP.**—A new Bulletin No. 314-5/69 on the Kistler subminiature, in-line Pieztron Impedance Converters is now available. When used with couplers, the converters replace charge amplifiers in single-range applications. The bulletin describes the five basic models available. It lists specifications common to all units, in addition to specifications for each model. Photographs of the Impedance Converters include detailed size information. Also included is the information on signal polarities, power supply requirements, and ordering information.

114. **MICROWAVE POWER DEVICES, INC.** — Data sheets covering the supply of Transistorized Power Amplifiers over the frequency range of 2 MHz to 2.4 GHz are now available. The data sheets fully describe the operation, characteristics and specifications of various narrow and wide band amplifiers in power levels of 1 watt to over 100 watts.

115. **MICROWAVE SYSTEMS CO.**—Four new color illustrated brochures are now available. The Passive Repeater Systems Manual includes passive repeater design and fabrication, path refraction and reflection, and critical path loss testing. Capabilities Brochure includes products and services. Path Loss Testing Brochure includes path loss testing for system assurance, path loss testing procedures, and microwave systems turnkey capability. The Passive Repeaters Brochure includes passive repeater models and how to order a passive repeater.

116. **MOSELEY ASSOCIATES, INC.**—A new four-page brochure entitled "AM Wireless or Radio (STL) Remote Control" is now available. With the approval by the FCC of Docket Number 17873, AM broadcast stations may now utilize complete wireless remote control. The approval allows the application of subaudible tones to the AM carrier for metering or telemetry purposes. The brochure outlines the basic principles and gives a complete systems approach to this type of remote control.

117. **NATIONAL SEMICONDUCTOR CORP.** — A TTL 54/74 Series Performance Guide is now available. The guide lists general rules of thumb to be used by the design engineer regarding particular uses of standard TTL Series 54/74. It also includes hints on present and clear pulses, clock pulses, expanders, line termination, decoupling and other topics.

118. **NET**—A collection of more than a thousand motion pictures produced by NET is now available. The entire catalog of 16 mm films from public television, distributed nationaly by NET Film Service at Indiana University, may now be incorporated into closed circuit and 2500 Megahertz instructional televisions installations, as well as other educational, non-broadcast, electronic distribution systems, such as dial-access and video-film scanning devices.

119. **RCA**—A new booklet with facts and figures for people considering the purchase of Learning Lab systems, is now available. The booklet describes the latest RCA equipment, from consoles and student position to headsets and lesson sources. Their capabilities are explained, and the booklet illustrates how each is used by both teacher and student.

120. **SIMPSON ELECTRIC CO.**—The latest test equipment Bulletin 2080 introduces five new instruments and gives complete operating specifications for equipment serving needs for industrial electronic and electrical testing. The Model 202 ACCU-LOG is the first VOM with maximum accuracy anywhere on a quasi-logarithmic scale. Model 603 portable chart recorders are available in AC voltage, AC current, DC voltage and DC current measuring ranges. Two multi-testers, Models 256, 257, measuring voltage, current, capacitance and resistance, a current leakage tester Model 229, and a solid state VOM Model 313 are new items in the Bulletin.

121. **SWITCHCRAFT** — A new Catalog No. J-110 on "Tini-telephone" Patching Systems Components is now available. The catalog describes and illustrates the system components. Also included are material specifications and price lists.

122. **TECHNICAL WIRE PRODUCTS, INC.** — A new four-page data sheet EMC-660 for designers of electronic equipment who must meet rigorous EMI/RFI shielding requirements for 19″ and 24″ cabinets is now available. The data sheet contains engineering drawings that show standard all-aluminum enclosures with EMI-RFI gasketed seams, honeycomb side vents and removable front, back, top and bottom panels.

123. **UNITRODE CORP.**—A new Short Form Catalog and Design Guide on the SSPI-Product-Group Thyristors, High-Power Transistors, Gate Turn-Off SCR's, Photo SCR's and Hybrid Power Integrated Circuits is now available. For reader convenience, SCR's are categorized by MIL, High Speed and Industrial Types and Transistors by Power, Power Switching, and High-Voltage Power and Power Switching Types. The Design Guide sections list those devices Unitrode recommends for use in new designs.

124. **VISUAL ELECTRONICS CORP.**—A new 8-page brochure covering the recently introduced Titlefile System is now available. The brochure describes the applications and versatility of the new TV titling system. The Titlefile System stores up to 30,000 characters of pre-programmed information which is rapidly accessible for TV presentation. The system is available at a fraction of the cost of previous titling systems.

125. **WESTINGHOUSE**—Portable solid-state monitors, specially designed for general use in closed-circuit televisions, are described and illustrated in a new bulletin. The monitors, particularly suited for daylight or outside applications, each have a compact picture tube offering 37 square inches of viewing area. They can be operated from a battery pack when the regular 120-volt, 60-Hz, AC power is not available. The bulletin describes the applications and design features of the monitors, and gives operating and dimensional specifications.

Moving?

Send Your Change

Of Address To:

Broadcast Engineering

1014 Wyandotte

Kansas City, Mo. 64105

FCC Gets New Chairman

Dean Burch is the 15th Chairman to head the Commission since it was formed in 1934. He was nominated to the Commission by President Nixon on September 16 and confirmed by the Senate on October 30. His term as Commissioner runs to June 30, 1976.

Burch graduated from the University of Arizona in 1948, and received his LL.B. degree there in 1953. Following his admission to the Bar, in 1953, he was appointed Assistant to the Attorney General of Arizona. He first came to Washington in 1955, as legislative and then administrative assistant to Senator Barry Goldwater, returning to private practice with Dunseath, Stubbs and Burch in 1959. He served as Chairman of the Republican National Committee from July 1964 to April 1965. In January of this year, he was named to the Arizona Board of Regents by Governor Jack Williams.

Robert V. Cahill

Chairman Burch has appointed Robert V. Cahill to the post of Administrative Assistant. Cahill had been Legal Assistant to Chairman Hyde.

Cahill is the author of a number of articles on the FCC published in legal and professional journals. He is a member of the Bar of the United States Court of Appeals for the District of Columbia and the United States District Court for the District of Columbia.

Wells Joins Staff

Robert Wells has been sworn in as a member of the Federal Communications Commission.

Wells entered broadcasting in 1936, while still in school, working as an announcer at KIUL, Garden City and then at KVGB, Great Bend, Kansas. He returned to KVGB, following his release from service. In January 1948, he became general manager of Station KIUL, a position he held until 1961 when he took on the additional assignment as general manager of the Harris Group. From 1957 to 1961, Wells was also publisher of the Garden City Telegram.

Send Your Station News To Broadcast Engineering For Better Coverage

Jerold Poulos, KOBI-TV, Medford, was elected president of the Oregon Association of Broadcasters at the 28th Annual Fall Conference. The new vice-president is Bob Thomlinson, KATR, Eugene. The new secretary-treasurer is Dick Brown, KPOJ, Portland.

Featured Conference speakers included Oregon Congresswoman Edith Green; Lee Fondren, KLZ, Denver; Maurie Webster, CBS Radio; Ken Draper, Programming dlb, and Ron Ogle, ABC News producer.

Visual Gives Scholarship To Fuller

The Visual Electronics Educom plaque and scholarship grant was presented by Vincent Wasilewski to Michael H. Fuller, a junior at Stanford University, Stanford, California, during the recent NAEB Convention in Washington, D. C.

Educom, Education for the Advancement of Communications, was established by Visual Electronics Corporation to stimulate the development of the future leaders of the broadcast industry by offering individual awards, thereby contributing to the industry as a whole.

Educom Scholarship Award winner Michael A. Fuller (center) receiving award from Vincent Wasilewski (right). Visual Electronics President, James B. Tharpe, Sponsor of the program, offers congratulations to Fuller.

IEEE Elects Top Brass

Dr. John V. N. Granger, Chairman of the Board of Granger Associates at Palo Alto, California, has been elected by the voting members to be President of the Institute of Electrical and Electronics Engineers for 1970.

Dr. Granger succeeds Dr. F. Karl Willenbrock, Provost of the Faculty of Engineering and Applied Sciences at the State University of New York, Buffalo. He will preside over the activities of the world's largest engineering society, having some 160,000 members located throughout the world.

The Directors of IEEE also announced the election of Dr. James H. Mulligan, Jr. as Vice President for 1970. Dr. Mulligan is Executive Secretary of the National Academy of Engineering in Washington, D. C. When the Institute's Annual Assembly meets in January, 1970, two additional Vice Presidents for 1970 will be elected.

Other elections announced included: Directors-at-Large—Joseph K. Dillard, Manager, Advanced Systems Technology, Westinghouse Electric Corporation, East Pittsburgh, Pa.; Dr. Glen A. Richardson, Professor and Head of Electrical Engineering, Worcester Polytechnic Institute, Worcester, Mass.: Regional Directors—Dr. James E. Storer, Director, Applied Research Laboratory, Sylvania Electronic Systems, Waltham, Mass.; Seymour Cambias, Jr., Manager, Electrical Engineering, New Orleans Public Service, Inc., New Orleans La.; Prof. Lloyd B. Cherry, Dean of Engineering and Professor of Electrical Engineering, Lamar State College of Technology, Beaumont, Texas; William H. Thompson, President and General Manager, L. A. Varah, Limited, Vancouver, British Columbia; Carlos A. J. Lohmann, Manager, High Voltage, Large Generators and Transformers, Naval and Railroad Divisions, Siemens do Brasil S/A, Sao Paulo, Brazil.

Taverner Heads NCTA

Taverner, President and board member of educational television stations WQED and WQEX in Pittsburgh, has built a record of achievement since he took the post in 1963.

The National Cable Television Assn. has named Donald V. Taverner, Pittsburgh educational television executive, as its new president. Taverner will take office Jan. 1 succeeding Frederick W. Ford, who submitted his resignation earlier in 1969.

Karnes To Cable Post

W. F. (Bill) Karnes has been elected president of Dallas based National Trans-Video, Inc., the nation's fifth largest operator of community television antennas systems.

NTV serves some 28 U.S. and Canadian communities, supplying over 75,000 subscribers with improved television viewing.

New MBS President Rep To NAB Board

The National Association of Broadcasters has announced that Victor C. Diehm, newly-elected president of the Mutual Broadcasting System, has been designated as the network's representative on NAB's Board of Directors, suceeding Robert R. Pauley, former MBS president.

Taylor To Kaiser Post

Kaiser Broadcasting has created an FM Stations Division. This is the first such divisionalization for Kaiser Broadcasting, which operates six television stations, one AM station and two FM stations.

Peter V. Taylor, WJIB general manager, has been appointed general manager of the new FM Division, assuming additional duties. Taylor will continue to headquarter in Boston. His primary responsibility will be to lead Kaiser's expansion in FM.

book eview

New Books Cover Broadcast Field

Hastings House Publishers, Inc., has a new book on the market that can be a fine addition to your reference library. **The Focal Encyclopedia of Film and Television** is the first major work covering the twin technologies of film and television.

The 1100-page book covers the following areas and many more: Bandwidth Problems; Difficult environments; Blanking and synchronization; sound dubbing; vision mixers; converter techniques; helical and transverse scanning; printing methods, color difference signals; transfer characteristics; laboratory techniques; and modulation methods.

The work of over 100 contributors, this book contains 1,000 illustrations and an index of 10,000 references. Raymond Spottiswoode, the general editor, was assisted editorially in film coverage by Bernard Happe and in television by Eric Vast. Spottiswoode is a Fellow of the SMPTE and author of **Film And Its Techniques.** Happe is the technical manager of Technicolor, Ltd., London, and a member of the British Standards Institution committees on motion picture and TV practice. Vast is on the technical staff of Thames Television Ltd.

The book is available through Communication Arts Books, Hastings House, Publishers, Inc., 10 East 40th Street, New York 10016.

AM/FM Radio

Harry Etkin has just completed a book entitled **AM/FM Broadcast Station Planning Guide.**

The book includes floor plans for stations of all sizes and markets, describes the necessary equipment and tells how to fill out the Form 301. In the maintenance sections, Etkin gives step-by-step procedures for proof-of-performance measurements, and gives installation and preventive maintenance guidelines.

This one is available from TAB Books, Blue Ridge Summit, Pa., 17214.

Generators

Loren Mages, author of two generator articles in recent issues of **Broadcast Engineering,** is working on a book covering many facets of the selection, installation and maintenance of generators. The book is not yet off the press, so we suggest you contact Loren concerning publication dates. His address is: Forces, Incorporated, 124 West Lake Street, Northlake, Illinois, 60164.

Advertisers' Index

Professional Services

Classified

Advertising rates in Classified Section are 15¢ per word, each insertion, and must be accompanied by cash to insure publication.

Each initial or abbreviation counts a full word. Upper case words, 30¢ each.

Minimum classified charge, $2.00.

For ads on which replies are sent to us for forwarding, there is an additional charge of $2.00 to cover department number, etc., which is printed in advertising copy, and processing of replies.

Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or a distributor.

Training

To advance in electronics, knowledge and ability are required. Grantham offers correspondence and resident instruction, in depth, leading to the degree of Associate in Science in Electronics Engineering. G. I. Bill approved. Credit for previous training and experience allowed. Free Catalog. Write: Dept. E-2, Grantham School of Electronics, 1505 N. Western Ave., Hollywood, California 90027. 6-67-tf

First phone through tape recorded lessons at home plus one week personal instruction in Washington, DC, Atlanta, Boston, Detroit, New Orleans, Minneapolis, Seattle, Denver, Portland, Los Angeles. Proven results. Our 17th year teaching FCC license courses. Bob Johnson Radio License Preparation, 1060D Duncan, Manhattan Beach, Calif. 80266. Phone 213-379-4461. 1-69-tf

Wanted

Wanted: Telefunken U-47 condenser microphone, good condition. Joel Newman, WOMN, Decatur, Georgia 30030. 12-69-2t

Seeking new ideas or products for the Broadcast Industry. Art Himmel, 342 W. 40th St., New York, N. Y. 10018 12-69-3t

Help Wanted

Job Headquarters for all Radio and Television Engineers. Immediate openings exist in 9 western states and elsewhere for qualified engineer and technical personnel. All categories from trainees to experienced transmitter maintenance, chief, assistant chief, live color video maintenance and technical operations. Send us your complete resume now. The AMPS Agency, 3924 Wilshire Blvd., Los Angeles, California 90005. Telephone DU 8-3116. By Broadcasters—For Broadcasters. 11-68-tf

KWWL-AM-FM-TV, Waterloo, Iowa, is expanding its engineering staff. Position is available at both studio and transmitter for 1st Class engineer having aptitude in the area of operations or maintenance. Contact E. M. Tink, Vice President of Engineering. 11-69-2t

IMMEDIATE OPENING for TV transmitter operator with 1st class license at Raleigh, N. C. Reply to Chief Engineer WTVD, Durham, N. C. 919-477-2131. Equal oportunity employer. 12-69-2t

TV DESIGN ENGINEERS

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Video Distribution and Switching
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Several positions are available at the senior and project level. EE or Physics Degree desired, equivalent experience is acceptable. 3-10 years' work in related circuit design a must.

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Call (collect) or write (resumé) Jim Barnes, Chief Engineer, to arrange a personal interview.

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Phone (714) 277-6700

An Equal Opportunity Employer

IMMEDIATE OPENINGS: Qualify for any of the following positions: RCA CCTV Equipment, monochrome or color. TV Systems Engineers — Project Engineers — Supervisors — Managers — Maintenance Technicians — Video Engineers — to work in either New York, Pennsylvania, New Jersey or California area. Write: RCA Rep., 1559 Jericho Tpke., New Hyde Park, New York 11040. 1-70-tf

Transmitter engineer with First Phone wanted for western part of Nebraska. Permanent state position. Experience desirable but on-the-job training possible. Salary commensurate with experience. Contact Director of Engineering, 1600 R Street, Lincoln or call collect 402-477-6974. 12-69-2t

TELEVISION EQUIPMENT SALES

Immediate openings in television equipment sales organization for aggressive sales oriented individuals with strong technical knowledge of television equipment primarily transmitting systems. A leading broadcast equipment supplier is rapidly expanding into the television market and has the following positions available:

District Sales Managers—TV Products
TV Product Manager
TV Service Manager

For further information call collect or send resume to Robert T. Fluent, Assistant Personnel Manager, 123 Hampshire, (217) 222-8200.

GATES RADIO COMPANY
A Division of Harris-Intertype Corporation
QUINCY, ILLINOIS 62301
An equal opportunity employer (M&F)

VHF TRANSMITTER MAINTENANCE ENGINEER. Must have good electronics background and transmitter maintenance experience to maintain RCA TT25EH and associated equipment . . . some studio maintenance . . . Small Market Full Color Station. Send resume to W. Douglas Drader, Chief Engineer, KGVO-TV, P. O. Box 1503, Missoula, Montana 59801. 1-70-1t

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BROADCAST CONSULTING FIRM SEEKS EXPERIENCED BROADCAST ENGINEER OR TECHNICIAN FOR POSITION OF JUNIOR ENGINEER. Applicant must be willing to travel. An Engineering Degree is desirable. Send Resume and References to Jules Cohen & Associates, 1145 19th Street, N.W. Washington, D. C. 20036. 1-70-1t

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Equipment for Sale

AM or FM Audio P.O.P. form kit $1.50 postpaid. Broadcast Service Co., Box 2605, Corpus Christi, Tex. 76403. 2-69-tf

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CARTRIDGE TAPE EQUIPMENT—Completely reconditioned Spotmaster and Tapecaster Record/Playbacks, $375.00. Playbacks $250.00. 30-day money-back guarantee on all equipment. BROADCAST PRODUCTS CO., INC. 12330 Wilkins Avenue, Rockville, Maryland 20852. Ph: 301-933-3400. 10-69-tf

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35 ft. semi mobile unit, 50 K W Generator, 4 electric cable drums, 10-ton air conditioner, electric elevator to roof level, GMC series 5500 tractor. Does not contain TV equipment. Broadcast Engineering, Dept. 236, 1014 Wyandotte St., Kansas City, Mo. 64105. 12-69-2t

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Tower Lite Control Panel Box containing alarm, telo & auxiliary circuits, auto transformer and flasher units—115V 60 cycle, unused. $125.00 each. Sierra-Western Electric Co., Oakland, Cal. 94623. Phone 415-832-3527. 6-69-tf

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Ampex MR-70 3 Channel (½" tape). Purchased new 8/13/68. Has never been used. Transport and electronics modified from original 15/30 ips to 3¾/7½ ips. (Modification performed by Expert Electronics, Chicago) To be sold "as is," F.O.B. Morton Grove, Illinois. Write D. J. Gulliford, Radiant Educational Corporation, 8220 North Austin Avenue, Morton Grove, Illinois 60053 (Phone 312-966-4200). 12-69-2t

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Surplus audio and video patch panels and patch cords. 500 to 500 ohm repeat coils flat to 20,000 cycles. Send for list. Gulf Electro-Sales, Inc., 6325 Beverly Hill, Houston, Texas 77027. 4-69-12t

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1000 watt FM transmitter, ITA FM-1000B. Also stereo generator. Box 2605, Corpus Christi, Tex. 78403. Other equipment available. 10-69-tf

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GE TT20 UHF TV Transmitter, one Kw, with two operating finals and two new finals, spare modulator. Evans, KPEC, Box 3548, Tacoma, Washington 98499. 1-70-1t

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Presto 8K disc record cutter. 3 speed. $75.00. Warren Arnett, 723 N. Horton St., Marion, Indiana 46952. 1-70-1t

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Equipment Wanted

Two Dumont TA-124, or RCA TK-30 or 31, or similar camera chains. Evans, KPEC. Box 3548, Tacoma, Washington 98499. 1-70-1t

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a fine stabilizing amplifier now at lowered prices...

Increased production efficiency and increased sales make reduced prices possible on this excellent stabilizing amplifier. The TVA1 with its associated series of plug-in units offers high level performance and versatility for studio or transmitter use. It removes all low frequency disturbances such as hum, bounce and tilt by sync-tip clamping. The back porch level is precisely stabilized without affecting color signals in any way. Sync is stretched after back porch stabilization and then clipped accurately to desired level. This level may be set by means of a front panel control or can be extended to a remote location. Stripped sync is provided at one 75 ohm internally terminated output connector, at a 4 volt level. The TVA1 chassis contains a plug-in compartment which accepts up to 4 plug-in units. Among these plug-in units is the TVA1-E, providing a stripped color video channel, and the TVA1-D which provides the means of adjusting peak-white clipping, white stretch and differential phase. Other plug-in units are listed below.

NEW LOWERED PRICES
F.O.B. NASHVILLE, TENNESSEE

Model TVA1 Stabilizing Amplifier (less plug-ins)...$950.00
Model TVA1-A Manually Operated Input Amplifier Unit...$250.00
Model TVA1-B Input Amplifier Unit, with Remote Master Gain and Chroma Panel...$375.00
Model TVA1-C Monitor Amplifier Unit...$175.00
Model TVA1-D White Stretch and Clip Unit...$160.00
Model TVA1-E Stripped Video Unit...$350.00
Model TVA1-S Remote Sync Level Control Panel...$25.00

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When Stanton engineers get together, they draw the line.

The frequency response curve of the new Stanton 681 Calibration Standard is virtually a straight line from 10-20,000 Hz.

That's a guarantee.

In addition, channel separation must be 35 dB or greater at 1,000 Hz. Output must be 0.7 mv/cm/sec nominal.

If a 681 doesn't match these specifications when first tested, it's meticulously adjusted until it does.

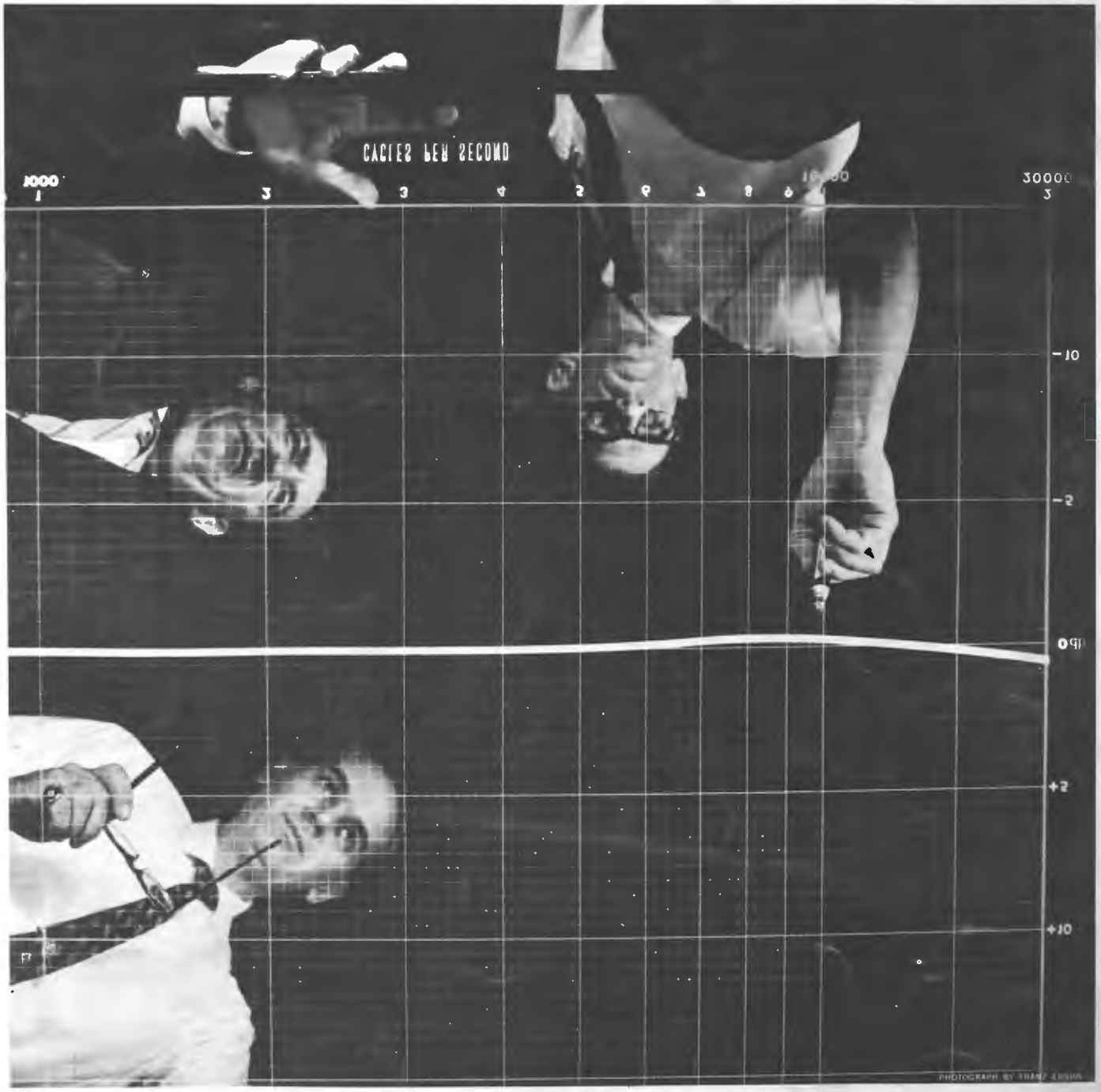
Each 681 includes hand-entered specifications that verify that your 681 matches the original laboratory standard in every respect.

Nothing less would meet the needs of the professional studio engineers who use Stanton cartridges as their reference to approve test pressings. They must hear exactly what has been cut into the grooves. No more. No less.

But you don't have to be a professional to hear the difference a Stanton 681 Calibration Standard will make, especially with the "Longhair" brush which provides the clean grooves so essential for clear reproduction. The improvement in performance is immediately audible, even to the unpracticed ear.

The 681 is completely new, from its slim-line configuration to the incredibly low-mass moving system. The 681A with conical stylus is $55.00, the 681EE with elliptical stylus, $60.00.

For free literature, write to Stanton Magnetics, Inc., Plainview, L. I., N. Y.



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