July, 1970/75 cents

Broadcast Engineering®

the technical journal of the broadcast-communication's industry

A HOWARD W. SAMS PUBLICATION

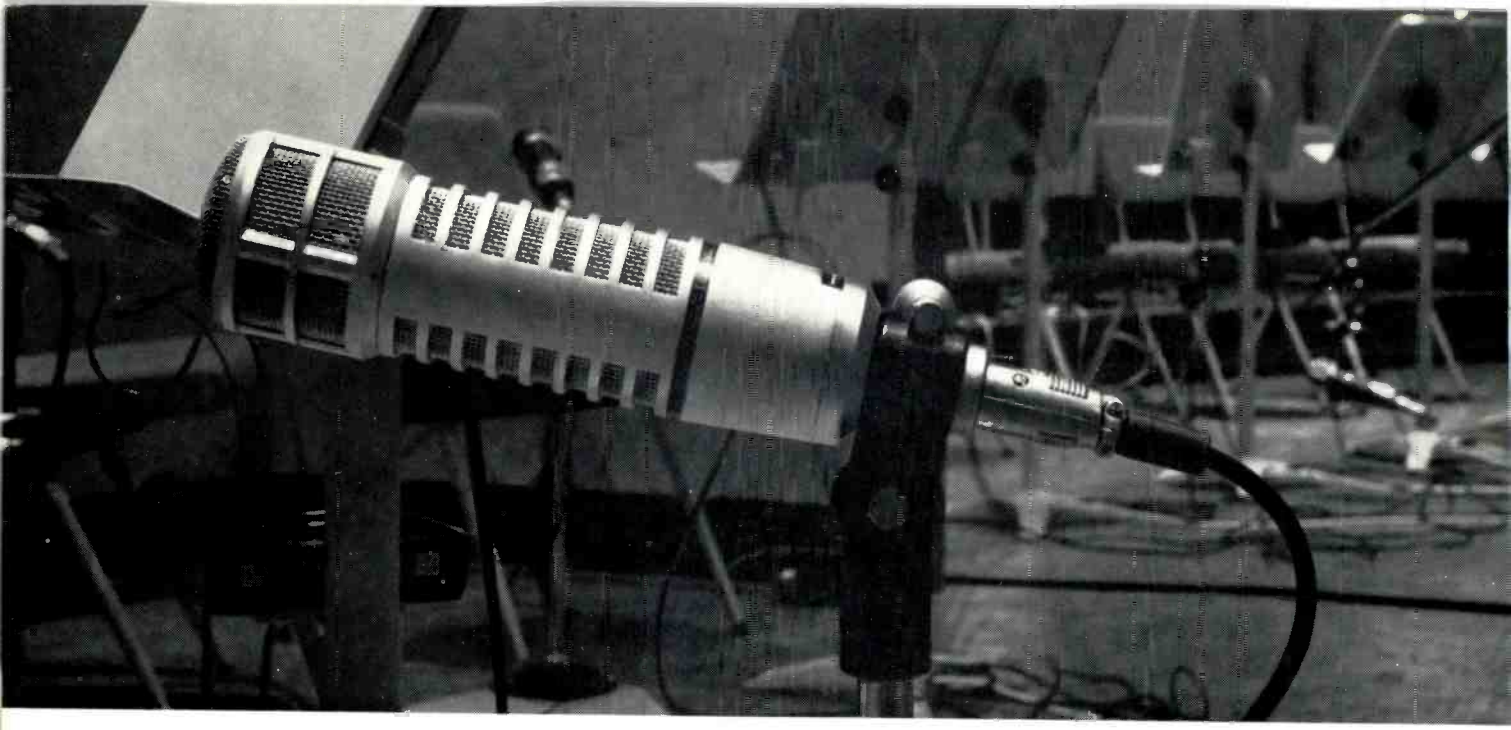
Measuring RF Output

page 24

Line Surge Protection

Setting Up SCA Operation

Campus Transmitter Control



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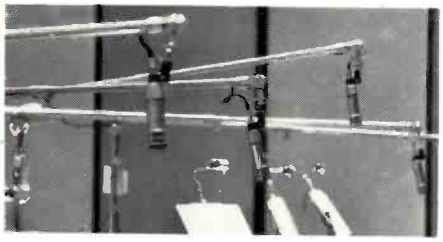

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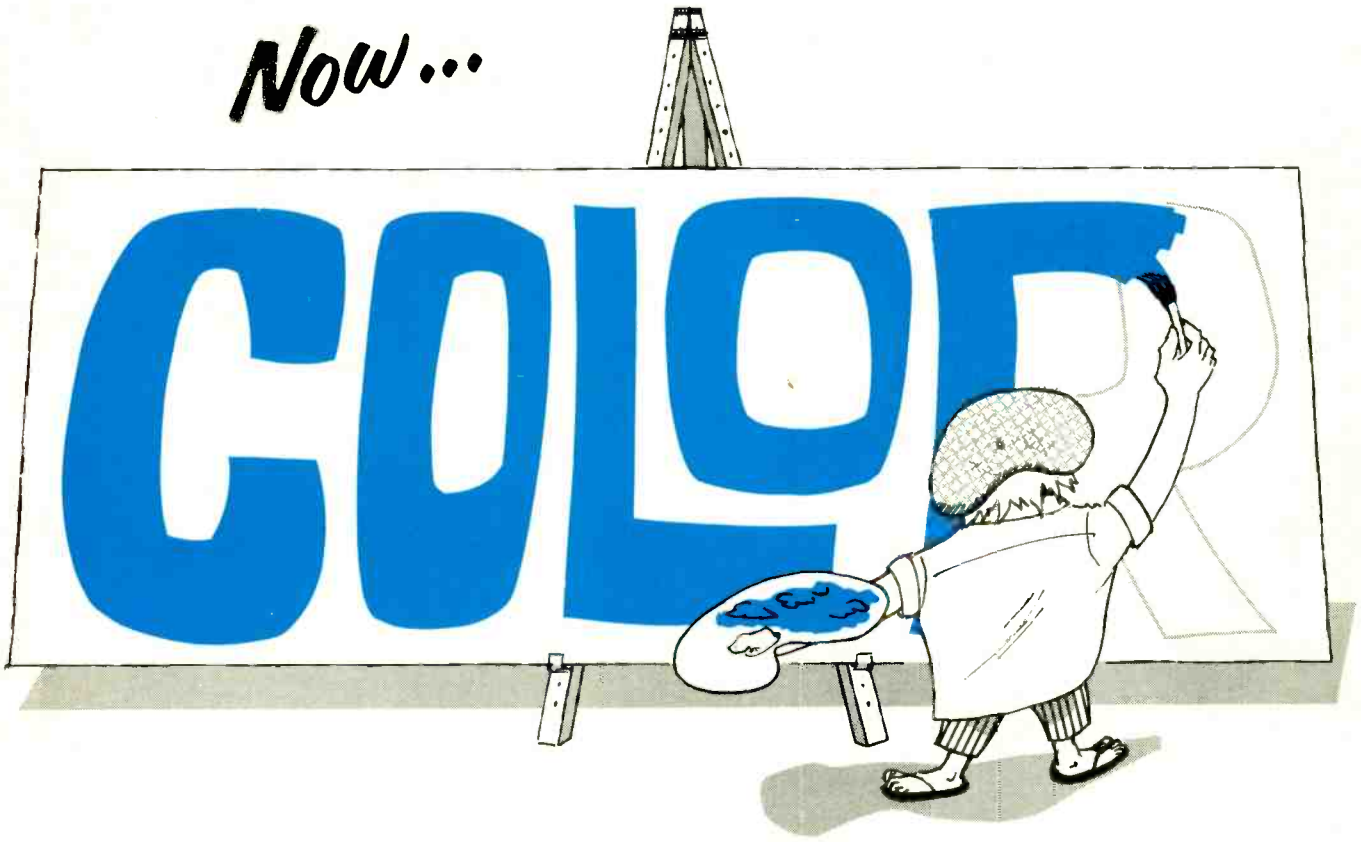

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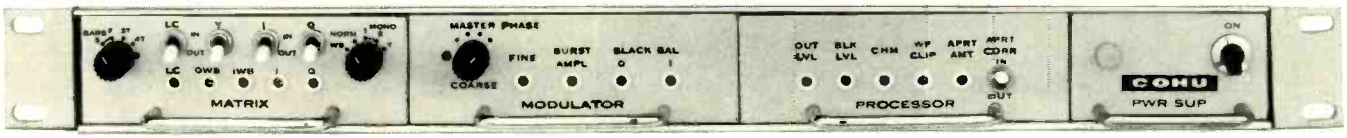

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SAN DIEGO DIVISION

July, 1970 • Volume 12, No. 7

Broadcast Engineering

The technical journal of the broadcast-communications industry

in this issue...

ABOUT THE COVER

Making RF power output measurements can become too subjective, unless accurately calibrated test equipment is used. See page 24 for a summary of measurement procedures. (Photo courtesy of Gates Radio Company.)

DEPARTMENTS

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DIRECT CURRENT FROM D. C.

July, 1970

By Howard T. Head

UHF Television Spectrum Reallocated to Land Mobile

As predicted (April, 1970 D.C. Pompous Predictions), the Commission has reallocated a substantial chunk of UHF television broadcast spectrum to the land mobile radio services. The upper end of the UHF television band, Channels 70-83 inclusive (806 MHz - 890 MHz), has been withdrawn from television service and reallocated to land mobile. Also reallocated to land mobile was half of the 942-952 MHz band formerly assigned for aural broadcast STL use (See Oct. 1968 Bulletin).

On the lower seven UHF channels (Channels 14-20), the Commission has authorized sharing between television and land mobile on a geographical basis. One or two television channels in this frequency range are being assigned for land mobile operation in each of the nation's ten largest urban areas. Engineering requirements are established to protect television station Grade B contours from co-channel, adjacent-channel, and intermodulation (including I.F. beat) interference.

The bite at the lower end of the UHF band was considerably less than the television broadcasters had feared. The Commission had originally proposed geographical sharing in the top 25 markets with as many as five television channels being shared in some areas. Also, the final protection criteria are substantially more conservative than the Commission had originally proposed. Also turned down was a proposal by the land mobile services for the complete reallocation of Channels 14-20 to land mobile over a period of years.

Numerous details remain to be worked out. Opening up television channels for land mobile in Chicago and Philadelphia requires reassigning presently authorized stations. Also, in the cases of Cleveland, Detroit, and Los Angeles, agreement must be reached with the Canadian and Mexican governments for the non-television use of the shared channels.

Also left dangling is the fate of over 800 UHF television translators now operating on Channels 70-83. The licenses of these translators will be renewed only on a "secondary" basis, that is, the translators will be required to accept any interference from land mobile operation and will not be permitted to cause any interference to land mobile operation. The Commission has proposed to open up Channels 14-69 for translators, but there is considerable question as to whether all UHF translators can be accommodated on these channels unless the present protection rules are substantially relaxed.

The Commission is also considering reallocating the frequency spectrum between 2150 and 2160 MHz as a replacement for aural studio transmitter links for the 5 MHz taken away between 942 and 952 MHz.

(Continued on page 6)

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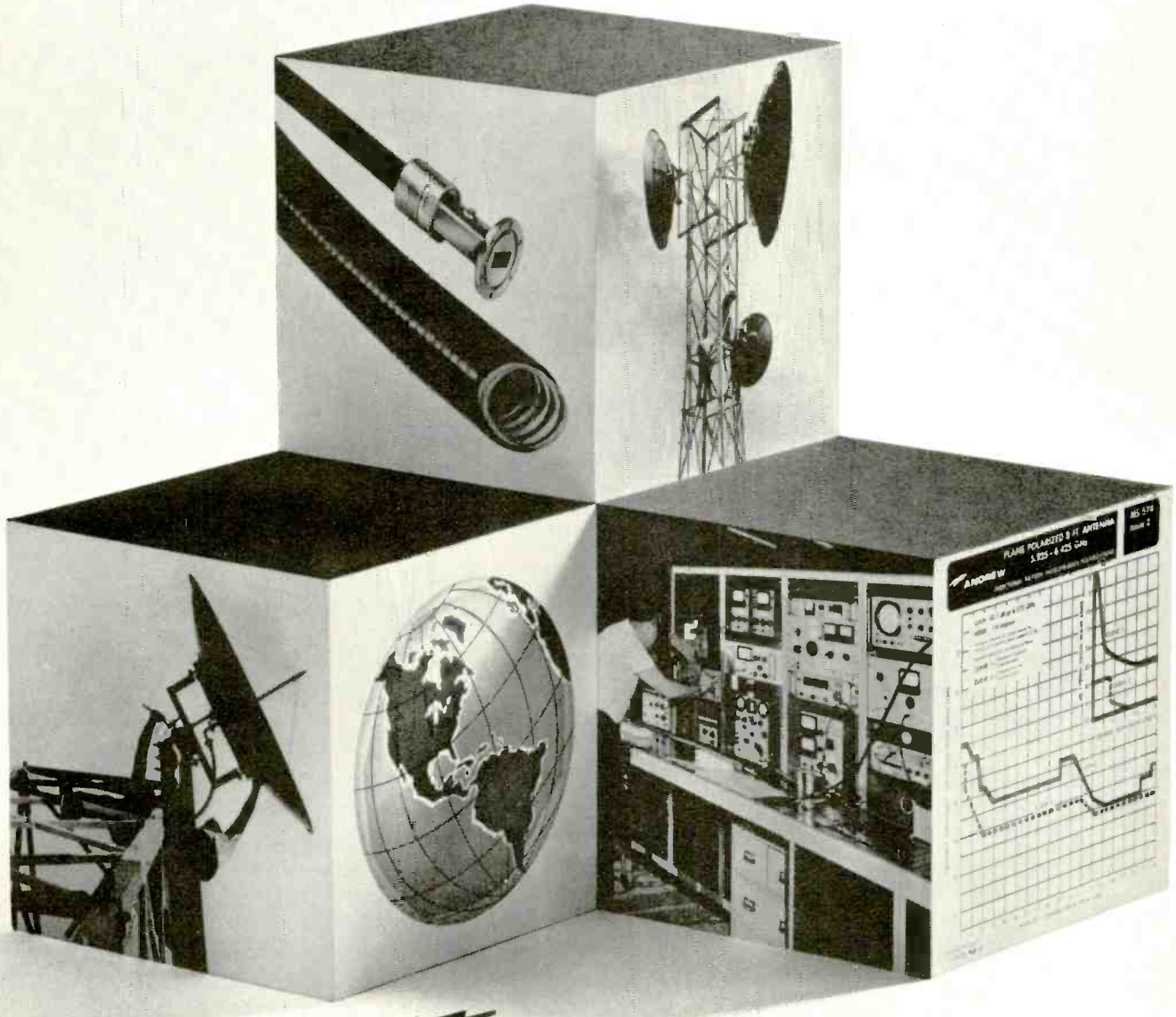
We sell more microwave antennas than anyone. Two or three times as many. It's this, plus a unique "degree of completeness" that makes Andrew the better buy. It's antennas. *And* waveguide or coaxial cable. Made to work together. *All* the hardware you need. Plus *all* of the software necessary to guarantee performance as specified. It's technical assistance *on an international basis*. Help all the way through the installation if you need or want it. Anywhere in the free world. Like to know more? Communicate with Andrew.



ANDREW

2-69

CONTACT THE NEAREST ANDREW OFFICE OR ANDREW CORPORATION, 10500 W. 153rd STREET, ORLAND PARK, ILLINOIS 60462

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(Continued from page 4)

The Commission does not intend to provide, at this time, for any further sharing of the lower UHF channels by land mobile. The Commission is pressing forward with plans for setting up a Regional Frequency Management Center in the Chicago area to improve existing land mobile frequency assignment proceedings, and is looking to the land mobile interests to exploit the new frequency assignments in the 900 MHz region.

Commission Working on Further CATV Relaxation

Also as predicted (April, 1970 D.C. Pompous Predictions), the Commission is preparing to announce plans for further relaxation of the present restrictions on CATV expansion. Expected to be announced shortly are proposals to permit CATV systems to import as many signals as necessary to provide all three network services and at least four independent signals. No limit would be placed on ETV importations.

The CATV systems would be required to delete commercials of distant independent stations and insert those of local UHF stations. Engineering standards would be proposed covering most aspects of CATV performance except on-channel ghosting. Consideration is being given to requiring a minimum of 20 channels for new CATV systems and possible requirements for two-way transmission. The system would be allowed a pay-television channel on the same basis as provided for broadcast systems (Feb. 1969 Bulletin).

Removal of AM Loss Resistors Proposed

An AM station at Havre De Grace, Maryland, required by the terms of its license to reduce the effective field of the antenna system, has asked the Commission to permit this reduction by reducing the transmitter output. Under present requirements, the station must operate its transmitter at the full 5 kW output while dissipating approximately 1.1 kW in a set of loss resistors.

The same procedure is required to be followed by approximately 200 AM stations whose effective field at full power would exceed that permitted by the allocation standards. The Commission's position in the past, in responding to informal requests for this change, has been that no type approval data are available for transmitters operating at other than the standard powers. The petition points out that this is a minor problem easily curable, and that the present system is wasteful in many respects by reason of the extra heat generated and the demands on final amplifier tube life. The petition points out the almost universal practice of operating FM and television transmitters at less than rated power to achieve desired radiated fields.

Time Set for Retention of "Local Inspection Files"

The Commission has amended the rules requiring the maintenance of "local inspection" copies of applications for construction permits and licenses so as to specify a time limit for their retention. The rules previously in effect required such files to be preserved indefinitely.

Under the new rules, these public inspection files must be maintained for a period of seven years. A single exception is made in the case of engineering material relating to a former mode of operation, such as a different frequency, power, or directional antenna pattern, which is required to be preserved for a period of only three years.

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Photographed at Capitol Records.

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Circle Number 7 on Reader Reply Card

LETTERS TO THE EDITOR

Who's What In Broadcasting?

Dear Editor:

I have just read with great interest the material in Mr. Head's portion of your fine magazine, as well as comments made at the Virginia Assoc. of Broadcasters by the FCC and as per your request for comments . . . here are some of mine.

I feel that one must go back to the days of radio when you had an engineer in one room and the announcer in another, this is rare today. The time came when the "Combo man" was born for several reasons, the major one I would say would be the advent of the "DJ" and economy on the part of radio in general at that time. Later on with more and more announcers getting into this "Combo man" position, a way was found to get around the requirement that a person know what he is doing from an engineering standpoint to pass the first phone exam . . . ala the advent of the "quickie school" or "six week wonder".

It is indeed funny that it has taken the FCC all of these years to finally realize that the "First Phone" is no longer an indication of the person's knowledge about technical subjects . . . it has come to the point that it is no more than a piece of blue paper that anyone with the time and money and average ability can obtain purely for the privilages it offers to the broadcaster/operator/DJ. For those of us that went to hours and hours of school to learn the material so that taking the test was easy it is nothing short of an insult. So what do we have now. . . the radio business is full of "six week wonders" and I feel that it is like a person holding a driver's license that he obtained without any more than taking the written exam.

The FCC is showing signs of citing the operators for violations that occur when they are "on the log" and making First Phone holders responsible for being engineers . . . this is great . . . it is one of the first truly great decisions that the Commission has come out with in years. For far too long the station has had to pay for a technically stupid First Phone . . . but now what happens to the DJ at a directional when the FCC drops in and finds the place "Out to lunch". Do they hold this First Phone responsible? I feel that NAB's proposal to allow 3rd Phones to operate high power and directional AM's is a step in the right direction. And the revision of the First Phone exam to eliminate the possibility of a person passing without actual knowledge of the material to the extent that the Commission requires the person to have and be responsible for is another "well it's about time" move on their part.

This has been a long time coming, but perhaps if we all hold our fingers crossed, the FCC, the schools and the management of broadcast facilities will know who is a technician, who is an operator and who is a combo man.

These are my feelings and trust those of many in my shoes, and I hope that in some way my contribution to **Broadcast Engineering** will help keep this movement alive and move it toward its logical conclusion.

Clay Freinwald
Chief Engineer
KMO
Tacoma, Washington

Get And Keep Talent With Reasonable Pay

Dear Editor:

I have read with much interest, your article in the April issue concerning Educational Television and the New Engineering Program. Indeed this should serve to eliminate some of the problems of obtaining competent technical people, especially for the educator. However, my reaction to the problem is a bit different.

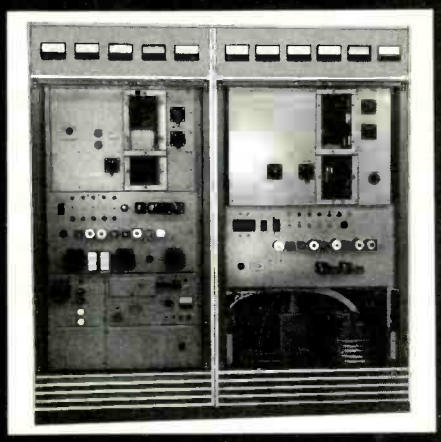
I believe there is one major problem involved in the marriage of the

CCA ELECTRONICS

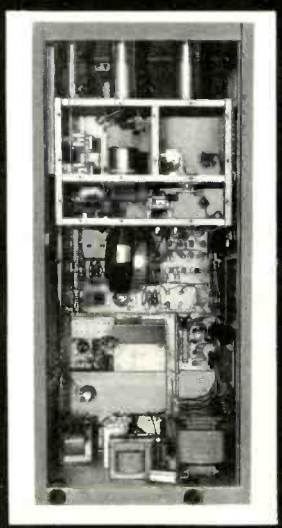
Announces a 25 KW FM

AIR COOLED TRANSMITTER...
WITH INDEPENDENT 3 KW DRIVER
AND ONE POWER AMPLIFIER TUBE

FRONT VIEW:
The CCA FM-25,000DS is self contained in (2) two modern cabinets. No external parts — An independent 3KW transmitter which serves as a driver and a 25KW Amplifier. Total floor space less than 18 square feet.

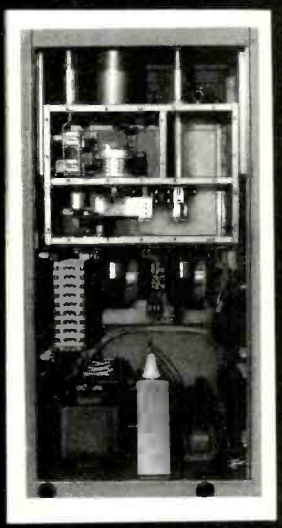


FRONT VIEW—DOORS AND FRONT COVERS REMOVED:
Note full access to all controls and parts. All controls are calibrated and all parts are standard and can be obtained from local sources.



REAR VIEW 3KW DRIVER:
Independent 3KW Transmitter can be used as emergency cutback. Normally only produces 1.5KW drive.

REAR VIEW 25KW AMPLIFIER:
Only one tube, a zero bias 3CX15000A7 triode is used in the FM-25,000DS and produces 25KW with less than 30KW input. (85% efficiency) No neutralization—Simplicity, stability and reliability.



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(Continued from page 8)

educator to television which tends to "breed" a shortage of talent available to him (the educator). This problem is created by the educator and in his hands is the solution. The problem is the educator's failure to recognize that television is a very specialized field and consequently, unwillingness to provide a salary commensurate with the technical talent required. I refer to the more sophisticated installations to be found in our institutions of higher education.

While this is not true in every case, I do know from experience that it is a real thing and is most certainly a deterrent to applicants for engineering positions. A university that spends a half-million dollars for the ultimate in a full color, network quality television production studio and then installs heavy-duty doors in anticipation of the on-rush of experienced, competent engineering personnel applying for the position at $9,000 to $10,000 a year is spinning its wheels and manifesting the epitomy of optimism. This is a rather sad commentary on knowledgeable people. Probably the most common argument against a request for salary on a level with ability is, "But our professors are only making $10,000 a year!". Of course if they can install, operate and maintain the system no problems. Obviously, this type of statement is simply evading the issue, side-stepping the real issue of selecting specialized talent for a specialized job.

Increasing Value

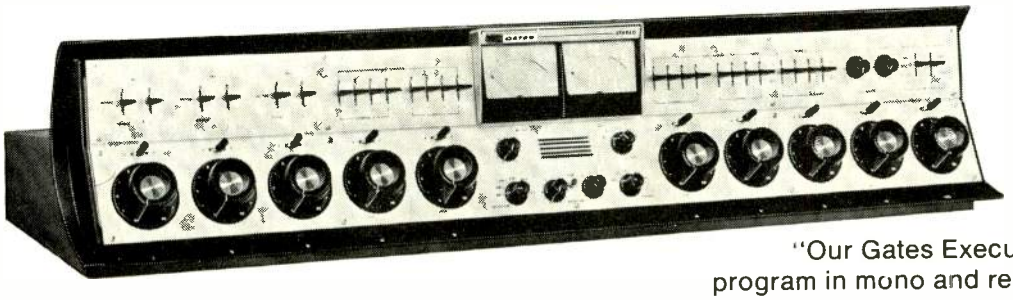
Industry has recognized that the experienced technical person, regardless of formal education, is a very valuable person and his value is ever increasing, even to the point of being preferred in some instances over degree-type engineers. I believe educators should be more aware of the nature of television hardware, its complexity, sophistication and the high degree of technical skill required to operate and maintain it. This type of understanding would loosen the purse strings a little, allow a little selectivity in personnel and buy some extra low-cost insurance for a very large investment. The benefits would be shared by educator and personnel alike. For example, the difference between $10,000 and $13,000 spent for salary could very possibly buy the extra technical "know-how" necessary to mean the difference in a system maintenance cost which is realistic and one which produces mild coronary thrombosis and general absenteeism at board meetings.

Price and quality have always been directly proportional, whether we're talking about groceries, cars, equipment or whatever. The same is true for personnel. Down-grade on either and you have only saved a small amount at the moment. If educators are willing to pay for what they get, then they can rightfully expect to get what they paid for.

Bob J. Henson, Engr.
ITV Services
Paducah Public Schools
Paducah, Kentucky

(Continued on page 12)

Look what our customers say about flexible Gates audio consoles . . .



"Our Gates Executive gives us the flexibility to program in mono and record in stereo at the same time."
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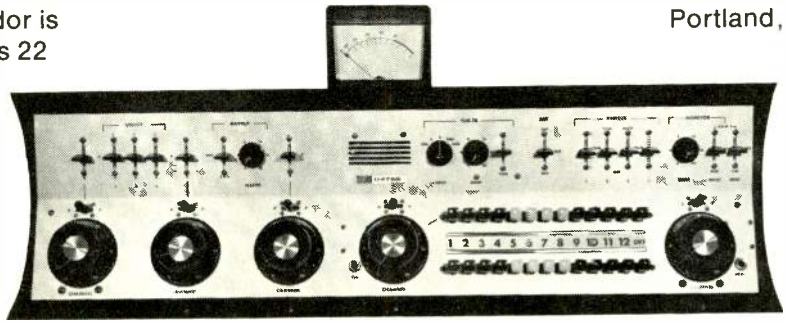
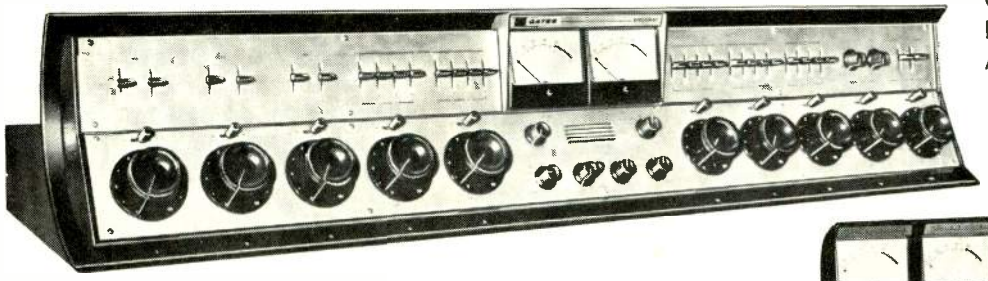
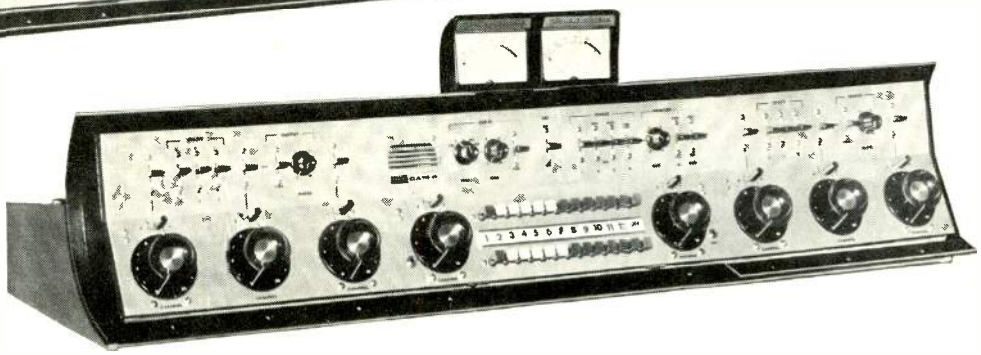


"A flip of a single key on our Diplomat audio console changes master operation from simultaneous to separate operation. Fastest we've ever seen."
George Paul
Radio Station WSLR
Akron, Ohio





"With our President audio console, we can mix six of twelve microphones simultaneously and still provide mixing facilities for our extensive medium level TV signals."
Orville Sather
Director of Engineering, WOR-TV
New York, New York

For the finest in 100% transistorized audio consoles . . . look and listen to Gates. Or ask our customers! For more information about "flexible" audio consoles, write today. Gates, 123 Hampshire Street, Quincy, Illinois 62301.

HARRIS INTERTYPE CORPORATION

GATES

A DIVISION OF HARRIS-INTERTYPE

Circle Number 8 on Reader Reply Card

(Continued from page 10)

Keeping Up With Op Amps

Dear Editor:

In Mr. Dale Wolter's letter to the editor, BE, April 1970, page 8, he makes reference to doing experimental work using op-amps for audio distribution amplifiers, and not having seen anything published yet.

This letter is to advise Mr. Wolters and all of your readers of the Television and Computer Corporation TelComp Model A-100 Audio Distribution Amplifier, which uses integrated circuit operational amplifiers.

The A-100 provides six 600 ohm balanced outputs at +20 dBm, with 60 dB isolation between outputs, 20 dB variable gain, and less than 0.5 percent distortion at rated output. The freqeuncy response is ±0.5 dB 20 Hz to 20 kHz.

Twelve A-100 amplifiers plus a regulated DC power supply mount in a 5¼" rack frame. The A-100 Amplifier sells for $171.00.

The unit was advertised in the March 1970 issue of **Broadcast Engineering** on page 97.

C. V. Girod, Jr.
Registered PE
Vice President
Television and Computer Corp.

Is The NAB Lowering Technical Standards

Dear Editor:

It is interesting to read on pages 8 and 9 of the May issue of **Broadcast Engineering** of the difficulties in obtaining competent engineering personnel for broadcast stations due to several reasons, most of which stem from the FCC decision about 20 years ago to allow remote control of broadcast transmitters and/or lesser-grade operators—and then to turn the page and read on page 11 that NAB is proposing still more of the same medicine for the industry and claiming in face of all evidence to the contrary that this will not result in a lowering of technical standards. I would like to see the reasoning behind the idea that replacing an engineer who "has knowledge of the facts" with someone who knows little and probably cares even less about technical matters will have no effect on the quality of operation of a station. The accompanying increase in FCC Rules violations proves such reasoning to be faulty.

Those who NAB proposes as operators are not engineers, they are announcers and they do not obtain a license for any other reason than to announce and to play records. They generally care little or nothing about the engineering responsibilities of their jobs and do that part grudgingly, if at all.

I am wondering when ALL the engineers are eliminated from the industry and their jobs are filled by these and the "minority applicants" who will then fix it when it quits and where will he have gotten his experience?

Lynn R. Williams, c.e.
WBEJ Inc.
Elizabethon, Tenn.

Hose That Gun

Dear Editor:

I would like to impart a helpful hint that I have found to be very useful in our shop.

To solve the problem of bent and damaged solder gun tips, I cut a five inch length of water hose, and cut it down the side the full length. The sleeve is then slid down the tip, all the way to the trigger. This sleeve will protect the tip from damage, even if the gun is dropped. For only a few cents worth of hose, you can forget about worrying about the tips, when carrying the gun in the tube caddy, or out on remotes.

Perry Ladd
KMNE-TV
Bassett, Neb.

Send Your Letters And Comments To

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The Only UHF Planar Triodes That Guarantee 20 dB Gain Up to 1000 MHz with Intermodulation Better Than -52 dB*

The oustanding linearity of our triodes allows the engineer to design TV transmitters and translators with the visual and sound carriers amplified through the same tube —exceeding FCC and CCIR specifications. 20 dB gain also permits driving these tubes with an all solid state exciter. All ceramic and metal construction assures long-life and reliability under severe environmental conditions. Thousands are in field use today at very low operational cost. These triodes are part of the most comprehensive line of UHF tubes available, ranging in output power up to 25 kW at 1000 MHz. A range of coaxial cavities is also available for UHF operation and assures the optimum performance of our tubes. For specific information please write or call your nearest Cain & Company representative, or contact us directly.

RATINGS	TH306	TH328
Heater Voltage (V)	5	5
Heater Current (A)	1.9	5
Anode Voltage (KV)	1.6	2
Anode Current (MA)	130	250
Power Output (W)	35	100
Intermodulation Level (3 tone test) (dB)	<52	<52

*Three Tone Test

Discuss these tubes with us at NAB, Booth 229, West Hall, Chicago Hilton, April 5-8.

THOMSON-CSF

Thomson-CSF Electron Tubes, Inc./50 Rockefeller Plaza/New York, N.Y./10020 (212) 245-3900

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INDUSTRY NEWS

CARS For CATV

FCC Holds Line On Links

Petitions filed by Laser Link Corporation, the National Association of Educational Broadcasters (NAEB), and the Association of Maximum Service Telecasters (AMST), asking reconsideration of a Commission order, released November 14, 1969, authorizing microwave stations in the Community Antenna Relay Service (CARS) to transmit CATV-originated program material have been denied by the Commission (Docket 17999). (CARS is a microwave service owned by a CATV system for the purpose of bringing in television signals for use over the system. The Commission's November 14 order also authorized the licensing of CARS studio to head-end links and CARS mobile pickup stations in the 12.7-12.95 GHz band.)

In denying the Laser Link and NAEB petitions, the Commission stated that they are substantially identical to pleadings filed and denied in a ruling involving the establishment of a CATV Local Distribution Service in the 12.7-12.95 GHz band (Dockets 18452, FCC 70-404).

AMST's petition, the Commission said, is largely a summary of its request for reconsideration of the First Report and Order in Docket 18397 (20 FCC 2d 201), concerning the origination of programing by CATV systems. To the extent that the AMST petition is directed to the origination of CATV programing generally and not specifically to programming carried over auxiliary microwave stations, the Commission remarked, the questions raised by AMST can more appropriately be considered in Docket 18397.

Specifically, AMST asked that the notification requirement of Section 74.1031(c) of the rules be extended to require CARS applicants to notify local broadcasters directly that they are applying for a station that will carry originated programing; that applications for studio head-end link stations not be granted unless the alternative of wire transmission is not reasonably practicable; and that a CARS applicant be required to show that it intends to make minimum use of its remote pickup station, and its license renewal be denied if it cannot.

The Commission found no need to require direct notice to local broadcasters of applications for transmission of CATV-originated program material. It stated that it presently issues public notices of all applications for authorizations in the CAR service; that a reporting form is being prepared that will make available current information on origination being undertaken by CATV systems; and there is no need to adopt special procedures just because auxiliary facilities are used to carry CATV-originated programs.

The Commission found it presently unnecessary to adopt minimum usage standards for CARS pickup stations. The Commission stated that it expects that CATV operators who invest in auxiliary microwave facilities will use them regularly, and that it does not wish to discourage investment in this type of equipment "by threatening, even in the absence of alternative users of the same frequencies, not to renew licenses if the equipment is insufficiently used."

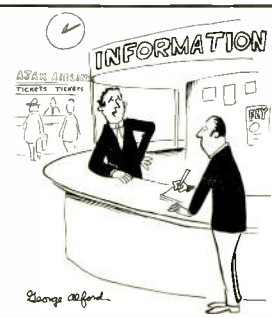
Commission Knocks "Plugola"

Rules to prevent outside financial interests from influencing selection or presentation of broadcast material, a practice known as "plugola", have been tentatively adopted by the FCC. They require that selection of broadcast material be insulated from such interests; that they be identified on the air when they are involved in a program; and that the licensee be alert to the problem to insure compliance with the rules (Docket 14119).

The Commission, in an appendix to the tentative order, issued a primer of typical situations and rulings.

They said the rules, in a new Section 73.1204 were adopted because sponsorship identification rules didn't go far enough. Present rules require disclosure to the public only where consideration has actually been furnished by others to the licensee or his employees for the broadcast of promotions or the inclusion of certain matter in broadcasts, and do not require disclosure where the benefit has accrued indirectly to the licensee or employee by reason of ownership of financial interest in the products or services promoted. The principle behind disclosure is that the public is entitled to know the real interests of those trying to influence it.

It was also stated that public interest requires that broadcast material be presented on the basis of its own merit, and when outside financial interests are a factor influencing the selection and presentation of broadcast material the provisions and purposes of Section 317 of the Communications Act require that the existence of such interests must be disclosed so that the audience "may evaluate the material with this knowledge."



"And then for negative carrier shift I'd recommend . . ."

Rule Adopted For Broadcast Of Phone Calls

Broadcast licensees will be required to notify in advance any party to a telephone conversation that is likely to be recorded for broadcast or to be broadcast as it is going on, under new rules adopted by the Commission (Docket 18601).

The new rule, Section 73.1206, specifies that: "Before recording a telephone conversation for broadcast, or broadcasting such a conversation simultaneously with its occurrence, a licensee shall inform any party to the call of the licensee's intention to broadcast the conversation, except where such a party is aware, or may be presumed to be aware from the circumstances of the conversation, that it is being or likely will be broadcast. Such awareness is presumed to exist only when the other party to the call is associated with the station (such as an employee or part-time reporter), or where the other party originates the call and it is ovious that it is in connection with a program in which the station customarily broadcasts telephone conversations."

On July 9, 1969, the Commission adopted a Notice of Proposed Rule Making, 34 F.R. 11984, in order to clarify the notice requirements for licensees for broadcast of telephone conversations. Prior to the Carterfone decision, (13 FCC 2d 420 (1968)) a "beep tone" was used to alert a party to a telephone conversation with a broadcast station employee that the call was being recorded, and that the station might broadcast the conversation. Now, however, broadcast stations may interconnect their facilities to exchange and toll telephones and broadcast live, two-way conversations without the "beep tone" warning. The tone is still required in cases where the conversation is being recorded, under the new rule the licensee now must inform the other party that the conversation, whether live or recorded, is going to be put on the air.

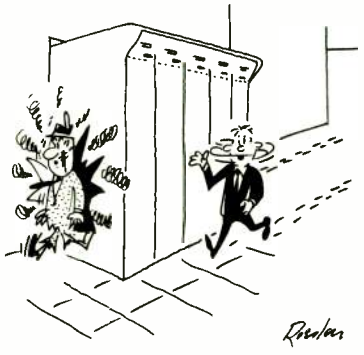
The Commission said there are some situations where awareness and therefore implied consent may be presumed from the circumstances surrounding the telephone conversation, such as "open mike" shows and conversation between station employees and station newsmen and "stringers."

FCC Cracks Down on Standard Broadcast Modulation Rules

To counter the use of radio transmitters with excessively powerful modulators capable of producing harmful interference, amended standard broadcast rules, limiting positive modulation to 100 percent and providing separate definitions of positive and negative modulation percentages, have been advanced by the Commission in a Notice of Proposed Rule Making.

The action would amend Part 73 of the rules, Sections 73.55 and 73.14. Present rules limit negative modulation to 100 percent, but set no limit on positive modulation.

The Commission stated that certain manufacturers are offering for sale broadcast transmitters with modulators capable of supplying considerably more power to the carrier than is necessary for 100 percent modulation with a symmetrical waveform—a 5 kilowatt transmitter equipped with a modulator normally intended for a 10 kilowatt unit, for example. Such transmitters, the Commission said, undoubtedly will be employed with a substantial degree of negative peak limiting, to produce positive peak modulation levels greatly in excess of 100 percent. This kind of operation will materially increase the sideband power and the potential for interference with other stations, the Commission remarked. The Commission expressed particular concern with the effect on co-channel and adjacent-channel operations.



"...AND THIS IS OUR TRANSMITTER,... ...MR. SMITH!...WHERE ARE YOU?"

The Commission found that 5 kilowatt transmitters with "souped-up" modulators are presently being delivered to broadcasters and are being used by them without any Commission authorization. (Commission acceptance requirements for particular types of transmitters do not cover the modulator design changes involved.)

The Commission noted that it is possible to achieve positive modulation levels somewhat higher than 100 percent with present transmitters, and that it has been considered permissible where the modulating waveform was only moderately unsymmetrical. Although proposing to limit positive modulation to 100 percent, the Commission said that it has not decided what higher limit, if any, should be permitted, and that it will accept comments on this point.

17 UHF Channels Taken For Land Mobile Use

A total of 17 UHF-TV channels in ten states has been withdrawn from television service by the FCC for the next five years to implement the Commission's program to provide additional spectrum space for land mobile radio services by utilizing certain UHF-TV channels for land mobile radio in the top ten urban areas of the United States.

The seventeen assignments, none of which have operating stations, are in the states of California, Illinois, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Rhode Island and West Virginia.

In Joliet, Ill., and New Brunswick, N.J., the withdrawn channels are assigned to authorized stations which have not yet been constructed. In both cases, the Commission said it was adding additional channels to the Table of Assignments for the cities affected, "so that interested parties may proceed with prompt activation and rendition of television service." Unoccupied channels in Elgin, Ill., and Asbury Park, N.J. will be reassigned for this purpose. In Santa Barbara,

Calif., where an application for Channel 20 was recently dismissed, the Commission said it was making educational Channel 32 available.

In a separate action, the Commission issued a rule making notice asking for comments on new assignments to accommodate ETV channels 70 in Bowling Green, Ohio, and 77 in Glen Ridge, N.J., both of which are in the Channel 70-83 area re-allocated by the Commission for land mobile use.

The Commission proposed to delete Channel 54 in Toledo to permit assignment of Channel 40 to Bowling Green. In the case of Glen Ridge, it noted that because of the number of UHF assignments in the Northeast, no replacement appeared possible. But it said a study would begin shortly on means to make another channel available and it asked for comments on possible replacements. The New Jersey Public Broadcasting Authority has filed an application for the channel for use at Montclair.

NAEB Selects Two For Top Positions

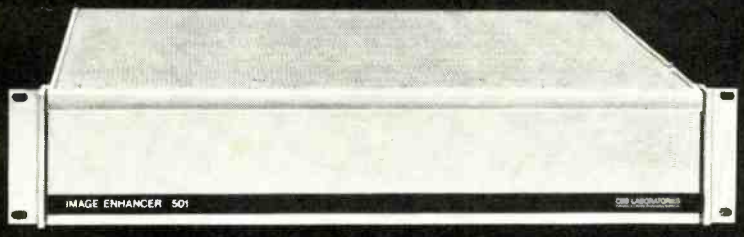
James A. Fellows, director of the Office of Research and Development, National Association of Educational Broadcasters, has been appointed executive director of the NAEB's newly-created Professional Services Department, according to an announcement by NAEB President William G. Harley. William Dale, who has been serving as assistant to the president, NAEB, has been appointed associate director of the Instructional Services Department.

Both appointments are part of a reorganization plan at NAEB which was voted by the association's Executive Board of Directors at a meeting held in May. Fellows and Dale assume their new responsibilities immediately.

Fellows, who will administer an expanded range of services to all categories of the NAEB membership, has been with the NAEB since 1962 when he was named associate director of the Office of Research and Development.

Dale came to NAEB last year. He had served for four years in the educational system in American Samoa.

The enhanced Enhancer



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The Mark II is the finest yet! It provides truly effective enhancing of both vertical and horizontal detail.

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EDUCATIONAL BROADCASTING

Proc Amps — The New Breed

Amplifiers which correct video waveform distortion resulting from imperfect transmission paths have been with the broadcaster since the early days of TV. Over the years their capability has been gradually extended and the past few years have witnessed the evolution of a sophisticated breed of processing amplifiers which can correct many video signal deformities quite reliably.

With program origination at a multiplicity of points, often not under ideal conditions, the use of processing amplifiers to restore the maximum possible degree of standardization to a signal is not only desirable but just about mandatory.

The educational broadcaster is beset by the same type of transmission difficulties as any other TV station; he utilizes network lines, originates and/or transmits remote feeds, he uses ST links, and off-air pickup. Within his own plant he may have a complex system of video interconnections requiring standardization and restoration of signal levels at many points—VTR's studio outputs, transmitter feeds, etc. In some cases the equipment he must work with may not be so sophisticated. He may for instance want to use a helical VTR for in-class use and later dub this tape into broadcast format. So a video processing amplifier must be used on the output of the helical VTR. All of these locations can be well served by a processing amplifier, so we'll take a look at what these devices can do in the way of signal restoration.

A color composite video signal is an extremely complicated waveform but there are a few basic parameters about it which allow many common distortions to be removed or minimized. Basically this boils down to that information which is recurrent or that about which there is some pre-knowledge. The flat recurrent portions of the horizontal sync interval can be used to DC restore the waveform, thus removing large hum components, tilt and low frequency bounce. The incoming sync can be stripped off and used to genlock a local sync generator which is in exact phase (both line and frame) with the incoming signal. Then the old blanking and timing information can be gated out and the clean local version reinserted with the proper timing restored to FCC specs.

Color burst can be gated out, amplified, limited and used to lock a local 3.58 MHz oscillator. This oscillator is in turn gated by a local burst flag signal and a new and regenerated burst is added back to the signal. These examples are the easy part, since all of the timing components of a video signal are known in advance, and are repetitive.

Video Signal Problems

The picture portion of the video signal cannot be regenerated. Any noise, distortion, ringing or smearing must necessarily be passed along with the desired picture information. The best we can do is to re-establish the correct peak level to 100 IEEE units and normalize luminance to chroma ratios. Peaks can be set either manually or automatically with video AGC. Chroma can be split off separately through a bandpass filter to give independent control, allowing non-normal levels to be brought back into balance. Black and white clipping can also be provided in the luminance channel, which allows clipping of overshoots and/or noise pulses. An overall black level control can be provided which allows matching the setup of the original signal or correction as may be necessary.

Since video processors are commonly used as an integral transmitter component, they also contain some circuitry to pre-correct normal video modulator distortions. This usually amounts to some white

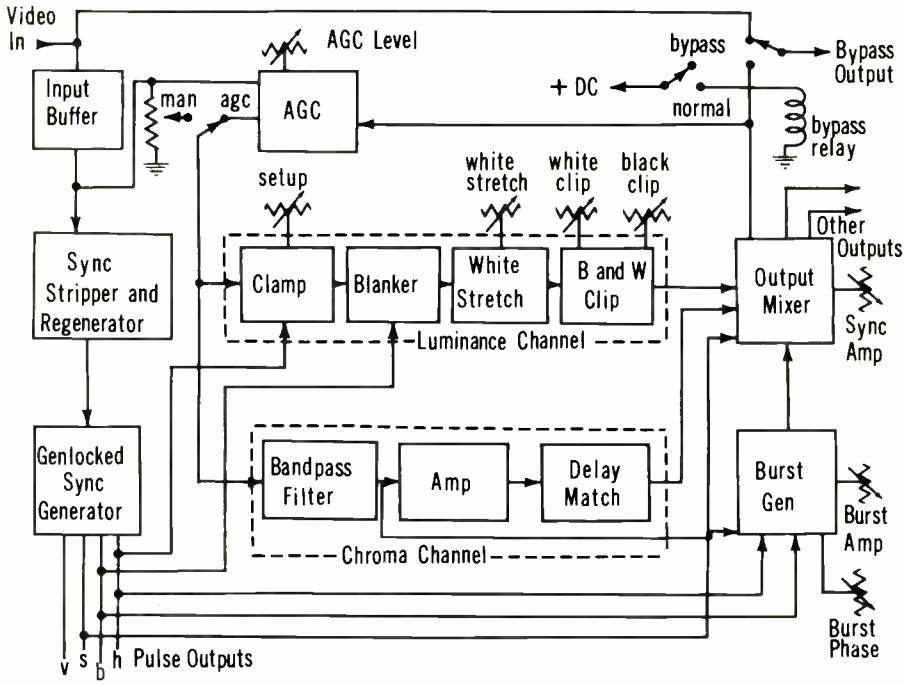


Fig. 1 Block diagram shows a video proc-amp broken into its component pieces.

stretch and differential gain adjustment to compensate for inherent non-linearities of the transmitter. These controls are not intended to correct for other defects, as other forms of distortion are not predictable.

These are the basics of what video processors can do today. Many options and versions exist of course; AGC or no AGC, burst regen or not, genlocked or regenerated sync just to name a few. The degree of elaboration necessary can only be determined by the individual assesing an individual situation. And with economics such an important factor, the luxury items such as automated control will get the most critical appraisal. In Figure 1, the block diagram shows how a video proc-amp can be broken into its component pieces. Judging from your own particular needs you can mentally select those features you need.

Input video enters the processing amplifier and is buffered by an input amplifier and applied to a sync stripper/regenerator and the manual gain pot. The sync stripper removes the sync portion of the video signal and shapes it to a uniform rise-time and constant level.

Although noise and amplitude variations are removed by this stage, the original timing may be lost due to pulse shape deterioration. To completely re-time all the sync and blanking information, the signal is applied to a genlocked sync generator which can restore complete and accurate timing of all pulses which make up the EIA waveform, even to the point of replacing missing pulses. This feature allows complete control of the output sync signals, and guarantees a constant sync signal, even in the case where the input disappears, wherein the sync generator provides a "black" signal.

The input video also feeds a manual gain control. The variable output of this pot feeds the video mode switch, which selects the manual mode or the AGC mode. The video is then split into two routes, the luminance channel and the chroma channel.

In the chroma channel, the video is filtered by a 3.58 MHz bandpass filter which selects the chrominance components, including burst. Burst is then split off separately and sent to the burst regen circuit. Continuing through the chroma channel, the overall chroma level is modified by a gain control which allows the correct luminance/chroma ratio to be re-established. A compensating delay is also used to match the delay of the luminance information and ensure correct luminance/chroma registration in the reproduced picture.

Luminance Processing

In the luminance channel the processing is a bit more complicated. An input clamp is used (driven from the horizontal drive signal) to DC restore the video signal and remove low frequency disturbances. The DC clamping level is variable, which allows adjustment of setup. Next, the old blanking is removed by the regenerated blanking signal which completely clears out the horizontal and vertical blanking intervals. Black and white clipping is used to clip transients above or below the desired levels, and the white stretch circuit gives a boost in levels around the 100 IEEE point. The corrected output of this channel is applied to the output mixer.

The burst regenerator gets a signal from the chroma channel and the sync generator. The sync signal is used to gate out the incoming burst, then it is amplified and limited to a constant level and used to phase-lock a local 3.58 MHz oscillator. This oscillator is running continuously and a local burst flag signal (generated from local sync and blanking) is used to key out a burst signal which is applied to the output mixer. This circuit also has a color kill stage which senses the absense of burst at the input and keys off the burst for monochrome signals.

As we said previously, the video channel can get its input from two sources, the manual control or the AGC circuit. The AGC circuit gets its input from the input buffer and an output sample signal from the output mixer. It acts to hold the output peak levels to 100 IEEE as the input varies over a nominal range. There is usually a preset lower threshold (to allow the fades to black) and a peak level control. These units usually allow the option of AGC action on either VITS or VITS and video.

Regenerated composite sync is also applied to the output mixer, along with all of the previously described signals; luminance, chrominance and burst. These four components are linearly mixed in the output stage to recreate a composite video signal. To gain a better feel for how all this fits together, the operational controls will be described. All of the primary ratios of a color signal can be adjusted independently: sync, white level, setup, burst, and chroma level. The burst phase of the re-inserted signal can also be adjusted. Additionally, the clip and stretch controls are available although these are generally not primary controls. With the option of automating many of these controls it can be seen how the complexity of one of these devices can grow. Commonly automated features are video AGC, color kill (delete burst and chroma), sync changeover (reverts to black with absence of input). Just how far you can go depends upon your requirements and pocketbook.

If you have a requirement for a video processing amplifier, these are a few basic things to keep in mind. Like almost anything these devices have their limitations. They will do a great job of cleaning up the sync portion of the waveform and re-establishing levels, but there is very little they can do with picture distortions. And also, like many other things, they come in various degrees of quality. It might pay to spend some "trial basis" time, if possible, to find the one proper for a particular requirement. When set up and operated properly, a video processor can do a remarkable job of restoring standardization to a degraded signal.

We have tried here to set down a few of the basics of video processing as a starting point. Should you want to dig into the area further try the references listed to see how different manufacturers approach these problems. With this knowledge and a familarity with your own particular requirements, you should then be ready to put one to work solving those signal problems.

References

1) Kenneth P. Davies, "Automatic Correction of Network Chrominance and Luminance Levels" 1969 NAB Convention Proceedings

2) Richard S. Wise, "A Combined Video Processing AGC Amplifier", Journal of the SMPTE, 78:261-265, April 1969.

SCANNING THE CATV SCOPE

For CATV

Community Antenna Relay

For July, let us take a look at what the Community Antenna Relay Service is and what it offers CATV operators.

The FCC, in Part 74, Subpart J, defines a Community Antenna Relay Station (CARS) as a fixed or mobile station used for the transmission of television and related audio signals, signals of standard and FM broadcast stations and cablecasting, from the point of reception to a terminal point from which the signals are distributed to the public by cable.

Assignments

In conjunction with this, specific FCC types of service assignments have been provided for use in the CARS program. These are:

1. Local Distribution Service (LDS)—This type of service usually is a fixed CAR station used within a CATV system or systems. Television, and related audio, FM and cablecasting signals, will be transmitted from a local point to one or more receiving points and then distributed to the subscribers by cable.

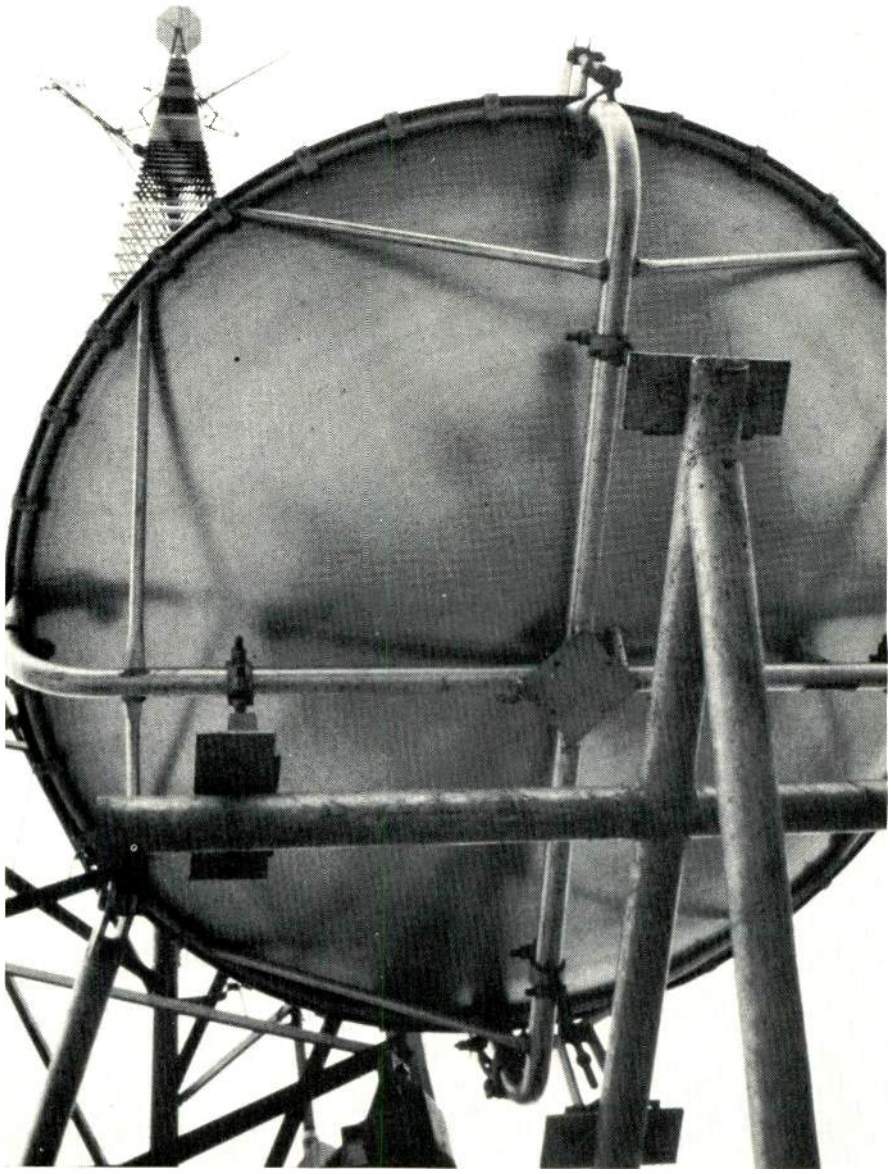
2. Community Antenna Relay Studio to Head-ed Link (SHL)—This is a fixed CAR unit used for transmission of television program material from a CATV studio to the head-end of a CATV system.

3. Community Antenna Relay Pickup—This is normally a land mobile CAR facility which transmits television signals from the scenes of events occurring at points distant from CATV studios and then fed to the CATV studios or head-ends.

Cablecasting is defined as that portion of the television programming originated by the CATV operator and then distributed on the CATV system. This is exclusive of television broadcast signals distributed on the CATV system.

The CATV system operator's attention is alerted to the fact that recent FCC actions have provided regulations so that CAR licensees may institute the transmission of origination programming material by CATV systems operating CARS as described in sections 1, 2 and 3. CAR licensees may interconnect their facilities with those of other CAR or common carrier licensees.

The frequency range set aside by the Commission for Community Antenna Relay Stations is essentially 12,700 to 12,945.7 MHz divided into five groups. Group A and B are for the sound portion of the signal using FM transmission. Group A frequency assignments range from 12,700 to 12,950 MHz and Group B are from 12,712.5 to 12,937.5 MHz. Under Group A and B there are ten 25 MHz primary channels along with nine secondary channels interspaced between the primary channels. The major factor in assigning the proper frequencies is that television pickup, STL and intercity relay stations shall not cause any harmful interference to CARS. Similarly, CARS shall not



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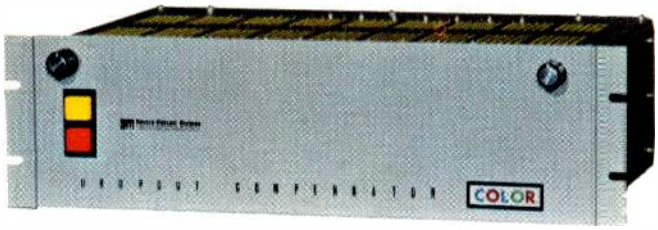

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(Continued from page 20)

cause harmful interference to television STL and intercity relay stations. As an example, television pickup stations and CAR pickup stations shall cause no interference to existing and subsequently authorized television STL, television intercity relay, fixed CAR, CAR SHL or LDS stations.

CARS authorized to operate with vestigial sideband AM transmission for the visual signal, will be allocated frequencies within Group C and D. The Group C and D frequencies normally use a channel which is 6 MHz wide. Auxiliary channels have also been assigned within the frequency bands of 12,-933.7 to 12,945.7 MHz.

Either AM or FM modulated microwave signals may be used but for vestigial sideband AM transmission the assigned visual carrier frequency for each channel listed in Group C or D should be 1.25 MHz above the lower channel-edge frequency. The center frequency for the accompanying FM aural carrier in each channel should be 4.5 MHz above the corresponding visual carrier frequency.

Limitations

In addition to the requirements described here, just what are some of the more important FCC regulatory limitations that CARS licensee will have to contend with when planning a new CARS microwave system? Here are some of the points which the operator must remember:

. . . **Remote Control Operation** —CARS can be remotely controlled, provided the equipment is designed, installed and protected to prevent tampering.

. . . **Unattended Operation** — A CARS system may be operated unattended if the transmitter is equipped with an automatic control which will permit the unit to radiate when it is relaying an incoming signal and provided the transmitting apparatus can be turned on and off at will from a location which can be reached at all hours and seasons. Licensed radio personnel should be available for technical servicing and maintenance to assure expeditious performance.

. . . **Power Limitations** — The transmitter peak power output should not exceed five watts on any channel. CARS LDS stations using vestigial sideband AM visual transmission should make sure that the visual peak power on all channels should be maintained within 2 decibels of equality. The aural mean power on each channel should not exceed a level of 7 decibels below the visual peak power.

. . . **Emissions and Antennas**— Any type of emission suitable for the simultaneous visual and aural television signals transmission may be employed in the CARS system.

Only directive CARS transmitter antennas can be used and the maximum horizontal plane beam width between half power points of the major lobe should not exceed 3 degrees.

CARS Microwave

What is a CARS microwave system? It is usually referred to that portion of the radio frequency spectrum as described and discussed in the FCC Rules and Regulations. The microwaves are transmitted and received over paths where the antennas are normally visible. Average distance covered by CARS is possibly 35 miles or more. Present CARS equipment manufactured usually is solid state designed and constructed, having very high performance characteristics.

The most important achievement of modern CARS microwave systems is the reduction of maintenance time which keeps operating costs down. The type of microwave system used for CATV operations normally requires a one way, rather than a two way, communications system. CARS in general are operated in shorter system paths and because of economic and other factors are only required to conform to the FCC standards discussed in Part 74, Subpart J.

The basic equipment required to set up a CARS microwave system for one way TV transmission contains a transmitter, RF transmission line and antenna, a receiving antenna, RF transmission line and receiver at the distant end of the path. The mounting heights of the antennas are determined by the equipment manufacturer after consideration of the physical path. Both antennas are 6 or 8 foot diameter dishes and the transmitting antenna serves to focus the signal beam and directs it towards the receiving antenna.

System Economics

Economics and performance parameters are the deciding factors in considering the use of cable or CARS in CATV operations. Microwave offers the advantages of high performance and reliability compared to a long line of cable repeaters.

The cable system operator should also note that the cars system should be capable of meeting the requirements of Sections 74.1050 and all sections listed in **Technical Operation** of Part 74 Subpart J.

The basis for overcoming the vital problems by prospective CARS users is usually solved by purchasing type approved and type accepted equipment and be sure to make a full study of the merits of the equipment relative to range limitations, video signal-to-noise versus signal input, fade margin, effects of moisture on path attentuation and atmospheric attenuation so that the beam of energy is not blocked thus reducing the received energy.

To maintain the CARS microwave system at an ideal peak performance efficiency, the system could be provided with an excellent test maintenance service. The application of the vertical interval as a carrier of video test signals in the microwave system could be incorporated. Test generators whose test signals may be added to the vertical interval where video is present could be used for testing at any point along the CARS microwave system during regular working hours, individually or in sequence.

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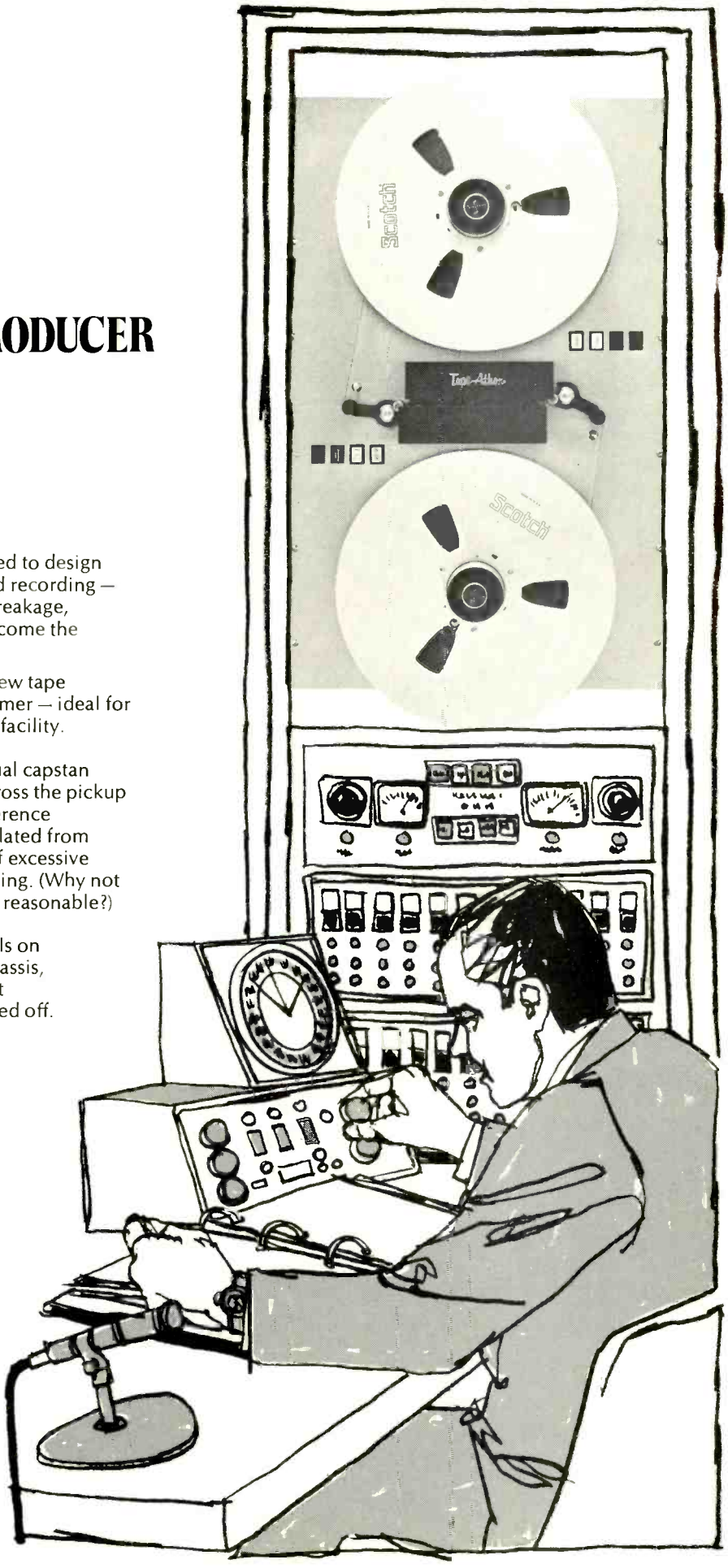

Circle Number 30 on Reader Reply Card

Measuring RF power output

"Everyone from the owner down to the janitor is a meter reader."

By Pat Finnegan*

Any broadcast station's RF output power should be maintained as near its licensed power as possible so that an adequate signal will be radiated into its coverage area, license requirements will be met, and the FCC Rules will find compliance. Knowledge that the transmitter is delivering the correct output power is especially important in those systems working near or at maximum ratings. This information can be obtained by using monitoring devices that are reasonably accurate, and properly calibrated.

Accuracy of the monitoring devices and calibrating instruments should at least fall within the accuracy prescribed by the FCC Rules. Don't expect to obtain "text book" accuracy. On the other hand, the use of the regular bench type instruments will not ordinarily be sufficient for power measurements.

The measurement should be made with a high quality meter, and it should be one designed for measuring antenna current, not a makeshift, haywire affair. Equally important, this meter should be one designed especially for use on or near your operating frequency. (Ed. Note: When repairing any test equipment, be certain to use a coolant on the parts you replace before putting the iron on the connection. Heat will change the value of the part, especially carbon resistors. Otherwise, your standard instruments will give questionable readings. See April, BE, page 46.)

* BE Maintenance Editor and Engineering VP at WLBC, Muncie, Ind.

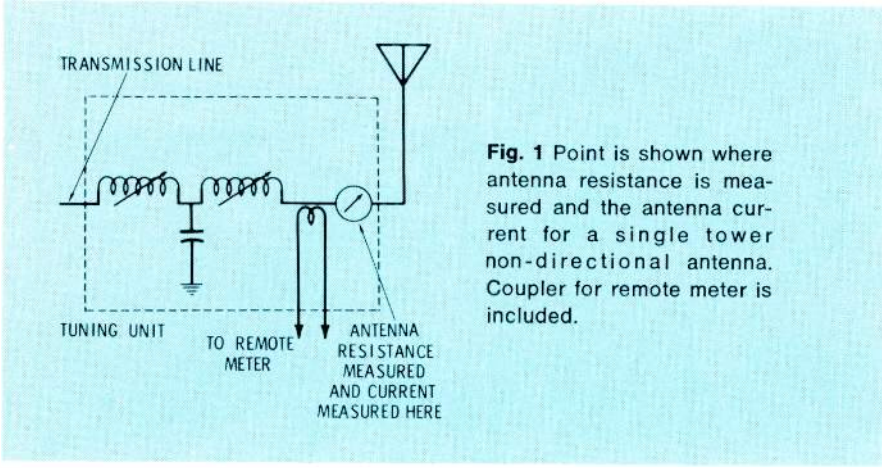

Fig. 1 Point is shown where antenna resistance is measured and the antenna current for a single tower non-directional antenna. Coupler for remote meter is included.

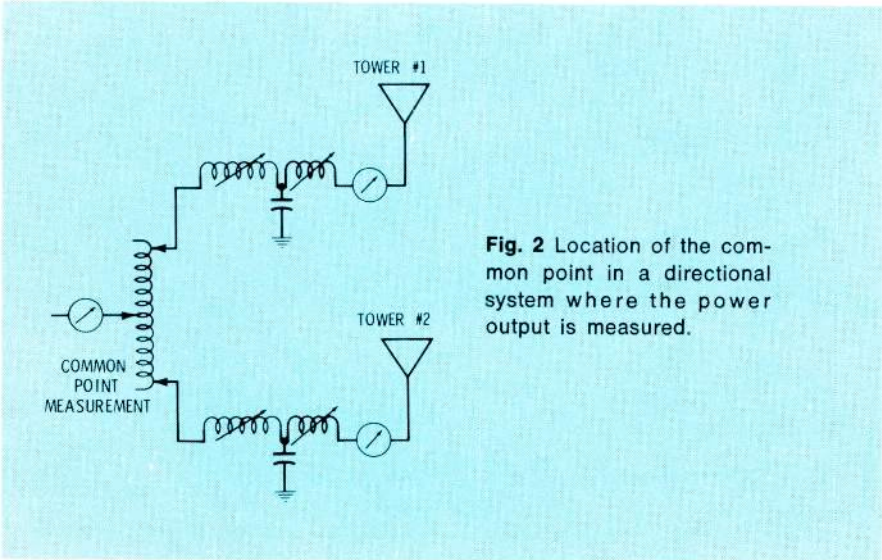

Fig. 2 Location of the common point in a directional system where the power output is measured.

AM Measurements

Parts 73.39, 73.51, 73.52 of the FCC Rules cover the accuracy of meters and methods of determining power for AM stations. Direct power measurements are required. This is the product of the antenna current squared times the antenna resistance. ($P=I^2R$).

AM stations use a variety of configurations, such as; single tower non-directional, multi-tower directional, and part time directional—part time non-directional antennas. Station output power is measured at one, two, or both positions depending upon whether it is non-directional, directional, or both. The majority of stations use a series fed tower, although there may be a few shunt fed towers still around.

Non-directional antennas are measured right at the lead to the tower itself. This point is after the tuning coils and other items in the tuning unit. The lead and tower are the antenna elements. The coils and capacitors of the tuning unit are used to cancel any reactance of the tower, and also to match the antenna resistance to the line impedance. Antenna resistance measured at this point becomes the R factor of the power formula.

The setup for measuring antenna resistance usually includes an RF

bridge, RF signal generator, and a suitable detector. Since many AM stations do not have the required test equipment, this measurement is usually made by a consulting engineer. It should be remembered that the antenna resistance will change as the tower, guys and insulators, and the ground system deteriorate. Large metallic structural changes in the vicinity will have some effect, too.

The RF current must be metered at the point where the resistance measurement was made. A meter must be permanently installed at this point, and provisions should be made to short the meter to protect it from lightning damage. Current measured at this point becomes the I factor of the power formula.

Directional Antennas

Directional antennas are considered as a system (the system as a single antenna) and power is measured at the "common point" feed to the system, rather than at a tower base. This is not to ignore the fact that each of the towers has its own antenna resistance, as well as mutual coupling among the towers. Each of these factors is measured and computed in the system design, as is the base current at each tower. These base currents must be maintained within 5 percent of their normal values, along with the proper phase readings, and all other parameters of the system.

The system includes all towers, transmission lines, phase and power dividers. The single point immediately before all this is the common point, and it is at this point that the resistance is measured. Since there is some loss of efficiency in a directional system, the resistance measured is modified by a factor of 0.925 for transmitters of 5 Kw or less, and by a factor of 0.95 for transmitters above 5 Kw. For example, the common point resistance is measured as 50 ohms and the station uses a 10 Kw transmitter. The R factor to use in the power formula would be 47.5 ohms. Should the transmitter be a 5 Kw unit, the R factor would be 46.25 ohms.

A proper RF current meter must be permanently mounted at the common point, and the current measured becomes the I factor of the power formula.

Part time directional and part time non-directional stations use both methods of measuring output power. During the non-directional period, the base current of the active tower is measured, but during directional operation, the common point current is measured.

Indirect Power

Indirect power measurements are permitted on a temporary basis for various reasons as outlined in the Rules. Such a case may be a defective antenna current meter or changes in the antenna system. Power is then computed by using the plate input power of the final stage times an efficiency factor. (P=Ep x Ip x Eff.)

The efficiency factor may be determined by various means. For an operating station, the logged values of Ep and Ip of the previous week are used and the average efficiency attained during that week is the value to use. When figuring power for a new transmitter that has no log time, you may use the efficiency factor supplied by the manufacturer, or use the charts in the FCC Rules.

When a station makes indirect power measurements, appropriate entries should be made in the operating log, along with the efficiency factor used and how it was derived. This should be included on each day's log when the indirect method is used.

Meters and Calibration

Meters used as remote reading

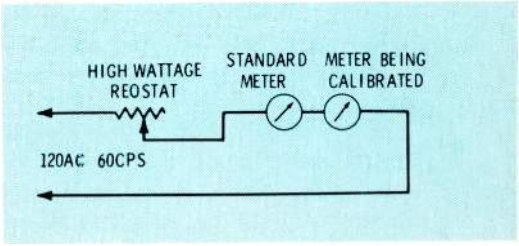

Fig. 3 Setup for calibration of antenna meter with a standard meter. Sixty cycle current is used.

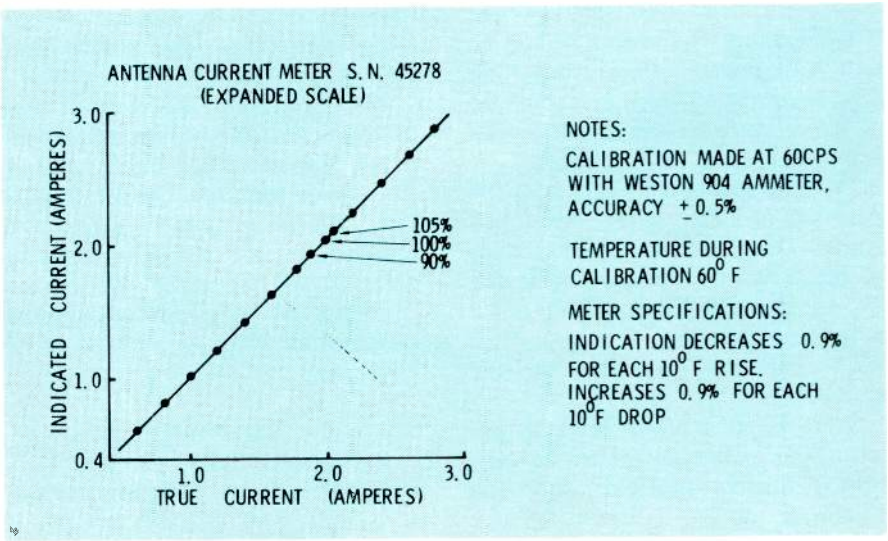

Fig. 4 Graph of a typical meter calibration. Special calibrations were made at the operating current points and the tolerance points.

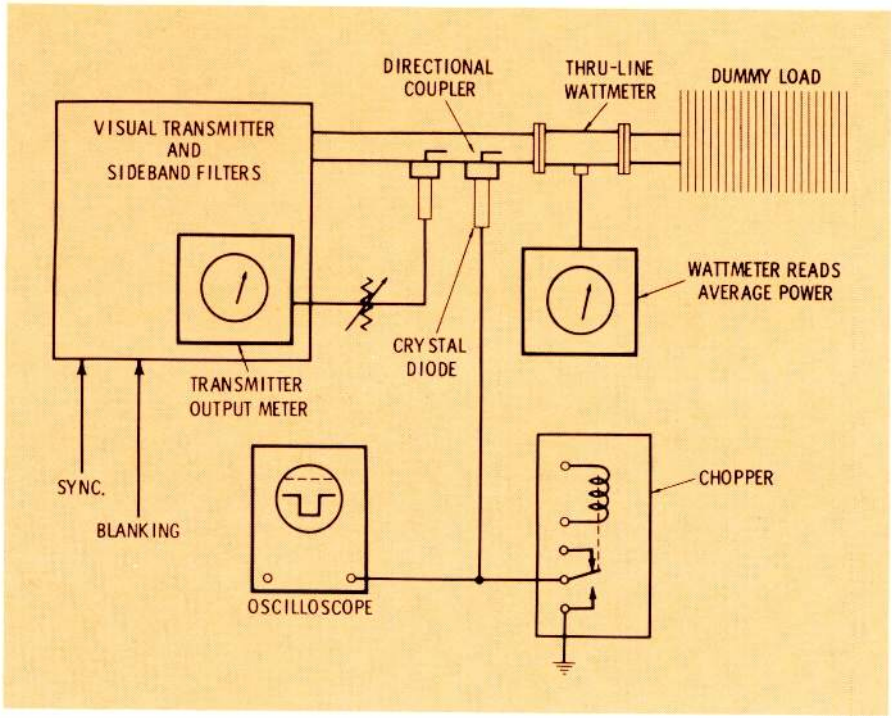

Fig. 5 Typical setup for calibration of the visual output power and power meter.

antenna current devices should be of the same accuracy and scale requirements as the regular base meter.

Any sampling device for remote meters must be on the transmitter side of the antenna current meter. Nothing should be added between the antenna meter and tower.

The antenna meter should be calibrated from time to time to insure accuracy. If the station doesn't have the equipment to repair or calibrate the meters, or a consulting engineer is unavailable, the meters should be sent to a meter repair laboratory. The equipment needed is a standard meter of known accuracy, a reostat and a source of AC voltage.

A thermocouple works on the principle of a DC voltage developed across the ends of two dissimilar metals, when their junction is heated by AC current. Frequency is not a determining factor. Thus, a 120 VAC line may be used for the calibration.

A meter that works with an external thermocouple should be calibrated together as a unit, and each should be marked to show that they do work together. Mixing thermocouples and meters will give erroneous readings.

To make the calibration, set up the equipment, starting with some lower value of current than will be used during normal operations. Make point by point readings and plot these on a graph. Make a special effort to check at three current points, which would be 90 percent, 100 percent and 105 percent power. These are the tolerances. If the meter has an expanded scale for use at two operating powers, do the same for each power value. Draw a smooth curve through the plotted graph, and post it near the antenna meter.

Thermocouples are effected also by ambient temperature of the air which may cause incorrect readings. The meter spec sheet will tell what these effects are and how much to compensate for various temperatures. It is important to note on the calibrations curve what the room temperature was at the time of calibration.

FM Power

Paragraph 73.267 of the FCC Rules applies to FM power measurements. The station has a choice of either using the indirect method or direct method of power measurement.

The indirect method is computed from the plate input power of the final stage and the efficiency factor as supplied by the manufacturer of the transmitter. As a formula, Output power=Ep x Ip x Eff.

All transmitters have some meter or device to indicate that output power is present. Unless such a device is calibrated, it can't be used for power measurement. When the station is using the indirect method, this meter can be arbitrarily adjusted to indicate 100 percent when the plate input power is 100 percent.

Power tolerance for FM is +5 percent and —10 percent of the licensed power. The plate input power should be computed for these percentages and posted at the transmitter or control point.

The direct method of measurement makes use of an output meter that is accurately calibrated. Ordinarily, the sampling device for this meter is a directional coupler mounted in the line right after the transmitter.

A directional coupler will sample the forward or reflected wave, depending upon how it is installed in the line. Therefore, if the coupler is an adjustable type, care must be taken that it is inserted and adjusted in the proper orientation. Two such couplers are often orientated so that one will intercept the forward wave, and the other the reflected wave. The output of these couplers is then fed through appropriate resistors and switches so that the VSWR on the line may also be measured and monitored. The output of the couplers is an RF signal and must be rectified to be useful. Ususally, this is done by crystal diodes or tube rectifiers.

In order that such an arrangement may be used for power measurements, it must be calibrated. The Rules require that calibration take place as a minimum at six-month intervals, although shorter intervals are preferred.

A dummy load and accurate wattmeter are needed for calibration. The dummy load must be able to absorb the full transmitter power output and should be equal to the line impedance and with negligable reactance. The wattmeter should be one that has been designed and cali-

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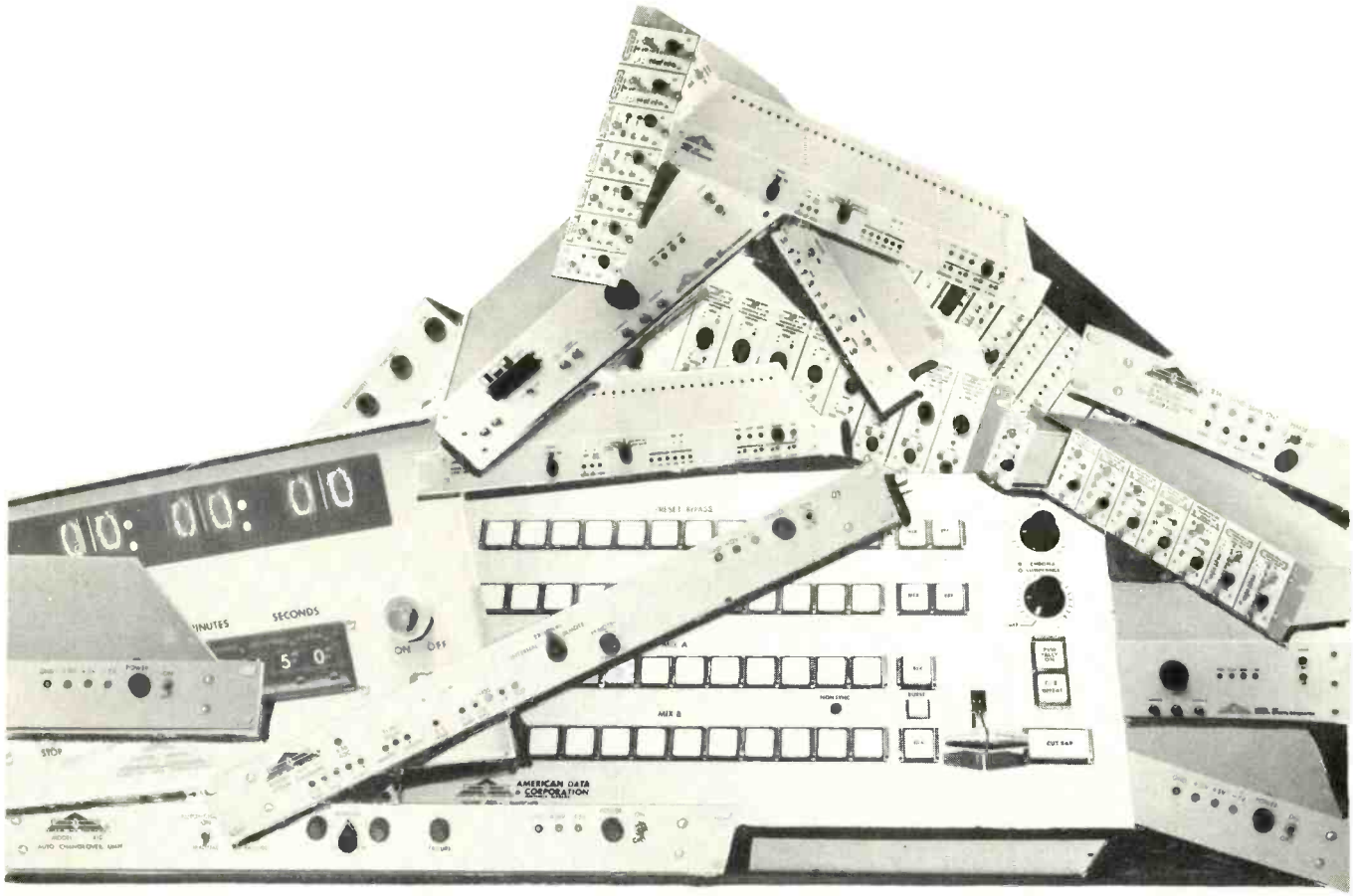

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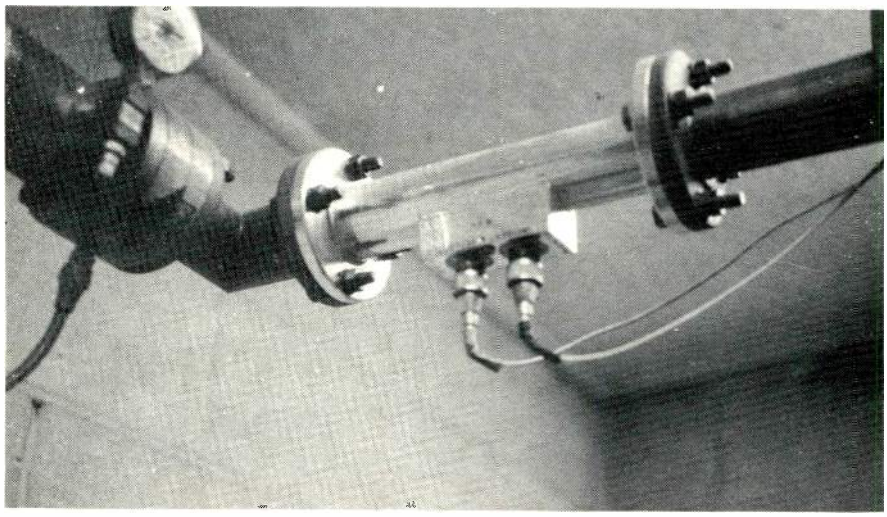
brated to work on the frequencies involved.

Calibration

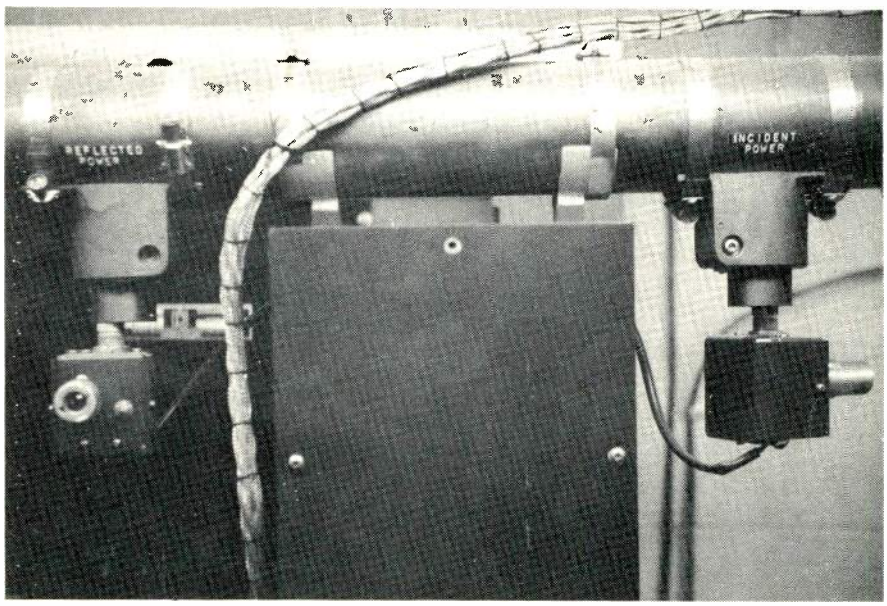
Connect the dummy load and wattmeter to the transmitter. Do not modulate the transmitter. Adjust the transmitter output power until the wattmeter reads the required power (licensed power). The output meter should then be calibrated to read 100 percent. When the wattmeter reads the correct output power and the meter is calibrated, record the Ep and Ip of the final stage, or the total Ep and Ip if there is more than one output stage.

Next, increase power output until the wattmeter reads 105 percent power. Note the output meter reading. It should read 105 percent. If it does not, mark the point where it is reading as 105 percent. Do not adjust any calibration controls. Record the Ep and Ip of the final stage. Then, reduce drive until the wattmeter reads 90 percent of licensed power. Calculation is again required. Mark the meter at this point if it is not reading 90 percent. Record the output stage readings, and lock the calibration controls in place.

The next step is to replace the line and antenna as a load on the transmitter. Go through the 90 percent, 100 percent, and 105 percent power positions and record the Ep and Ip of the final stage. These readings should be essentially the same as those measured into the dummy load. If they do not agree, there is something wrong either with the load and wattmeter, or with the antenna. Any problem in the antenna or line will show up as high VSWR. If the VSWR appears normal, the load and wattmeter may have been damaged and will need to be returned to the factory for repair and recalibration.



Dual directional coupler with crystal diodes to measure both forward and reflected power in a 1⅛ inch coax line.



Dual directional couplers for forward and reflected powers in a 3⅛ inch line. This one uses tube rectifiers.

TV Power Output

The television transmitter is actually two transmitters in one, the aural and the visual. Each side has a different mode of modulation. When measuring or calibrating power meters, the opposite transmitter should be turned off so as not to interfere with the calibrations. Rules pertinent to power measurements will be found in Paragraph 73.689.

The aural transmitter is basically an FM transmitter, and except for the carrier frequency and cross ties with the visual transmitter, its output power is measured and calibrated the same as an FM transmitter. There is the same choice of using either the direct or indirect methods of power measurement. Most TV stations use the direct power measurement as there is a calibrated load and wattmeter on hand for the visual side.

The procedures for the aural are basically the same as those for an FM station. Since the procedures have already been given, only the differences will be given here.

Operating power tolerance is different, in that +10 percent and —20 percent are permitted. The Rules call for measuring the power at the output terminals of the transmitter. This is not always an easy matter, especially in those cases where the aural is diplexed into the sideband filters of the visual. To open the line at this point may require disassembly of the coax line and fittings. Most UHF transmitters are of this nature. If this is the case, the load and wattmeter may be connected at the point immediatly fol-

lowing the filter unit, at the same place the visual is measured.

The filter unit will have a fixed loss at the aural carrier as shown in the checkout sheet of the filter unit. This loss will not change unless the filter unit has been damaged and, in that case, other problems will be readily apparent in high VSWR readings and visual picture problems.

When calibrating the output meter for direct power readings, add the loss in the filter unit to that which is read on the wattmeter to get the licensed power output. For example, if the aural transmitter is required to put out 2.2 Kw and the fixed loss in the filter unit is 200 watts, the wattmeter will read 2 Kw.

Visual transmitters are amplitude modulated and the power output method must be by the direct method. That is, the transmitter must be working into a dummy load with zero reactance and resistance equal to the line impedance. Both the load and wattmeter should be designed and calibrated to work with the range of carrier frequencies that will be present.

The calibrations are made with the transmitter modulated with a standard black picture. A standard black picture is sync and blanking only (no picture and no fixed setup) at modulation percentages of 100 percent sync and 75 percent blanking.

The wattmeter will read in average power, so a factor of 1.68 must be used in the calculation to obtain peak power as is read on the transmitter power meter. Thus, Pav x 1.68 = Ppk.

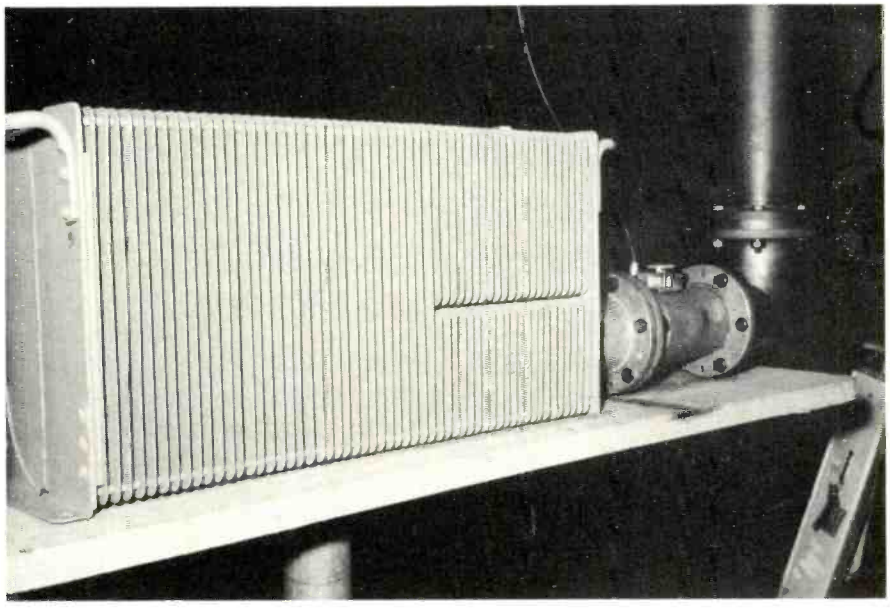
The factor of 1.68 is based on the duty cycle and pulse widths of the modulating signal and their relationship to peak power. It is important that the pulse widths be correct and that the current modulation percentages are maintained during the calibrations.

At 100 percent modulation, the carrier disappears (in amplitude modulation). Disappearance of the carrier would represent zero output from a diode detector. Thus, to simulate this condition when monitoring with an oscilloscope, a chopper is used to short out the recovered video signal at repeated intervals. This will produce a straight line display across the scope and give a reference base line for the modulation percentages.

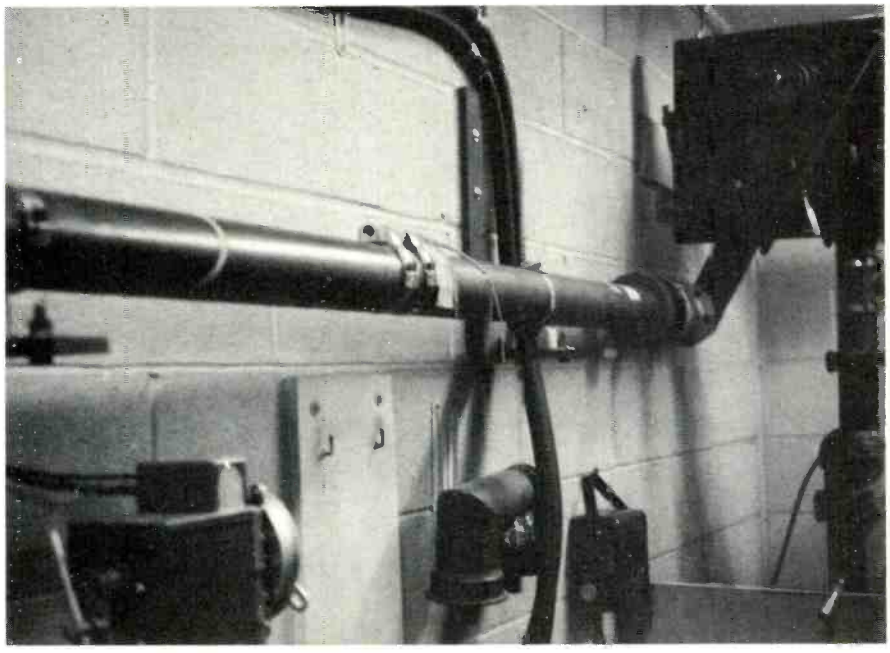
Start by connecting the load and wattmeter at the output of the filter unit. This filter unit is considered as part of the visual transmitter. Leave the aural transmitter turned off.

If the dummy load is water cooled, it is important that the water flow begins before power is applied. Without water flow, the load would soon be damaged.

Calculate what average power will be required at licensed power output, 80 percent and 110 percent. Increase the transmitter output until the wattmeter reads the correct average power. At the same time, using the chopper and observing the oscilloscope, make certain that the cor-



Fixed 2.5 Kw air cooled load and thru line wattmeter. It is shown here being used as a reject load on a diplexer.



Water cooled 25 Kw UHF load and thru line wattmeter connected to a coax patch panel.

rect percentages of modulation are maintained. At this point, the engineer will normally find that he has some juggling to do; that is, a combination of adjustments of sync and blanking levels and transmitter output. The correct modulation levels and average power must occur at the same time.

Once these are correct, observe the transmitter power meter. It should read 100 percent. If not, change the calibration controls to read 100 percent. Lock the controls in place.

Now record the Ep and Ip of the final stage, or the total Ep and Ip if more than one stage is used. The next step is a measurement at 80 percent and 110 percent power. Do this by changing the transmitter output controls until each is reached. The wattmeter should read the average power for 80 percent and 110 percent. If the transmitter meter does not indicate these percentages correctly, mark the meter where they do occur.

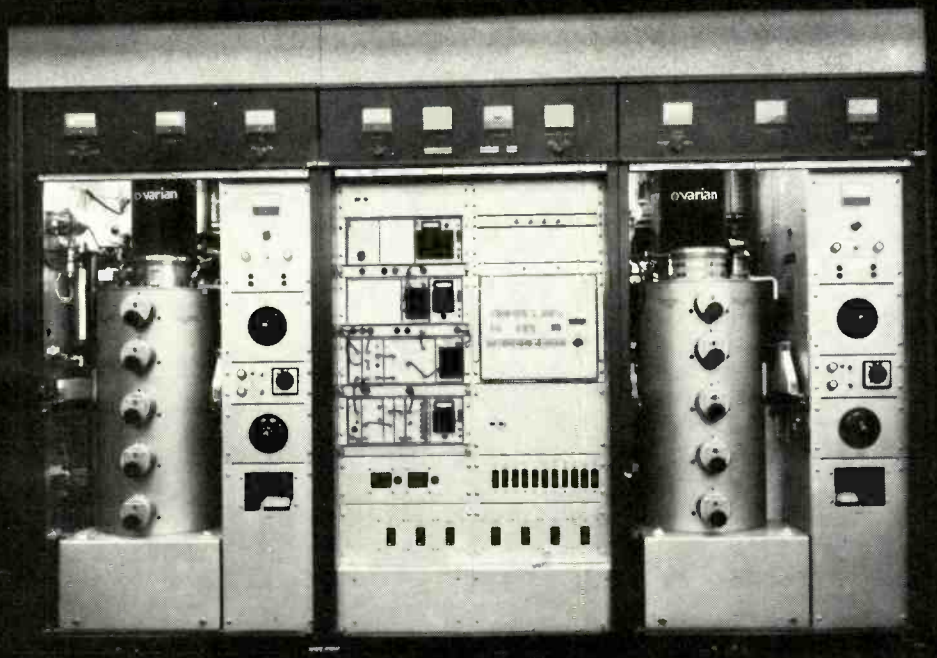
The dummy load and wattmeter should be removed and replaced by the line and antenna. Go through each of the power points and record the final Ep and Ip at each power percentage. The readings should be essentially the same as those with the dummy load. If they do not agree, there is something wrong either with the load or with the line and antenna. Line or antenna problems will quickly show up as high VSWR and ghosts in the picture.

You may think that going through the measurements again on the line and antenna is useless effort. This procedure does two things: first, it will reveal problems with the line or antenna since a correctly operating line and antenna will match the line impedance so should put an equivalent load on the transmitter as did the dummy load; secondly, it serves as a reminder to restore the line and antenna to the transmitter so that the morning man will not be programming to himself.

On Pleasing Everyone

Several years ago in a small eastern UHF station the chief engineer was having difficulty making full visual output. The tube was going sour and there was no better spare available. The station was having cash problems and the chief had tried to convince the owner that money must be spent for a new tube. The transmitter and studios were combined, so many on the staff could see that the output meter was reading far from full output — for which the chief received much criticism. As he put it, "Everyone from the owner down to the janitor is a meter reader." Tired of the criticism and failure to get the needed tube, he simply adjusted the output meter until it read 100 percent. Everyone was happy, but the output power continued to decrease until viewers in the city (2 miles away) started complaining that they were not getting a signal from the station. At that point, he got the new tube. ▲

England's ITA took our integral cavity klystrons.



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Circle Reader Service Number 41.

Line surge protection for remote FM stations

By Tom German*

*President of Professional Electronics and Chief Engineer of KCFA-FM, Spokane, Washington.

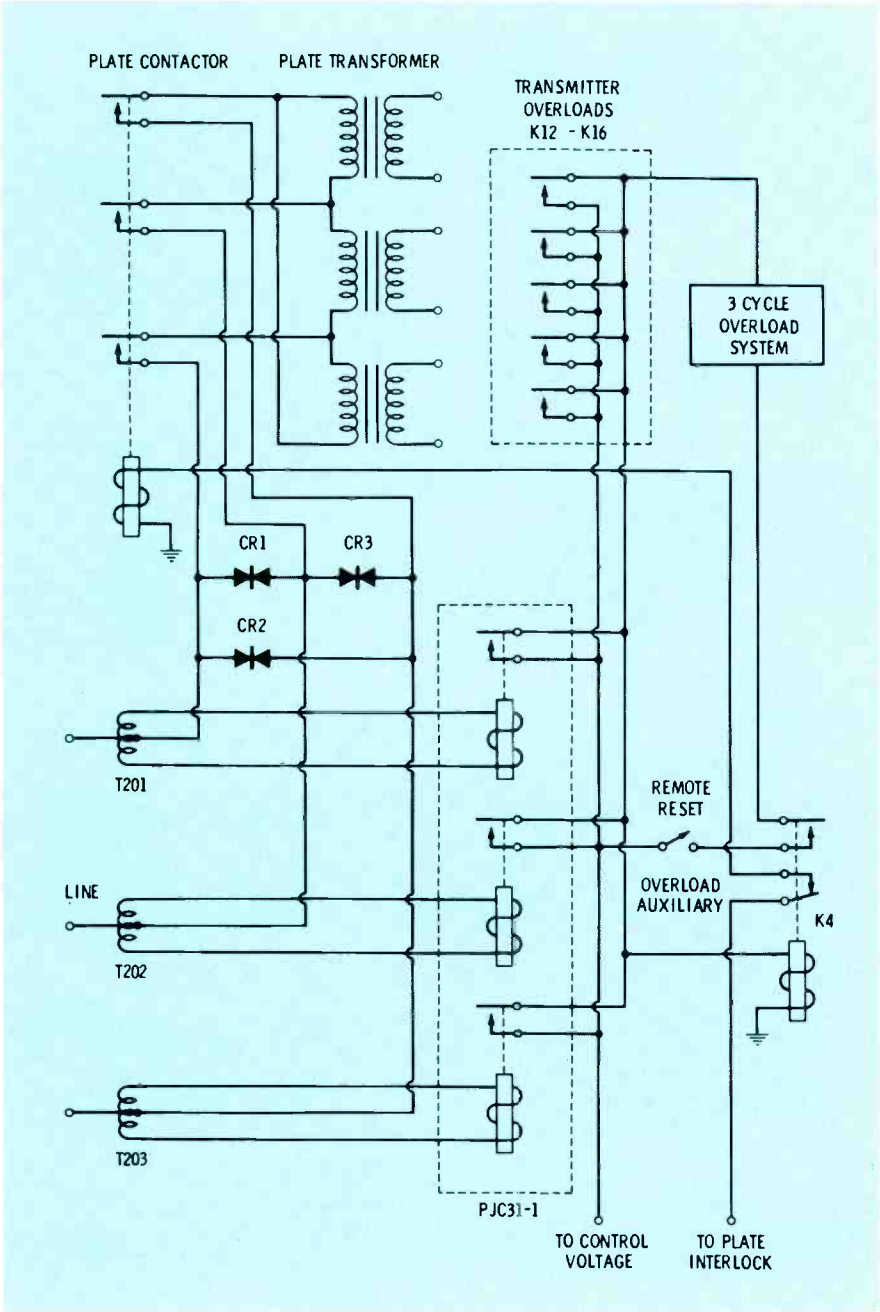


Fig. 1 Schematic of the first circuit using a PJC31 in the plate transformer primary. CR1, CR2, CR3, T201, T202, and T203 have been added to the original circuit.

Aside from the fact that it was ideally situated for maximum coverage, the most important factor in choosing our FM transmitter site was that there was a high powered radar station operated by the Air Force and the FAA only a thousand feet away. This gave us the assurance of an adequate, reliable power source on our remote mountain top. The power source was of particular importance because we would not be able to afford standby generators in the forseeable future.

It was this reliability factor which gave us our greatest problem in the initial months of operation. After much checking, hunting and many trips up the mountain, we found that the radar station personnel, accustomed to being alone on the end of the power line, were in the habit of dumping over 300,000 watts on the line every time they checked out their standby generators. This normally takes place once a week, but just after we first went on the air, it was happening several times a day. And did we have troubles! We arced, sparked, and flashed our way through each broadcast day.

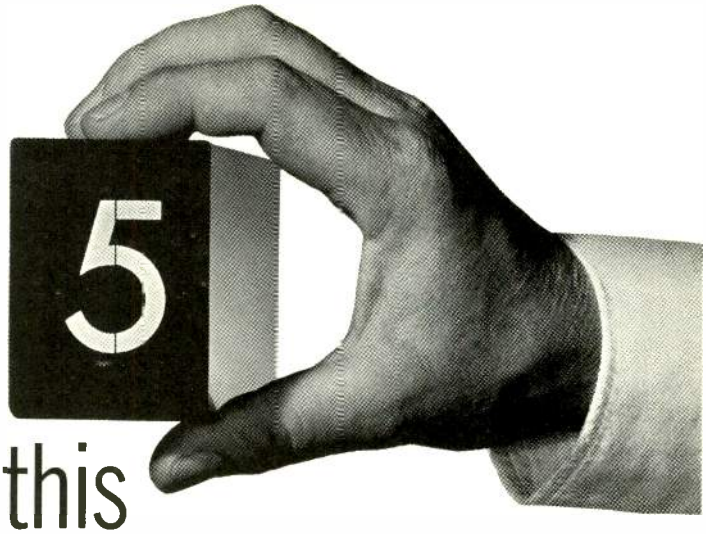
After a few calls to the power company and the radar personnel, we got their assurance that all future testing and switching would be done on a slow transfer basis in order to enable the power company's regulators to act. But assurance could be given that, under failure conditions, we would no longer receive transients up in the thousands of volts on our 230 volt line. These surges had power behind them and were really raising havoc with diodes, capacitors, transformers, meters, circuit breakers and even resistors.

According to power company engineers, some of these surges were still over 200 percent of line voltage, some 45 cycles after initial surge. This is when their regulators kicked in.

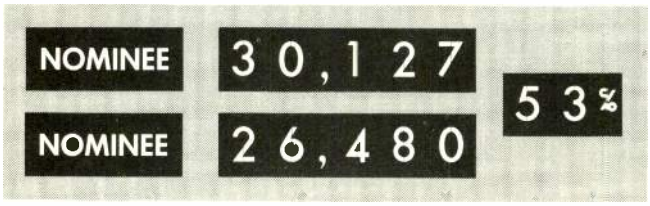
Surge Protectors

We tried commercial lightning arrestor type surge protectors on the power line. Then we tried thyrectors, which were supplied by the

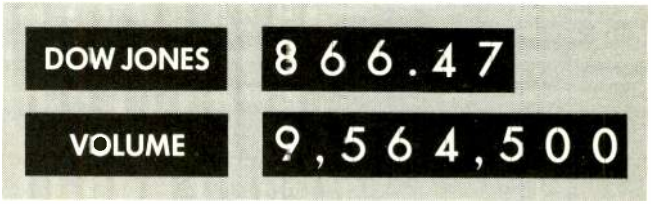
Look what your cameras can do with display units like this



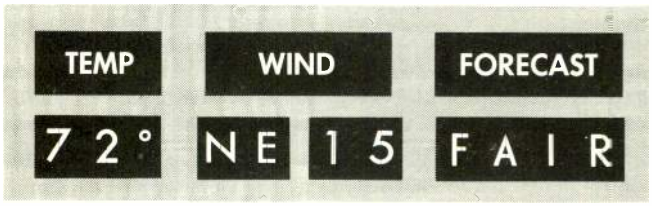
CBS Laboratories' Digital Display Units are part of
a low cost, compact system that works daily wonders in any size TV studio!



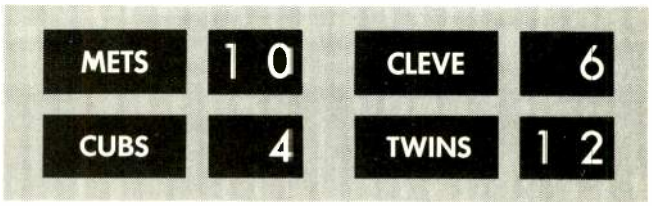
ELECTIONS–No contest.
These modular units were designed specifically for TV use to give optimum clarity up to 70 feet — from any camera angle up to 145 degrees.



STOCK REPORTS–Excellent for the long pull.
Rugged electro-mechanical operation is fool-proof and built to last. No bulb burn-out or the other problems of rear-illuminated displays.



WEATHER–Cool operation.
Only 2.7 watts required per unit, with no power between postings. Glare-free even under the strongest lighting conditions.



SPORTS–An easy set-up.
Just stack these units in a flat to suit any requirement. Custom designed matrix wiring also available for complete flexibility.

And all operated by one Controller that can handle 192 units — as many as 12 groups of 16 units each. This means up to 12 two-candidate election races; or runs, hits and errors for all major league teams; or 40 local stock issues plus volume and Dow Jones closing. A one-time investment for the professional way to take care of all your daily display needs.

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Circle Number 16 on Reader Reply Card

transmitter manufacturer. Both types of surge protectors did seem to hold down the extreme peaks, as we had less arcing, but since these allow 150 percent or more voltage before any appreciable limiting, there was still considerable over voltage for relatively long time periods.

The use of surge protectors also had the disadvantage of constantly poping circuit breakers which were not resetable by remote control. At 50 miles per trip and with some damage still being done to the transmitter, we soon concluded that what we needed was an instantaneous type of protector, preferably allowing remote recycling.

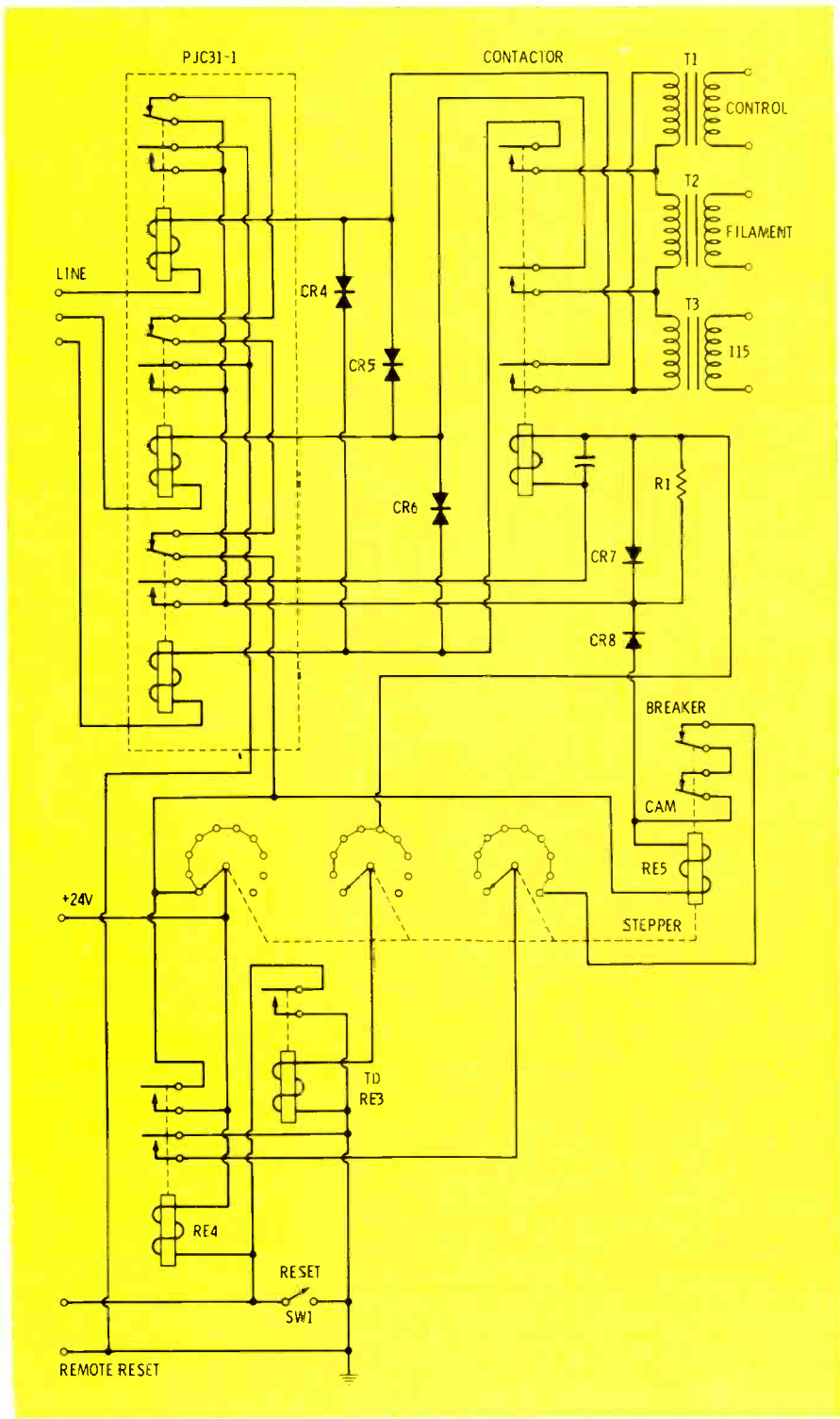


Fig. 2 Over-voltage circuit for the transmitter, audio and microwave gear. CR4, CR5, and CR6 give added transient protection and help load the circuits for the over-current relays.

Instantaneous Relays

After a long search, I found that GE makes an instantaneous over-current relay that responds in 1½ to 3 cycles. The basic relay, model PJC31, comes in several wiring configurations to meet specific needs. The armatures are adjustable over a 1 to 4 pickup range so they can be set to critical overcurrent requirements in the field. The cost of three-phase units was about $270 each.

Figure 1 shows the installation of the first PJC31 in the plate transformer primary. For current this heavy it was necessary to use current transformers, T201, T202 and T203 at about $30 each. With over-current conditions, the over-current relay or relays close, sending a pulse to the regular three cycle overload circuit in our 20 kW CCA transmitter. Thus, when a voltage surge hits, the plate contactor is opened for 1 second, then is re-closed. By this time the power company's regulators have had time to remove all trace of over-voltage and we continue on the air with just a 1 second break.

The thyrectors Cr1, Cr2, and Cr3 give added transient protection and help to load the over-current relays. We used IR's Clip-sell, KL11DBF at about $11 each. These are rated through 250 amps, while the PJC31 relay we have picks up at as low as 2 amps. The continuous current rating is 6 amps. The one second rating of the overload coils is 275 amps.

Installation Protection

The instantaneous relays proved very effective, but there was no protection for low voltage circuits. Figure 2 shows the overvoltage circuit we installed for the entire transmitter and even the rack of microwave and audio gear. We installed thyrectors, Cr4, Cr5, and Cr6 for added transient protection and to help load the circuit for the over-current relays.

In this application, the PJC31 is wired in series with the 230 volt primary lines. The armature of each

coil is adjusted in service for optimum protection, and one set of contacts of the PJC31 is changed to normally open operation. Contactor Rel operates on 24 volts DC and the resistor R1 and capacitor C1 are a time delay network while Cr7 shorts through the N/O contacts of the PJC31 to allow for instantaneous opening upon overload.

Re2 is a stepping relay, counting the number of overload cycles. Eight cycles will turn off the transmitter until the overload is reset either at the transmitter or by remote control. Time delay relay Re3 resets the stepping relay to "start", if less than 8 cycles have occurred within two minutes.

The filament time delay relay in the transmitter drops out in about 5 seconds. Any problem of longer duration necessitates waiting for a two minute time-delay before the transmitter is restored to the air, but that is better than the hour it takes to drive up the mountain.

Additional AC Circuits

T115 was installed in order to achieve powerline isolation and true one-point ground and to provide circuit protection for our microwave, control, telemetering and audio circuits. We also added a battery and an inverter as an emergency power supply for telemetering circuits for remote trouble shooting purposes. We can isolate most problems to specific areas remotely, even if overloads or circuit breakers are open . . . a considerable saving in diagnostic and driving time.

Our ideal site gave us nothing but headaches at first, but our final circuit greatly simplified our operation. That's why we also installed a second over-current relay. It may seem to make the first unnecessary, but, as installed, it makes an excellent remote resetable breaker and offers faster protection than the overload protection supplied with the transmitter. It is also a redundant protection for expensive high voltage components.

We have had no equipment damage or outages in the last year due to surges of any type. And just as important, we have complete control and monitoring possibilities and our protection circuits are resetable by remote control.

SCA principles and practices

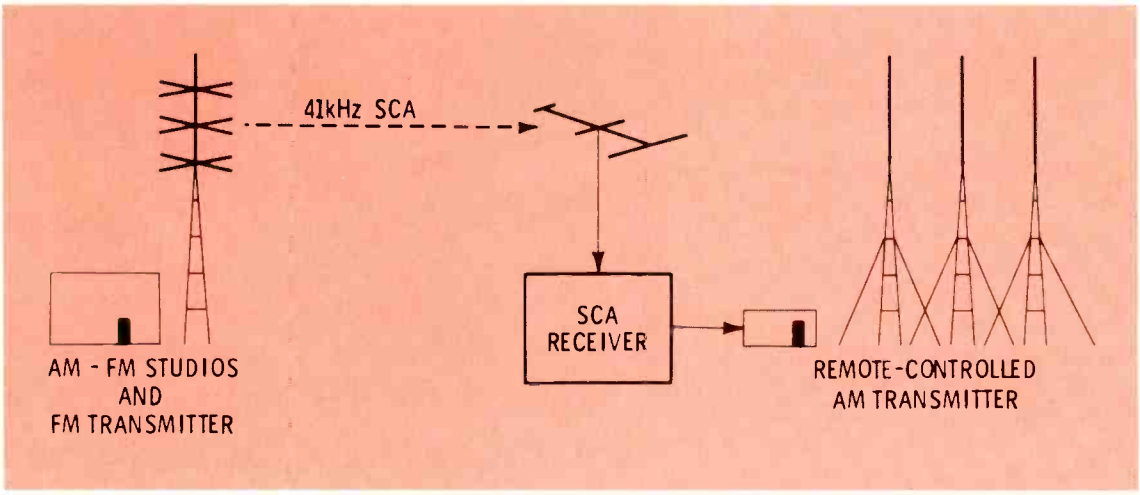


Fig. 1 A41 kHz SCA used as an AM backup STL.

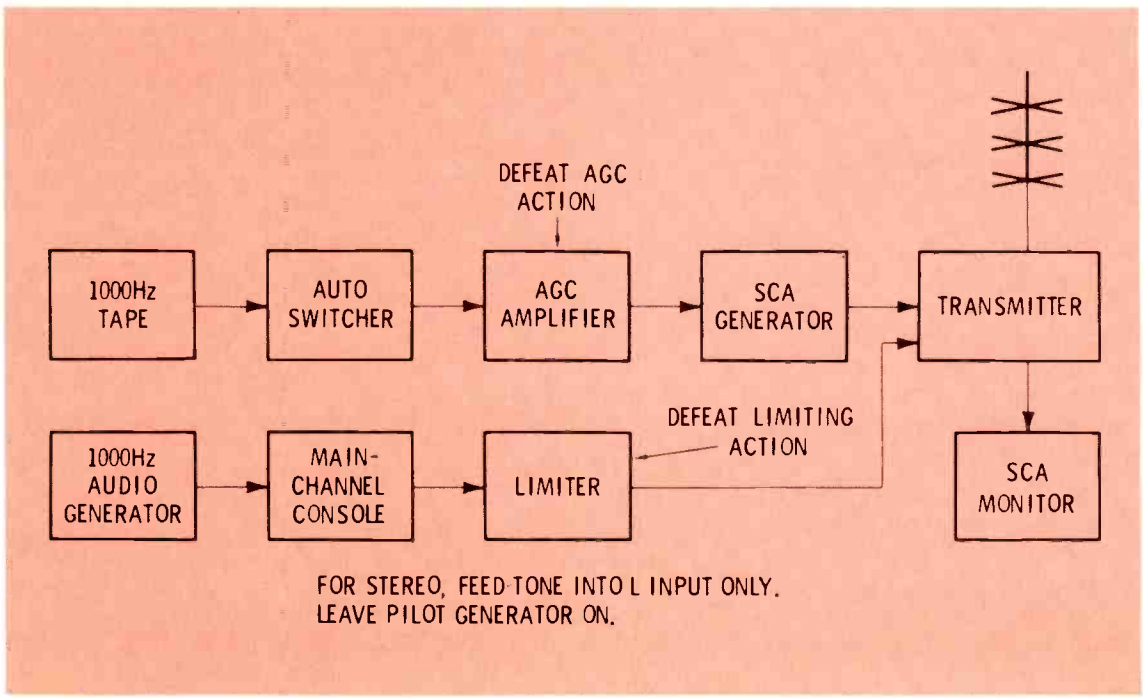


Fig. 2 Inserting 1000 Hz tone for adjustment of modulation at 100 percent on the subchannel.

By T. R. Haskett

An SCA subchannel is sometimes used to relay news or sports to other FM and AM stations. This mode is occasionally useful when an AM station is the key for a baseball network, but when its affiliated FM station is programmed separately and does not carry baseball.

An ingenious use for an SCA subchannel is shown in Figure 1. The studios of commonly-owned but separately programmed AM and FM stations are located at the same site as the FM transmitter. The AM transmitter is remote-controlled and located at another site, and the normal AM program line is a Telco circuit. An SCA subcarrier is available as a backup.

What is even more interesting is that the FM station can normally program stereo, and use a 67 kHz SCA for paying subscribers. A 41-kHz SCA is used as the AM backup STL. When the backup is needed, the FM station simply kills its 19-kHz pilot generator (thereby eliminating its stereo sideband channel) and turns on the 41 kHz SCA generator. By remote control, at the transmitter site the SCA receiver is switched to feed the transmitter.

A further use for SCA is to telemeter a remote-controlled FM transmitter back to the studio. You need a wire line or STL to control the transmitter, but you don't need a return line to take transmitter readings. The required readings are converted to audio tones in the range of 20-40 Hz and transmitted on the SCA subchannel. With proper filtering, you can provide background music or other subscriber service on the SCA, and telemeter back your own transmitter on the same subchannel.

Required Test Equipment

To install and maintain an SCA system, certain instruments are necessary.

1. Main-channel frequency and modulation monitors, and SCA monitor. These are required by the FCC.
2. A high-impedance electronic voltmeter (VTVM or FETVM).
3. An oscilloscope with vertical frequency response from DC to about 5 MHz, and a low-capacitance probe.
4. An audio generator with no more than 0.1 percent harmonic distortion in its output.
5. A harmonic distortion meter with no more than 0.1 percent internal distortion.
6. A wideband FM detector.
7. An AM noise measuring set.
8. Two dummy loads — one for the main transmitter and one for the exciter.
9. A wattmeter, to check transmitter power output and efficiency.
10. A frequency counter. Obviously, this is an expensive item which few stations have used. It is, however, becoming essential if you do anything beyond straight mono FM broadcasting. If you are both stereo and SCA, a counter will be useful in making daily frequency checks of the pilot and SCA subcarriers.

An accurately calibrated communications receiver is also useful. With it you can use Bessel functions to check your modulation monitor(s).

System Operation And Maintenance

Having made the decision to get into SCA, you will get FCC permission, buy the equipment, and get to work rounding up subscribers. But you cannot simply connect the equipment and expect everything to work properly. As Murphy's Law states: "In any endeavor, if anything **can** go wrong, it **will.**"

From the standpoint of troubleshooting, it makes no difference whether you are setting up an SCA system or keeping it operating. The most common problem is crosstalk in the SCA subchannel—crosstalk which comes from the main channel or the stereo sidebands—crosstalk which annoys your subscribers and generates complaints.

Obviously the entire SCA system —from tape deck to subscriber speakers—must be operating properly for everyone to be happy. When crosstalk occurs, however, it usually leaks in at only one point in the system.

Actually, creeping crosstalk sometimes occurs at several points in the system. You may find 5 dB of crosstalk here, 4 dB there. The total is enough to seriously worsen crosstalk and S/N. But you still troubleshoot by cleaning up each piece of gear in turn.

To localize crosstalk, it's convenient to divide the overall system into two separate subsystems: the transmitting gear and the receiving gear. Fortunately, there are two separate monitoring instruments which permit you to divide the overall system into two parts. These are the SCA monitor and the client's receivers. If you hear crosstalk in the monitor, it's getting in at the transmitting system. If you can't hear crosstalk in the monitor, but you can at the receiver, it's getting in at that receiving system.

The SCA Monitor

The monitor is the prime reference for the SCA system. It is essential that the monitor be free of internal crosstalk, and that it perform all indications within rated accuracy. If you have any doubts whatsoever about the monitor, write the manufacturer for instructions. He may instruct you to perform simple field checks, or he may have you return the instrument for overhaul and recalibration.

The monitor is the readout indicator you will watch while troubleshooting the transmitting system. If you have leased the SCA to an outside contractor, what you see on the monitor is the last you will see of your signal.

Crosstalk Localization

Here is a relatively simple method

for checking each element in the SCA system. It must be performed while the station's normal programming is off the air. Of course, all the equipment—including the transmitter—must actually be on.

Referring to Figure 2, if you want to establish the 100 percent modulation point on the SCA subchannel, make up a test tape containing several minutes of 1000 Hz tone. Run this on a tape machine which is normally used to feed the SCA audio line. Defeat any compression or limiting action, but leave the compressors or limiters in the circuit as straight amplifiers. Try to keep all attenuators at their normal settings, but adjust gain so that SCA modulation (deviation) is at the normal 100 percent point. Depending on your particular practice, this may be a deviation of ±7.5, 5, or 3.5 kHz.

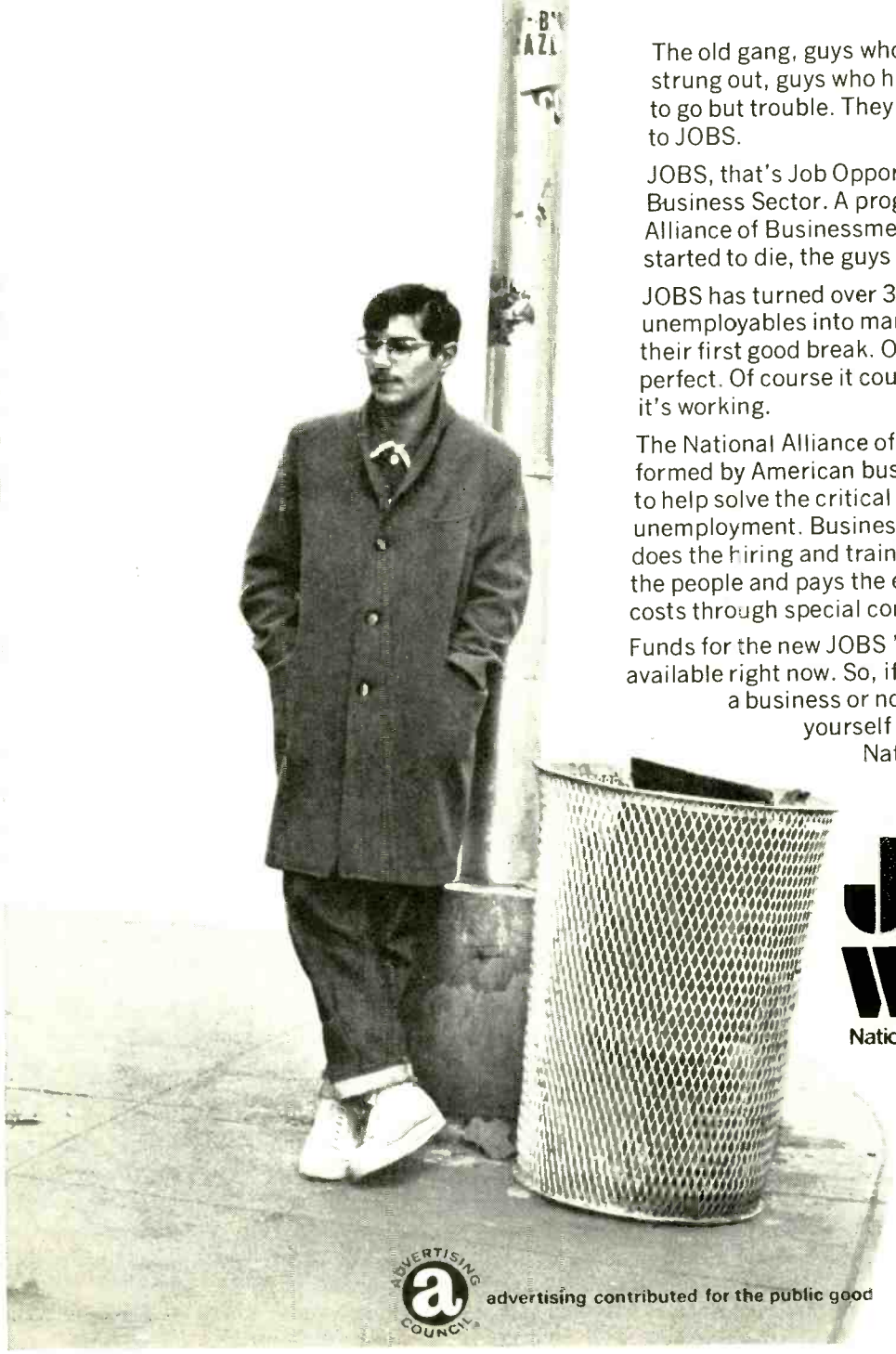
With the tape still running and SCA modulation at the 100 percent point, set the SCA monitor to take

SCA Generators

Manufacturer	Model No.	Unit Design	Frequencies Available	Center Freq. Stability	
AEL	2204	Self-contained	30 through 75 kHz	±400 Hz	
Bauer	7566,68	Plug-in unit	41 or 67 kHz	±500 Hz	
Collins	786W-1	Plug-in for Collins 310Z-1 Exciter	67 kHz only	±0.2%	50-15,000 Hz
Gates	M-6160*	Plug-in for Gates M-6146 Stereo Gen.	Any, 25-75 kHz	±500 Hz	30-15,000 Hz
Gates	M-6507	Plug-in for Gates TE-1 Exciter	Any, 25-75 kHz	±500 Hz	30-15,000 Hz
Marti	SCG-67	Self-contained unit	41 or 67 kHz only	±500 Hz	40-6,000 Hz
Moseley	SCG-4T	Self-contained unit	Any, 25-90 kHz	±0.5%	30-12,000 Hz
RCA	BTX-1B	Plug-in for RCA BTE-15A Exciter	Any, 30-75 kHz	±0.2%	30-10,000 Hz

*Vacuum-tube model supplied for existing transmitters. Not recommended for new installations, having been superseded by M-6507.

JOBS is breaking up that old gang of mine



The old gang, guys who dropped out, got strung out, guys who hung out with no place to go but trouble. They went to work, thanks to JOBS.

JOBS, that's Job Opportunities in the Business Sector. A program of the National Alliance of Businessmen. The gangs have started to die, the guys have started to live.

JOBS has turned over 300,000 hard core unemployables into manpower. Given guys their first good break. Of course it isn't perfect. Of course it could be better. But it's working.

The National Alliance of Businessmen was formed by American business communities to help solve the critical problem of hard core unemployment. Business provides the jobs and does the hiring and training. Government finds the people and pays the extraordinary training costs through special contracts.

Funds for the new JOBS '70 contracts are available right now. So, if you're an employer for a business or nonprofit organization, do yourself a favor. Call your local National Alliance of Businessmen.

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a crosstalk reading. Then stop the tape, but don't disconnect or turn off the tape machine. When the tape stops, the head won't pick up any signal. You don't want program material going through the SCA system, but you do want every piece of equipment in the chain and operating. Be sure to defeat SCA generator muting.

Now feed a 1000 Hz tone from an audio generator into the main channel, preferably as far back toward the system input as possible. The ideal place is the announce-microphone jack on the console. Defeat any compression or limiting action in the main channel, but leave the compressors and/or limiters in the circuit. Adjust main-channel modulation to about 2 percent less than the maximum allowable level for your mode of operation.

Check SCA injection level and be sure that it's at the proper value. Then check total modulation and make sure it does not exceed 98 percent.

If you are operating stereo, leave the 19 kHz pilot on, and feed the 1000 Hz tone into the left channel only. Short the input of the right channel preamp at the console. This is the worst-case test of a stereo system, since you are transmitting a left-only signal, with half the information in the main channel and half in the stereo sidebands. Both can cause crosstalk in the SCA.

(A left-only signal is not only worst-case, it is somewhat unrealistic and doesn't occur very often in stereo programming. If you cannot get an acceptable crosstalk figure on the SCA with a left-only signal which modulates the main L + R channel to the legal maximum of 40 percent, back it off a little. The SCA may still have a bit of crosstalk, but only on extreme left or right main-channel programming.)

You should now take a crosstalk reading with the SCA monitor. There is no modulation on the SCA subchannel, but there is nearly maximum modulation on the main channel (and on the stereo subchannel, if you are stereo). Therefore, anything you read on the SCA is crosstalk. If you are lucky, it will be about 50 dB below the 100 percent modulation point, which is just about the best obtainable figure for an SCA. Most likely you will find the Cx about 40 dB down, which you can live with. If Cx is only —30 dB, you have trouble.

Reading Cx

Some SCA monitors include a function which indicates crosstalk in dB below 100 percent SCA modulation. Others don't. If yours is the latter type, you will have to use the following method of reading Cx. Feed the SCA monitor's audio output (the one marked "for distortion measurements") to a harmonic distortion meter. Then simply set level at the HD meter using 100 percent SCA modulation by the test tape. Finally, remove the modulation and read Cx on the HD meter as residual noise. In this process, it's a good idea to hang a scope across the HD meter output and observe exactly what the Cx waveform is. It should be some component of the 1000 Hz on the main channel.

Obviously, the main channel normally contains frequencies other than 1000 Hz. Therefore you should make a frequency run, taking crosstalk readings with main-channel tones at several points between 50 and 15,000 Hz. Readjust main-channel modulation at each tone so that total modulation does not exceed 98 percent.

Refer again to Figure 2. First you will check the audio elements of the transmitting system, by shorting out each in turn and noting if the crosstalk gets better or worse. First eliminate the tape gear from the system by shorting the input to the AGC amplifier. If Cx was —30 dB before and is now —40 dB, the tape gear is at fault. If Cx is still —30 dB, the trouble is farther along in the chain. Do the same with any other units in the chain.

Finally, short the audio input on the SCA generator. If crosstalk remains the same, it's getting in down the line.

Still keeping the SCA generator audio input shorted, connect its RF output directly to the SCA monitor. Turn off the main-channel exciter and power amplifier. If the crosstalk figure remains substantially the same, the trouble is in the SCA generator. But if Cx goes from —30 dB to —40 dB (or something similar), the trouble is in the transmitter, line, or antenna.

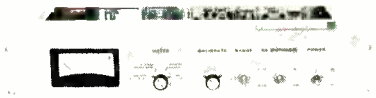
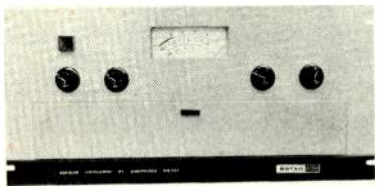
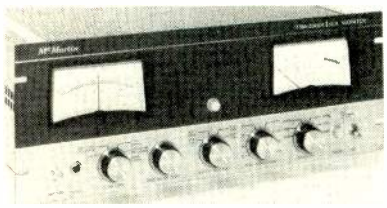
Reconnect the SCA generator to the main-channel exciter. Disconnect the exciter RF output from the power amplifier, and terminate the exciter in a dummy load. Be sure the power amplifier is off, and couple the SCA monitor sampling line to the dummy. Now you have isolated the power amplifier, line, and antenna by removing them from the circuit. If crosstalk remains, it is in the exciter; if it doesn't, the trouble is in the PA, line, or antenna.

Reconnect the exciter to the transmitter and terminate the transmitter in a dummy load. Reconnect the SCA monitor to sample normal transmitter RF. Again you have eliminated the line and antenna, and are including only the power amplifier. If crosstalk is reduced when driving the PA dummy load, the trouble must be in the line or antenna.

You don't need to go to such lengths to check the receiving system. Since you have many receivers and receiving antennas, you can always check one against another. It's a good idea to have at least one well-aligned receiver driven by one well-installed antenna as a reference. Some chief engineers install an SCA receiver at their home for this purpose. If you've leased your SCA to an outside contractor, his maintenance technicians will have such a reference system on their test bench.

Now your have seen how to break the system into its component parts. In the last part of this series, we will cover specific problems and solutions in audio origination equipment, the SCA generator, the exciter, transmission line, antenna, and the receiving installation. ▲

SCA Monitors

Manufacturer	Type No.	Use	Usable SCA operating frequencies	100% SCA modulation indicated at	Indicates	SCA mod. peak flasher
Belar	SCM-1 	Plug-in for Belar FMM-1 main-ch. mon.	Any 4 from 24-74 kHz	2, 4, or 6 kHz deviation	SCA freq. SCA mod. SCA inj. Cx in SCA	Yes
Collins	900F-1 	Plug-in for Collins 900C-2, 900C-3, 900C-3A main-ch. mons.	67 kHz only	5 or 10 kHz dev.	SCA freq. SCA mod.	No
Gates	GTA-6741* 	Plug-in for Gates GTM-88M, GTM-88S main-ch. mons.	41 or 67 kHz only	5 or 7.5 kHz dev.	SCA mod. SCA inj. Cx in SCA	Yes
McMartin	TBM-2000A 	Plug-in for McMartin TBM-4000A, TBM-4500A main-ch. mons.	Any 2	4 or 6 kHz dev.	SCA freq. SCA mod. SCA inj. Cx in SCA	Yes
McMartin	TBM-4000A	Self-contained mono/SCA mon.	Any 2	4 or 6 kHz dev.	SCA freq. SCA mod. SCA inj. Cx in SCA	Yes
RCA	BW-95A 	Plug-in for RCA BW-75A main-ch. mon.	Any 4 from 24-74 kHz	2, 4, or 6 kHz dev.	SCA freq. SCA mod. SCA inj. Cx in SCA	Yes

*GTA-88F Pilot SCA Frequency Comparator required as accessory to measure SCA frequency.

Feeding and Controlling Carrier Current Transmitters

Campus station WRST-FM solved their campus limited transmitter problems by using the old "Phantom Circuit".

*By John A. Bredesen, P.E.**

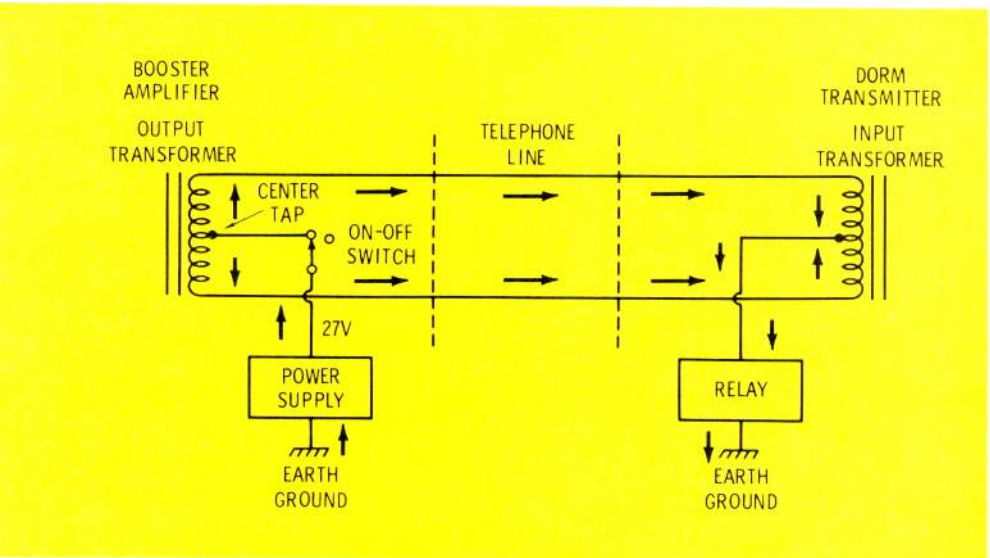


Fig. 1 On/Off control was achieved by using an old "phantom" circuit. The current equally divides to both sides of the output transformer terminals.

The Wisconsin State University at Oshkosh has had for several years a student operated radio station, WRST-FM. It began as a 10 watt educational station serving the city of Oshkosh, but as the number of students living on campus increased, we decided to install a "Carrier Current" or limited field transmitters in the dormatories to enable students to listen on conventional AM receivers. Equally persuasive, a survey of the resident students indicated that only 25 percent owned FM receivers.

Our student enrollment of about 11,000 is served by six low powered transmitters covering 14 dorms, with additional dorms planned for the future. This number of transmitters posed two problems at installation time, the solutions of which are the subject of this article. First was the problem of feeding the six audio lines (we lease lines from the telephone company but will be installing our own in the near future) with the proper impedance and audio level, and secondly the problem of controlling the ON/OFF function of the transmitters.

Feeding The Transmitter

Let's look at the feed problem first. A telephone line should be terminated with a nominal 600 ohm impedance. Moreover, these lines for best hum cancellation and noise immunity are balanced, meaning that neither side of the line is grounded, and the level into the line should be about +8 dBm. In our case, the dorm transmitter takes care of obtaining the proper conditions at the input end.

The audio board in most stations has an output level of +8 dBm at 600 ohms. This is just what we need to feed one line. It is obvious that we shouldn't simply parallel the six audio lines across the output of the board because six 600 ohm lines parallel is not 600 ohms, but 100 ohms.

One possible solution would be to use a series of "building-out"

*Director of Engineering for Radio, Television and film at Wisconsin State University—Oshkosh.

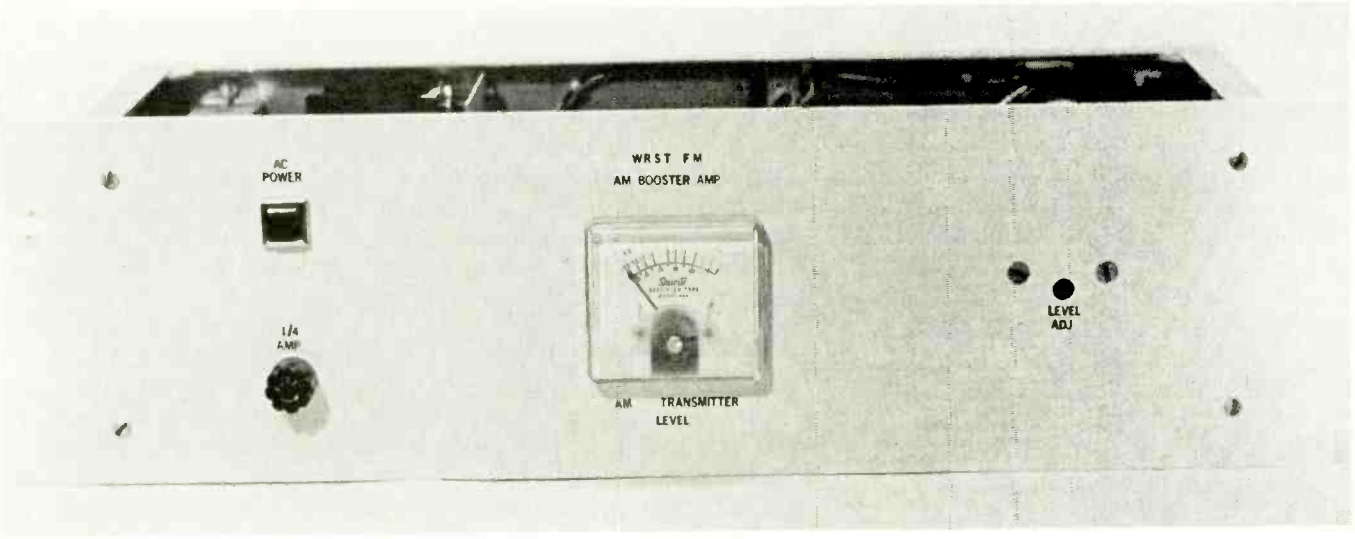


Fig. 2 Front view of the WRST-FM AM booster amplifier.

pads or splitters. The trouble here is that while we could maintain the proper impedance this way, we would lose our desired signal level, and this is not good from the standpoint of signal-to-noise ratio on the telephone line. It was decided to go to an audio booster amplifier to overcome these problems.

Transmitter Control

The second problem, that of ON/OFF control, is solved quite neatly with this unit, using what is referred to as a "phantom" circuit. This is not a new concept. It goes back to some of the earliest days of open wire telegraphy! (See Figure 1.) In the phantom circuit 27 volts DC is applied to the centertapped secondary of the output transformer through the switch controlling the ON/OFF function. The current equally divides to both sides of the output terminals of the transformer; therefore, it is equal on both sides of each audio line.

Another way to understand the circuit is to measure across the audio pair with a voltmeter. You wouldn't measure any DC voltage at all, whether the transmitters were ON or OFF. If, however, you were to measure from either line to ground, you would read the power supply voltage, assuming that the transmitters were switched ON.

At the transmitter proper, the audio pair terminates in a balanced input transformer which has a centertapped primary. The DC voltage is available here to operate a relay to apply power to the transmitter. The control voltage return to the station is through earth ground, therefore it is imperative that each transmitter and the distribution amplifier at the studio be well grounded.

The reason the DC doesn't interfere with the audio signal is that the line is balanced to ground. The audio signal is "push-pull" on the line while the DC is "push-push". Any hum or other noise introduced by the power supply will cancel out. There is, however, always the possibility that some unbalance may occur; this is one of the reasons why I used an electronically regulated power supply with an inherently low hum and noise level.

The particular relay selected for installation at each transmitter is a Potter & Brumfield ML11D with a 10,000 ohm coil. This is a high enough resistance to avoid a sizeable voltage drop on the phone line.

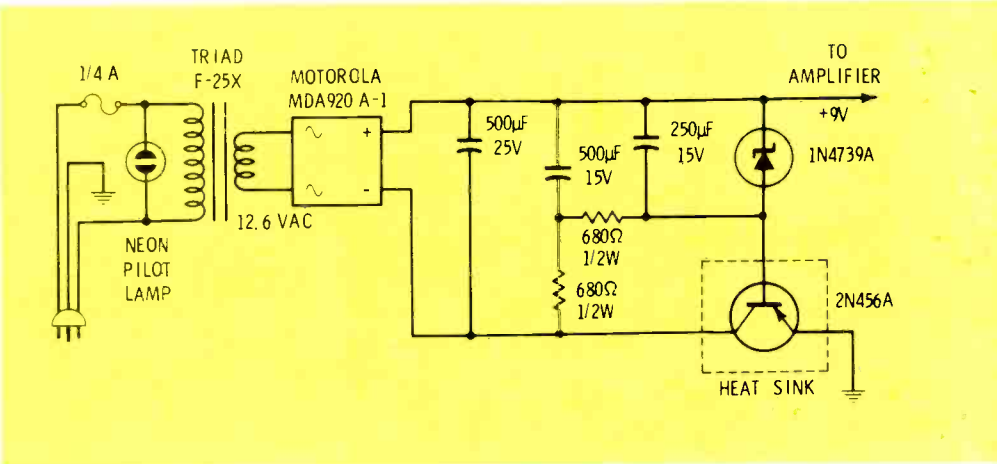


Fig. 3 Power supply.

One of our lines is more than two miles long by the time it is routed through the telephone central exchange. It still works well. When ordering the line, make certain that you specify the need for DC continuity, otherwise the phone company may put a repeat coil in the line which will block DC.

With this research behind me, I built a unit that would give the desired results (See Figure 2). I used an amplifier that was commercially available rather than build one up from scratch. The one selected is a small solid state printed circuit unit manufactured by Amperex Electronic Corporation, Model PCA-1-9. The price is reasonable (about $10), and the performance is quite adequate for this purpose. Only one addition is required on the PC board and this will be discussed later.

The amplifier has a rudimentary power supply requiring only an externally mounted transformer for operation, but the hum level is quite unacceptable in this application. The regulated power supply solved this problem.

The power supply was designed to provide an output of 25 volts to allow operation of the transmitter relays. However, the amplifier requires only 9 volts, so a 10 watt zener diode and a dropping resistor is used. An alternate power supply (See Figure 3) provides the required 9 volts directly, if relay operation is not required in your installation.

Construction Details

No particular attempt was made to build a compact unit. Ours is constructed using a 5¼" rack panel and dish chassis, but it could be very easily built using a 3½" panel.

The circuitry (See Figure 4) is straight forward. The amplifier is mounted with two spacers to the rear side of the front panel in such a manner that the gain control is accessable through a hole in the panel (See Figure 5). The amplifier specified has mounting holes that lend themselves to this type of mounting.

The amplifier output coupling capacitor has a value of 125 mfd, not large enough to prevent an undesirable low frequency rolloff. To remedy this, connect a 500 mfd, 15 volt cap across the one supplied and support it with its own leads. Be sure to watch polarity. Bypass the diode Crl on the amplifier, it isn't needed.

Construction of the power supply isn't critical. Ours was built on perforated vector board with components mounted by their own

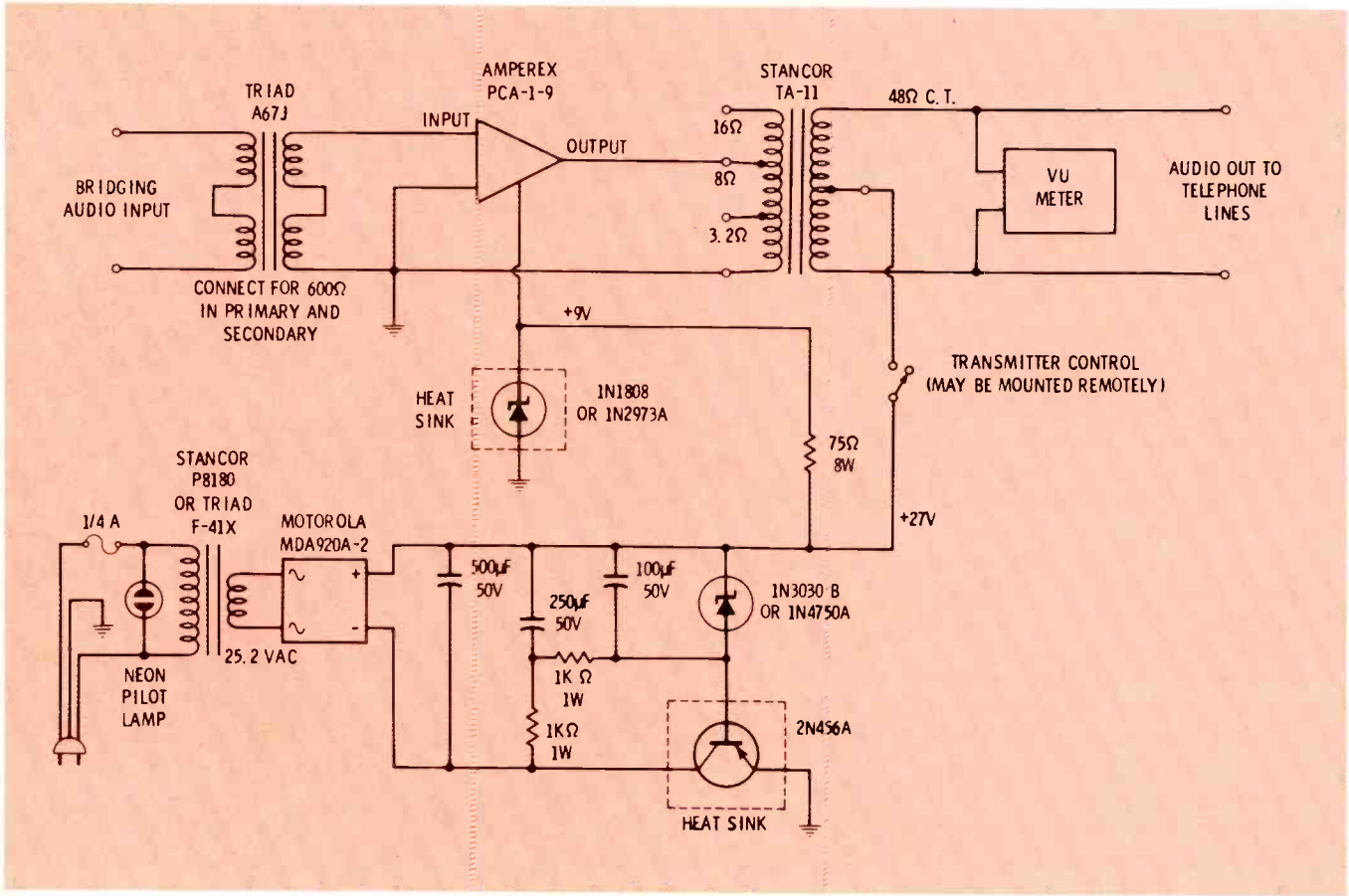


Fig. 4 Simple schematic of the booster amplifier.

leads, but the supply is simple enough to construct using terminal strips and point-to-point wiring if desired.

The 2N456A transistor Q1, must be mounted on a heat sink with at least 12 square inches of surface. Mount the heat sink so that the fins are vertical to allow maximum use of convection cooling currents. A coat of flat black paint from an aerosol spray can on the heat sink will aid in heat rejection. Don't get any paint on the area where the transistor will be mounted and be sure to use a silicone heat sink compound to assure thermal continuity from the transistor to the heat sink.

While the input transformer T1, is rated 600 ohm to 600 ohm, this unit, and indeed any other transformer with similar characteristics, will reflect a 600 ohm load in the primary only if the secondary is terminated in 600 ohms. Since the transformation ratio is 1 to 1, the primary will reflect a much higher impedance because the secondary is terminated with a minimum of 220k ohms. Therefore, the input of the booster amplifier may be freely bridged across a 600 ohm line, balanced or unbalanced without any significant loading.

It isn't necessary that the output of the booster be terminated with all 12 lines if you don't have that many to feed. The amplifier isn't critical at all within the range of 600 ohms (one line) to 50 ohms (twelve lines). This means that from 1 to 12 audio pairs may be connected at will.

The VU meter (if one is used) will read accurately with any number of lines connected, but it may be necessary to adjust the gain as lines are added to maintain the desired level. The VU meter was included as an aid in setting the gain control. It is not really needed if some other means is available.

Our booster has been in operation for almost a year and has not required any attention in that time. It has fulfilled every design objective and has done so with a very modest original cost. ▲

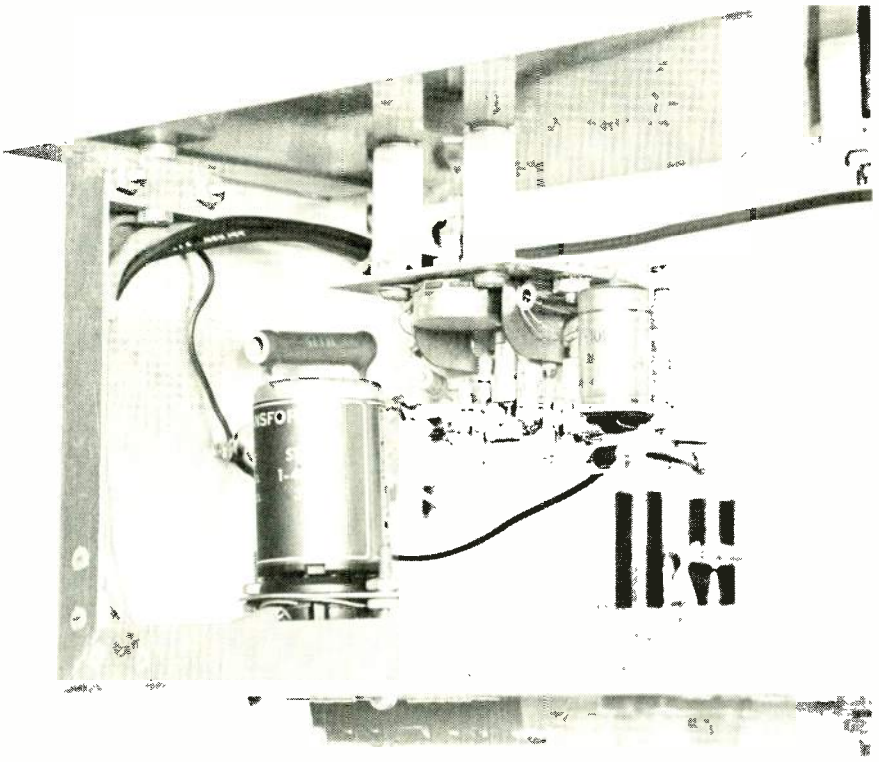


Fig. 5 The amplifier is mounted on a subchassis with a hole cut in the front panel for access to the level adjust pot.

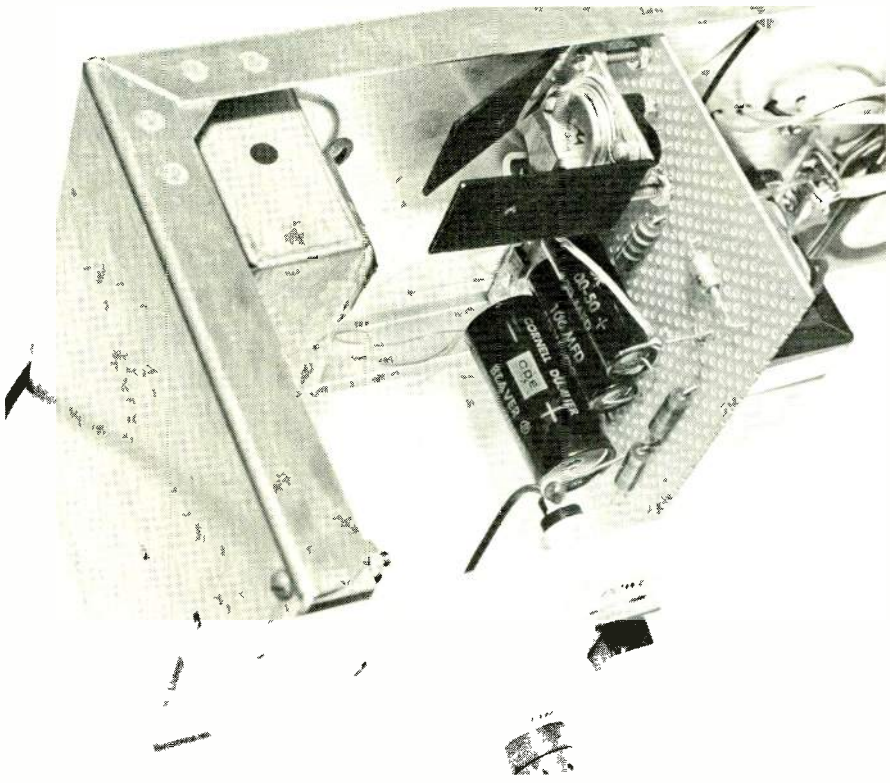


Fig. 6 Top inside view of the power supply station.

Burst phasing can be an operational adjustment

By Elmer T. Schorle, Jr.*

Of all the equipment in use in TV broadcast stations, none is more involved in both production work and on the air revenue production than the videotape recorder. Because of this dual role most stations evolve a complex work load for their machines that sandwiches air playback of spots between recording assignments, often utilizing every available moment on each VTR's log for one function or the other.

At WCAU-TV this means putting up for air playback an average of 60 (and as high as 80) short term (60 seconds or less) playbacks per day, plus three or four half-hour shows which are either nationally syndicated or locally produced. To help the operator get the best color quality, these VTR's have auto-chroma, Mincom color drop out compensation, velocity compensators, and vectorscopes and color monitoring for each machine. However, if care is not paid to the burst phasing of each of these tapes, all the other gear could be superfilous, as we would air flesh tones ranging from green to purple. Meanwhile, the sponsors and public would match the colors as they look on in disbelief.

The Ampex recorder does not have a quick or easily accessible adjustment for changing the burst phase. Ampex takes the view that this should not be an operating adjustment. However, some of the tape coming out of production houses has not been subjected to quality control. When we run some of those low quality tapes, we need to make some adjustment or the flesh tones end up covering half the rainbow. Since we run as many as 30 sources in one day, the chance of getting a poor tape is high.

Realizing that we wanted the operator to correct for improper color phasing, it was apparent that to adjust it by the book often required more time than he could spare, and chanced a slipped screwdriver falling down through the proc amp PC boards while trying to quickly tweak the delay line. The control had to be as convenient and as quickly set as the other operating controls and had to provide the range needed to cover variations found in tapes in our library.

After considering voltage controlled delay lines, and tapped coaxial delay lines, we rejected each, for cost and size reasons. We then asked ESC Electronics Corporation, who makes the delay lines used in Ampex recorders, to blend two of their products to give us a 25 nanosecond delay line with a ¼" shaft for a knob. This would give us a range of plus or minus 22 degrees, with a five-turn control, and would amply cover our needs.

Electrically, the unit is placed in series with the burst routing from the colortec to the proc amp. Mechanically, we chose to mount it in signal system jumper module number 8. The spare coaxial jack, and the unused "'RF Dub In" jack on the rear of the signal system were used for the cables. Terminating the delay line drops the burst level some, but it means only that the proc amp burst gain must be set at

*Videotape Technical Director, WCAU-TV, Philadelphia.

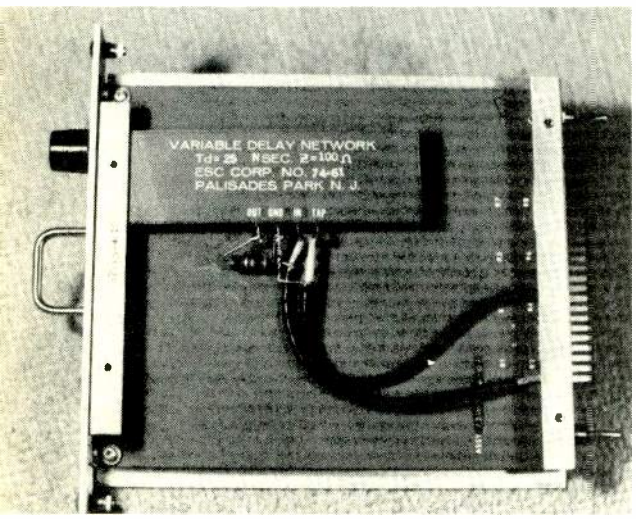


Fig. 1 View showing mounting of the delay line within the jumper module. Actual pin wiring would depend upon individual preference in the VR1200 or VR2000.

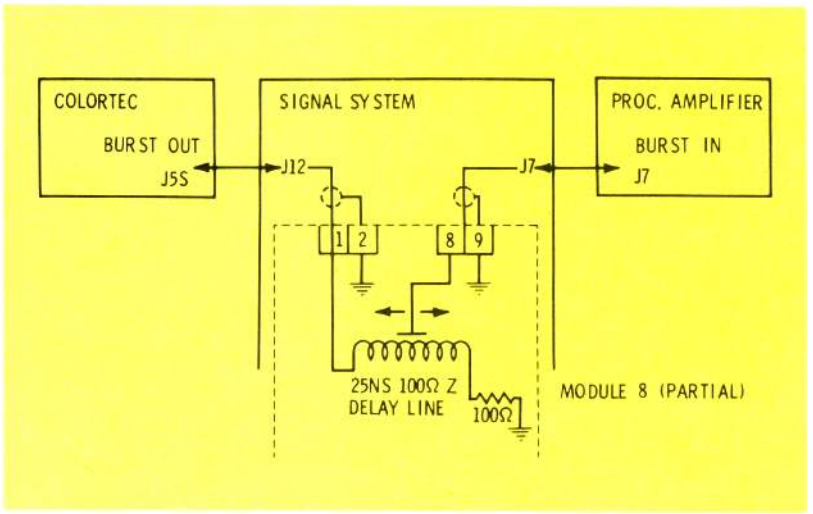


Fig. 2 WCAU-TV's wiring plan, with the delay line inserted in the burst path from Colortec to the proc amp.

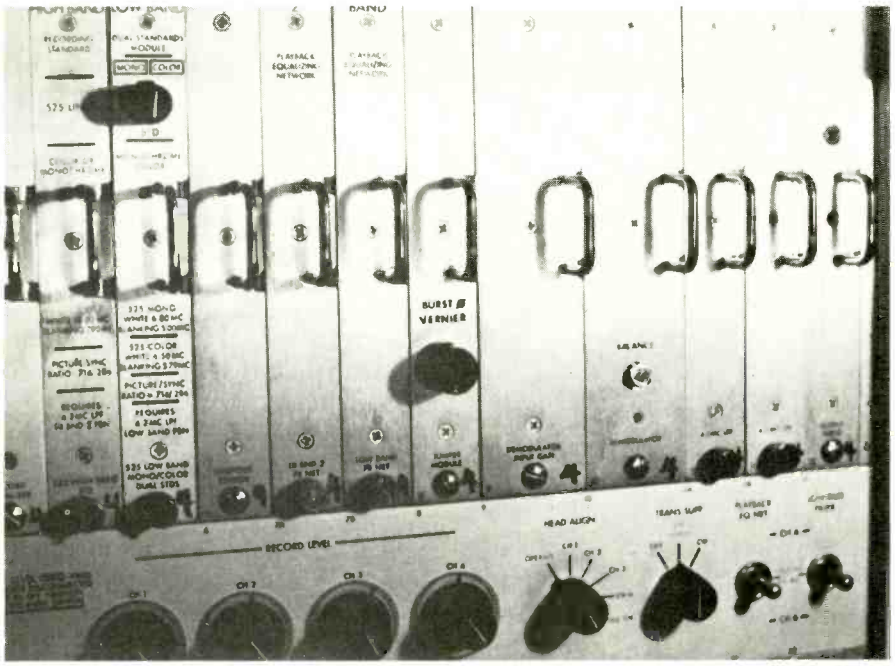


Fig. 3 Rub-on type lettering was used on the front of the module. Covered with a thin lacquer, the lettering blends with Ampex's lettering.

about the 1:30 o'clock position instead of straight up in order to get 4 IRE units of burst again.

We align the system by putting the 5-turn control in the middle of the range, and adjust the proc amp delay line for zero shift thru the machine. Then when the control is reset for a spot, it is quick and easy for the operator to come back to standard phasing after it airs.

Thus, for $67 per machine, we have added a convenient operating control that aids in maintaining better color quality. We have not yet eliminated all the grumblings that all non-standard tapes should be rejected by sales (who ever heard of sales rejecting spots for electronic quality). At least now, by the time he has grumbled, he is also finished correcting it, instead of still being in the act of trying to find the slot in the proc amp delay while he watches the monitor or vectorscope.

Television: A long range forecast

At a time when we are all seeking to crystalize at least the goals of television, scientists are signaling even greater challenges from a distant horizon.

By Dr. Dennis Gabor
C.B.S. Laboratories

The following is a paper delivered to the NAB convention in Chicago this year. While **Broadcast Engineering** does not necessarily agree with all Dr. Gabor says, we think it is important to bring the subject to the attention of the broadcast/communications industry. **The Editor.**

I wish to give an outlook into the scientific-technological possibilities of television. As a scientist I will take the liberty of not bothering too much about the economic viability of some of these exciting projects, but I cannot leave it quite unmentioned. Everybody knows that it takes 10-20-30 years after an invention has proved technically feasible, before it becomes an "innovation", that is to say it can be successfully marketed.

The popular belief is that this time is required for the engineering development, for pilot manufacture, for debugging, but this takes usually only 5-10 years. In most cases the delay is caused by finding the economic-financial basis for successful marketing. The technical feasibility of television was demonstrated in 1928 by Zworykin. It took only 8 years for a television service to start in Britain, where it was financially based on a public corporation, the BBC. In the USA it took 20 years, because here the financial basis had to be created by advertisements. If later on I speak boldly about some technical projects, I certainly do not underrate the difficulties created by vested interests and habits.

British television started in 1936, with 405 lines. The USA leapfrogged this in 1948 with 525 lines. Continental television leapfrogged this again with 625 lines, and Britain had to follow suit. Millions of Americans have seen the superior Continental services, and it is fair to expect that the USA will jump to the front again, with something like 750 lines, which would be as good as perfection at the present screen sizes. In the case of color this would mean stretching the existing techniques a little, but everything is ready, except that we do not know where to take the 10 MHz waveband which would be required.

Cassette Television

There may be also another way by which high-quality pictures can appear in the homes. There can be no doubt about the great future of "cassette television", which is not **tele**-vision at all, but a customer-controlled visual display, analogous to the phonograph; the EVR of CBS, the video tape of Sony-Philips and the SELECTAVISION of RCA. There is no difficulty in making these good enough for 750 or even 1000 lines. For some years of course people will use these with their ordinary TV sets, but it is probable that in not too many years wide-waveband sets will become available for office communications, and this may open the way for high resolution EVR devices. This in turn may encourage entrepreneurs to speed up the development of high-quality cable television networks.

Let us now look farther ahead, towards large screen television, say 4 ft. by 3 ft. 750-1000 lines would be sufficient for these too, if people would view them not from the usual 4 ft. distance but about twice as much. Assuming that the wavebands of 10 MHz will be available by that time, the bottleneck will be in the display device. There are four possible solutions which I will discuss.

One solution is ready; it is the projection system based on the Eidophor tube, and its improvements by Dr. W. E. Glenn, Jr. It is perfect, but far too expensive for the home.

A second solution is the ingenious image amplifier of Prof. Baumann of the ETH, Zurich, who was also one of the chief architects of the Eidophor. This too appears to be far too expensive for the home.

A third solution has been much talked about for the yast 20 years. It is the "solid state" television screen, composed of electro-luminescent elements. In spite of the enormous amount of work done on solid state physics, I do not think that we have got much nearer to it in 20 years. The brightness of the electro-luminescent substances is still so low that they would have to be excited during the whole time from frame to frame, not during a few millionth of the time, like cathodoluminescent powders. Hence

each element of the screen would have to be a device which feeds power into the electro-luminescent substance during the whole time, proportional to the signal which it has received. Any electronic engineer can construct such a device, but I can hardly believe that it could be done at 0.1 cents apiece, which would put a screen with a few million elements into the thousand-dollar range.

The possibility of a fourth system is just becoming visible. An exciting new invention has just been announced; a glass fibre which amplifies the light passing through it by laser action. If it were possible to produce such amplifying fibres for the three basic colors, one could think of a large screen composed of glass fibres which lead to a small, conventional color tube, amplifying the light on the way to the large screen to full brightness.

Future Requirements

Let us now take a further step into the future, towards the all-wall, three-dimensional television screen, the favorite of the science fiction writers. We can perhaps believe in it, if we believe in Herman Kahn's extrapolation into what he calls the "Post-Economic Society" in which the G.N.P. per capita of U.S. citizens will be in the $20,000-100,000 bracket. But let us leave economics aside, and look into the technical problem. The waveband requirement is not insuperable. We have coaxial cables with 100 MHz bandwidth, and helical waveguides with 1000 MHz. This would be enough for an all-wall two dimensional picture. But the 3D feature is very doubtful. Holography has been often mentioned as an exciting possibility, and holograms are indeed real three-dimensional pictures, but at what an expense! Even with present-day screen sizes a 3D hologram would require at the very least a 100 MHz waveband, and at the receiving end it would require a large Eidophor with strong lasers. For color pictures one would require three lasers, because we have not yet a medium for producing erasable volume holograms, which could be illuminated with white light.

So it would be an enormous technical **tour de force** and very costly to produce a 3D television picture of the present-day size, but the crux of the matter is that it **would not be worthwhile.** I have, long ago, played about with 3D projection and it was very impressive in cinema size. But when I tried it in television size, the result was pretty, but one could not take it seriously. It was like a puppet theatre! As soon as one asks a realistic feature to a picture, the eye asks for more; for real dimensions.

So, to my regret, I cannot believe in full 3D television, except in the remote and rather unlikely future, the post-economic society, in which people will be willing to spend about as much on entertainment as they now spend on everything put together. Perhaps they will be satisfied with cheaper substitutes, with stereoscopic pictures, viewed through Polaroid spectacles, but this is rather unlikely.

Ultimate Focus

Finally, I wish to say a few words about television (and visual) displays in general) as a cultural medium. We do not need Marshall McLuhan to tell us how important it is. Until he goes to high school the American boy or girl has spent many more hours watching television than doing school work. He or she has formed many of his views on the world from television.

The American television networks are doing admirable work in entertaining children and are faced with a growing responsibility to play a more vigorous role in educating them as well as entertaining them.

Unless we can harness all the idealism of which young people are capable and direct it into constructive channels, I do not think that we need worry much about all-wall television in the 21st Centry. By that time there may not be even small black-and-white sets!

Film Systems In CATV

"The most meaningful area of activity is your ability to originate truly local programming along with local advertising."

By Tom Levy, Eastman Kodak

"The CATV industry is going to have a profound effect on the whole field of communications . . . and we want to furnish you with a better understanding of the potential of the film system for cable TV."

The man speaking was Dr. Norwood Simmons, assistant vice-president and general manager of the Motion Picture and Education Markets Division, Eastman Kodak Company. His recent appearance (5/6/70) before more than 100 cablecasters at the Pennsylvania CATV Convention in Lancaster underscored Kodak's interest in the capabilities of cable TV.

"Cable television has a potential far beyond that of simply providing a signal from a distant TV station," Dr. Simmons said. "As a result, the local scene already is being reflected by several cable systems with some very effective local origination."

Citing the strength of the industry, Dr. Simmons pointed out that while the Gross National Product has been growing at a 7.8 percent rate, the CATV industry, over the past five years, has shown a compound growth rate of 13.5 percent.

"We challenge anyone to name another industry that has come so far, in the face of so many antagonists," he said.

Dr. Simmons then went on to compare the film system, often taken for granted by TV people, with the newer, and therefore more glamorous, technology of videotape.

He asked his listeners to reverse the present situation and imagine that CATV systems had available only videotape for all programming other than live transmission or material picked up directly off the air.

"Then," he said, "suppose you heard about a remarkable discovery that offered a complete system for producing program material, requiring fewer components, less expensive equipment, smaller and more portable pieces of hardware, fewer skills to operate, worldwide standardization, easier editing, and comparable, if not superior, color fidelity.

"Furthermore, this system could record events under extremely difficult conditions, and could produce either black-and-white or color programs. In short, it would improve on virtually every characteristic of the videotape system except for one —it would require a more complex processing procedure. As you know, I've just described the characteristics of the film system."

Pointing out the importance of film in broadcast TV today, Dr. Simmons noted that some 85 percent of prime time TV is on film, and at least 90 percent of network commercials are on film.

Artistic Flexibility

Dr. Simmons commented that while simple commercials, produced by local stations, are, for the most part, on videotape, film is the medium of choice where a commercial calls for realism, artistic flexibility, outdoor shots, and rapid switching of scenes.

As for programming, he said, film is hard to beat "if the situation calls for lively physical action of either the subjects or the cameraman, if there is going to be any editing, and if your crew totals only one or two people."

He added that videotape has some definite plus values, especially if immediacy is essential. "We believe that tape will exist side-by-side with film," he said.

Dr. Simmons then turned his attention to the basic equipment for an effective film system for cable TV. He counseled his listeners that 16mm film and 16mm equipment will continue to be the most widely used film format in television.

8 vs. 16mm

Citing the current discussion about the potential of Kodak's super 8 film format for TV, he said:

"We haven't the slightest doubt that super 8 is going to find a place in both broadcast TV and CATV. For anyone, however, to go into super 8 exclusively now, on the assumption that they are on the wave of the future, would be a grave mistake."

He pointed out, for example, that 16mm offers a wide choice of equipment, while super 8 equipment is limited at the present time. Likewise, there is very little on super 8 in the way of existing film library materials—available free or otherwise. In contrast, there are literally thousands of titles of 16mm.

"Furthermore," he said, "this pattern will continue for some time since 16mm is the choice of serious producers of documentaries, educational films, syndicated TV shows, and business and industry films."

Dr. Simmons summed up the 16mm-super 8 choice this way:

"When super 8 finds its way into

TV, we believe it will be as a means of recording news. We hope that this occurs, since super 8 has many attractive attributes. When it does, the equipment probably will be less expensive and more highly automated. For the present, we think that the most practical choice will be 16mm as the basis of your film system, supplemented by 35mm slides. Eventually, super 8 should be added."

Film processing, according to Dr. Simmons, is the most inconvenient step in the film system—yet the many advantages of film outweigh this one drawback. He cited the streamlining of current procedures, widespread availability of processing services, and the number of simple, high-quality film processing machines now available. He noted that Kodak's ME-4 process currently is installed in about 300 TV stations and 140 labs around the country.

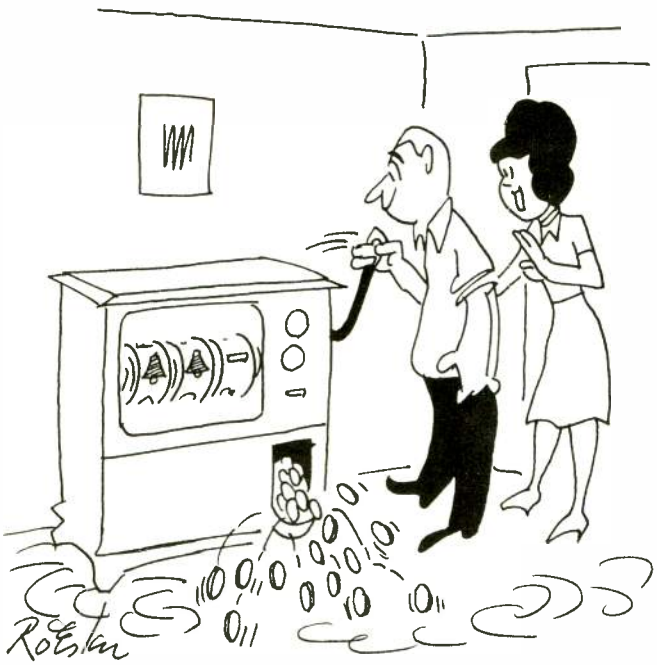
"We find that most of these machines, using the ME-4 process, particularly those in television stations, are being made available to other film-users for fast processing service," he said. "Many are doing work for business and industry as well as for other TV stations."

The remaining two elements in the complete film-handling system are editing equipment, available from a number of service and specialty dealers; and the film projector, with associated multiplexer and pick-up vidicon camera, which receives all film originations.

Present And Future

Dr. Simmons acknowledged that the long-term prospects for CATV include such possibilities as the use of satellites, cable networks, and the development of the cable as the pipeline into a home communications center.

"But what of the present?" he asked. "The most meaningful area of activity is your ability to originate truly local programming along with local advertising. Just as the public is entitled to programs that explore local issues, so the small business is entitled to local advertising outlets. The broadcaster, already feeling the pressure for more local origination, cannot compete with the capabilities of CATV in this area. There seems little doubt that the immediate future will see transmission of distant TV signals as the minor—not the major—activity of CATV."



"WHAT DO YOU MEAN - 'YOU'VE HOOKED IT UP WITH LOS VEGAS' ?!!"

ENGINEER'S EXCHANGE

IC's In Audio Applications

Don't overlook the Fairchild 716 Integrated Circuit simply because it is sold as a "hobbyist" item by electronics parts houses. These IC's, designed to feed a load of 150 ohms or higher at power levels up to ¼ watt, offer very low distortion amplification at audio frequencies.

The inexpensive blister-packaged 716's appear substantially identical to the regular 716's available from Fairchild distributors except some have a higher noise level. The noise was low enough in two dozen samples I checked for program if not preamplifier applications.

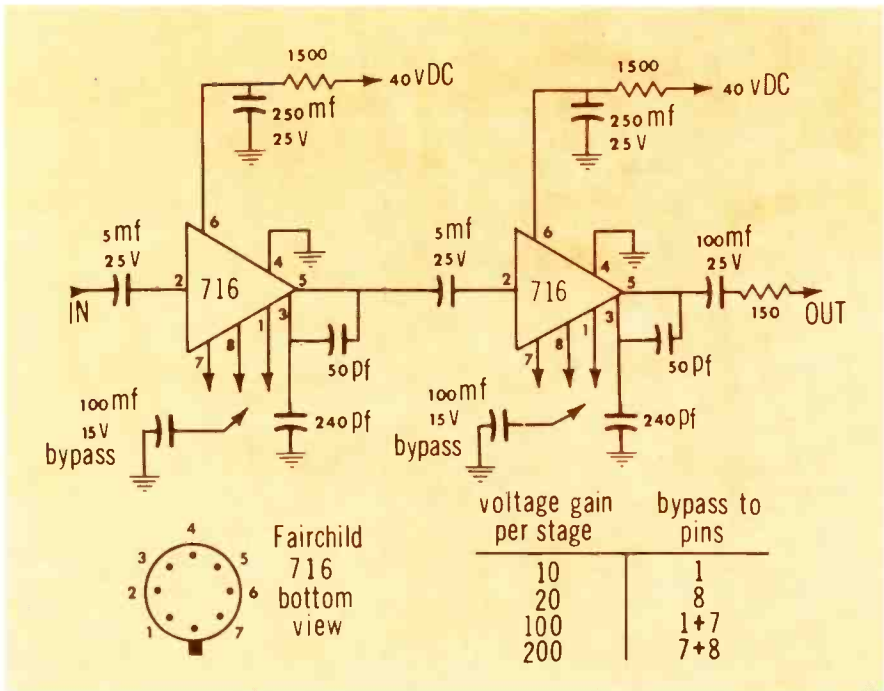
The schematic shows two stages which can be adjusted to voltage gains of 100 to 40,000 in steps of 6 dB. One stage should be used if a range of gain from 10 to 200 is adequate. If gain of no greater than 10,000 in two stages is used, distortion remains below 0.25 percent at levels up to 50 milliwatts output. The voltage gain is determined by the bypass capacitor connection to singular or a combination of pins 1, 8, 1 and 7, and 1 and 8.

Output source impedance is about 1 ohm, but loading with much less than 150 ohms destroys the IC. A 150 ohm resistor wired in series with the output makes the amplifier immune to external shorting. Oscillation also destroys the IC, so watch lead dress if high gain is used. Attach a heat sink to the IC's TO-5 case.

I built two control boards recently using these amplifiers. They resulted in lower cost and considerable simplification over amplifiers using discrete components exclusively.

Ronald Pesha
Chief Engineer
Greeley, Colo.

Send your Engineer's Exchange Ideas To:
BE, 1014 Wyandotte
Kansas City, Mo. 64105



Voltage gains are in steps of 6dB.

Plumber's Delight For Engineers

At some long forgotten time in broadcast history, there probably were at least a few engineers who were handling strictly electrical/electronic station duties. But a modern day chief could hardly make a scratch on his weekly work load if he were not also functioning as a construction engineer, design engineer, plant maintenance engineer, and mechaical engineer. (You can add your own categories to the list!)

It is with this thought in mind that we give you the following account of Fred Clinger's debut in yet another form of engineering. Call the category what you may, but add it to the list for the stations in the corn fields. **The Editor.**

A number of radio stations have a problem of supplying water for transmitter personnel, when the transmitter is in a rural area, with no running water, and the station is either unwilling or unable to drill a well. WBCO was one of this number.

The transmitter site is located more than two miles from the nearest town, and about a quarter mile from the nearest farm, in what was in days past, a farmer's field. For washing hands, cleaning up the transmitter room and workshop-studio, water was hauled every day from the nearest farm in milk cans.

This soon became a large pain for the chief engineer and the duty engineers. After the water was hauled from the farm, a small electric pump moved the water into an overhead 30 gallon storage tank, which was connected to the wash basin.

This system was complicated by the fact that the duty engineer could not leave his post to haul water. He had to wait for the chief to show up, or until his relief appeared before going to get the day's supply of water. This created an overtime situation for supplying water, a problem that continued until I decided the water problem would be solved. The answer was very simple. All we needed was a rain barrel!

(Continued on page 54)

Engineer's Exchange

(Continued from page 53)

I spotted the evespout from the transmitter building roof, which was draining the water into the field. The obvious solution was to catch the rainwater in a container, and then get it into the transmitter building. The answer was to use a 55-gallon oil drum to catch the water.

The spout was removed from the center of the eaves (the hole cemented shut) and inserted at the end of the building. Then a square hole of about three inches was made in one end of the rainbarrel to accommodate the evespout.

A one-inch hose from an electric pump was brought out through the transmitter wall, through a hastily made hole in the concrete wall block. The plug in the drum was then removed, and the hose inserted through the hole.

After the first rain, we noticed that about five percent of the water entered the barrel, which was then full, and 95 percent went onto the ground around the foundation of the transmitter building. Obviously, an overflow system was necessary. This was constructed by chiseling a small round hole in the barrel about six inches from the top. Then a small piece of water pipe, about ten feet long, was inserted in the hole. The pipe was then cemented into place, using the black roof patching compound.

Fred Clinger
WBCO-Ohio

Setting Up Remotes For Church Services

If you have found it difficult to get part time help to cover those church pickups, or you wonder why you lug all that gear around, perhaps this little gadget is just the answer you have been looking for.

We had a problem! Our church broadcasts originated from the same church for one month and then moved to another location for the next month. It was possible to leave the equipment set up, but we had problems finding part time help to mix the broadcast and set up the gear for each month's service. When I had been called out two Sundays in a row I decided to solve the problem with the device shown in Fig. 1.

A shielded transformer with four 150 ohm windings is the main item. It was mounted on an aluminum right angle bracket inside a mini-box just large enough to hold it, the three female mike connectors, and the one male mike connector. Wiring is straight forward, just watch the phasing and ground connections. If you use the RCA mike wiring system, just tie all the pin 1's together and do not ground them.

In the church three mikes (which will do almost any pickup) are set up and connected to the combining network, and a mike cable is plugged into the output of the network and run to a single mike input remote amp. The remote amp can then be placed in a convenient location for AC, Telco loop, and where it will not be tampered with.

The trick to this setup is the choice of microphones. They must be chosen and placed to do the balancing. For example, the organ choir will be the loudest part of the pickup. If the choir is located in two lofts facing each other, a bi-directional mike would be a good choice. Pick up the organ by natural balance as usually the organist will try to balance to the choir, so a good clean choir pickup will do it.

For the pulpit or lecturns, a mike with more output and a cardioid pattern would be a better choice. Try something like an EV RE15 which has an output of –56dBm. For certain special pickups with soft speaking you could chose a mike with higher output such as an EV 667A. Its output is –51dBm. An Altec 639 can also be useful because you have six patterns. This can be used to control the congregation level. Just one final point: when selecting mike outputs always reference them to the same rating, e.g.; 1 mv/10 dynes/CM².

William Graham
Kitchener, Ontario

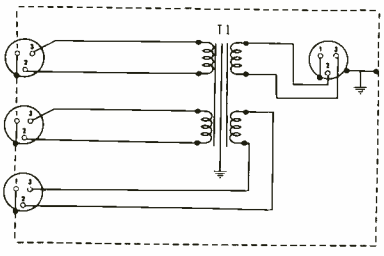


Fig. 1

NEW PRODUCTS

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

Ampex Unveils Duplicator

A prototype ADR-150 was demonstrated for the first time at the National Association of Broadcasters' convention in April.

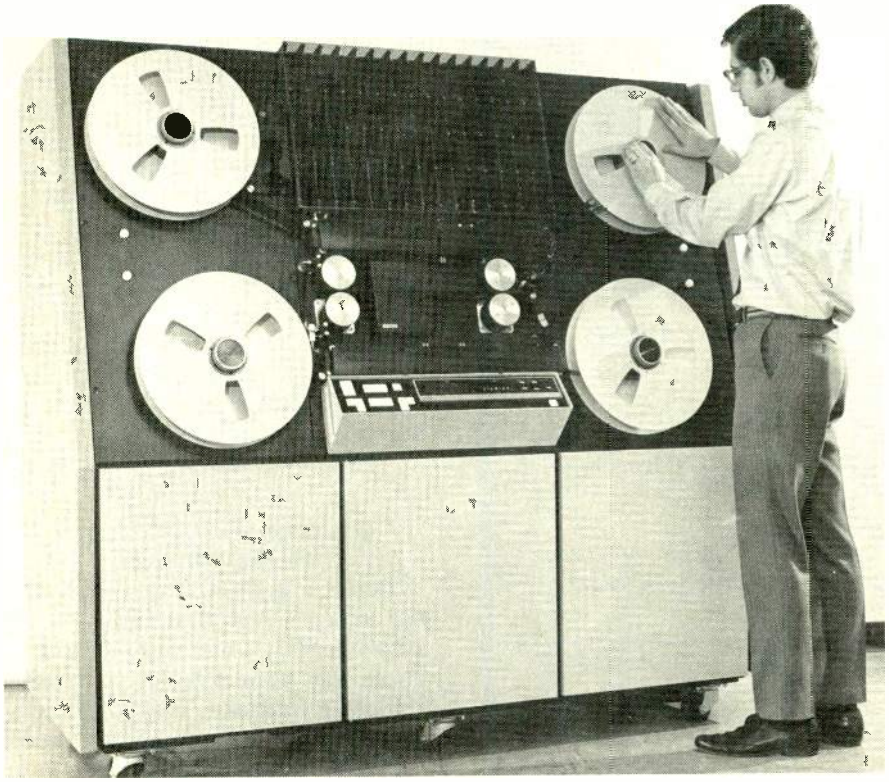
The ADR-150 is designed for modular expandability to accommodate up to five slave reel systems, permitting duplication of from one to five copies in a single operation. The price starts at $79,950, depending on the number of slave modules employed. Deliveries will begin early in 1971.

The ADR-150 is designed for television stations, networks, teleproduction centers and advertising agencies that frequently require several copies of video taped commercials, promos, syndicated or network programs, news and sports clips and feature segments for rapid distribution.

Duplicates made on the ADR-150 can be played on any standard quadraplex broadcast videotape recorder, and are interchangeable with all conventional transverse-oriented, two-inch-wide video tapes. All broadcast formats, including high-band and low-band, color and monochrome and 525 and 625 line standards, can be faithfully duplicated on the ADR-150.

The new duplicator uses a dynamic transfer system by which a specially formulated master tape is brought into direct contact with conventional blank transverse-scan video tape. The blank, or slave tape assumes the arrangement of magnetic particles present on the master tape with insignificant degradation of video signals on the master tape after repeated uses.

The duplication process occurs in a magnetic transfer chamber located in the center of the tape paths on the ADR-150. Both the master and slave tapes, which are loaded on separate reels, are threaded through the same transport area and brought into direct contact in the magnetic transfer chamber.



Ampex ADR-150 Duplicator

Vacuum chambers located on the ADR-150 transport permit easy tape threading and gentle tape handling, and provide for positive tape control through the magnetic transfer chamber.

Ampex Model ADR-150 will enable producers and distributors of television commercials and programs to make quality tape copies of a master recording in one-tenth the time currently required in video tape dubbing, according to Lawrence Weiland, vice president-general manager, video products division.

Circle Number 45 on Reader Reply Card

Portable Mixer

Under type designation MP4, **Philips** has introduced a portable four-channel mixer specially intended for radio and television studios and outside broadcast units.

Though compact and lightweight —a mere 38 pounds (including batteries for mains — independent opperation when necessary)—the MP4 meets the highest studio standards; its performance being comparable to that of advanced custom-built modular mixing consoles, according to the manufacturer.

Clean-sound circuitry has been incorporated, there are two separate mixing busbars, and every channel (input and output) has insertion points for external equipment (equalisers, limiters, compressor amplifiers, etc.).

Primarily intended for broadcasting purposes the MP4 nevertheless fits the bill for many audio installations. Its installation can be by building it into a 19-inch rack in company with other audio equipment such as tape recorders, power amplifiers, etc.; when mounted in a suitable frame, two or more MP4 mixers in combination, with the facilities by equalizers, compressor amplifiers and intercom equipment, results in an attractive low-priced studio mixing console capable of handling a wide variety of programs, in both mono and stereo.

A three-position key-switch is associated with each of the four channels. The center position of the switch is for channel muting and the

New Products

(Continued from page 55)

other two positions are for input selection. Each channel's input sensitivity can be set to any of four different levels by means of a rotary switch. Four selection switches mounted inside the mixer adjust their associated channel pre-amplifier for use with either 200 ohm or 50 ohm microphones. In the standard version of the MP4 carbon-track rotary channel faders are used. Other types of faders can be supplied on request and provision has been made for sliding faders to be mounted externally. Each channel has its own push-button switch for connecting the input signals to the selected mixing busbar.

Circle Number 46 on Reader Reply Card

Digital Multimeter

Triplett Corporation is introducing a new 3-½ digit table-top, Digital Multimeter Model 8000-A with solid-state circuitry that retains storage of any displayed readout indefinitely; has good AC accuracy and linearity and 10 Megohm input resistance; and virtually no kickback current, allowing voltage measurements in high reistance circuits at stated accuracy.

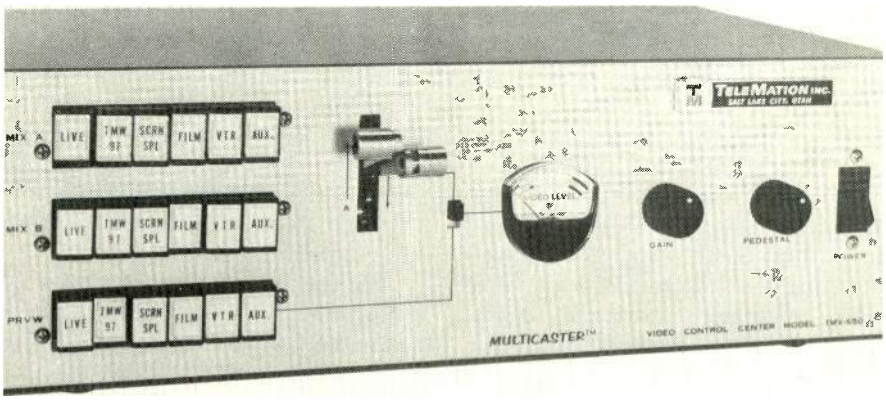
Triplett's Model 8000-A has protective circuitry preventing damage to the unit when voltages as high as 100 volts AC or DC are applied as inputs on and of the selectable voltage ranges. Also, it has as much as a 50 percent over-range and a sample rate of six times per second.

Measurements are displayed with excellent resolution in the decimal number system by three gas-filled readout tubes. The numeral "1" is displayed for over-range meausrements. The readout display is complete with a movable decimal point, and automatic over-range indication (O/R).

Circle Number 47 on Reader Reply Card

Video Control Center

For multi-camera television productions in educational, military, medical and CATV systems, **Tele-Mation, Inc.,** has designed a compact unit which handles all synchronizing, switching and control functions of the several video sources.



The MULTICASTER® Video Control Center (Model TMV-650) ties as many as four cameras to one central system for smooth, synchronous switching. Included are a video processor, video level meter, two solid-state vertical-interval program switching buses, separate preview bus and splitarm fader control. Looping jacks in the MULTICASTER® can route the video from each camera to other system equipment, eliminating the need for separate video distribution amplifiers, or each input may be terminated in 75 ohms by switch.

Multi-conductor camera inputs can be used for non-synchronous sources, such as a video tape recorder or tuner. Gain and pedestal controls are provided for professional one-man control of all sources.

Circle Number 48 on Reader Reply Card

New Clark 100A Stereo Headset

David Clark Co., Inc. announces the redesign of Clark/100 series stereo headsets. Internally the transducer has been redesigned to give smoother frequency response, more rugged voice coil structure, better transient response and more low frequency output.

The improved models will carry an "A" designation; Clark/100A (17 ohms), the Clark/103A (300 ohms), the Clark/106A (600 ohms).

The transducer is the result of nearly four years of research and development. Physically, the transducer is a dynamic, moving coil with a mylar cone and ceramic magnet. Power input, 1 watt continuous. The frequency range is 20 to 22 KHz, frequency respones 20 to 16 KHz. Distortion is less than 1 percent over the audio band.

Circle Number 49 on Reader Reply Card

Automatic Peak Controller

CBS Laboratories unveiled a new automatic peak controller. Designated the Volumax model 4000, this unit offers the broadcaster the opportunity to turn the asymmetry of speech waves to his advantage by ensuring that the highest amplitude peaks always positively modulate the transmitter.

If the predominant asymmetry polarity is positive, the signal is passed through a non-inverting variolosser circuit. Conversely, if the predominant asymmetry polarity is negative, the signal is passed through an inverting channel. The switching action between polarities is silent. A front panel switch allows the positive modulation level to be limited at either 100 or 120 percent.

The Volumax analyzes all program material and automatically selects the appropriate regulation speed. Limiting action may be gentle or microsecond fast, depending upon the nature of the program waveform.

Circle Number 50 on Reader Reply Card

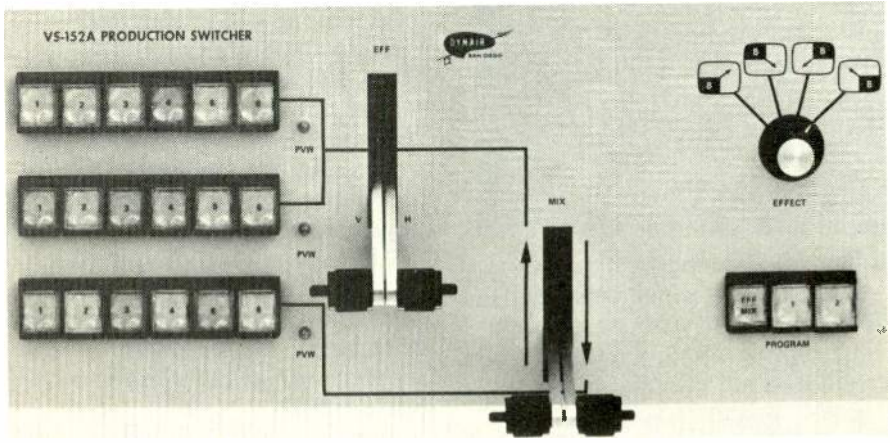
Vertical Interval Production Switcher

DYNAIR Electronics, Inc., has added a new low-cost vertical-interval three-buss mix/effects production switcher to its line of professional video programming equipment. The new VS-152A is completely solid-state and has all the capabilities necessary for professional programming, including instantaneous switching, fade-in, fade-out, lap-dissolve, superimposition and special effects.

The switcher accepts six non-composite and two composite video inputs. The non-composite inputs are connected to three busses, two of which feed an effects amplifier with a split-lever control. The output of the effects amplifier and the third buss is applied to the mixer, which also has a split-lever control. The composite inputs are switched by a separate three-button buss, which provides a selection between the mixer output and either of the two composite inputs. All video signals are switched by solid-state crosspoints during the vertical interval to assure a glitch-free transfer of signals.

The special effects amplifier produces a single electronically combined signal from any two of the six non-composite input sources, with capabilities for inserts from each of the four corners, and full horizontal and vertical wipes. The inserts can be expanded horizontally, vertically and diagonally.

Circle Number 51 on Reader Reply Card



Dynair's VI Switcher

New Products

(Continued from page 57)

Lead-Oxide Target Vidicon Camera Tubes

A new family of RCA lead-oxide target vidicon television camera tubes, called Vistacons, that are directly interchangeable with competitive lead-oxide target types, was announced by **RCA Electronic Components** at the 1970 National Association of Broadcasters Convention.

"Two series of Vistacon camera tubes are included in this initial announcement to the broadcast industry," according to C. H. Lane, division vice president and general manager, RCA Industrial Tube Division. "One series has internal mesh connections and the other series has separate mesh connections."

Both series of Vistacon tubes feature lead-oxide targets that are characterized by high sensitivity, very low dark current, very low lag, and a "gamma" of nearly unity.

Circle Number 52 on Reader Reply Card

DC Voltage Standard

Cohu Electronics, Inc. has announced production of a new DC voltage standard designed for control by computer. The Model 381 Programmable DC Voltage Standard's accuracy/stability factor will hold the instrument within 0.003 percent of set value for 12 months. It supplies output voltages to 120 volts at either polarity. Current up to 100 milliamperes is limited to a selected level according to the control equipment program.

Commands can be applied to the instrument either automatically from a computer or by an operator using a decimal-to-BCD converter (available as an option). The Model 381 responds to parallel-entry, 4421 or 8421 binary-coded-decimal, 27 bit commands. Twenty bits set the magnitude of the output voltage, two bits determine the polarity, three bits select the proper voltage range and two bits set the limit of the output current.

Technical specifications for Cohu's programmable standard are engineered to meet the needs of a wide range of user and OEM applications including use as a DC stimuli generator in instrumentation computers; calibration of amplifiers in process control computers; and as a precision DC source in automatic or semi-automatic checkout systems.

Noise and hum on the 1V and 10V ranges is less than 20 microvolts rms and less than 30 microvolts on the 100V range. Fast settling time brings the output within rated accuracy ± 0.01 percent of step change in less than 100 milliseconds from time of address.

Common-mode rejection is better than 120dB from DC to 400 Hz, up to 350V rms or 500V DC. Output voltage changes less than than 10^{-6} of the applied common-mode voltage. Output isolation permits either terminal to be floated up to ± 500V peak from chassis to ground.

Circle Number 54 on Reader Reply Card

Discussing the new **Fairchild** Custom Console, designed and built for KWWL, Waterloo, Iowa, are Edward M. Tink, Vice President, Engineering of the Blackhawk stations and George Alexandrovich Vice President and Chief Engineer of Fairchild Sound Equipment Corp.

The new Fairchild console will be utilized primarily as an operating console for KWWL-AM and in addition will provide certain control and monitoring capabilities for KWWL-FM's automated facilities.

Circle Number 53 on Reader Reply Card

Duplication Tape

Memorex Corporation has announced a breakthrough in color TV recordings for broadcast, educational and ultimate home use—a new low-cost high-speed process for the mass duplication of video tapes.

The Memorex duplication process is made possible by a new chromium dioxide magnetic tape which Memorex will produce and market beginning this summer.

Memorex President Lawrence L. Spitters revealed that the duplicating equipment now operating in the company's laboratories simultaneously turns out multiple duplicates at high speed for an effective production rate 10 to 15 times faster than present processes. Existing video type duplicating processes must utilize a separate expensive video tape recorder which takes one hour to duplicate a one-hour program, whereas the new Memorex process takes only minutes. The Memorex process requires no electronic circuitry to transfer between the master and an unlimited number of copies.

"The physical properties of chromium dioxide also produce copies which have twice the magnetic energy or 'brilliance' of conventional original video tapes," Spitters said.

The greater video information storage capacity of chromium di-

oxide will open the way to the development of a new generation of video equipment operating at speeds down to one-half those of present recorders. This means twice the programming per reel or a significant cost reduction per program for the user. This sharply reduced media cost coupled with the economies of the Memorex duplication process should set magnetic tape as the standard mass visual medium.

Circle Number 55 on Reader Reply Card

Wide Range Cardioid Microphone

The latest advancement in dynamic microphones, the RE20, is currently being marketed by **Electro-Voice, Inc.** This microphone is a rugged, wide-range, quality cardioid dynamic microphone. It has been designed and manufactured for use in the professional recording applications as well as broadcasting.

The RE20 has a wide uniform response curve comparable in characteristics to high quality condensers. Another important characteristic of the RE20 is its transient response. These electrical advantages are complemented by the usual ability of the dynamic microphone to "take it."

Circle Number 56 on Reader Reply Card

CATV Data Modulator

A new data modulator to provide an interface between the video output of alphanumeric generation equipment and the RF transmission capabilities of community antenna television systems has been developed by the **Catel Corporation.**

Designated the DTM-2500 "Data-Mod," the device incorporates special video filtering to allow the presentation of alphanumeric information without ringing and/or overshoot and further allows the use of character generator chrominance information. Since the Data-Mod is designed primarily for use with CATV systems, a normal aural carrier is provided, which can be modulated with a local FM/AM tuner, tape deck, or other audio source.

All solid state silicon device construction, the Data-Mod is available for standard television channels, with midband and special frequencies optional at extra cost.

Circle Number 57 on Reader Reply Card

Microwave Repeaters

A new series of all solid state Microwave Heterdodyne Repeaters (no klystron) will be shown publicly for the first time at the AFCEA Show by **RHG Electronics Laboratory, Inc.** These repeaters supplement the company's line of microwave FM-TV relay links and expand their complete line of microwave receivers, transmitters and components.

The heterodyne repeaters, Series "HR", are completely tubeless and utilize a unique double balanced parametric upconverter which permits transparent operation over the range of 2 to 8 GHz with output powers to 2.0 watts.

Meeting applicable FCC requirements, the repeaters incorporate preselection, delay equalization, and crystal stabilized oscillators. Their 70 MHz IF provides for tie in to existing systems.

Circle Number 58 on Reader Reply Card

Base Station Yagi

The **Phelps Dodge Communications Company** has developed a new 4.75 pound base station yagi antenna in the 450-470 MHz range and offering 10 dB unidirectional gain. Nominal input impedance is 50 ohms and maximum power input is 250 watts with a VSWR of 1.5:1. Bandwidth is 20 MHz.

Circle Number 59 on Reader Reply Card

UHF Translator

Rodelco, Deer Park, New York has a new all solid state UHF translator ready for the market. Offering low power drain and virtually no warm-up time, this translator is capable of 10 watts visual output at peak sync and 2 watts aural.

Other features include complete circuit metering, automatic gain control, .001 conversion accuracy, and an input level minimum to maximum range of 100 to 5,000 microvolts. Input impedance is 50 and 75 ohms unbalanced, 300 ohms balanced. Output impedance is selectable at 50 or 75 ohms.

Circle Number 60 on Reader Reply Card

TECHNICAL DATA

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

100. **AMERICAN ELECT. LABS.** — An 8-page AM/FM Broadcast Transmitter "short-form" catalog, which highlights the products of its BROADCAST TRANSMITTER DIV. is now available. The AM series includes a variety of quality transmitters with power from 250 watts to 110 Kw. Using the latest "start of the art" techniques, AEL assures the production of transmitters of highest quality. The sister line of FM transmitters begins with a 10 watt unit and includes other standard powers up to a 20 kW model (FM-20KB). In addition to AEL's transmitter line, the catalog focuses on the AEL AM/FM Automatic Transmitter Switch Model # ATS Series (to 100 kW), the Model 2203 all solid state Stereo Generator and the improved Model 2202A all solid state direct FM Exciter.

101. **AKG-NO. AMERICAN PHILIPS CORP.**—A 20-page catalog describing AKG's CMS F.E.T. condenser microphone system is now available. The brochure describes in detail phantom powering techniques for F.E.T. condenser microphones. The C-451E system permits interchanging of condenser microphone capsules of various pick-up characteristics such as cardioid, omni-directional, figure-eight and interference tube (shot gun) attachment.

102. **AMPEX CORPORATION.** —A two-color, 16-page brochure describing the full line of Ampex television transmission products is now available. It describes the company's VHF and UHF transmitters, translators, antennas and coaxial products and antenna accessories for use by commercial and educational television stations. In addition to technical descriptions and specifications of the products, the brochure gives space requirements and describes the Ampex antenna test range in Westfield, Massachusetts.

103. **BIRD ELECT. CORP.** The new 4-page Short Form Catalog SF-70 lists nearly all the coaxial load resistors, absorption wattmeters, and directional wattmeters stocked by Bird Elect. Corp. The feature product is a portable peak (and average) reading directional RF wattmeter, now equipped with a battery charger/eliminator for extended bench use at no additional charge. In addition to basic performance specifications and prices, SF-70 also describes related custom-built accessories such as coaxial filters and the new Self-cooled 10kW RF Terminating Systems introduced at the IEEE Show. A useful chart of RF letter band designations with their associated frequencies is included with a directory of regional offices and overseas representatives.

104. **BOSTON INSULATED WIRE & CABLE CO.** — A new brochure covering the company's unique capabilities in the design and manufacture of specialized wire and cable products and systems is now available. Developments described include both insulation materials and processes. Special attention is given to BIW's wide range of production facilities, including: extrusion systems, taping machines, rubber compounding, finishing and asesmbly. The braiding, shielding and armoring facility is one of the most versatile in the industry. Modern laboratory, engineering, testing, and quality control facilities are also described. The sophistication of the company's capability is indicated by examples of innovations developed to meet customer's needs.

105. **COHU ELECT. INC.**—A 6-page condensed catalog on broadcast television products is now available. This catalog (6-545) has photographs and brief specifications on nearly two dozen items—from production video switchers to color video encoders.

106. **ITT JENNINGS**—A new 20-page catalog describing its entire line of vacuum contactors is now available. The contactors are used to control DC, RF, and AC circuits at voltage levels from 0 to over 70 kilovolts. They also provide primary control of power supplies in high-power transmiters, heating equipment, and industrial controls. The contactors can be coordinated with current-limiting uses in circuits that have high fault currents. In addition, they can control furnace loads, lighting loads, and high-powered RF antenna switching. The catalog lists ITT Jennings' new 250-to-900-amp three-phase contactors. Standard operating voltages are 1500 volts; interruption ratings are 3,000 amps and 9,000 amps. Included in the catalog are several pages of application notes which describe the characteristics and testing of vacuum contactors and how best to apply them in circuits.

107. **JFD ELECTRONICS CORP./SYSTEMS DIV.**—A new 8-page catalog of hardware for equipping school districts and individual schools with complete Instructional Television Fixed Service (ITFS). 2500 MHz micro-wave systems is now available. The new catalog covers 10 watt transmitters, mini-power transmitters, micro-power transmitters, repeaters, receiving systems, down converters, distribution systems, transmitting and receiving antennas, accessories and calibration equipment. Using this ITFS equipment, a school district may originate one to four instructional TV channels and transmit them to all schools within the district.

108. **POMONA ELECTRONICS** —The 1970 general catalog of electronic test accessories is now available. The new edition is expanded to 56-pages and now contains 420 items—50 of which are new this year. Featured new products include: a new series of 3″ high shielded "Black Boxes" with card guides; a new series of shielded "Black Boxes" (now offered in four different sizes); two versions of shielded "Block Boxes" with isolated BNC connectors; new Twinax patch cords and receptacle jack; two series/parallel isolation plugs; two pin connector test adapters; new miniature (½″ spaced) pin tip plugs and jack; plus several miscellaneous banana plugs, adapters and accessories. Catalog provides complete engineering information on all items, including product photographs, dimension drawings, schematics, spe-

cifications, features, and operating ranges.

109. **PRINCETON APPLIED RESEARCH CORP.**—A new 20-page catalog includes new additions to the company's line of instrumentation for research. Signal processing instrumentation described includes lock-in amplifiers, signal correlators, signal averagers and low-noise pre-amplifiers. Other equipment included are electrochemical analysis systems, Evoked Response Systems for neurological study, and an Instrument/Computer Interface System which can interface analog or digital instruments to a remote time-shared computer via an ordinary telephone.

110. **RCA**—A new 12-page brochure and series of catalog sheets detailing the complete complement of color television equipment is now available. The brochure provides an overview of innovative color cameras priced under $10,000. Color film systems and video tape recorders are also described. Several typical TV systems for instructional and training applications are depicted.

111. **TELEMATION**—A heavily-illustrated 24-page booklet outlining progression from a single camera/VTR television facility to a multi-camera, full-color production system is now available. The purpose of the System Expansion brochure is to help CATV and ITV operators select equipment for a very small TV operation which won't become obsolete or incompatible as they expand to a larger system. Nine systems are detailed in the brochure, each "complete" in itself but capable of being incorporated into gradually more elaborate systems. In each major expansion, such as from a single-camera to multi-camera operation requiring switching, options in equipment are included to meet various budgets.

112. **TENNEY ENGINEERING, INC.**—An improved 3-cubic-foot Bench Model Temperature-Humidity Test Chamber is described in Bulletin No. 101C. This latest compact version of the popular TH Junior has extremely wide operating range capability, occupying minimal space. With temperature range from 10°F to 200°F, and humidity range from 20 percent to 95 percent, the available work space is an ample 16½" x 20" x 15¾". Relatively maintenance-free because of its simplicity, the TH Jr. employs separate solid-state SCR instrumentation to control its wet bulb and dry bulb temperatures. These instruments feature automatic reset and proportional controls, and a pyrometer with an accuracy range of 1 percent is provided for indication.

113. **TRIPLETT CORPORATION**—A comprehensive new 20-page catalog D-70 featuring standard and special panel meters that are designed for such applications as electronic instrumentation, communications equipment, industrial process control, military ground support equipment, laboratory and educational uses plus many more, is now available. The two-color Triplett catalog D-70, three hole punched for ring binder reference usage, is complete with detailed electrical and mechanical specifications and dimensional and mounting drawings. User net prices are also given for all panel meters listed. Many new instrument additions are provided in the new catalog. Some of these are: a new line of Pyrometers with thermocouples; special meters that are available with mirrored scales, special scale readings, pointers, illuminated kits, custom inserts, special accuracies; four new shallow barrel "G" type meters for space saving instrumentation requirements; new DC millivoltmeters with suspension type movement in the 3½" and 4½" "G" Series panel meters with optional half-bezel for mounting behind panel and conventional flush type mounting; Triplett's new Model 300 meter amplifier with linear scale on all AC measurements; null meters; and portable instruments for schools, labratories or shops.

114. **TROMPETER ELECTRONICS**—A new 1970 Catalog illustrating a complete line of COAX, TWINAX, TRIAX and QUADRAX Connectors, Patch Panels, Plugs, Jacks, Patch Cords and Accessories is now available. The 44-page catalog details high and low frequency COAX switches and matrices employed in TV Broadcast, CATV, CCTV, ETV Communications, Telemetry, Telephone, Nuclear Instrumentation and Information Retrieval.

(Continued on page 62)

(Continued from page 61)

115. **UNITRODE**—A new Zener Surge Selection Guide which lists all Unitrode zener types from 1 to 10 watts with their specific voltage and surge rating for each idividual type is now available. Included is a graph showing typical reverse surge power for pulse durations from 100 μsec to 10 msec for each family. The handy reference guide is especially useful when designing for surge applications.

116. **UNIVERSITY SOUND,**—A division of LTV Ling Altec. A new 1970 comprehensive PA catalog with the technical data on the latest commercial products is now available. Information on all University Sound products from Power-Line amplifiers to portable Power-page systems is included in the new catalog.

117. **UPSON TOOLS, INC.**—A new catalog No. 171 consisting of the addition of 44 new items including assortments, kits and individually carded tools is now available. The catalog also contains a list of sales representatives as well as important conversion tables applicable to the hand tool industry.

118. **VIKOA, INC.**—A new illustrated 63-page catalog featuring wire, cable and electronic products for Internal Distribution System uses and needs is now available. Complete and extensive delineation has been made regarding all types and construction of wire and cables used by the communications trades. Pictorially depicting wire and cable as well as electronic products, this IDS/MATV equipment catalog has a handy thumb-thru index as well as a complete alpha-numerical index.

119. **VISUAL ELECTRONICS**—This new brochure describes the Visual Educom 620P Portable Tape Recorder which is a professional quality, high-fidelity recorder/amplifier/speaker system. It provides the untimate in reliability and crisp audio reproduction at a cost within the reach of most institutions. The 620P consists of a magazine-type tape deck, dual channel amplifier and speaker system packaged in a compact, rugged carrying case. Storage space is provided for headset, tape magazines and other accessories.

ADVERTISERS' INDEX

Reference List Of FCC Forms

For your reference we are including the following list of FCC forms. These often used forms may be obtained from your field office or by writing directly to: Federal Communications Commission, 1919 M Street, NW., Washington, D.C. 20554.

FCC Form		Page
202	Standard Broadcast RMS and Radiation Pattern Data	98:101
301	Application for authority to construct a new broadcast station or make changes in an existing broadcast station	98:103
301-A	Request for modification broadcast station authorization (Remote Control)	98:127
302	Application for new broadcast station license	98:131
303	Application for renewal of broadcast station license	98:138a
309	Application for authority to construct or make changes in an international, experimental television, experimental facsimile, or a developmental broadcast station	98:147
310	Application for an international, experimental facsimile, or a developmental broadcast station license	98:155
311	Application for renewal of an international, experimental facsimile, or a developmental broadcast station license	98:157
313	Application for authorization in the radio broadcast services	98:159
314	Application for consent to assignment of radio broadcast station construction permit or license	98:161
315	Application for consent to transfer of control of corporation holding radio broadcast station construction permit or license	98:179
316	Application for consent to assignment of radio broadcast station construction permit or license or transfer of control of corporation holding radio broadcast station construction permit or license (Short Form)	98:197
318	Request for subsidiary communications authorization	98:199
321	Application for construction permit to replace expired permit	98:201
323	Ownership report	98:203
324	Annual financial report of networks and licensees of broadcast stations	98:209
340	Application for authority to construct or make changes in a noncommercial educational TV, FM, or standard broadcast station	98:212e
343	Application for authority to construct or make changes in a television broadcast booster station	98:213
344	Application for television broadcast booster station license	98:219
346	Application for authority to construct or make changes in a television broadcast translator station	98:221
347	Application for television broadcast translator station license	98:229
348	Application for renewal of television broadcast translator station license	98:231

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.

Equipment for Sale

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

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

Highest prices paid for good used 1KW and 10KW AM Transmitters. FM Transmitters also. Geleco Electronics Ltd., 2 Thorncliffe Park Drive, Unit 28, Toronto 17, Ontario, Canada. Phone: 416/421-5631. 3-70-tf

FOR SALE
RADIO STATION—5,000 watts. Absentee owned. $175,000. Terms. KHIL, Willcox, Arizona. 4-70-5t

RCA AVQ-10 Weather Radar system complete with Raydome. Heater, 400 cycle power supply VJ-B monitors, cabling and spare parts—excellent condition. Broadcast Engineering, Dept. 240, 1014 Wyandotte Street, Kansas City, Missouri 64105. 6-70-2t

SURPLUS 2 INCH VIDEO TAPE. Over 200 full hour reels available in good usable condition. Mostly 3M type 379, master tapes, few splices, low dropout count. Priced "as is" F.O.B., N.J., 1-5 hours $50/hour, 6-10 hours $35/hour, 11 or more hours $25/hour. COMQUIP, P.O. Box 12, Ridgewood, N.J. 07451 (201) 444-0196. 6-70-2t

Gates 10 watt FM transmitter model BFE-10C, 91.1 MHz. Includes complete set extra tubes. Gates FM-22 (2-bay) antenna. Total package, perfect condition, 1-yr. old, sacrificed, $1000 FOB. WGGL-FM Michigan Technological University, Houghton, Michigan 49931. Area Code 906/487-2617. 7-70-2t

RCA TK-30 and TK-31 image orthicon cameras: RCA TR-2 and TR-5 videotape recorders plus many incidentals. Television Facilities, Inc., Box 396, Montgomeryville, Pa. 18936. Tel. 215-855-0970. 7-70-tf

3-RCA COLOR CAMERAS TK-41C. Updated to NBC Specs., includes "paint pots". 50' camera cables, lenses, dollies, lenses, dollies, tilt heads, and Orthicons. All 3 for $43,500. COMQUIP, Box 12, Ridgewood, N.J. 07451 (201) 444-0196 7-70-2t

RCA TK60 field chain, ready for studio or remote. Includes sync gen, tripod, waveform monitor, video monitor, and cabinet. Also TK30's, TK31's, MTI ORTH I's, and MTI solid state monitors. Heflin Electronics, Box 53B, Schwenksville, Pa. 19473. 7-70-1t

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

CIRCUIT/PRODUCT DESIGN ENGINEERS

The engineers we seek will include their talents in Video. Audio and Computer related circuitry designing products for the Television Broadcasting Equipment market. Send resume to the personnel manager, Vital Industries, Inc., 3614 S. W. Archer Road, Gainesville, Florida 32601.

Technical Services

Metropolitan NYC and surrounding states. BSEE provides sales and technical services for out of town firms. Flexible working arrangements. Broadcast Engineering, Dept. 238, 1014 Wyandotte St., Kansas City, Mo. 64105. 7-70-3t

Position Wanted

First Class Radio Telephone Licensee desires job as Transmitter Technician, preferably in the south east, but will consider other locations. Available after 15 October. Contact TSgt Duane L. Mitchell, 105 North Boundary Ave., Proctor, Mn. 55810. Phone 218-624-9138. 6-70-2t

Services

CUSTOM CARTRIDGE RELOADING, and refurbishing. Fidelipac replacement parts and cartridges. Write us today for prices. PROFESSIONAL AUDIO SERVICES, BOX 1953, FORT WORTH, TEXAS 76101. 6-70-6t

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

IMMEDIATE OPENINGS: Qualify for any of the following positions: RCA CCTV Equipment, monochrome or color. Salesmen — TV Systems Engineers — Project Engineers — Supervisors — Managers — Maintenance Technicians — Video Engineers — to work either New York, Pennsylvania, New Jersey or California area. Write: RCA Rep., P. O Box 268, New Hyde Park, New York 11040. 4-70-tf

FCC 1st PHONE LICENSE 6-Week Course Results Guaranteed. Institute of Broadcast Arts, Sharon Broadcast Training, Inc. WPIC, 2030 Pine Hollow Blvd. Sharon, Pa. (near Youngstown, Ohio). 7-70-1t

Wanted

WANTED: Used Allen Mod/Demod Model 1114 for VR1000—Ken Blue—Sacramento State College Television, 6000 Jay Street, Sacramento, California 95819. 7-70-1t

GET COMPLETE DETAILS

about the products advertised or described in this issue.

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The time is tomorrow. The name is TEAC. The machines are the Simul-trak™ Series TCA-40. And they're here today.

This series of tape decks combines the best features of high-quality quarter-track, two-channel operation with four-channel stereo capability. It's the best of two worlds, in three versions, four channels.

All three models feature four-channel playback, as well as regular two-channel playback with auto reverse. What's more, Models 40 and 41 can be modified later to the full four-channel capability of Model 42, at moderate cost. Meanwhile, any one of these machines is compatible with your present equipment; no modifications or reassembly are necessary.

So what are you waiting for?

Simul-trak™ surrounds you with sound – and gives you a headstart on tomorrow.

TEAC

TEAC Corporation of America • 2000 Colorado Ave. • Santa Monica, Calif. 90404

General Specifications

- Speeds – 7½ and 3¾ ips
- Motors – 1 hyst. sync., 2 outer rotors
- Wow and Flutter – 0.12% @ 7½ ips
- Freq. Response – ±3 dB 50-15,000 Hz @ 7½ ips
- S/N Ratio – 50 dB
- Crosstalk – 48 dB

TCA-40

• ¼-track, 2-channel stereo playback, plus 4-channel stereo playback (in-line) • ¼-track, 2-channel erase and record heads for future "step-up • Automatic reverse for uninterrupted playback of conventional 2-channel tapes • Readily modified to TCA-41 or 42 • Built-in solid-state preamplifiers • Ideal for duplication master or copy deck

TCA-41 *(Illustrated)*

• ¼-track, 2-channel stereo playback, plus 4-channel stereo playback (in-line) • ¼-track, 2-channel record • Automatic reverse for uninterrupted playback of 2-channel tapes • Readily modified to future 4-channel recording capability, or TCA-42 • Solid-state playback and record preamplifiers • Off-the-tape monitoring selector

TCA-42

• ¼-track, 2-channel stereo playback, plus 4-channel stereo playback (in-line) • ¼-track 2-channel stereo record and 4-channel stereo record (in-line) • Automatic reverse for uninterrupted playback of 2-channel tapes • Total of 8 separate solid-state playback and record preamplifiers • Off-the-tape monitor selectors

HIGH FIDELITY

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At WMOC Chattanooga, after 6:00PM the loudest off-the-air sound is the slop of the mop!

But On The Air . . . Wow!

At WMOC, they lock the doors and turn out the lights each evening at 6 PM. Yet the live modern Country-Western sound floods Chattanooga and the surrounding area all through the night. The secret? Creative programming and a remarkable Schafer Automation System.

This amazing 24 hour-a-day AM station, featuring around-the-clock programming of 7 of the area's top modern Country-Western disc jockeys, is a solid second in ratings for adults in the metro area—out of a tough field of eight. And it runs completely unattended from 6 PM until 6 AM—365 days a year!

Popular? You bet! Profitable? Wow! WMOC has a total full time staff of only 5 people; including the manager (who doesn't announce or cut spots), a copy writer, a secretary and a full time saleslady.

Plus, of course, the remarkable Schafer Broadcast Automation System.

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