

NOVEMBER, 1971/75 cents

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the technical journal of the broadcast-communications industry

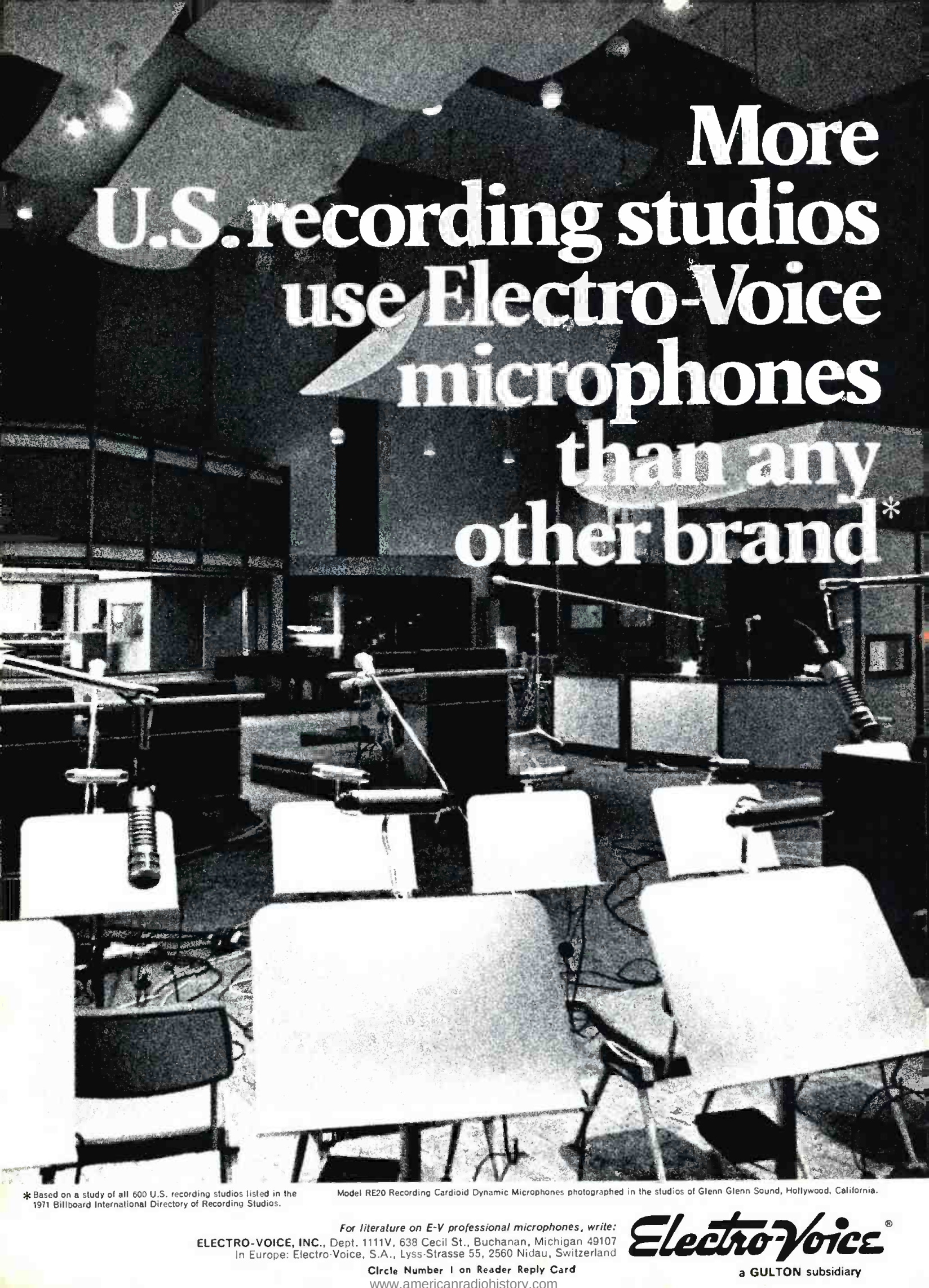


A HOWARD W. SAMS PUBLICATION



**Multiply, Mix, and
Modulate with IC's** page 28

**Originating With Film
Digital Logic Basics
TV Titling Shortcut**



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Broadcast Engineering

The technical journal of the broadcast-communications industry

in this issue...

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-
- 28 Multiplying, Mixing, and Modulating With IC's.** BE's Solid State Editor kicks off a two-part series that will look at the IC balanced modulator and trace its development as a multiplier. **Walt Jung.**
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ABOUT THE COVER

This month's cover was supplied by RCA and shows Walt Jung in the CR at Maryland ETV. His IC article on the balanced modulator-demodulator begins on page 28.

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Tokyo, Japan
INTERNATIONAL MEDIA
REPRESENTATIVES, LTD.
1, Shiba-Kotohiracho, Minato-ku
Tele: 502-0656



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

BROADCAST ENGINEERING is mailed free to qualified persons engaged in commercial and educational radio and television broadcasting. Non-qualified subscriptions in the U.S. are \$6.00 one year, \$10.00 two years, \$13.00 three years. Outside the USA add \$1.00 per year to cover postage. Single copy rate 75 cents. Back issue rate \$1.00. Adjustments necessitated by subscription termination at single copy rate.

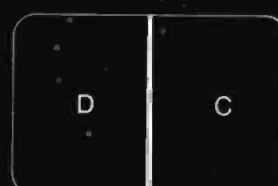
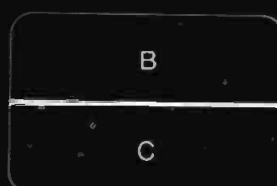
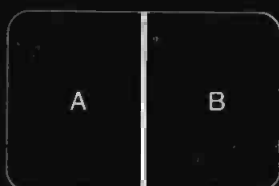
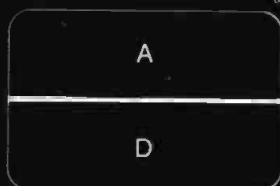
Controlled Circulation postage paid at Indianapolis, Indiana.



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DIRECT CURRENT FROM D. C.

November, 1971

By Howard T. Head

Satellite-To-Home Broadcasting Planned for Rocky Mountain Area

A group of federal agencies, in cooperation with state governmental groups in the Rocky Mountain states and Alaska, have announced plans for a demonstration which would include actual satellite-to-home television broadcasting. The demonstrations would employ the ATS-F satellite, now scheduled for launch in May, 1973. In addition to conducting several other experiments, the ATS-F is eventually intended to be parked in a stationary orbit to provide TV transmissions to India using community receiving stations.

The U.S. transmissions will be in the ITFS band between 2500 and 2690 MHz. Transmission will be broadband (20 MHz) FM, with power levels comparable to those employed for microwave relaying in this region. Educational programming is contemplated.

With these transmitting parameters, high-gain receiving antennas with sensitive receivers and converters are an obvious necessity, and such installations are planned for 500 locations in the test area. In announcing the planned tests, it was suggested that individual receivers could be so equipped for something less than \$200 each, an optimistic prediction if there ever was one.

EBS Does It Again

We noted in D.C. for August of this year that no "random" EBS messages had been transmitted since the NORAD incident of February 20, 1971, when a tape of an actual emergency alert was transmitted to the public instead of the customary test message. Investigations of the February incident are continuing and the repercussions have not completely died away.

On September 14, a random EBS closed-circuit test was scheduled but never took place. The test started and ended in confusion, with the result that there were no transmissions on any of the network lines. Several of the networks actually pre-empted commercial time to keep the lines available for the test message, but the result was nothing but "dead air".

This latest episode simply adds to the uncertainty over the future of the EBS. The Office of Civil Defense (OCD) meanwhile continues with plans for an alerting system at low radio frequencies, while the Commission's staff continues to push for action on a two audio tone system on broadcast carriers.

(Continued on page 6)

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TV Coding Schemes Still in Difficulty

International Digisonics Corporation (IDC) continues to experience difficulties with the Commission's Rules adopted last year which provide for visual identification codes in the corners of television pictures (See October, 1970 D.C.). The present rule, which was adopted in response to IDC's original proposal, requires that the code be confined to the first and last ten microseconds of the first three and last three active lines in the coded TV field. Almost universally, however, the codes have been applied to motion picture film, and neither film processing laboratories nor station telecine rooms have been able to come even close to meeting the requirements.

The Commission has now, in response to a further Digisonics plea, invited comments on a proposal which would permit the use of six field lines each at the top and bottom of the picture plus an additional three lines (total of 15) at either the top or the bottom as a tolerance. In the meantime, on a temporary basis, the Commission is permitting the use of the six lines at both the top and the bottom but without the tolerance. Furthermore, in granting this temporary relaxation, the Commission has announced that it is establishing monitoring facilities and will take steps to enforce the interim requirements.

Meanwhile, the Commission is reviewing test data filed by proponents of monitoring systems which rely on coded material in the aural rather than the visual channel. Not only do these systems have no potential for degradation of the television picture, but they may also be employed for encoding radio as well as TV transmissions.

Spectrum Commissioner Considers UHF Taboo Study

FCC Spectrum Management Commissioner Houser has released a report prepared by his staff recommending a thorough-going review of the system of mileage separation "taboos" which govern the assignment of UHF television broadcast channels. Noting that the present requirements have remained unchanged since their adoption in 1952, and speculating that present-day TV receivers may differ in performance from that assumed 19 years ago, the report concludes that the time has come to restudy the problem.

A two-pronged approach is recommended on an urgent basis. Actual measurements of receiver performance would be made, while simultaneous computer analyses would study the prospects of increased channel loading on the assumption that the receiver measurements would indicate the permissibility of reduced mileage separations. If receiver performance should prove deficient, improvement might be sought either through present Commission Rules or new legislation.

The Commission already has plans for making studies of this sort, but on a modest basis. The substantial funds which would have been required for a large-scale study were requested by the Commission for the current fiscal year's budget, but were deleted by the Office of Management and Budget (OMB) as an economy measure.

And the purpose of all of this activity? To free more UHF TV spectrum to be turned over to land mobile operation, the desirability of which the report swallows without question.

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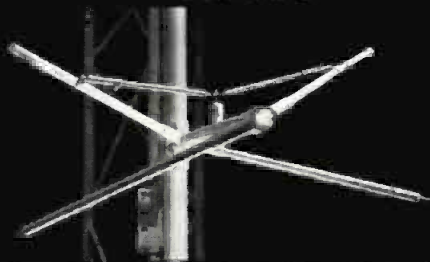
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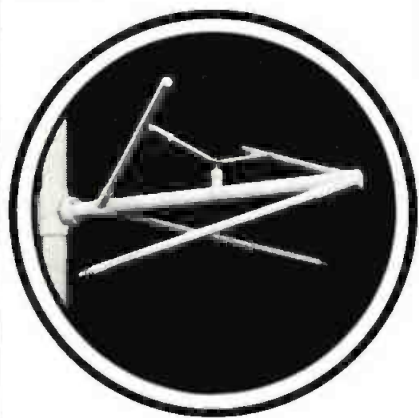


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LETTERS TO THE EDITOR

Finnegan's Rainbow

Dear Editor:

The letter by Mr. Harold L. Thompson in September **BE** criticizing Mr. Finnegan's treatment of diode transient suppressors is, I believe, in error where Mr. Thompson attributes the transient suppression to the "Zener breakdown characteristics of the diode".

From the standpoint of the diode, the polarity of the back-EMF generated in the relay coil is opposite to that which the diode "sees" from the supply voltage source. Therefore, the diode is forward biased for transient currents, effectively putting a "short" across the relay coil during the transient.

The circuit can be understood if it is remembered that upon interrupting the current through the relay, the collapsing magnetic field will generate a back-voltage. This back-EMF acts in series with the relay coil and is of such a nature that it will try to sustain the current through the relay in the **same direction** it was going before it was so rudely interrupted by the opening of a switch.

John Carlini
Liberty, N.Y.

Positive Modulation

Dear Editor:

With all this talk about positive modulation limits for AM I would suggest that straight AM is old fashioned.

Compatible single sideband offers normal modulation peaks of 200 percent both positive and negative in comparison to today's double sideband operation.

This approach is not new, the telephone company has been using a form of CSSB since the mid 30's.

KDKA has conducted well documented tests with CSSB; however, they discontinued use of this modulation mainly because the equipment at that time was not as stable

as is possible today.

In addition to 6 dB more modulation (four times as much power in the upper sideband), CSSB would drastically reduce or eliminate adjacent channel interference.

Maybe the day is nearer than we think when routine maintenance will include the nulling of the lower side band.

Crail W. Floyd, CE
WEDA
Grove City, Pa.

LP Info Is Needed

Dear Editor:

Recently I discovered upon removing several prized production LP's from their jackets that they were warped so badly that the outer cuts could not be used. This damage obviously resulted from improper storage. Shame upon me!

Anyway, perhaps a fellow reader has some advice on how the discs can be "straightened out" so that they are again playable. Of course, storing correctly (any information on this would be helpful, too) would have prevented the problem, but for now I need a solution. Help!

R. Dennis Alexander
Radex Productions
Greencastle, Pa.

Perspective Is Essential

Dear Editor:

For some months now I have been attentively reading the many comments in your Letters to the Editor column on the First Class operator discussion. I must say many of the pro's and con's toward lessening of the operator license requirements for standard broadcast directional stations are very interesting and thought provoking.

It came to mind that many of the

(Continued on page 10)

Television transmitter users tell it better than we can.

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Gene Napier
Chief Engineer
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William B. Nielsen
Executive Vice President
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KUAM-TV, Agana, Guam

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Weldon B. Paulsen
Chief Engineer
KPAX-TV, Missoula, Montana

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Engineering Committee Set

NAB Convention Planning Underway

Vincent T. Wasilewski, president of the National Association of Broadcasters, has announced the appointment of ten broadcast engineers to the Association's 1972 Engineering Conference Committee.

The annual conference will be held in conjunction with NAB's annual convention in Chicago, April 9-12.

Committee chairman will be Ralph F. Batt, vice president and manager of engineering, WGN, Continental Broadcasting Co., Chicago.

Serving with Mr. Batt will be Ernest L. Adams, vice president for engineering, Cox Broadcasting Corp., Atlanta, Ga.; Eugene A.

Chase, chief engineer WKJG, Ft. Wayne, Ind.; William B. Honeycutt, director of engineering, KDGW Television, Dallas, Tex.; Andrew M. Jackson, director of engineering, LIN Broadcasting Corp., Louisville, Ky.; Leslie S. Learned, vice president for engineering, MBS, New York; James D. Parker, staff consultant, telecommunications, CBS Television Network, New York; Royce LaVerne Pointer, director, broadcast engineering, ABC, New York; Russell B. Pope, director of engineering, Golden Empire Broadcasting Co., Chico, Calif., and William H. Trevarthen, vice president, operations and engineering, NBC, New York.

Commission Clarifies Tower Painting Rules

There appears to be a misunderstanding on the part of some licensees and tower erection and maintenance firms with respect to the manner of painting antenna structures.

Section 17.23 of the Rules requires that antenna structures which come within the painting and lighting requirements of Section 17.21 (b) shall be painted alternate bands of aviation surface orange and white with orange bands at both top and bottom of the structure; and that the bands be equal in width and approximately one-seventh the height of the structure. It provides further that the bands shall not be more than 100 feet nor less than 1½ feet in width.

The meaning of the above rule is that antenna structures up to and including 700 feet in overall height above ground should be painted with seven equal width bands, the width of each band to equal approx-

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imately one-seventh the height of the structure. Structures greater than 700 feet will require additional alternate orange and white bands in the ratio of two paint bands for each additional 200 feet, or fraction, of structure. A structure 1223 feet above ground level, for example, would require 13 bands whereas a structure 1323 feet high would require 15 bands. In all cases, international orange bands shall be applied at top and bottom of the structure.

Licensees are given until their structure(s) next requires painting to comply with Section 17.23 but in no event later than November 1, 1977.

FCC Examines Digital Modulation In Microwave

A study of the use of digital modulation techniques in microwave radio operations, and the desirability of imposing restrictions on their use has been initiated by the Commission in a Notice of Inquiry.

The Commission said that equipment manufacturers, data systems operators, carriers and others have shown a strong interest in relaying business information by digital modulation systems such as pulse code modulation (PCM), and indicate that the demand for such operations will increase greatly in the next ten years.

Proponents of digital transmission said that the systems are capable of carrying encoded speech, telephone signalling, telegraphy, digital data, encoded video or visual information, or any mixture of these forms, with negligible inter-circuit interference.

The Commission noted that present PCM systems, when used for voice transmission, seem "extravagant" in their use of radio spectrum space and that some authorities believe that pulsed systems will cause destructive interference to the frequency division multiplex (FDM) systems now used in private and common carrier microwave operations. The public interest, the Commission concluded, requires the consideration of rules to govern digital modulation use by microwave common carriers.

Interested persons were invited to comment on the technical restraints that should be imposed on proposals for using digital modulation in microwave systems. Parties were also asked to comment on related questions, including the expected technical impact of digital systems on conventional FM operations; the technical limitations needed; whether digital transmission should be authorized in all microwave bands, limited to 11 or 12 GHz bands or relegated to bands above

13 GHz; if a minimum required voice channel should be established for digital systems and what it should be; if phase shift keying is proposed, whether there should be a lower limit on the number of phases used; if regeneration of the bit stream should be required at every relay or every "n" relay; if digital operations should be confined to certain locales or certain radio services; if digital voice carriage should be prohibited and transmission limited to digital

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data; and how the bandwidth needed for microwave systems using digital transmissions should be determined considering the various keying methods used.

For The Latest News
Read Direct Current
Page 4

FCC Explains Freeze

In response to a number of questions from the communications industries, the FCC has issued the third in a series of releases providing refinement of rulings by the Cost of Living Council.

Prepared by the Policy Review Division of the Cost of Living Council, the release is made up of eight questions and answers applying directly to TV and Radio advertising rate practices and covers rate increases made prior to the wage and price freeze, applicable rates when programs are changed, seasonal pricing, new rate cards adopted because of major changes in facilities, rate protection, change of basis for sale of program, advanced agreements, and seasonality. The text of the release is presented here.

Persons with questions on the freeze as it applies to communications may call 202-632-7052 or 202-632-7030. Commission staff will handle inquiries when appropriate replies are apparent, based upon Cost of Living Council rulings. Matters of policy or complex questions will be referred to the Cost of Living Council for reply.

TV-Radio

Questions and Answers

1. **Q.** If a rate increase has been effectuated prior to the freeze in a substantial number of transactions, but some advertisers had rate protection or were on a long-term contract extending into the freeze period, can the latter be charged the higher rates when their rate protection or long-term contracts expire?

A. The price ceiling is based on the prices at which the services were delivered to customers during the base period, and if the ceiling is higher than the price under the expiring long-term contract, it is permissible to charge the higher rate after the contract expires.

2. **Q.** What rates are applicable in

cases where a station sells by program and time slots, and changes its programming? For instance, a station was selling a one-half hour local program at a specific price. Now he plans to change the local program to a different time and substitute a syndicated program for which it would ordinarily charge a higher rate.

A. Ceiling prices for television and radio advertising charges may be determined on the basis of (a) the rates charged for the same program shown during the base period, or (b) the rates charged for the same time segment (day and time) during the base period. However, each seller must calculate the ceiling price for all his programs on the same basis.

3. **Q.** How does the seasonal pricing exception apply for stations which have been on the air for less than three years?

A. New establishments or activities may determine their qualification from that generally prevailing for similar establishments or activities in the immediate area.

4. **Q.** How does the price freeze affect the station which has made a major change in facilities and adopted a new rate card consistent therewith. For example, a typical case is a TV station which has purchased a new transmitter and installed a new antenna atop a higher tower, and has advertised a new price effective sometime during the freeze at the commencement of its increased and better coverage.

A. If the service qualifies as a "new service" pricing is based on the following guidelines:

A product or service is new if it is substantially different from other products or services in purpose, function, or technology, or if its use results in a substantially different outcome.

A product or service that differs

slightly from other products and services in appearance, arrangement, or combination is not considered to be "new." Changes that are solely a matter of fashion, style, form, or packaging, do not qualify a product as "new." A slight functional modification to an existing product or service does not make it "new". What is normally referred to as a "new model" is not necessarily a "new product."

The ceiling price of a new product or service is determined by the seller applying the percentage mark-up he received during the base period on the most nearly similar product or service to the direct unit or net invoice cost of the new product or service.

The ceiling price of a product or service that is new to the seller, but not to the market, is the price realized on the same or comparable product or service by the most nearly comparable competitor during the base period.

5. Rate Protection: (Example) A new rate card, with a general rate increase, was announced by a station on July 1, 1971, and the new rate card became effective for all clients who did not have continuing schedules on that date. Substantial transactions were made under this new rate card between July 1, 1971, and August 4, 1971. In accordance with past practice, the station offered 90-day protection at old rates to both local and national accounts with certain minimum continuing uninterrupted purchases, with such old rate protection to expire on October 1, 1971, when the new rate card would automatically apply to those protected accounts. For those accounts who did not have continuing schedules and who were, thus, unprotected, the new rates applied at once.

Q. May the station, on October 1, 1971, extend the rate increase of the new card to those clients who have rate protection under the station policy, even though that date falls within the 90-day freeze period?

A. See Question 1.

6. Change of Basis For Sale of Program: (Example) A station pro-

(Continued on page 59)



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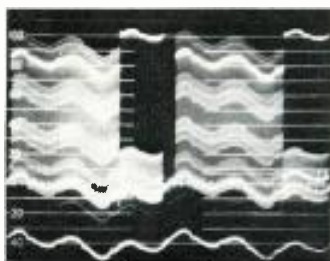


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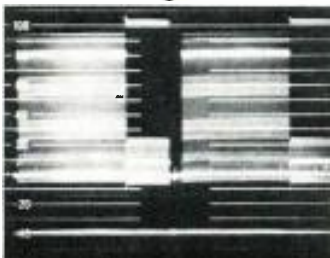
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Circle Number 17 on Reader Reply Card

CATV SCOPE

By Leo G. Sands

Don't Run For The Hills

One of the last issues of Look Magazine (September 7) carried an article about CATV in which the author, John Kronenberger, opened up the subject as follows: "If any of you, seeing the Fall TV schedules, feels compelled to head for the hills and stay there until after the 1984 Super Bowl—don't".

In the article he quoted Irving Kahn, chairman of TelePrompter, as having said in part "Five years from now, we'll be getting less than 25 percent of our cable revenue from the services we're providing today". He also quoted H. J. Schlafly, TelePrompter president, as saying about hard copy transmission over CATV, "I'll be embarrassed if we don't have a small market test before the end of the year and a permanent system in use by the end of the year".

Kronenberg concluded his timely article with: "A year or two, a decade or two—the cable age is probably upon us. Television to date, viewed in retrospect, may appear to have been pretty small potatoes".

A technical bulletin put out by one of the leading makers of CATV equipment states the following in its introduction: "In recent years there has been considerable discussion and written material on bi-directional CATV systems. Most of this effort, however, has been directed toward the public, FCC, Congress, stockbrokers, etc., which probably accounts for the orientation of these articles. The exotic uses of the 'Cable' have been stressed, but the technology required for these futuristic systems, the problems in designing practical systems, and the economic feasibility of a glamorous system have been ignored by most. Why bother

to confuse the public with facts?" The introduction went on to state: "The problem is that many CATV system operators and town councils are also victims of the deluge of PR-oriented information on bi-directional services".

The bulletin contains much valuable factual material on how this particular company has solved some of the problems. However, your CATV editor does not agree that all or even most of the information published about bi-directional CATV was promulgated for public relations purposes. A top Bell System official said a few years ago in effect that "the truly revolutionary possibility in mass communications lies in the full utilization of the capabilities of coaxial cable". He made the statement to "engineers", not the public.

Also, a few years ago, W. Walter Watts, retired senior executive vice president of RCA and a pioneer in broadcasting, told your CATV editor that he foresees in the near future the use of CATV for voting without leaving home and for receiving mail and newspapers.

Tried And True

Bi-directional transmission over a single hard-wire medium is not new. The telephone companies have been doing it since telephones have been in use. For more than 40 years, the telephone companies have been "multiplexing" wire pairs to enable transmission of several bi-directional telephone conversations simultaneously. Of course, it's much simpler to transmit voice channels on a multiplexed basis than it is to transmit television signals. But, the principles are the same.

Bi-directional transmission over a single coaxial cable is also not

new. Back in 1961, Harold Gruen, who was then with Philco and who is now president of i.i. Communications, designed a bi-directional coaxial cable amplifier which could be used in systems transmitting either or both telephone channels and television.

Your CATV editor must assume some of the responsibility for publicizing bi-directional CATV before the required hardware had been developed. The articles he wrote on this subject were not PR-motivated. Their intent was to stimulate the CATV industry into developing the required hardware and at the same time to help create a demand for bi-directional CATV. The industry would stand still in technology were it not for new challenges.

Canada Moves Ahead

Bi-directional CATV is no longer something that has to be put off into the future because of the lack of the required hardware. In fact, the lack of off-the-shelf hardware did not deter a Canadian CATV system operator from providing bi-directional CATV facilities several years ago. In this particular system, reverse-direction transmission is used for conveying remote pickup programs to the head end for forward-direction transmission to the subscribers.

There are two practical approaches at the present time to implementation of two-way cable transmission. One way is to use a single cable for transmission in both directions. The other way is to use separate cables, one for each direction of transmission. From the standpoint of engineering problems, the two-cable approach is simplest and perhaps best. But it is more expensive than using a single cable.

To convert an existing unidirectional CATV system for two-way transmission, retrofit kits are available. By using these kits, a second trunk cable does not have to be added. The kits offered by one manufacturer are used with existing line amplifiers and enable transmission in the reverse direction within the 6-32 MHz range of three color TV channels and several digital channels and continued transmission in the forward direction of TV channels and FM band signals to the subscribers. The

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Film In Local Origination

Part 4 of a series

By John G. Spence, Eastman Kodak

"With a small staff, a minimal investment in a camera that takes 35mm slides, and the part-time help of area high school students, we have proved that a cable television system can make a profit from local origination."

The man speaking is Robert W. Davison, general manager of Cablevision of Hendersonville, N.C., Inc. He continues:

"After six months of trial-and-error experimentation with sophisticated production techniques, we decided to simplify . . . to do what we can do best. In brief, we decided to offer local origination to subscribers as a source of material not available on other outlets. And it's worked."

In its effort to streamline operations, Cablevision first selected a local high school student (a senior with some experience in radio) as a control room trainee. After only three days, this student was able to handle live programming with virtually no errors. Then, as the experiment proved successful, the management hired two more teenagers as cameramen, gradually ex-

panding to the current complement of five part-time high school students in various phases of Cablevision's program origination.

Except for professionally produced materials, such as national automobile spots, most all of the commercials are created on slides shot by Cablevision's own photographer. The system sells these commercials in four programming segments:

- 1) Spots for the automated weather station.
- 2) Ads for special program sponsorships.
- 3) Spots for sponsors of regular programs.
- 4) Commercials for run-of-schedule (ROS) use.

Davison continues: "The weather station became a revenue source about the time that we reevaluated our programming and decided to streamline. Our weather unit was already equipped with a Kodak Carousel 650 projector, with an 80-slide capacity. We developed a method to add a cartridge-loading continuous-loop playback unit. It could be triggered by a mechanical

switch operating on the side of the projector, and closed by 'bumper' discs on the tray.

"A commercial spot package for the weather station now consists of four slides shot at the sponsor's store, plus an audio track. The price of the package is \$30 a month for continuous showing.

"Thus, 30-second commercial is broadcast at the end of each full sweep of the weather dials. With a full tray of 20 sponsors, each spot would be shown in rotation about every 39 minutes—with a potential monthly income of \$600. Our best month to date netted almost that amount."

Cablevision is a good example of the value of the building-block approach in the film system. As Davison describes it: "Color slides are the least expensive item in the production of a commercial. The reasons: A 20-exposure roll of Ektachrome-X film, bought in quantity and processed through a local camera shop, costs less than \$5 . . . or about 25 cents a slide. In addition, all slides are added to our in-station file and become a source of ad reruns and visuals for news shows."

Looking Ahead

The CATV management has learned that color slides are useful in other areas, too. For example, although Cablevision is now programming in black-and-white, a switch to color would be relatively simple, and plans are underway to make the conversion. Thus, reference sources, such as the color slide file, must be built for that eventuality. The CATV system also uses color slides for public relations efforts and for illustrations in talks before local civic groups.

"Slides are produced on a detailed shooting schedule," says Davison. "Photography is done after school hours and on weekends. We also shoot our own station IDs, as well as creative slides for special promotions."

Cablevision of Hendersonville, it turns out, is not solely tied to slides. Another profitable special centered on the use of football coaches' films from area high schools. The football programming ran from 1:30 to 7:00 p.m. on Saturdays during the season, and it was sold in three segments:

Film Behind The Scenes In CATV

There are, literally, dozens of other behind-the-scenes stories that could be told:

There's the CATV system in the Northwest that originates at least four hours of programming daily, including a newscast and local sports specials. Sixteen millimeter and super 8 film projectors have been incorporated into the film chain, along with a Kodak Ektagraphic slide projector. The manager is convinced of the need to move into full-color programming as quickly as possible, and he feels that film offers the best all-around choice for his CATV operation.

Another small cable system in California has done such a good

job of programming local events that it regularly attracts 30 to 40 percent of the daytime audience in the community. As a result, the system has been able to sell many local commercials. A problem arose when local advertisers found they were competing with black-and-white spots made on location against the sophisticated color ads seen on commercial TV.

The CATV manager solved the problem with color film shooting on location—even though he had access to a color videotape van for special events. Film has proved itself for day-in, day-out production at reasonable costs.

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Company Name _____

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Telephone _____

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From 1:30 to 4:00 p.m., Cablevision scheduled a scoreboard show that consisted primarily of college conference team cards, with scores posted as they came over the radio news. A card was on the screen for one minute, and then a 30-second slide commercial was aired.

From 4 until 6 p.m., Cablevision programmed 10 minutes of scoreboard cards, and five minutes of live comments.

In the last segment, from 6 to 7 p.m., the system ran the high school coaches' film. In this, the management successfully utilized the talents of high school students to photograph the contests and gather game notes.

"Often, we asked a boy to add his own comments during the show," recounts Davison, "and we were able to use live commentary by the coaches in the studio."

Slides, Film, Tape

Another successful student-made program was "Sights and Sounds of the '60s." For this, Cablevision put together ten 30-minute segments, using films, slides, and videotaped interviews on major topics that had produced the leading news stories of the last decade. Between 500 and 600 slides were shot by the station photographer, who also produced several hundred feet of 16mm film.

Cablevision broadcast this special every night for a week, with complete sponsorship. Advertising income from this single effort totalled \$2400.

Davison sums up: "Just how elaborate we can become in the future with our local program origination depends on the growth of our cable service, which now reaches 500 subscribers with a 27-channel system. I predict, however, that our programming will continue to offer our viewers something they cannot find on any other channel. We feel that this is the key to producing advertising revenue—and a unique role for CATV in our community."

Color Origination Using Film

The CATV technicians produced and edited 16mm color film under the guidance of Kodak experts. What led to the decision to participate in the workshop?

According to John Monroe, regional vice president of CableCom-General, Inc., "We all recognize the importance of being able to originate color from our studio and on location for local news, other programming and commercials.

"Because of the comparatively high cost and creative inflexibility of producing color tape on location (the three cable systems share a mobile color van), we decided to experiment with film."

For the workshop, which consisted of two four-hour sessions, the CATV crews were divided into teams to create and produce a color film commercial. Later, the processed film was edited by the production teams, who then narrated sound onto magnetically striped film. Finally, the completed commercials were evaluated by the workshop.

As a result of the sessions, CableCom-General of Santa Rosa is now producing color film commercials, and is planning a daily news program on color film, according to John Cardenas, the station's production manager. Similar experiments are planned by the other two outlets as well, and all three systems plan to make use of the free consultation services provided by Kodak to all professional users of the company's films in the Northern California area.

Hopscotching back across the nation, we can take a look at the innovative, sophisticated—and profitable—film use by South Florida Closed Circuit, Inc.

The cable system provides 24-hour services on two channels (8 and 9) to some 34,000 subscribers living on or visiting Miami Beach.

"We are a very unusual cable television system because we never broadcast anyone else's signal," explains General Manager Glenn Boundy, Jr. "Since our first day on the air in 1966, we have sold our service by originating our own programs and commercials. And our unique target audience is willing to pay for this specialty.

"As a result, we quickly found that sponsors were also willing to pay for access to our unusual group of subscribers."

The TV system, a division of Wometco Enterprises, uses 38 miles of cable in a nine-mile-square area

to carry its programming to subscribers who are, for the most part, affluent and recreation-oriented.

Approximately half of SFCC's installations are in Miami Beach's skyscraper hotels. Thus, Channel 9's programming is aimed at convention-goers and tourists. Its coverage includes extensive financial news, plus a great deal of original film and tape produced at on-going conventions.

Channel 8, on the other hand, directs its programs at residents of Miami's expensive high-rise apartment buildings. Many, if not most, of the subscribers are retired—and affluent—with a good deal of leisure time.

Special Programming

"We cover the local sports scene, which appeals to this audience," explains Boundy. "Our emphasis is on horse and dog racing and jai alai. We also take our camera into subscribers' buildings for a one-hour show called 'On the Go,' where we film the activities in which they themselves participate. And while we no longer try to compete with local commercial stations for news coverage, we do cater to our subscribers' special interests."

For example, Boundy cites a popular series of film reports based on interviews with the captains of charter fishing boats. The cable system often sends a 16mm film crew to meet a returning boat, document the day's catch, and interview participants, paying particular attention to anyone who identifies himself as a subscriber.

Both national and local advertisers look at the SFCC system as a way to reach a recreation and sports-oriented market with the money to satisfy many of its desires. At the outset, Boundy foresaw that airlines, sports clothing stores, cosmetic suppliers, and recreation promoters could zero in on this audience. He also realized that ads would have to be customized for these special viewers.

"As a result," he says, "we produce about 80 percent of the commercials, mostly on 16mm film, that we cablecast for advertisers. In addition, we customize almost all of the prepared commercials by editing and changing narration.

"This has proved to be a profitable venture. And it has also en-

hanced our ability to sell commercial time because the ads generally pull measurable results. Then, too, once we had developed our production capability, we discovered that there was a ready-made market among our advertisers for industrial filmmaking services."

The SFCC studio is equipped with full-size broadcast quality cameras and control boards, film chains, and a magnetic tape system. Most film production is done with a lightweight Auricon camera equipped to record single-system sound on film. The crew generally works with either Kodak Plus-X reversal film 7276, which is pre-stripped for precording magnetic sound on film, or prestriped Kodak Tri-X reversal film 7278, when the action is faster or light levels are lower.

"It's really a simple decision to make," says Mr. Boundy. "If we want to do an interview at a fishing pier on a bright, sunny day, we generally use Plus-X film because its relatively slower recommended exposure index provides the right latitude.

"However, if it is overcast, or if

we are working on an assignment such as a sports event, where we want to hold the depth of field, we generally use Tri-X film."

At present, SFCC is not equipped to transmit color from its studio, although they have fed color film, on occasion, with equipment provided by a local commercial TV station. However, SFCC produces color programs and commercials for its clients to use on other outlets. In these cases, the same camera and lighting equipment are used with either Eastern Ektachrome commercial film 7252, or Kodak Ektachrome EF film 7242 (tungsten).

Speed Is A Factor

Again, the main criterion is film speed, according to Boundy. Ektachrome commercial film is a low-contrast positive film with a recommended daylight exposure index of 16 (with Kodak Wratten filter no. 85), and 25 in tungsten light. Ektachrome EF film is used indoors with 3200K tungsten light at a recommended exposure index of 125. Outside, the same film can be used in daylight with a Kodak

Wratten filter, No. 85B over the camera lens at a recommended exposure index of 80.

"This gives us great flexibility to film almost any event, anyplace, anytime, and under almost any conditions," say Boundy.

Like the black-and-white film, color is processed at nearby Reela Labs, which can also produce copies when needed.

In addition, SFCC's color work is expanding in industrial films, with completion of its second half-hour motion picture for a major manufacturer in recent months.

"We have completely reoriented our thinking," sums up Boundy, "since the system opened in 1966. In many ways, we are duplicating the trial-and-error period of the early days of commercial television. We try something to see how the subscribers like it; then we gear our planning to the response. On one program, for example, we asked viewers to mail us a game card in order to qualify for a prize. We got 10,000 returns, so we knew that we were on the right track."

And SFCC gets similar feedback from its satisfied advertisers.

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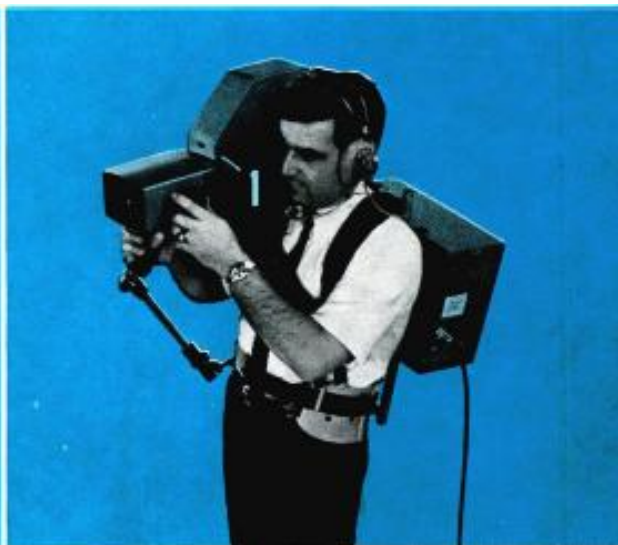


Norelco PC-100A...the only camera with A.C.T. Plumbicon* tubes ... solve high-contrast problems at the source.

Here's the camera that introduced two revolutions in color television. A cable revolution—using light, low-cost triaxial cable. And a tube revolution with the new Anti-Comet-Tail "A.C.T." Plumbicon.

A new gun design gives the A.C.T. Plumbicon tube an unprecedented dynamic range (inherent overbeaming capability equivalent to five or more f-stops overexposure) with no washout or loss of detail even in action scenes with brilliant highlights and deep shadows. It's standard in the PC-100A, and the contrast problem is defeated at the source ... not partially offset through complicated, costly, extra-option hardware. As a bonus, the A.C.T. tube handles low-light situations with matchless fidelity.

This is the camera that stunned every audience at NAB with its remarkable reliability ... with quick, easy assembly ... three and one-half minute cable butting ... and sparkling color pictures that were called "the best color television picture ever achieved."



Norelco PCP-90B...the only broadcast-quality portable. It operates ☐ RF fully system-integrated ☐ Triax system-integrated ☐ Backpack-to-VTR fully N.T.S.C.

This is the tried and proven hand-held color camera that is enabling broadcasters and production firms to go where they never went before, get pictures never before attainable.

Part and parcel of the Norelco camera revolution, the PCP-90B is adding daily to its illustrious record of getting the action—anywhere and anytime—and getting it in faithful, crisp Norelco color.

Best of all, the PCP-90B operates on triaxial cable to afford the same kind of day-in and day-out savings now possible with the PC-100A. When it isn't on a remote, the three-Plumbicon PCP-90B doubles as a studio camera. Truly far-out mobility comes with the camera's optional microwave link; great examples are the widely acclaimed helicopter applications of this unique broadcast-quality camera. It is the most versatile camera available, and can be fielded as a self-contained battery-operated camera with a portable video tape recorder to record the action. And remember, you get all these revolutionary advantages on top of tremendous operational dollar savings.



†Write on your letterhead for our detailed report, "The Economics of Triaxial Cable Color Television Cameras." Plug in your figures and compute your short- and long-term savings.

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Circle Number 25 on Reader Reply Card

Multiplying, Mixing, and Modulating with IC's

Part 1 of a series

By Walt Jung*

One of the most important developments in IC technology as far as the world of communications is concerned has been the development of the **balanced modulator** in monolithic form. This circuit, in itself a basic element of RF modulation and demodulation, is also the basis for a further refinement of its fundamental form, the **four-quadrant multiplier**.

In this two-part article we're going to look at the balanced modulator circuit in monolithic form, to see how this circuit evolves into another basic type of IC (the multiplier) which promises to approach the op-amp in range of application.

The Balanced Modulator Configuration

The general circuit configuration for the balanced modulator is shown in Figure 1. In this circuit signal input A represents a carrier input channel and signal input B is a modulating input channel.

The outputs of the upper two differential pairs are cross coupled to provide a balanced output. This means that the output signal will be zero if either input is zero, and will also mathematically provide the correct output product (including the sign) of the A and B inputs. The output signal is the product of the two inputs times a gain factor, K . Let's follow a pair of signals through the device to see how this is true.

For simplicity's sake, assume a single ended input to the two channels as shown. If B is positive, the

*BE Solid State Editor

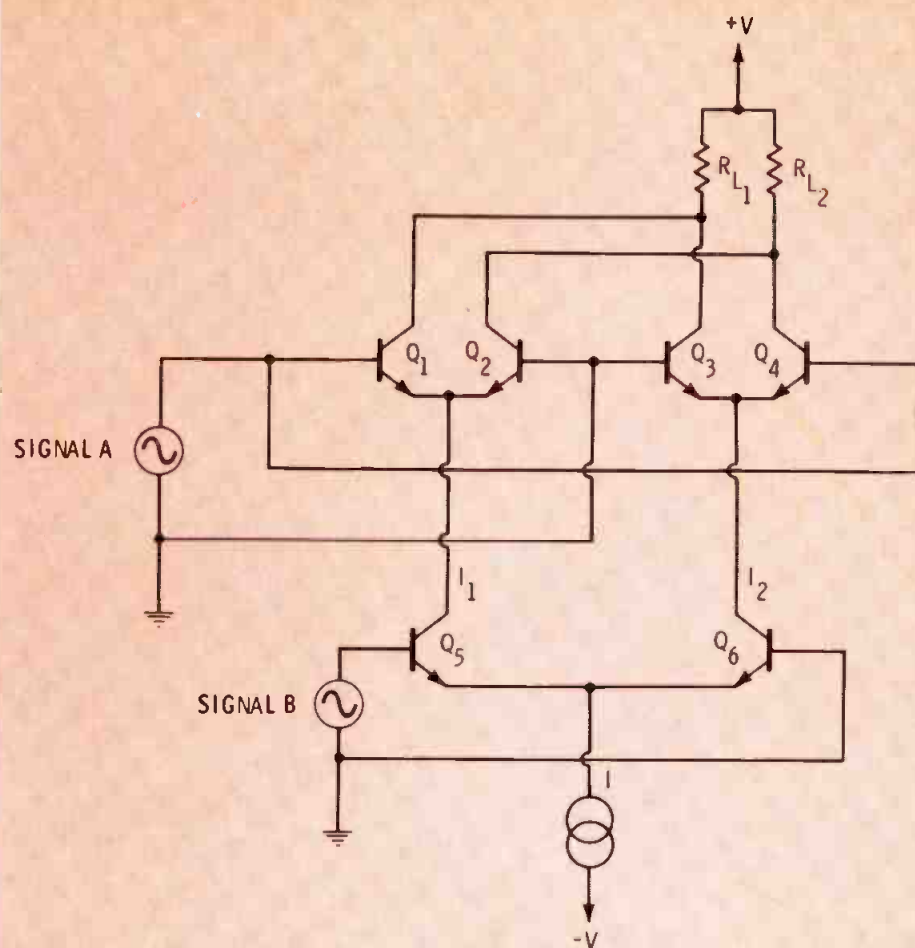


Fig. 1 Doubly balanced modulator in basic form.

current from the current source I will flow through $Q5$. And if A is also positive, the current will divert through the $Q1$ path to $RL1$. In this case the result of the two "plus" inputs is a positive result, current in $RL1$. If A is still positive but B negative, current flows through $Q6$ and $Q4$, reaching $RL2$ and not $RL1$. So this can be considered a negative result from $RL1$'s standpoint, it does not receive current. If A were negative and B positive, the end result is the same but the path would be different ($Q5$ through $Q2$ to $RL2$). So, if either A or B is negative the output is negative. But look at the condition where **both** A and B are negative. In this case $Q6$ and $Q3$ conduct, again feeding current to $RL1$! Two negatives make a positive, behaving just as they should algebraically.

Further examination of this circuit reveals some more interesting properties. Assume zero signal input to channel B with $Q5$ and $Q6$ conducting an equal current (ideal matching). In this case $I1 = I2$. Then visualize the output at $RL1$ due to a varying signal input at

input A. If A is positive, $Q1$ conducts and $RL1$ receives $I1$. If A is negative, $Q3$ conducts and $RL1$ receives $I2$. But since $I1 = I2$, there is no change in the output due to the variations of signal A; it is **suppressed**.

Now turn the situation around and view the output at $RL1$ with the A channel equal to zero and $Q1$ - $Q4$ all conducting equally (again, ideal matching). Apply a time varying signal to the B input and see what happens.

In this case $I1$ and $I2$ will be equal and out of phase signals due to the differential coupling of $Q5$ - $Q6$. $RL1$ receives an equal signal from $Q1$ and $Q3$, or an equal share of $I1$ and $I2$. But $I1$ and $I2$ are equal and out of phase, so they cancel at $RL1$. Again there is no output and the B signal is also suppressed!

Looking back on this discussion, we can summarize it by stating this configuration is a doubly balanced modulator. Its output is the algebraic product of the two inputs. And finally, since correct adherence to these rules is dependent

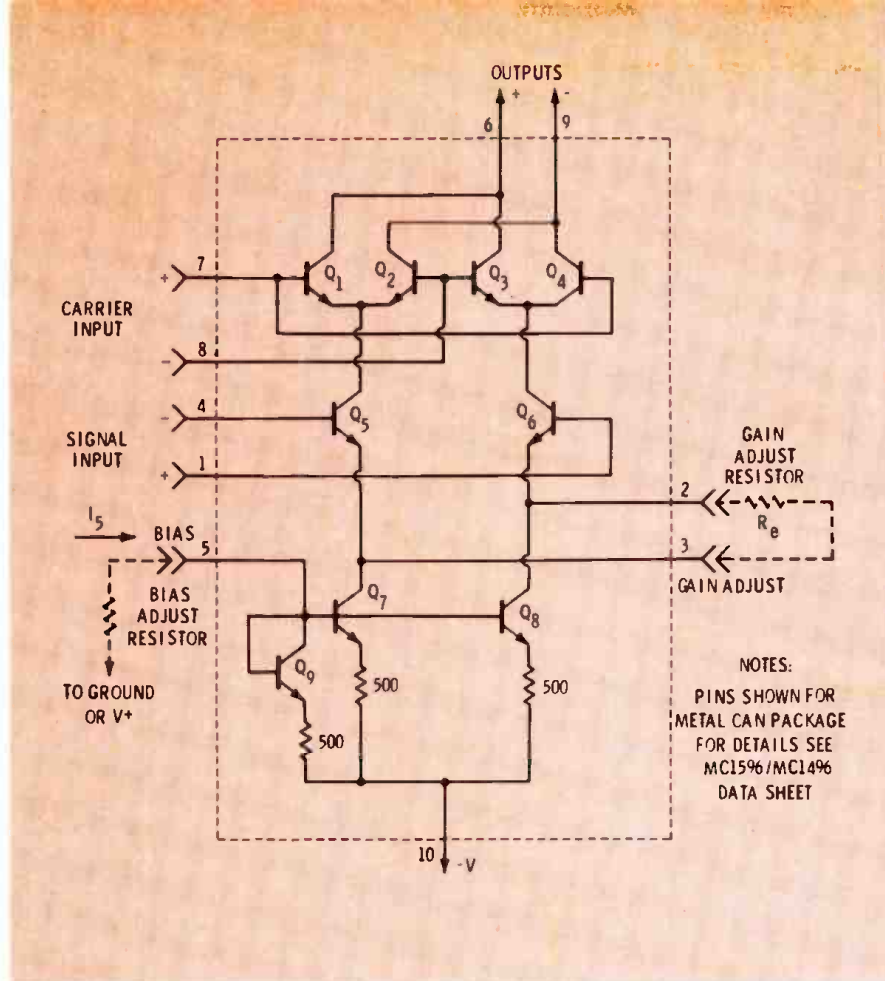


Fig. 2 Motorola MC1596 or MC1496 balanced modulator-demodulator IC.

upon close matching of transistor parameters and biases, it follows that integrated circuit transistors with their matched properties should be suited to a workable circuit exploiting these principles. It turns out this is quite true, and we now turn to a discussion of just such an example.

The MC1596/1496 Balanced Modulator Demodulator

Motorola Semiconductor has developed an entire line of chips based on the balanced modulator principle in IC form. There are many variations, but in fundamental form the representative device is the MC1596/1496, shown schematically in Figure 2.

These MC1596/1496 devices are extremely flexible in that there are relatively few internally committed connections. This allows operation in a wide variety of modes. They can be used at supply potentials up to 30 Volts and bias currents of 10 ma maximum. They also utilize small geometry, low ca-

capacity VHF transistors . . . a fact which makes operation possible not only at DC but also up to 300 MHz. Differential output signals are provided allowing either a choice of single ended output phase, or a push-pull output drive. The gain of the chip can be scaled by manipulating the ratio of R_L to R_e . Both the carrier input and the signal input can be operated either single ended or push-pull.

The device can be RC coupled, transformer coupled, or tuned with LC tanks for a specific frequency. In general, it can be utilized as a modulator or demodulator from DC through lower UHF frequencies. The concept of a circuit such as this is as basic to communications as the single differential pair is to the operational amplifier. So let's go further into how it works and what it means.

You will note that Figure 2 is similar to the basic circuit of Figure 1, the main difference being the addition of current source transistors Q7 and Q8 to bias Q5 and Q6. These two transistors replace the single current source of Figure 1.

In so doing they extend the dynamic range of differential signal swing Q5 and Q6 can handle, allowing it to be externally tailored. This is accomplished by an external resistor (R_e) across the gain adjust terminals.

Note that the dynamic signal current in Q5 and Q6 will be directly proportional to this resistor as the full differential input to Q5-Q6 appears across it. Note also we said **differential** input. This circuit has excellent common mode rejection (85 dB typical) due to the high impedance emitter feeds to Q5 and Q6 from Q7 and Q8, and thus will reject voltages common to both Q5 and Q6. The operating bias for Q7 and Q8 (and in turn Q5-Q6) is derived from a matched monolithic bias divider (Q9) whose current (I_5) is set by an external resistor. The current in this resistor will be identical to the Q7 and Q8 emitter current due to the monolithic matching. And it also will determine the dynamic range since the AC current in Q5 and Q6 can be no larger than that supplied from Q7 and Q8.

The Q1-Q4 upper differential pairs can operate in either the switching mode (large signal input) or linear mode of control. Operation in the linear mode is confined to levels of 50 mv p-p or lower, an important point which we will return to in part two. For levels beyond this, the quad switches act as current mode limiters (being overdriven) and remove the effects of amplitude modulation on the carrier input signal.

In communications circuit use, the output spectrum of a MC1596/1496 device has some very useful properties. For linearly multiplied signals (low-level carrier input), the output will contain only the sum and difference of the two signal

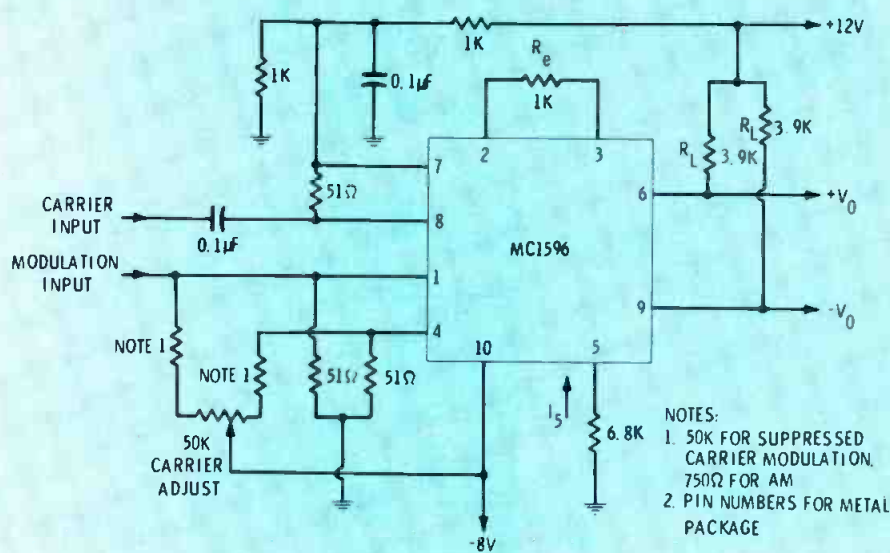


Fig. 3 Modulator circuit for DSSC or AM

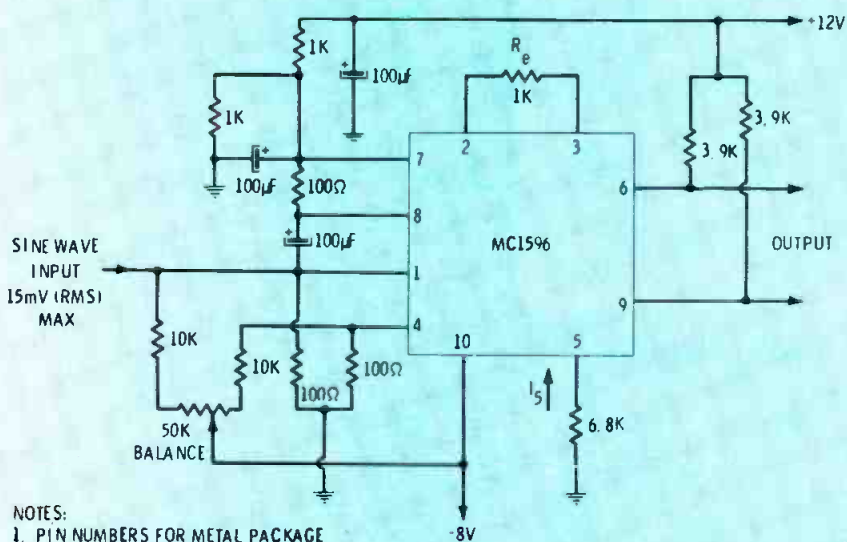


Fig. 4 Frequency doubler.

frequency inputs, or $F_c \pm F_m$. The frequencies themselves will be suppressed by the balanced circuit properties. In the case of high level carrier inputs (switching mode of carrier port) the output will consist of the sum and difference frequency products of the modulating input frequency and the carrier fundamental plus its odd harmonics; $F_c \pm F_m + 3F_c \pm F_m + 5F_c \pm F_m$.

Applications

Obviously a device such as this has many communications uses, but the one which immediately comes to mind is a double sideband suppressed carrier modulator. Motorola's typical modulator circuit for the device is shown in Figure 3.

Here the carrier port is fed a low level carrier signal and the modulating input to the signal port is 300 mv RMS (max.) Both signals are applied single ended, their opposite sides held at AC ground. An R_e of 1K sets input level capability with I_5 at 1 ma via the 6.8 K resistor. Exact balance of the Q5-Q6 operating points is provided by the carrier null control to adjust their currents to be precisely equal, the point of minimum carrier in the output. The degree of carrier suppression attainable under these conditions is typically 65 dB at 500 KHz and 50 dB at 10 MHz.

One example of where the improved performance of a linear balanced modulator in IC form is extremely useful is in the process

of NTSC color encoding. The performance of the device here provides carrier suppression approaching 60 dB @ 3.58 MHz. This area has been a troublesome one in the past, particularly in the all important area of generating the color burst.

Previously used hard transistor switches suffer from many ills; notably on-off transients (causing phase modulation), offsets (causing modulation pedestal), uncontrolled rise and fall times (which again influence net phase) and carrier suppression (or lack of) in the off state.

Contrast all of this with the monolithic balanced modulator. On-off transients and rise and fall can be controlled ideally by modulating the subcarrier with a burst flag key with $\sin^2$ rise and fall times. This provides a burst envelope of ideal shape and minimum phase disturbances. Modulation pedestal due to offsets is minimized by the matching of the monolithic transistors and the balanced nature of the switching configuration.

All of this performance is possible with the basic circuit of Figure 3, in fact, this circuit can form the burst modulator of a black burst generator. By linearly mixing the output with sync and blanking waveforms, a colorized black background waveform is formed.

The same basic circuit also can be used for conventional amplitude modulation by offsetting the static balance of Q5-Q6 to inject a constant amount of carrier in the output. In this manner the modulation input will then add to (on positive peaks) or subtract from (during the troughs) the average carrier level, accomplishing AM. It will be necessary to increase the range of the bias adjustment so two sets of values are indicated, one for DSB and one for AM.

One extremely interesting feature of the linear multiplier is the ability to double its frequency without tuned circuits. This is done by feeding an identical signal to both carrier and signal inputs. The output will then be a second harmonic. A circuit to do this is Figure 4.

WILKINSON LINE SURGE PROTECTORS REALLY WORK



2827 OLD DIXWELL AVENUE, HAMDEN, CONN. 06518

Wilkinson Electronics, Inc.
1937 MacDade Blvd.
Woodlyn, Pa. 19094
Attention: Guffy P. Wilkinson

Dear Sir,

In May of 1970 WKCI was thrown off the air by a large line voltage surge that arked our rectifier stacks in our FM xmtr. During July of 1970 we purchased and installed a Wilkinson Surge Protector model SLA3. Since that time I know of two times that the line voltage surges have been large enough to blow the fuses in the primary of the power companys on the pole distribution transformers which are located outside our building. Both times the Wilkinson has kept our equipment from being damaged.

I have a few questions that I would like to have you answer if possible. The last time we were hit only one fuse of the three phase line was blown and this left the other two legs in tact. It also made some of the lights in the building glow at half power. Our transmitter had low voltages and would not stay on the air but while this was happening the announces reported that much smoke was coming from the Wilkinson surge protector. Visual examination revealed no damage. This brought up much discussion around the station as to:

1. How can you tell if the Wilkinson is working?
2. How can you tell if the Wilkinson has been damaged?
3. How can you test this Wilkinson?

There must be some way to test this 'blue gray box' that just seems to keep working and working.

Thanks in advance for any information that you can send me, and many thanks for a piece of equipment that is really doing a job.

Very truly yours,

A handwritten signature in cursive script that reads 'Winston R. Sutor'.

Winston R. Sutor
Chief Engineer



WILKINSON
ELECTRONICS, INC.

1937 W. MacDADE BLVD.

WOODLYN, PA. 19094

TELEPHONE (215) 874-5236/874-5237

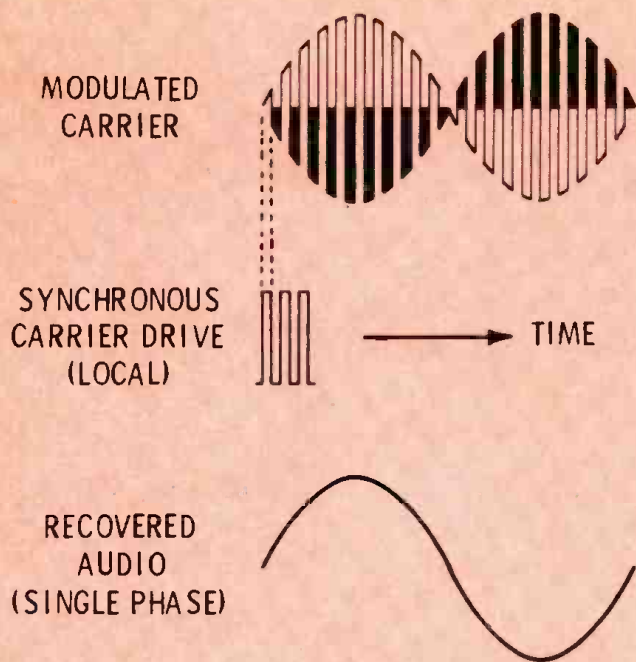


Fig. 5 Balanced demodulator waveforms.

All of these examples have been forms of modulation using the MC1596/1496. But this same device can also be used for AM or FM demodulation, SSB product detection, and phase detection. In these types of circuits, the upper sets of switching transistors are operated at a relatively high level and the signal port operates in a linear mode. Demodulation is accomplished by the synchronous detection of the quad switches. A low pass filter is used at the output to remove all but the low frequency modulation products.

The process of demodulation is where the versatility of this circuit really becomes obvious. Not only does it demodulate all conventional forms of modulated carriers, but also it does so in a precise fashion.

Take a double sideband signal for instance, such as the upper waveform of Figure 5. By multiplying this waveform with a local carrier (directly below), synchronous detection of the envelope occurs. The recovered audio is available (after low pass filtering) in two phases at the two outputs, one of which is shown. Figure 6 is a circuit

example of this demodulator.

The carrier can be derived from the input signal by amplification and limiting or locally generated by a phase locked oscillator. Conventional AM is demodulated in the same manner.

The important feature of this type of demodulation is that it is a low distortion process since it does not have the diode threshold of a conventional peak detector. Thus its dynamic range is much wider and it can recover clean audio with carrier inputs in the millivolt region.

The same basic circuit is also useful for FM detection. In this type of demodulation the carrier will be a constant level at both inputs, but one is shifted 90° in phase to form a quadrature detector. The phase of this input will vary with frequency, and the FM at the input will cause a duty cycle modulation of the demodulator switching. The output is then integrated by the low pass filter and the audio modulation recovered.

Phase detection is the basic form of FM demodulation process just described, so it can be understood easily in the same manner. If one input is a constant phase and the second varies with respect to the first, the conduction angle of the switching will also vary. The desired information contained in the phase difference can be either DC or rapidly varying intelligence (such as audio in FM). The detection bandwidth will be determined by the response of the low pass filter.

Summary

The balanced modulator is another example of an old circuit technique made attractive performance wise and economically by IC techniques. It forms the basis for a wider variety of IC circuits whose presense will be felt increasingly as time progresses. The second part of this article will look into the next evolutionary step of the monolithic balanced modulator, the **four quadrant multiplier** and its operations and applications in signal processing functions. ▲

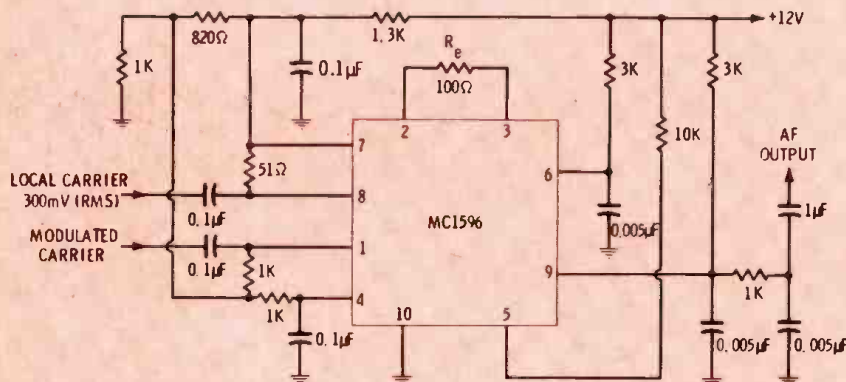
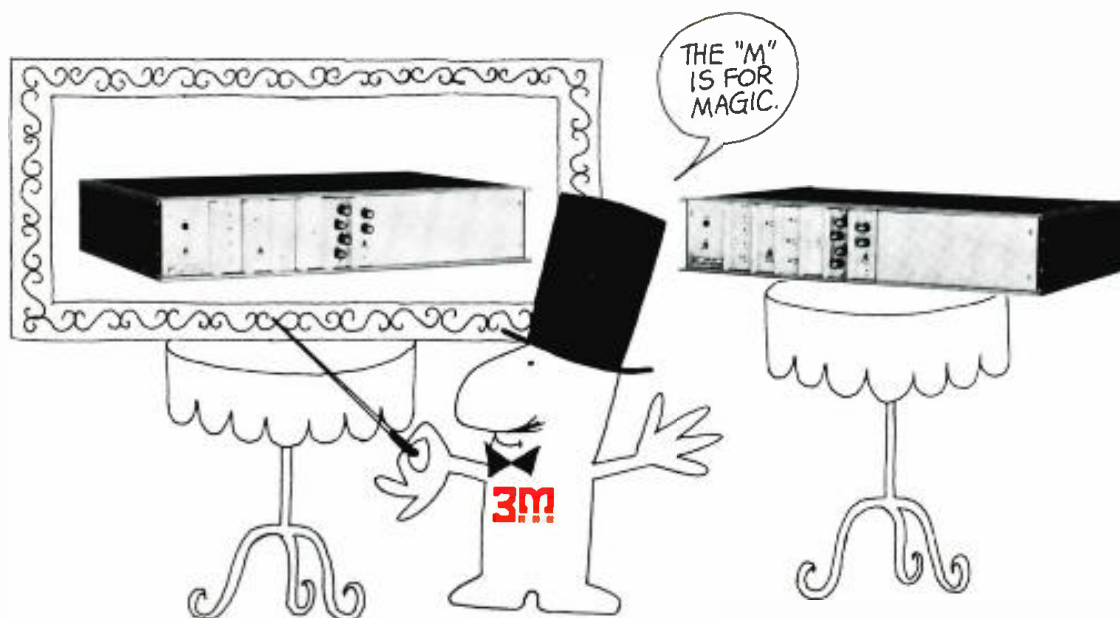


Fig. 6 Demodulator circuit.



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Transmitting terminal can be as simple as a small industrial TV camera, monitor, and video compressor. Location can be up to 10 miles from the transmitter.

Compressing TV on an FM SCA Channel

By C. Elmore, Gates Radio

One of the latest innovative uses of electronics in education, Compressed TV utilizing the FM SCA channel, was demonstrated by Gates Radio Company, a division of Harris Intertype Corporation, at the 1971 NAEB show held Oct. 18, 19 and 20 in Miami, Fla.

This new application of the audio/visual medium is the television equivalent of a slide projector . . . a video system in which a single frame of information, either pictorial or graphic, is transmitted in seven seconds.

Although "Slow-Scan" TV equipment has been offered by several firms in the past, what Gates demonstrated at the NAEB show is a new concept in convenience and a far less expensive means of signal distribution utilizing the FM subcarrier to transmit visual information.

By compressing the video spectrum down to audio range, the equipment transmits visual signals over an existing audio channel, in this case an FM broadcast subcarrier channel, to any number of receiving locations.

A simple system may consist of a standard industrial-grade TV camera connected to a bandwidth compressing device. The narrow band video signal from the compressor is fed into a subcarrier generator which modulates the main carrier of the FM transmitter. In the system offered by Gates, picture transmission is normally achieved in seven seconds, but slower or faster transmission rates may be implemented for specific requirements.

The receiving terminal system consists of a slightly modified SCA receiver which allows reproduction of frequencies down to DC. The receiver is coupled to a special video disc recorder which converts the narrow band video signal back to standard 525-line television rates for viewing on one or more normal television monitors.

Picture storage is accomplished by the magnetic disc memory and pictures may be viewed indefinitely. However, because of the time required to transmit a single frame, motion is not portrayed . . . and reproduced images are all "still-

life."

Glen Southworth, president of Colorado Video, Inc., manufacturer of the Compressed TV equipment distributed by Gates, addressed NAEB delegates on the applications of, and theories behind this emerging use of video technology.

In his talk on "Narrow Band Video Transmission of the FM Station Subcarrier," Southworth explained that "in normal television 30 complete images per second are transmitted to achieve the illusion of motion. These signals require a great amount of spectrum space, typically 4 MHz, and pose a series of problems in transmission and recording."

"By comparison," he continued, "Compressed TV signals operate with only a small fraction of the bandwidth of conventional video, perhaps 1/1000th, greatly reducing transmission costs."

"Although Slow-Scan TV transmission has been used frequently over normal phone lines," explained Southworth, "the FM system is a much faster and less costly means of communications. The FM system

transmits a clean, high-quality signal within the radius covered by the FM transmitter at a fraction of the cost of television or phone lines, and when needed, FM relay stations can be used to increase the coverage area."

Gates design engineers, who have conducted extensive tests of Compressed TV equipment, recognize the systems' potential in the fields of education, "store-casting" and private communications. Compressed TV could well be labeled "network of knowledge" . . . a link between the repositories of knowledge and graphic information with institutions and individuals throughout the world.

Currently the narrow band video technique, utilizing the FM subcarrier, is being tested at Southern Illinois University at Carbondale and proposals for FM transmission use have been submitted by public school systems in Flint, Mich., and South Bend, Ind.

Slow-Scan TV, transmitted by phone line, is now used by a number of educational institutions for illustrated lectures as well as for a

link between hospitals, clinics and major medical centers.

The application of Slow-Scan TV between medical centers and hospitals has attracted much attention in the last two years. Using telephone lines, the University of Wisconsin Medical Center at Madison transmits a series of programs to hospitals within the city, while in California, two hospitals, located some 500 miles apart, are using this type of equipment to send medical diagnostic pictures over audio channels. The system can be used to transmit electrocardiogram tracings, portions of X-rays and other records.

While these applications by phone lines have become realities, more extensive use of Compressed TV is possible through the more economical FM subcarrier method.

For instance, in this decade engineers feel Compressed TV utilizing the FM channel could become the video equivalent of "store-casting." Presently one chain of drug stores is studying the feasibility of transmission of coded signals such as "Today's Special . . . Bayer Aspirin

. . . one bottle full price . . . next bottle half price." This signal could be picked up only by the drug store receivers activated by their specific code while other subcarriers would receive their own commercials or public service announcements.

Instruction of the home-bound could be accomplished via Compressed TV and, in the municipal field, the same technique could allow the rapid transmission of police information . . . mug shots, fingerprints or other identification. Compressed TV could be used as a major distributor of facts and figures from the great metropolitan libraries and museums to receivers throughout the world.

With the advent of this Compressed TV concept, pertinent graphic data can now be placed before specific audiences for a designated length of time at a reasonable cost.

Compressed TV via the FM broadcast station subcarrier channel is another step forward in the practical application of electronics in the field of education and communication. ▲

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Circle Number 28 on Reader Reply Card

Digital logic basics

By E. S. Busby, Jr.*

Part 2 of a series

September's installment described the various families of Integrated Circuit logic devices and how to understand the functioning of logic gates.

Logic performed with gates alone is called combinational logic. A number of inputs, each one of which may be true or false, is "combined" (using gates) so that an output appears when, and only when, all the inputs are right.

There are at least two ways to

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

go about arranging a combinational circuit. One is to make sure that when all inputs are right, the output is energized. The other is to make sure that when any input is wrong, the output is inhibited. Sometimes one approach requires less hardware or is more fail-safe than the other. There are methods which can lead to a least-hardware design.¹ In large systems, especially when a number of outputs are to be generated from the same set of inputs, these methods can be worth the time spent using them.

Combinational logic is important and vital but is only a part of a logic system. This is because the right output persists only so long as all the right inputs are present

and steady. In a broadcast studio hardly anything is steady very long. Examine the following typical statements and what is implied by them:

- A. "Momentarily depress the start button" (MEMORY)
- B. "Video will switch at the first vertical interval after the 'take' button is pressed" (CLOCKING)
- C. "Video erase is delayed approximately 10 milli-seconds" (DELAY)
- D. "18 Frames later, the video record heads are energized" (DELAY BY COUNTING)
- E. "The machine will then automatically stop, rewind, re-start, and record the next 'take'" (SEQUENCING).

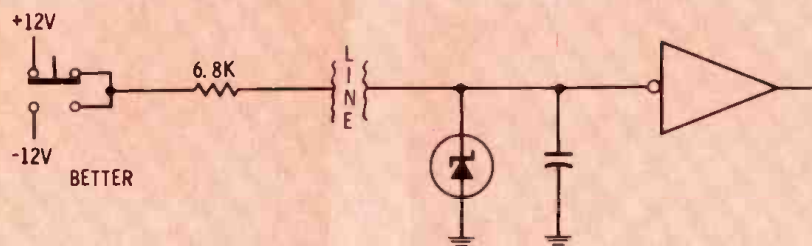


Fig. 1a

NOTE: DIODE IS 4.7V ZENER FOR DTL & TTL,
ANY DIODE FOR RTL

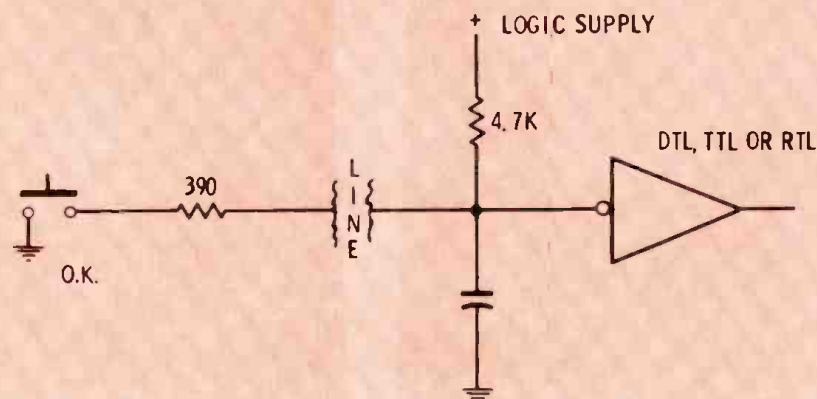


Fig. 1b

NOTE: TURN-OFF TAKES LONGER THAN TURN-ON

In Part 1 of this series, page 28, column 3 September issue, the second reference to RECORD BUS should read RECORD BUS. The lack of the overhead bar over those words changes the meaning 180°.

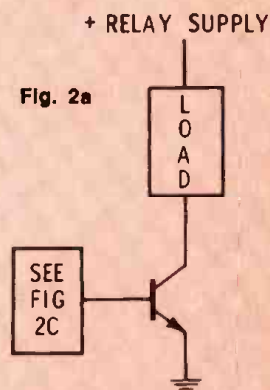
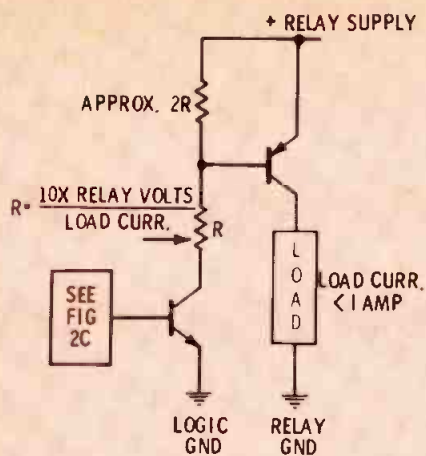


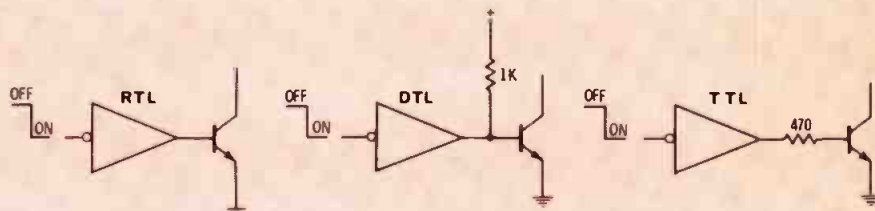
Fig. 2a

OK IF RELAY SUPPLY AND IC SUPPLY
ARE IN THE SAME EQUIPMENT.



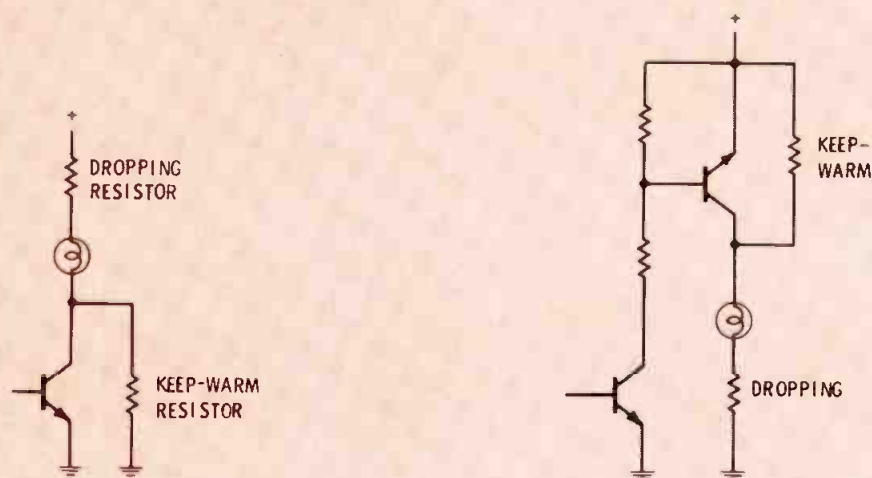
BETTER IF SUPPLIES ARE SEPARATE

Fig. 2b



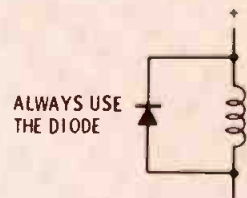
TRANSISTOR IS SILICON. BETA > 30
MAX. COLL. CURRENT, ABOUT 100 MA.

Fig. 2c



SELECT DROPPING RESISTOR SO LAMP IS
BRIGHT ENOUGH WHEN ON.
SELECT KEEP-WARM RESISTOR SO LAMP IS
DIM ENOUGH WHEN OFF.

Fig. 3



ALWAYS USE
THE DIODE

DIODE MUST BE ABLE TO WITHSTAND
NORMAL VOLTAGE ACROSS COIL.
DIODE MUST BE ABLE TO CARRY
NORMAL COIL CURRENT.
DIODE SHOULD TURN ON FAST.

Fig. 4

The idea is . . . timing, control, and memory are something else again.

Also obvious from these examples is that inputs are likely to originate from buttons, switches and other non-IC items, and result in the operation of lamps, relays, solenoids, motors and the like. The IC logic is in between.

This installment will dwell on the problems of getting signals into and out of logic IC's (interfacing), some of the non-combinational uses of IC gates, and edge-triggered devices.

Remoting Panel Controls

A popular equipment modification is to extend panel controls to

a comfortable place where there is a chair. If the panel control connects directly to IC's, be wary. A relay takes from 4 to 40 milliseconds and 50 to 500 milliwatts to energize. An IC equivalent can do it in 4 to 40 **NANO** seconds on 1 to 5 milliwatts. The wire to the remote control can easily pick up this much energy from an adjacent wire, especially if that wire is "unsanitary".

Since it is difficult to press a button for less than 10 milliseconds, some form of R-C filtering at the IC input can be used to de-sensitize it to short noise spikes (the usual problem). A simple shunt capacitor across the input will work, but renders its control wire unsani-

tary because of the large current surge through it when the capacitor discharges through the wire and the switch contact. Figure 1 shows a couple of workable answers. The idea is to furnish a moderate current, over an extended time, and also limit the rate of voltage change in the control wire (out of respect to its neighbors).

The wires leading to IC inputs should be bundled separately from those leading to higher powered devices such as lamps and relays. If a ground is necessary at the remote point, assign one or more wires in the cable as ground returns. **Don't** use a shield for this purpose. A shield must be **able** to conduct, but shouldn't be used so that it **must**.

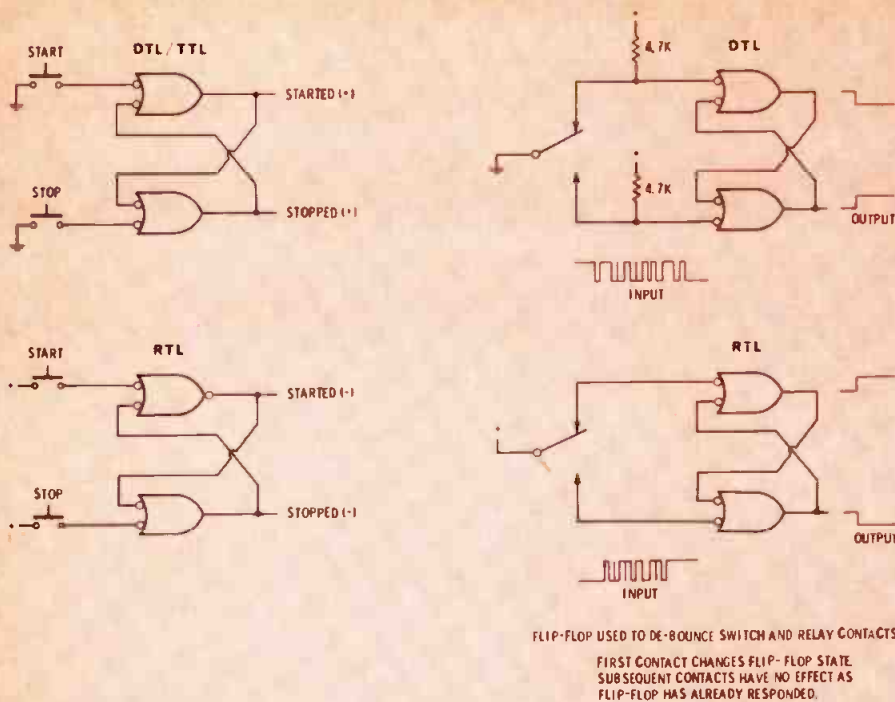


Fig. 5

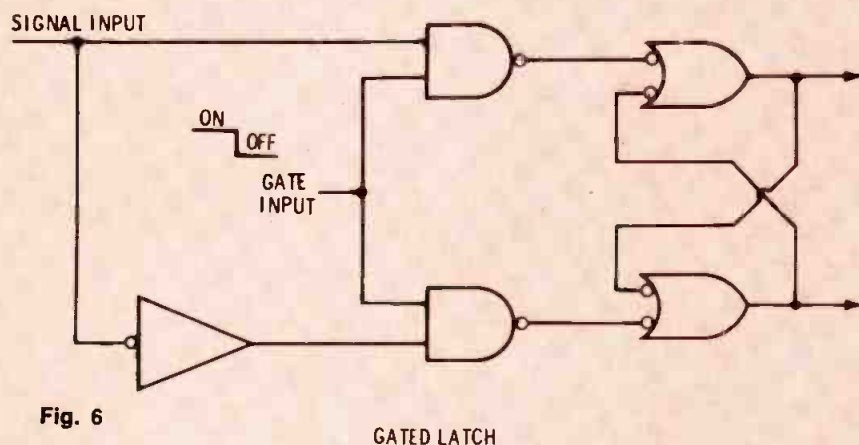


Fig. 6

Stealing Logic Signals From Existing Equipment

As thief, it is your responsibility to avoid fouling up a logic circuit in the process of extracting a signal from it. If the wire you attach is going any distance, isolate it by interposing an inverter or gate between the signal source and your wire. Unused spare gates and inverters are frequently found on circuit boards. Steal them.

Always isolate when taking a signal from a flip-flop. Antennas on flip-flops are indiscrete. Make sure your input doesn't cause the drive capability of the output you are using to be exceeded.

Altering Logic In Existing Equipment

Probably the cleanest approach is to design your new circuit so that its installation requires minimum surgery to the circuit board. Mount and prewire your new circuit on a piece of pre-punched board. Mount this outrigger board on or nearby the one to be modified. The idea is to make it easy to restore the equipment to original condition. Its second-hand market value is better that way.

Driving With IC's

Most of the common items that need turning on, like lamps, relays and solenoids, use a higher volt-

age than the IC's use, and are powered by a supply that is not only separate, but may often be part of another system. Figure 2 shows a method of turning on something that is part of another system without tying the grounds tightly together. It is tolerant of minor differences in ground potential.

Incandescent lamps present a turn-on problem because the cold filament resistance is so low. Figure 3 illustrates two approaches which reduce the turn-on current surge. Either one or both together help, and extend the life of the lamp as well.

The problem with relays and solenoids is turning them off. Being inductive, they resent it, and kick up a vicious voltage "spike" when their current supply is interrupted. Properly used, this effect operates automobile spark plugs, but is death to transistors. A diode connected across the coil will "catch" this spike and prevent it from exceeding the supply voltage. See Figure 4. The presence of the diode causes the magnetic field to decay more slowly than it normally would. If this added turn-off delay is a problem, you probably shouldn't be using such a device anyway.

It is prudent to include a similar diode in lamp circuits, since sooner or later some less knowledgeable person will attach a relay to the lamp circuit without benefit of diode.

Put It In Writing

Whatever you do to existing equipment, document what you do. Put a note on the old schematic referring to the new page you will add for the new circuit. If it's complicated, write an explanation of how it works and put that in the book, too. The kind of job security that comes with "keeping it all in your head" can get a little too secure.

The Most Common "Memory"

Figure 5 shows how two ordinary gates can be connected to each other to form a bistable flip-flop.

In the configuration shown, the outputs of the flip-flop will always reveal whether its corresponding input is **active**, or was the **last to be active**. Ideal for remembering that a momentary push-button was pressed, this circuit is also called a "latch", and an "R-S" flip-flop. (The inputs are called the "set" input and the "reset" input.)

Metallic relay and switch contacts are unreliable for the first few milliseconds after they are whacked together. Figure 5 also shows how a simple flip-flop can be used to derive a single edge from a switch instead of the usual shower of sparks.

When a button, switch, or relay contact is feeding an IC circuit which produces alternate action (ON-OFF-ON-OFF) or which counts the number of button pushes, it is mandatory to "debounce" the button.

The Gated Latch

The circuit of Figure 6 illustrates how a gate can be connected between an input and the latch. As shown, when the gate is on, the output of the latch will "follow" the input. When the gate is shut off, the latch is disconnected from the input, and stores the input's state at the instant the gate shut off.

The fact that the output follows the input while the gate is on can sometimes be a problem, in which case simply turn on the gate with a short pulse at the time you want to "examine" the input.

Making Pulses

To make a short pulse out of an "edge" (a transition from high to low or vice versa) simply AC couple the transition to a gate or inverter's input as in Figure 7A. Figure 7C shows what to do to get long pulses from short inputs.

The internal component values of IC's can vary about ± 25 percent between samples. Therefore don't use these circuits where tight control of pulse widths is required. Pulse widths will vary with temperature as well.

Pre-packaged "one-shots" (mon-

ostable multivibrators) are available, one or two to a package. You connect a resistor and capacitor to each to determine the one-shot's active period. They may be connected to be positive-edge or negative-edge triggered, and may be made "retriggerable". This means that if a new triggering edge arrives during the active period started by a previous trigger, a **new** active period is defined. Thus a string of input triggers whose repetition

period is shorter than the active period will cause the output to stay continuously "active". This feature makes the unit useful as a "missing pulse" detector.

Edge-Triggering

No matter how short a pulse is, there comes a point in the design of things when something must happen at the beginning **or** the end of a pulse (upon an edge) instead of **during** the pulse. There is a vast

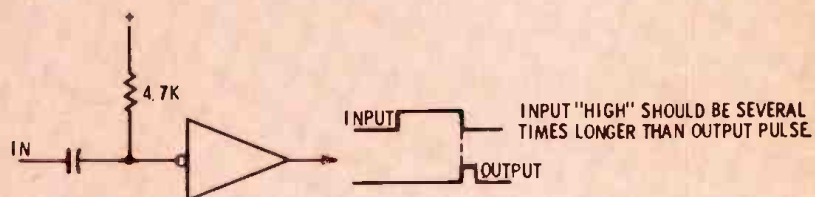


Fig. 7a

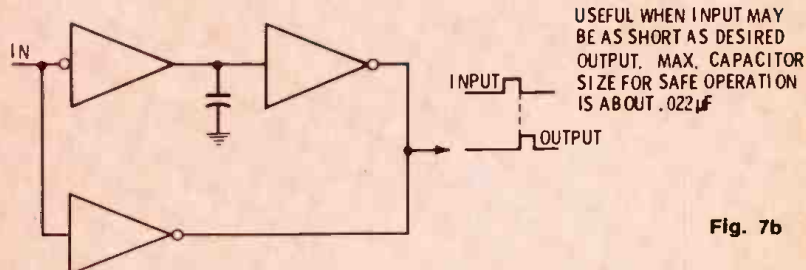
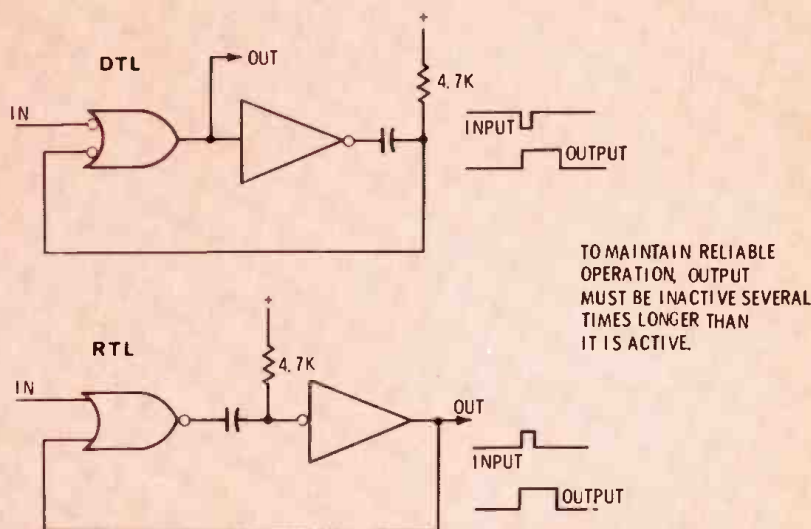
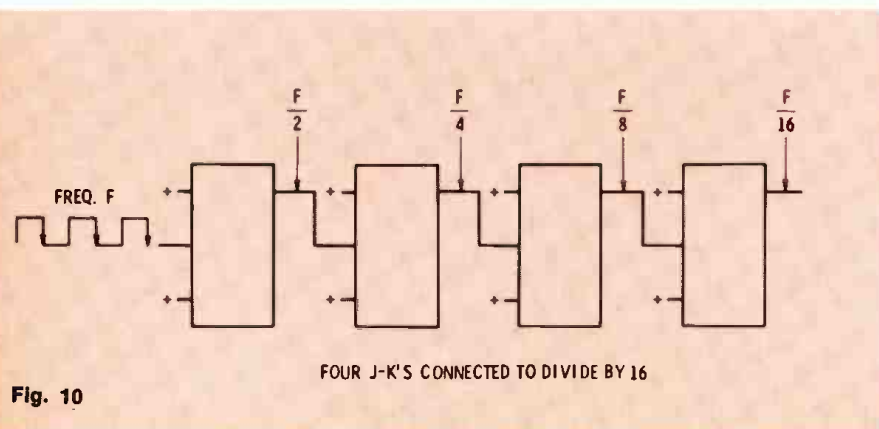
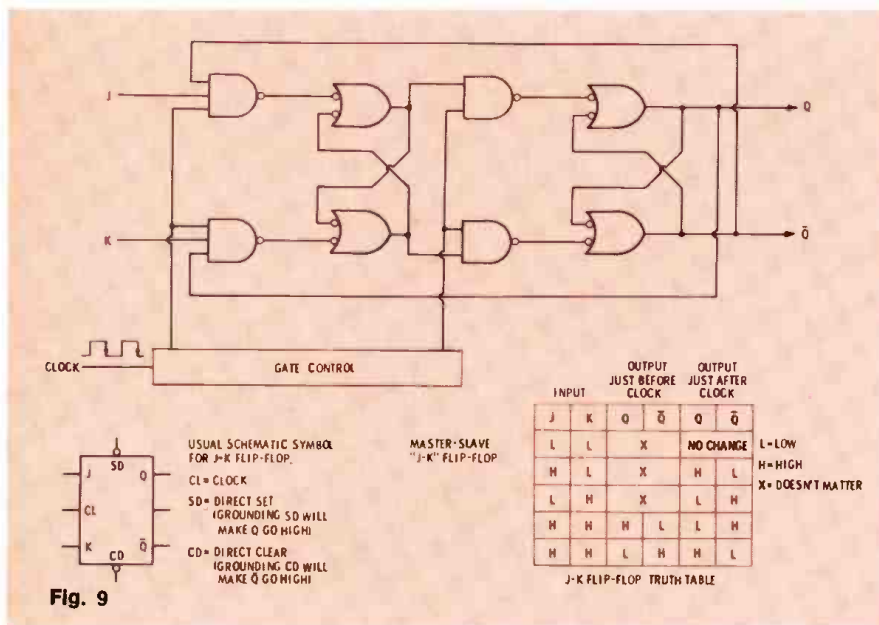
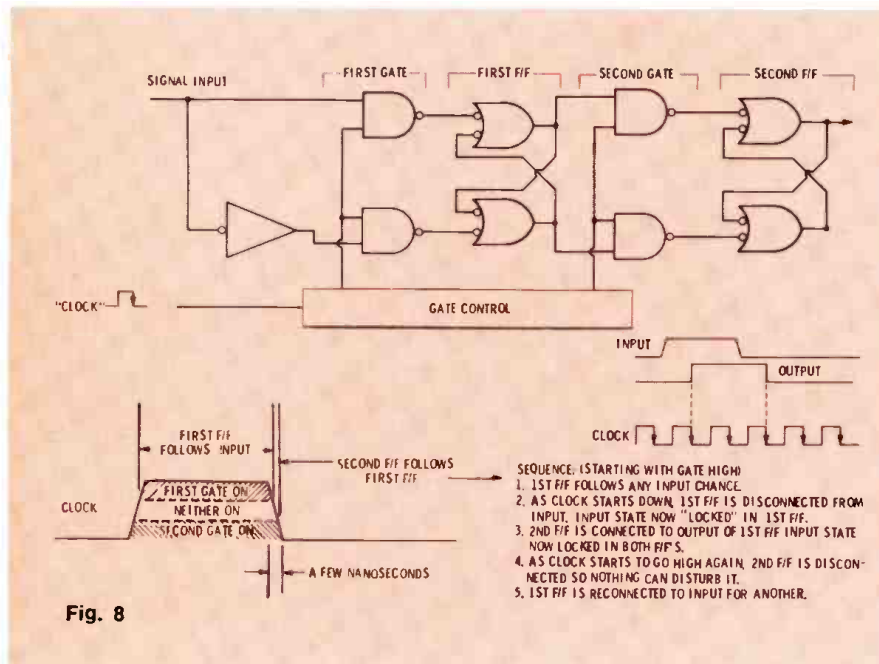


Fig. 7b



IN ALL CASES SELECT CAPACITOR FOR DESIRED OUTPUT PULSE DURATION

Fig. 7c



array of IC devices which do their thing only upon a **transition** at the control input.

Figure 8 shows how two gated latches may be connected in series to form a master-slave type flip-flop. In the form shown, it is called a "D" flip-flop (I don't know why). The output will "follow" the input, but only after a high-to-low transition at the control input. The control input to edge-triggered devices is usually called the "clock" input.

Figure 9 is the same circuit with feedback applied from outputs to inputs. The resulting action has been found to be very useful. The circuit shown is one way of forming what is known as a J-K flip-flop. (There are other ways of doing it.)

The significant rules of such a flip-flop are as follows:

1. Nothing at all can happen except upon a specified edge. (Either a positive-going or negative-going one, depending on the device.)
2. If both inputs are inactive, the output will never change.
3. If one output is active, and the other is not, the output will assume the status of the inputs a few nanoseconds after the clock edge. If the outputs were **already** like the inputs, they don't need to, and won't change.
4. If both inputs are active, the output will change to the opposite of what it was before.

The important thing is this: every cycle of an input waveform has two transitions—one negative, one positive. Only **one** of these can produce a change in the flip-flop. If operated as in rule 4 above, every **two** input transitions produce **one** output transition. The result is a divide-by-two, a binary divider.

J-K flip-flops come one or two to a package. Besides the two inputs (called J&K for reasons I know not), two outputs are provided (usually called Q and $\bar{Q}$) as well as one or two **DIRECT** set and clear inputs, which affect the output directly whenever they are ener-

gized. This is done so the flip-flop can be used as an R-S flip-flop if desired. Also, since flip-flops can "wake up" either way when power is first applied, they are useful to "initialize" the device, to make sure it gets out of the right side of bed.

Operating a J-K as a binary divider, and connecting its output to the "clock" input of another produces two divide-by-two's or a divide by four. Three stages divide by 2^3 or 8. Four stages divide by 2^4 or 16, and so on. Applying judicious feedback from later stages to earlier ones can "force" some "counts" that really didn't happen, causing the output edge from the last stage to occur after some number of inputs **less** than normal. A divide by 16 can thus be connected to divide by 16 or any number **less** than 16. Figure 10 shows a divide by 16, and Figure 11, two ways of dividing by 10.

Figure 12 shows a number of J-K's connected in series with all clock inputs driven from a common source. At each clock edge, each J-K's output assumes the condition of its inputs, and the input signal advances one "J-K" per clock edge. Since the output can only change **after** a clock edge, the progression of the signal from left to right can **never** jump **two** J-K's in one go.

The connection shown in Figure 12 is called a "shift register". The input condition, whatever it is, is "shifted" one step to the right for each clock edge. Shift registers with feedback applied from output to input can form a kind of frequency divider.² The maximum division is $2 \times N$ where N is the number of J-K's in the circuit. It's useful for dividing by small numbers.

Shift registers are also useful in delaying an input logic signal. The delay time is $N \times \text{CLOCK PERIOD}$. Prepackaged shift registers are available with up to several hundred stages. Ones having 4 or 8 stages have pins connecting to each stage's output. Larger ones provide input, output, and clock connections and sometimes a few "taps".

Sometimes whole logic systems, or large parts of logic systems, operate on a "clocked" basis, that

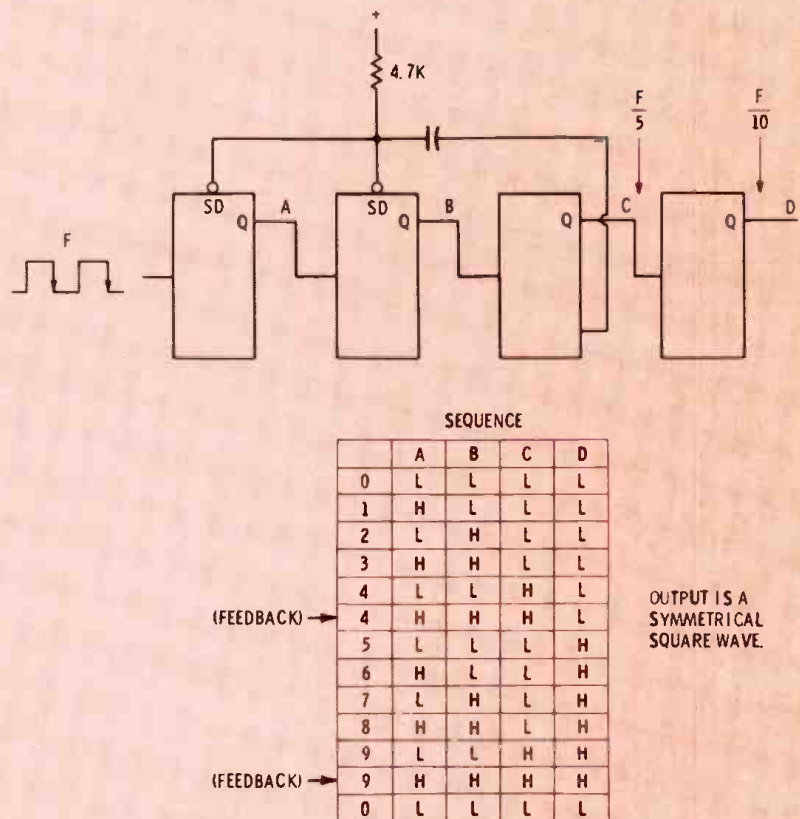
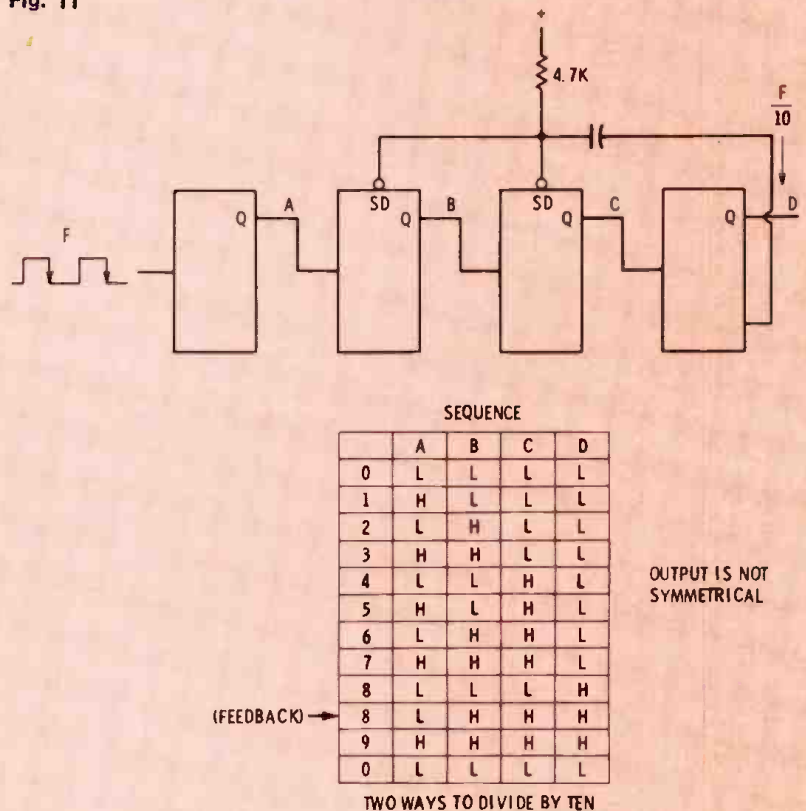


Fig. 11



is, anything that **can** change will do so **only** at a clock edge. In such a system you can at least **predict** when something **won't** happen. You can also predict that nasty switching transients will always occur **after** a clock edge when all the devices are insensitive. Such a system is called "synchronous".

Figure 13 illustrates a method of "clocking in" asynchronous inputs (like from a push-button) into a synchronous system. It produces a single pulse per input edge, which begins precisely at the clock edge following the input, and ends precisely at the next clock edge after that. It guarantees an output pulse of fixed duration and known timing, and is often more useful than a one-shot in making short pulses out of input transitions.

Something was left unsaid about frequency dividers. A divide-by-16 makes one complete cycle of events per 16 input cycles. Four J-K's connected thusly have 2^4 or 16 **different** combinations of which flip-flops are "on" and which are "off". Each input edge produces a different combination. By properly examining the circuit one can tell **HOW MANY** input edges have ar-

rived. A frequency divider can be and usually is a **COUNTER**. ▲

Footnotes

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Other Reading

1. J. Anderson, T. Gray, R. Walker. "A second generation one-shot", Fairchild Application bulletin APP-173.
2. **Application Memos**; Signetics Corp. 811 East Arques Ave., Sunnyvale, CA. 94086. 1968.
3. Robert G. Middleton, **Pulse Circuit Technology**, pub. by Howard W. Sams.

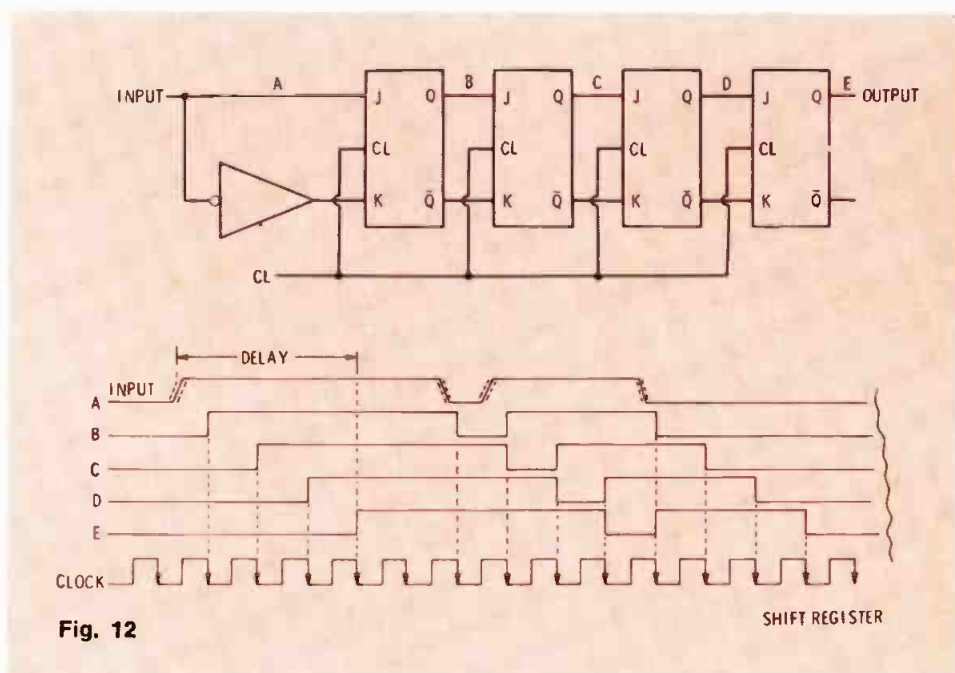


Fig. 12

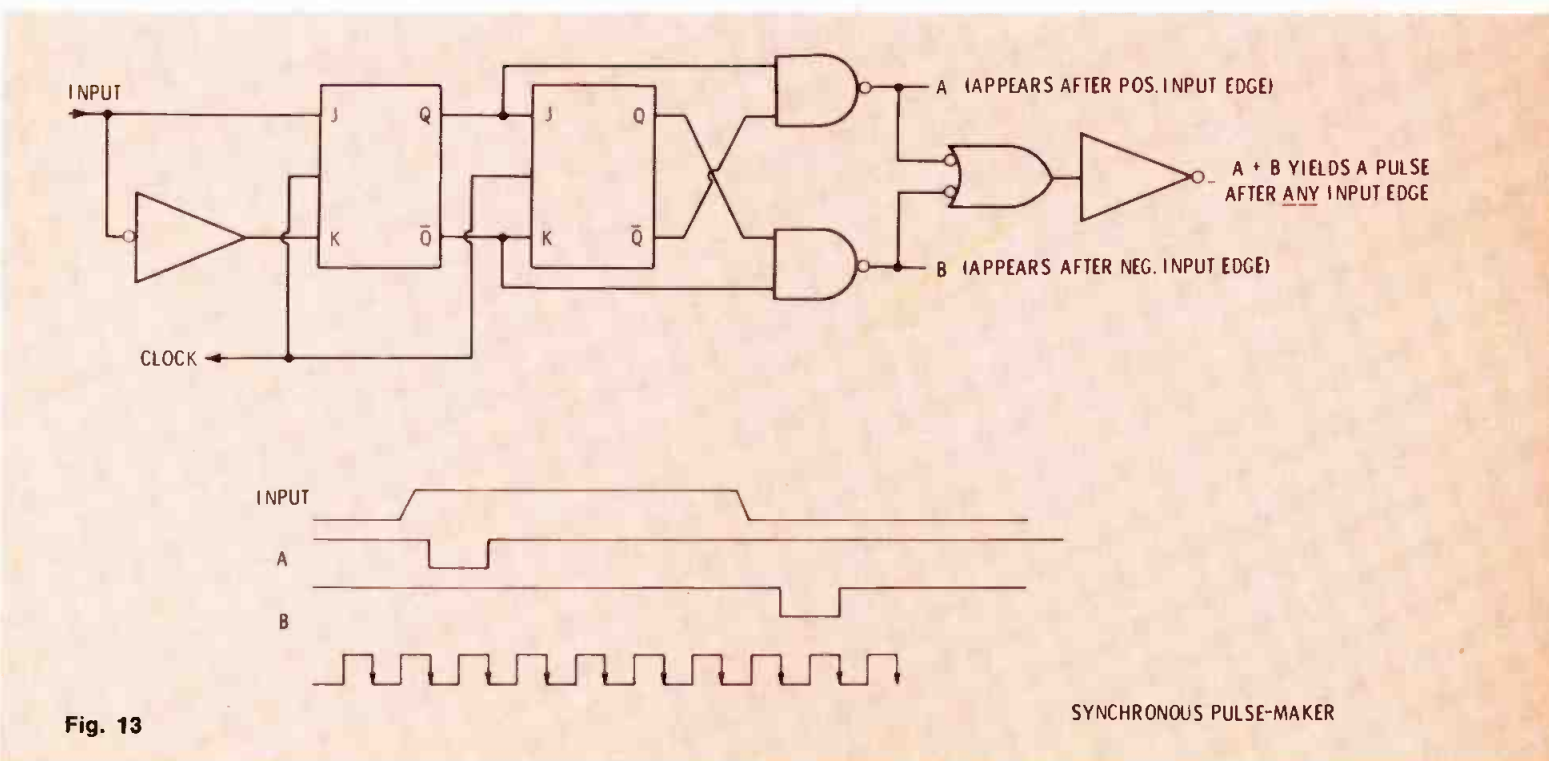


Fig. 13

Film In Local Origination

Part 4 of a series

By John G. Spence, Eastman Kodak

"With a small staff, a minimal investment in a camera that takes 35mm slides, and the part-time help of area high school students, we have proved that a cable television system can make a profit from local origination."

The man speaking is Robert W. Davison, general manager of Cablevision of Hendersonville, N.C., Inc. He continues:

"After six months of trial-and-error experimentation with sophisticated production techniques, we decided to simplify . . . to do what we can do best. In brief, we decided to offer local origination to subscribers as a source of material not available on other outlets. And it's worked."

In its effort to streamline operations, Cablevision first selected a local high school student (a senior with some experience in radio) as a control room trainee. After only three days, this student was able to handle live programming with virtually no errors. Then, as the experiment proved successful, the management hired two more teenagers as cameramen, gradually ex-

panding to the current complement of five part-time high school students in various phases of Cablevision's program origination.

Except for professionally produced materials, such as national automobile spots, most all of the commercials are created on slides shot by Cablevision's own photographer. The system sells these commercials in four programming segments:

- 1) Spots for the automated weather station.
- 2) Ads for special program sponsorships.
- 3) Spots for sponsors of regular programs.
- 4) Commercials for run-of-schedule (ROS) use.

Davison continues: "The weather station became a revenue source about the time that we reevaluated our programming and decided to streamline. Our weather unit was already equipped with a Kodak Carousel 650 projector, with an 80-slide capacity. We developed a method to add a cartridge-loading continuous-loop playback unit. It could be triggered by a mechanical

switch operating on the side of the projector, and closed by 'bumper' discs on the tray.

"A commercial spot package for the weather station now consists of four slides shot at the sponsor's store, plus an audio track. The price of the package is \$30 a month for continuous showing.

"Thus, 30-second commercial is broadcast at the end of each full sweep of the weather dials. With a full tray of 20 sponsors, each spot would be shown in rotation about every 39 minutes—with a potential monthly income of \$600. Our best month to date netted almost that amount."

Cablevision is a good example of the value of the building-block approach in the film system. As Davison describes it: "Color slides are the least expensive item in the production of a commercial. The reasons: A 20-exposure roll of Ektachrome-X film, bought in quantity and processed through a local camera shop, costs less than \$5 . . . or about 25 cents a slide. In addition, all slides are added to our in-station file and become a source of ad reruns and visuals for news shows."

Looking Ahead

The CATV management has learned that color slides are useful in other areas, too. For example, although Cablevision is now programming in black-and-white, a switch to color would be relatively simple, and plans are underway to make the conversion. Thus, reference sources, such as the color slide file, must be built for that eventuality. The CATV system also uses color slides for public relations efforts and for illustrations in talks before local civic groups.

"Slides are produced on a detailed shooting schedule," says Davison. "Photography is done after school hours and on weekends. We also shoot our own station IDs, as well as creative slides for special promotions."

Cablevision of Hendersonville, it turns out, is not solely tied to slides. Another profitable special centered on the use of football coaches' films from area high schools. The football programming ran from 1:30 to 7:00 p.m. on Saturdays during the season, and it was sold in three segments:

Film Behind The Scenes In CATV

There are, literally, dozens of other behind-the-scenes stories that could be told:

There's the CATV system in the Northwest that originates at least four hours of programming daily, including a newscast and local sports specials. Sixteen millimeter and super 8 film projectors have been incorporated into the film chain, along with a Kodak Ektagraphic slide projector. The manager is convinced of the need to move into full-color programming as quickly as possible, and he feels that film offers the best all-around choice for his CATV operation.

Another small cable system in California has done such a good

job of programming local events that it regularly attracts 30 to 40 percent of the daytime audience in the community. As a result, the system has been able to sell many local commercials. A problem arose when local advertisers found they were competing with black-and-white spots made on location against the sophisticated color ads seen on commercial TV.

The CATV manager solved the problem with color film shooting on location—even though he had access to a color videotape van for special events. Film has proved itself for day-in, day-out production at reasonable costs.

NCTA Wants Flexible Incentive

NCTA told the Office of Telecommunications Policy that only if the government adopts policies of "flexible incentive rather than coercion" will the cable television industry be able to fully serve the public interest.

The assertion was included in NCTA's response to OTP's request for "concise written statements" on broad issues related to cable's growth. In addition to urging that "a flexible and generally less restrictive regulatory environment would best serve the public", NCTA stressed that prompt adoption of the FCC's August 5th proposals is necessary to allow initiation of the measured growth of CATV. The association also noted that unless further government delay is eliminated, enormous social and economic advances will be forestalled.

OTP asked specifically for comments on six complex issues related to the future of cable television.

PUBLIC IMPACT — "Without fear of exaggeration," NCTA stated, "the long term impact of CATV on the public-at-large will be nothing less than revolutionary. But if the potential of cable is to be realized, some government regulation of non-broadcast channels is necessary—for example, minimum channel capacity requirements."

INDUSTRY STRUCTURE—NCTA stressed that cable TV should not be treated as a total common carrier if it is to evolve into an integrated distributing and programming service encompassing a total communications program. The CATV industry favored "some limits on the number of systems which any one entity can own or control and short term restrictions on cross-ownership of various media in the same market." NCTA also opposed municipal ownership of CATV systems.

ACCESS—The association said all responsible persons and groups

should have the opportunity to express themselves via a public access CATV channel. It noted, however, that development of access channels should be accompanied by legislation limiting the liability of the system owner.

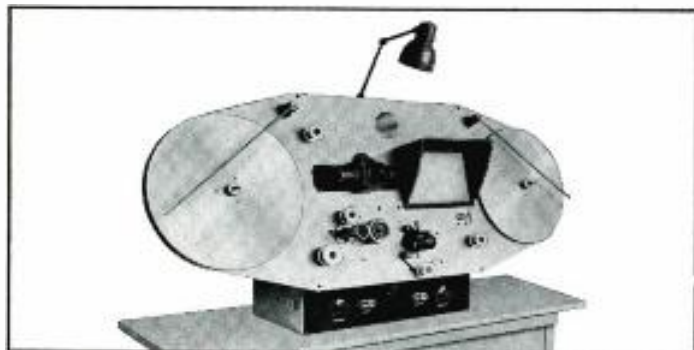
COPYRIGHT—The CATV industry supported "a blanket copyright solution to be included in a new law covering all non-originating uses of copyright materials." The association suggested a "compulsory licensing plan scheme" would be fair to all.

IMPACT ON EXISTING MEDIA—The development of CATV will have minimal, if any, adverse economic effects on networks or network affiliates, NCTA said. But it noted a failing stations doctrine could be instituted to rescue any station so affected where the public interest could be served.

REGULATORY FRAMEWORK—NCTA urged that there be "Federal preemption of the field of CATV regulation." The choosing of franchise areas, however, should be left to local communities.

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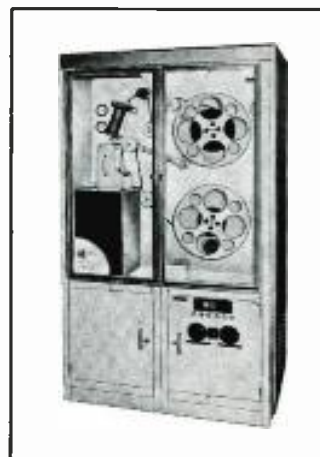
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hardware because of deterioration and/or obsolescence.

Figure 2 is a block diagram showing one trunk line amplifier, a diplexer and a line extender amplifier as would be used in a single-cable bi-directional CATV system. Reverse-direction signals are transmitted within the 6-32 MHz range and forward-direction signals are transmitted within the 50-220 MHz or 50-270-MHz range.

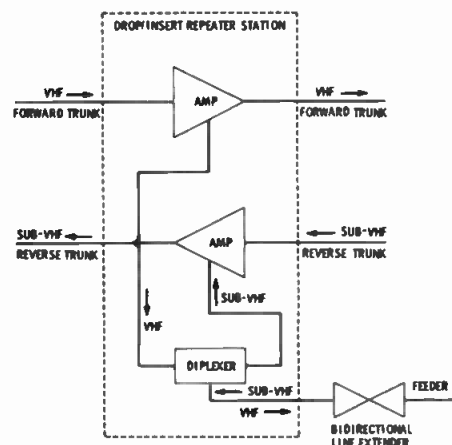


Fig. 3

Figure 3 is a block diagram showing a reverse-direction trunk line amplifier, a forward-direction trunk line amplifier, a diplexer and a bi-directional line extender amplifier as would be used in a two-cable system. Reverse-direction signals can be transmitted within the 17-90 MHz range and forward-direction signals in the 50-270 MHz range. Or reverse-direction signals can be transmitted also within the 50-270 MHz range. When dual-feeder cables are used as shown in Figure 4.

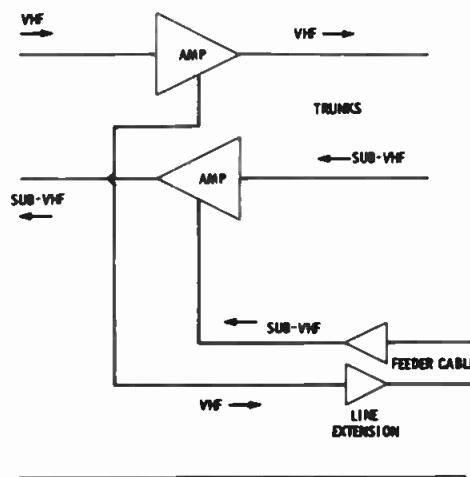


Fig. 4

The advantage of limiting reverse-direction transmission to the 17-

90 MHz range is that fewer trunk line amplifiers are required in the reverse-direction trunk cable. Another advantage is that reverse-direction television channels can be transmitted on the aural and visual frequencies of Channels 2 through 6 to the head end and then routed back over the forward-direction cable without requiring frequency translators at the head end, as shown in Figure 5. This, however,

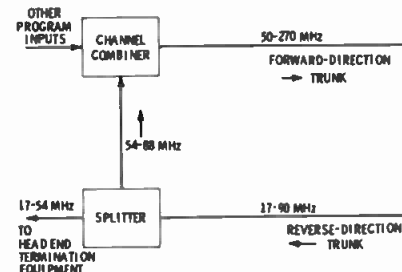


Fig. 5

could prevent the use of some or all of these channels for transmitting of off-the-air programs.

The diplexer mentioned earlier routes the signals from the forward-direction trunk cable into a feeder cable, and signals from the feeder into the reverse-direction trunk cable.

The reverse-direction frequency bands of 6-32 MHz and 17-90 MHz mentioned here are those suggested by one manufacturer. Others may opt to use other frequency bands starting higher or lower. The wider the separation between the reverse-direction and forward-direction frequency bands in a single-cable system, the less costly the required filters and the fewer the technical problems.

When Do We Start?

It is true that bi-directional transmission capability does not come cheap and requires carefully engineered electronic hardware, particularly for single-cable systems, but the day has arrived when it is no longer a matter of "if" two-way CATV is practical, but is now a matter of "when" implementation is to be started. One engineer, when asked about how long it took to design bi-directional CATV hardware, replied: "since it was impossible, it took a little longer".

An important word from your local sponsor.

If you want to attract new subscribers, use the power of film. Film can cover your market, and make local origination truly local. Film's flexibility and portability make it an ideal medium for putting local news, sports, and public-interest features into a CATV system.

Film can help cover your expenses, too. With film you can shoot simple commercials that fit the needs of your local sponsors. Film lets you go out to the advertiser, and record his message right at his place of business.

Local origination can be a lot easier with film. And nobody knows more about film than Kodak. If you want the complete story, call the Kodak office nearest you. Find out how easy it is to get the evening news on film, before and after a word from your sponsor.

EASTMAN KODAK COMPANY

Atlanta: 404/351-6510; Chicago: 312/654-5300; Dallas: 214/351-3221;
Hollywood: 213/464-6131; New York: 212/262-7100; San Francisco: 415/776-6055.



manufacturer states that these kits can be used with any make of line amplifiers. The availability of this kind of hardware makes it practical right now to add two-way capability to a CATV system.

The alternative is to add a second cable using one-way amplifiers of the same type as used for forward-direction transmission. This provides as much transmission capacity in the reverse direction as in the forward direction. The cost and complexity of such a system de-

pends upon whether reverse-direction signals are to be applied to only the trunk cable or to both the trunk and feeder cables, as well as if parallel reverse-direction feeders are to be installed or if the existing feeders are to be equipped with bi-directional amplifiers or filtering devices. These options are illustrated in Figure 1.

Initial Decisions

When starting from scratch, the decision on whether to use the single-cable technique or the two-

cable technique has to be based on cost and performance standards, as well as on required reverse-direction transmission bandwidth. Since no one can accurately predict how much reverse-direction bandwidth will be required in the future, particularly in highly populated areas, it might be less costly in the long run to install a two-cable system initially. Also, consideration should be given to estimated cable life and to when in the future it may be necessary to replace the electronic

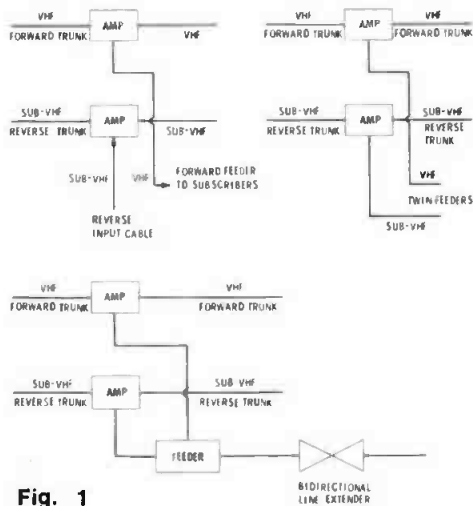


Fig. 1

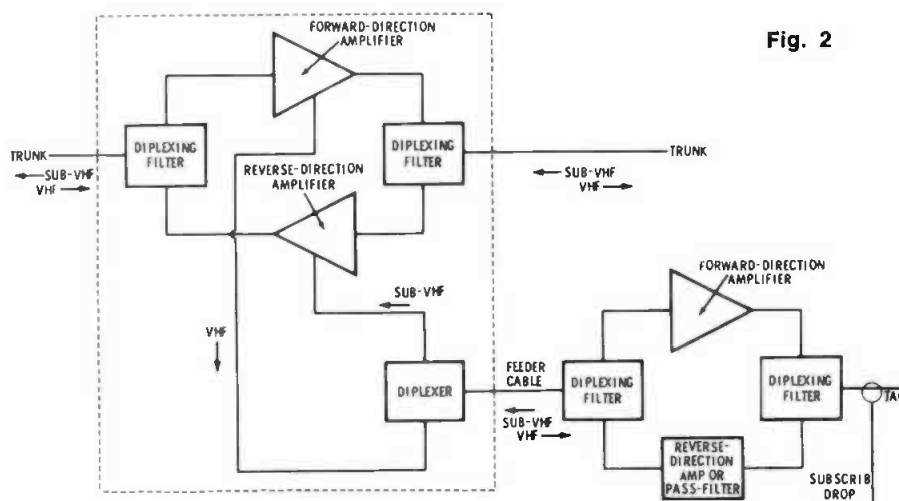


Fig. 2

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(216-300 MHz) ± 1.5 dB or better.

No sensitivity drop-off at high end.

Also available VHF-UHF Model FS-3.

Meter shown with 5-54 MHz MARK 11 Adaptor, available separately

BE-1

new. Back in 1961, Harold Gruen, who was then with Philco and who is now president of i.i. Communications, designed a bi-directional coaxial cable amplifier which could be used in systems transmitting either or both telephone channels and television.

Your CATV editor must assume some of the responsibility for publicizing bi-directional CATV before the required hardware had been developed. The articles he wrote on this subject were not PR-motivated. Their intent was to stimulate the CATV industry into developing the required hardware and at the same time to help create a demand for bi-directional CATV. The industry would stand still in technology were it not for new challenges.

Canada Moves Ahead

Bi-directional CATV is no longer something that has to be put off into the future because of the lack of the required hardware. In fact, the lack of off-the-shelf hardware did not deter a Canadian CATV system operator from providing bi-directional CATV facilities several years ago. In this particular system, reverse-direction transmission is used for conveying remote pickup programs to the head end for forward-direction transmission to the subscribers.

There are two practical approaches at the present time to implementation of two-way cable transmission. One way is to use a single cable for transmission in both directions. The other way is to use separate cables, one for each direction of transmission. From the standpoint of engineering problems, the two-cable approach is simplest and perhaps best. But it is more expensive than using a single cable.

To convert an existing unidirectional CATV system for two-way transmission, retrofit kits are available. By using these kits, a second trunk cable does not have to be added. The kits offered by one manufacturer are used with existing line amplifiers and enable transmission in the reverse direction within the 6-32 MHz range of three color TV channels and several digital channels and continued transmission in the forward direction of TV channels and FM band signals to the subscribers. The

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Circle Number 18 on Reader Reply Card

PBS tries shortcut to TV tilting

By Jim Karayn, PBS, and
Walter Muckle, CBS Labs

■ The increasing use in television broadcasting of visual titles superimposed upon the video presentation of special events and news programs has presented a challenge for a long time to television research engineers for faster, better and less expensive means of producing the needed graphics. Various methods developed over the past 20 years have required many people and complex, expensive equipment—and a camera.

The introduction of computer display terminals a few years ago sparked various methods of using, in one form or another, computer characters for television titling.

The basic dot pattern, used in most computer graphic systems, simply was not adequate for regular home viewing. It lacked clarity as well as flexibility. Continued research evolved the stroke matrix. Strokes offer a distinct advantage over dot patterns by analyzing intersections on a line-to-line basis, instead of viewing the letters on a fixed-grid pattern or matrix.

Exhaustive studies into proper character height, shape, line-to-line spacing and other essentials enabled CBS Laboratories to develop a new system design concept, with the resultant production of a highly flexible and legible electronic character generator. This CBS Laboratories system is known as Vidifont.

Vidifont is designed to eliminate the major need for artwork or menu board titling—or a camera—by providing the broadcaster with instantly available electronically generated graphic looking characters, simply by pushing a few buttons.

Vidifont provides the user with two switch selected fonts or type sizes, each with proportional spacing. All characters assume their full spread and width. For instance, "W" occupies four times the space of "I".

The equipment configuration for the Vidifont is based on a modular concept for improved maintainability and reliability. The basic system is contained in a logic drawer 8.75 inches high, 19 inches wide and 19 inches deep.

Vidifont On NET

Vidifont was used recently on National Education Television's (NET) fast-paced Homefront 71 network documentary. Homefront 71's producer Jim Karayn, director Alvin Mifelov and production

manager Jim Solt expressed their belief that this working demonstration of Vidifont's flexibility, clarity and versatility enabled them to add to their home viewers' digestion of this highly information program via the quality of the visual supers of questions put to panel members and of their answers—virtually a sophisticated version of "show and tell" for better understanding of the conclusions on vital subjects developed by the program.

The use of the Vidifont system on Homefront 71 was a step-by-step example of the system's efficient adaptability to special events and "ad lib" programs. The studio Vidifont operator was provided with a regular show script. Simple blocks were used to illustrate the text and

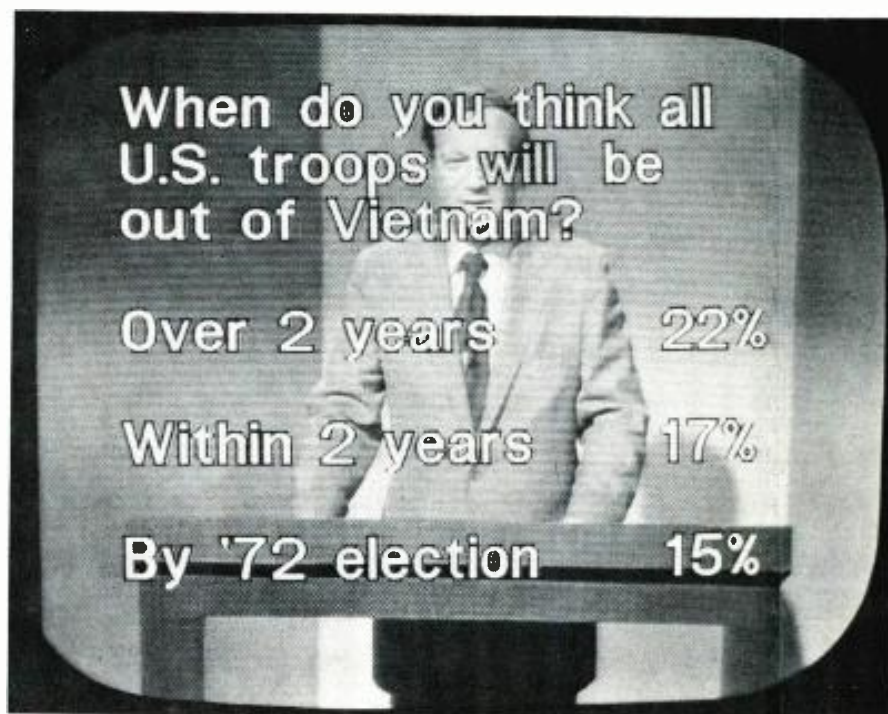


Fig. 1 A mix of upper and lower case letters enabled NET to super any kind of length or title in real-time over a participant or commentator.

its planned location on the screen. Each page (title) ran in show sequence. The operator set up the font size, typed and centered the text from his keyboard, and stored the information in a selected group of address locations. Each title was

given a number and worked into the director's script. When a title was needed, a number was called, the operator pressed two buttons, and the title appeared on the studio switcher for immediate insertion by the director.



Fig. 2 Vidifont system is operated by a typist who punches out programming information as needed.

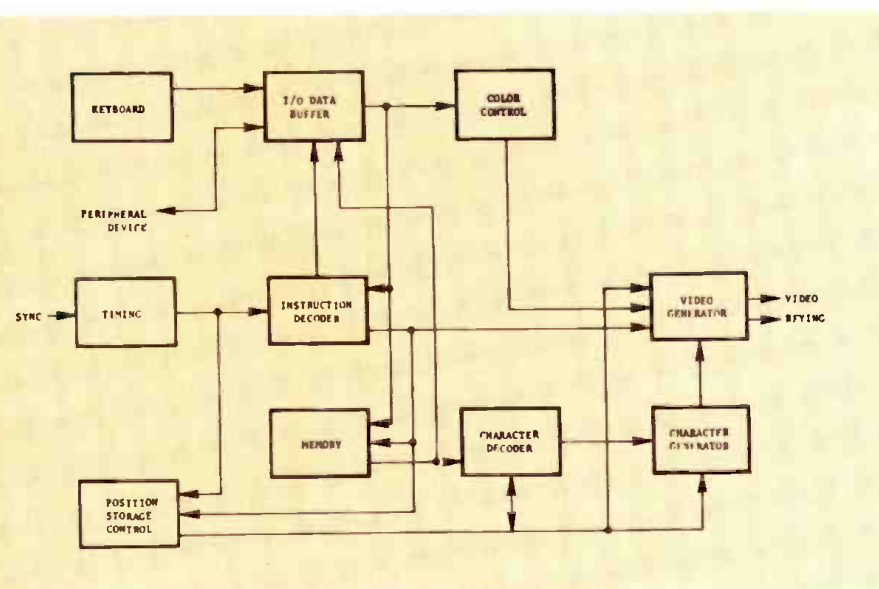


Fig. 3 The block diagram of the Vidifont character generation system for TV titling depicts adaptability to real-time demands.

System Flexibility

During the broadcast, every form and type of title was utilized. Panel members had from one to three line supers. Dates were inserted over video segments shot months before. The live commentator read messages as they were rolling up the screen with certain key words colored and flashing for greater emphasis. At the director's request, titles were changed and rearranged out of the original sequence. And not a single piece of "hot press," title cards menu boards or slides were used during the production.

The Vidifont system has the capability of producing a 62 character set, 28 video scan lines high, with upper and lower case and full punctuation. An additional set of 64 upper case characters, 18 scan lines high, permits the studio operator to display on demand up to 10 or 12 rows of information, with a maximum of 50 characters per row. Special font styles can be designed and changes made in the field to implement them.

Slides and supers which cost up to five dollars to produce with conventional methods can be done instantly without special preparation or processing. Any message, properly composed and stored, can be re-shown not only in a full page mode, but also in roll (bottom to top) or crawl (right to left).

Standard two speed roll and crawl, with word-by-word color in six hues plus black and white, and automatic tabs and centering are available.

Magnetic storage devices, which permanently retain broadcast material from week to week and longer, allow any recorded information to be recalled by an address for display. Storage capacity of 800-9600 display rows are available. Any row or page of titles can be aired immediately by pressing four address keys and a "READ" button. The memory automatically advances from one address to the next as each message is recalled. A whole program can be aired by pushing

HOW TO SPOT A GREAT AUDIO CONNECTOR

only two buttons—at the operator's speed.

Basic System Functions

The compact Vidifont system provides four basic functions: Interface, Timing and Control, Storage, and Character Generation provided on 17 subsystem logic cards.

The Interface provides access to and from the basic Vidifont and its keyboard and peripheral devices.

The Timing and Control subsystem provides the basic timing and generates the necessary internal command lines and instructions to sync properly the characters generated with the display, to provide proper format of video output, and to provide basic timing comparisons.

The Storage subsystem is the Memory itself. The Memory consists of circulating shift registers with eight bits of character storage provided per character word, up to 50 character words permitted per row, and 12 or 16 rows of complete storage depending on the system configuration.

The Character Generation information is stored in dynamic recirculating MOS shift registers which are utilized as a controlled delay line. One single Memory package is equivalent to 600 transistor stages, dissipates approximately one milliwatt per stage, and costs less than one cent per transistor.

In addition to the enhancement of special events coverage with the use of Vidifont, the system drastically reduces costs as it increases efficiency. If the average station pays only \$75 per day, including manpower and materials, to produce titles by special art and camera, it is faced with an annual expenditure of \$27,300 based on seven days a week usage. No special equipment is needed to make the system perform. The output is video. Vidifont, which can be switched like a camera without tying up a costly camera and crew, represents an entirely new state-of-the-art advance in electronic character generation for television. ▲



U.S. Patent No. 3,219,961
Canadian Patent No. 761,114



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A solid state design for a 2 GHz heterodyne repeater

By F. P. Collins and D. Shine*

■ The requirements to transmit wide band information such as video or multi-channel telephone and wide band data over long distances with minimum distortion requires highly sophisticated transmission equipment. Historically, this equipment has been with remodulating terminals with base band repeaters or intermediate frequency heterodyne systems.

The remodulating type repeaters take the base band information, be it multi-channel multiplex signal or an actual video signal, and directly modulate a radio frequency oscillator. Older type equipment employed a klystron oscillator operating directly at the desired microwave frequency.

In later remodulating equipment, a transistor oscillator was used to drive solid state power amplifiers which, in turn, drove varactor multipliers at the desired microwave frequencies. In some of the more recent equipment, these oscillators and power amplifiers operate directly at the lower microwave frequencies and in these cases no varactor multipliers are required.

The receiver portion of the remodulating terminal converts the microwave signal to an intermediate frequency and then fully demodulates and amplifies the base band signal to a level comparable to that of the original input signal.

Due to the demodulation, amplification and remodulation, distortion can become appreciable in long-haul systems. This distortion is chiefly caused by the phase and gain slope distortion in the modulator, discriminator and base band amplifiers necessary to restore the original base band information. High frequency phase and gain linearity is also affected by the IF and RF circuits which can cause intermodulation distortion. For short-haul systems this small distortion can be tolerated but in long-haul systems the total accumulative

affects of this distortion can be severe.

As an example, if a video signal is to be transmitted where low frequency pulse response is important, the distortion will increase arithmetically one for one with the number of hops. Also, the base band frequency response of the system degrades randomly as the number of hops.

Intermediate frequency, heterodyne repeaters are used for medium- and long-haul service since they do not suffer demodulation and remodulation distortion. Figure 1 is a typical block diagram of a heterodyne repeater. In a heterodyne system the received microwave carrier is mixed to an intermediate frequency where it is filtered, phase equalized, and amplified to an appropriate level where it is remixed back to a different microwave channel for further

amplification and retransmission.

Since the intermediate frequency signal is not demodulated and a new RF carrier is not generated by means of a baseband modulator, this type of system does not suffer the distortion inherent in a demodulating type repeater.

System Distortion

There is some distortion that is common to both remodulating and heterodyne systems. These distortions are caused by non-linear phase and gain slopes in the intermediate frequency and RF circuits. For medium- and long-haul applications where many hops are involved, the heterodyne type system with its lower distortion characteristics has proven to be required. Great care must be given to the time delay equalization in the IF and RF circuit filters if the total accumulative

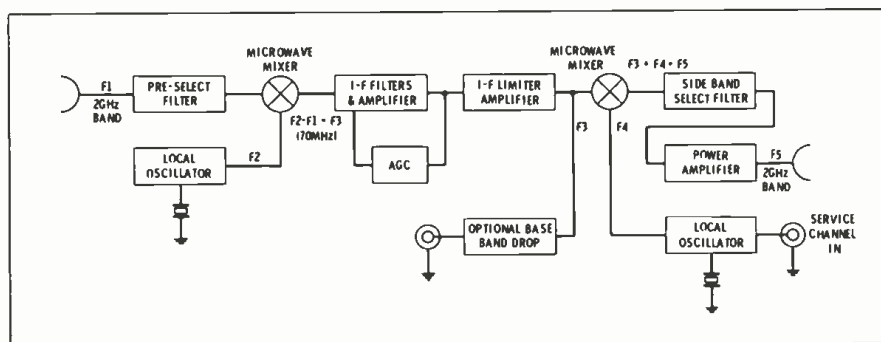


Fig. 1 A 2 GHz heterodyne repeater.

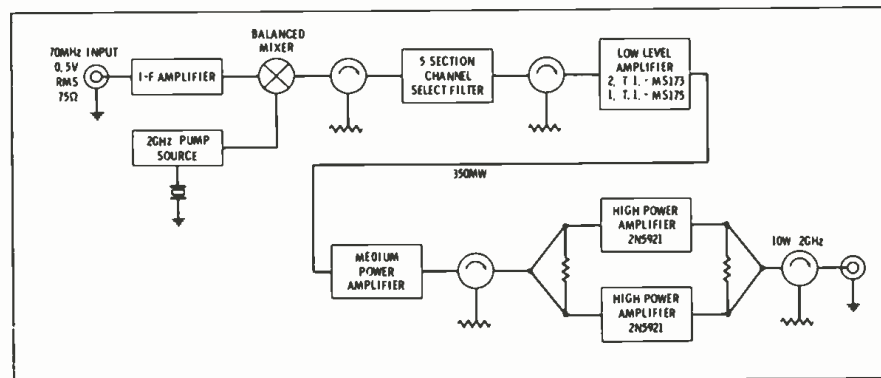


Fig. 2 2 GHz RF source.

*Microwave Associates

distortion is to be kept at a low level.

Heterodyne transmitters generally have higher output powers since they are designed for use in long-haul links in order to minimize the number of hops required and provide high fade margin. The power output generally ranges from 3 to 10 Watts for heterodyne equipment whereas remodulating transmitters range from 0.1 to 4 Watts.

Appreciating the need for a total solid state, high power, low noise and low distortion 2 GHz heterodyne repeater, the MA2H was developed. It is designed to provide medium- and long-haul transmission of wide band data on video information. The advent of high power solid state components initiated the development of a 10-Watt high power source. This amplifier provides one of the first requirements for the successful development of the high power heterodyne repeater.

This source, as shown in Figure 2, consists of a low level upconverter which drives a low power 2000 MHz amplifier. The output from this low power amplifier drives a series of amplifiers which generate the 10 Watts of RF output.

The Upconverter

The upconverter uses a stripline hybrid type balanced mixer and IF amplifier. The IF amplifier amplifies the 70 MHz signal which drives the mixer. The 2 GHz pump source consists of a crystal oscillator operating at approximately 100 MHz which drives a transistorized power amplifier and high order varactor multiplier which produces 60 mW of power at 2 GHz. The 2 GHz pump source and the 70 MHz IF signal are mixed together to produce the desired 2 GHz carrier frequency.

A sideband select filter is used following the mixer in order to select the desired signal and attenuate the pump signal and unwanted sideband.

The filter is a five section interdigital filter providing a further 60 dB of carrier rejection and 70 dB of unwanted sideband rejection.

Following the upconverter and side band filter is a 3-stage strip-

line amplifier. This amplifier has a gain of 17 dB and produces an output of 350 mW.

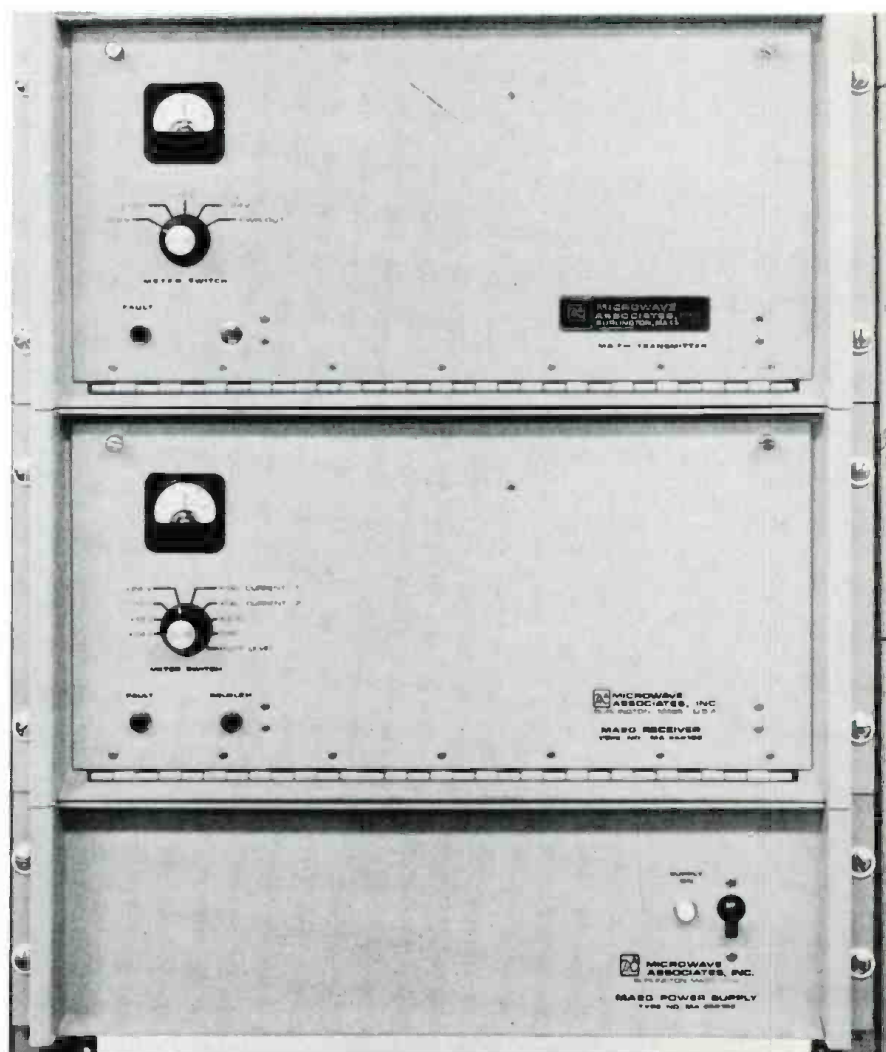
The amplifier utilizes Texas Instruments TMS173 transistors in the first 2 low level stages and a TMS175 in the output stage. All three stages operate Class A in a grounded emitter configuration providing linear operation over a wide dynamic range. The output from the low level stage drives an RCA 2N5920 transistor which has approximately 10 dB of gain. This transistor is operated in common base configuration in a coaxial circuit which provides optimum efficiency. The DC to RF efficiency of this amplifier stage is approximately 40 percent.

DC To RF Efficiency

The output from this stage drives a 3 dB 90° power splitter which drives a pair of RCA 2N5921 tran-

sistors. These transistors also are used in a common base coaxial configuration. The output from the 2 transistors are recombined in a 90° stripline hybrid producing in excess of 10 Watts. With this conservative power combining approach, if one final amplifier transistor should fail, then the power would only decrease 6 dB and the system would still function. The total DC to RF efficiency of the amplifier chain is approximately 15 percent with a total gain of 33 dB. Since the bandwidth of the amplifier chain is in excess of 120 MHz and the total occupied bandwidth in any given repeater is less than 25 MHz, the group delay or phase nonlinearity through the amplifier is insignificant.

Since these amplifiers do not contribute any appreciable phase or group delay, the transmitter need only be phase equalized for the de-



Complete 2 GHz heterodyne repeater.

lay contributed by the side band pre-select filter. The delay contributed by the side band filter is equalized at IF with an all pass phase equalizer.

The pump source may be phase modulated by a high frequency single side band suppressed sub-carrier providing service channel and fault alarm insertion at each repeater. This provides an inexpensive means of transmitting fault alarm information.

The output power of the transmitter is monitored and in case of a failure, an alarm is provided which may be used to switch to a redundant system in a hot or cold standby configuration. This will provide the protection necessary in long-haul circuits where protection is required.

This product represents the first commercially available 2 GHz all solid state heterodyne repeater using 2 GHz high power transistors.

An optional power amplifier unit is available extending the power

output capability to 20 Watts where required.

This transmitter represents maximum power and efficiency capabilities of solid state devices currently available at this frequency. With the advent of the 2 GHz transistors enabling amplification at the actual output frequency, the only further advances expected in the next few years is lower cost transistors which would result in lower system cost.

The receiver used in the heterodyne repeater is similar to the receiver that would be used in a re-

modulating type repeater with the exception that output is taken directly at IF in order to drive the transmitter. IF splitters are used and base band drops at repeater points are available.

The amplitude and phase equalization is more critical since there are generally more hops involved in a heterodyne system.

It is anticipated that the output power achieved at 6 and 12 GHz using the all solid state techniques will increase during the course of the next few years. ▲

Manufacturer's Test Results

	1 Hop	4 Hops
*Video signal to noise ratio	75dB	69 dB
*Video signal to noise ratio versus path loss	See Figure 3	
*Differential phase 3.58 MHz	0.1°	0.2°
*Differential gain at 3.58 MHz	0.1 dB	0.15 dB
*Signal to hum	60 dB	54 dB
Power output	11 Watts typical	
DC input power per repeater	100 Watts	
960 Channel message performance	See Curve #4	

*Measured per EIA Standard RS250A.

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I explained them, and the DJ immediately suggested that we use the tone to indicate the end of recorded material on commercial cuts. Installation of a light near the console VU meter, and a power supply to operate it, was all that was necessary to institute the system. The result is neater, tighter on-the-air production. Figure 1 shows how.

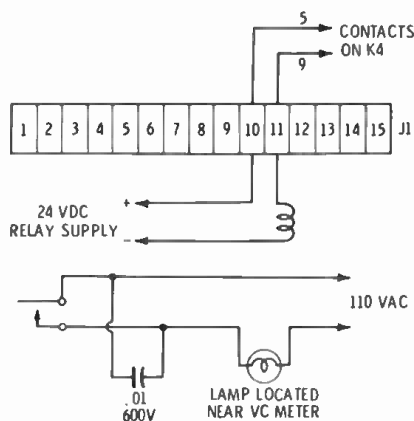


Fig. 1

Another of the air staff wanted to know why I didn't install a switch in the production room cart machine, to disable the record cue head so that he could make more than one cut in succession without having the machine stop between them on playback. It seems this feature is handy in preparing certain types of commercials with a whole series of sound effects or cuts from albums for Country-Western "show" spots.

I deferred doing anything about it for a while, since I have a strong objection to drilling holes in the front panels of commercially built equipment. It spoils the resale value, and often the looks and operating convenience designed into the gear.

The machine in question is an ATC Criterion, and it did have an extra switch, never used at KAYO, for a tertiary 8KHz cue tone oscillator. I thought about simply installing a "push-on, push-off" switch, like the machine's AC switch, across the record cue head, but gave that up as sort of crude. A study of the Criterion diagram, however, suggested a sophisticated approach, at least in terms of not cutting holes.

Associated with the tertiary cue tone record button, is a relay K-604, which supplies lamp indication to the moxex lamp/switch, and switches the -22.5 v. supply from cutting off transistor Q-902 to supplying voltage to the cue bias oscillator, Q-801 and Q-802. K-604 is a P & B KHP17D11, which is a 4PDT relay. (See Figure 2.) The following wiring changes in its circuit, allow the button, formerly used to control the tertiary cue, to disable the stop cue, give a visual indication that the cue is disabled, and without affecting the operation of the secondary cue.

The wire which connects pin 8 of each of the three relays, K-603, K-604, and K-605, should be removed from pin 8 of K-603 and K-604. Pin 8 of K-604 should be connected to pin 4 of K-603, without changing the existing wiring at that point. Pin 3 of K-604 should be connected to pin 8 of K-605 and the bias oscillator B terminal. Refer to Figure 3.

In addition, so that the indicating lamp will indicate if the cue is disabled when the tape is not in motion, remove the wire from the side of the S-602 Moxex switch that isn't connected to the coil of K-604 and

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300	8 1/2 min. (320')	3.70	
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the lamp. Wire this switch connection to the -22.5 v. supply at a convenient point (pin 8 of K-601, for example).

The machine will now operate normally if the red light behind the Molex switch is not lit. If the light

comes on when a cart is inserted in the machine, it will record normally, but will not put a stop tone burst on the tape. It will be necessary to change the Molex switch to a "push-on, push-off" type, instead of the momentary contact type, of course.

**Ben Dawson
CE, KAYO
Seattle**

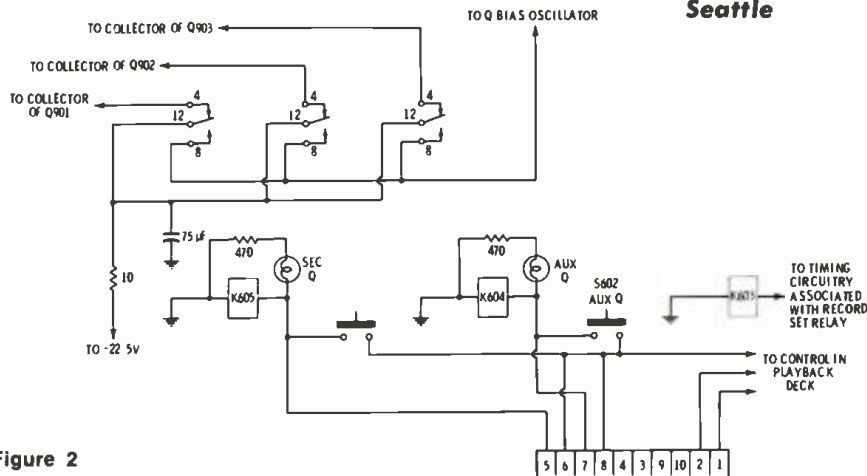


Figure 2

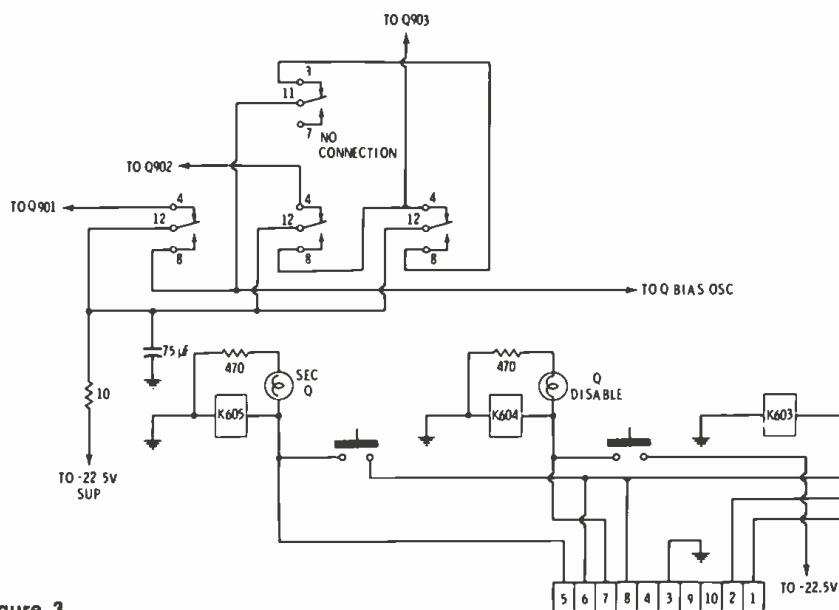


Figure 3

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BROADCAST ENGINEERING

Church Remotes Revisited

I was greatly amused with the article "Riding Church Remotes" in the February 1971 issue of BE and deeply sympathize with Phil Whitney, of WINC and all others who find themselves with these problems. Perhaps I can offer some help along these lines.

I would suggest a circuit that I developed many years ago, which licked most of these problems. It may be used in various ways, from turning on remote amplifiers, to giving signal cues to speakers, as well as a PL to talk over when needed.

The 600 ohm line transformers are used, (these are available from the telephone company or many other sources) and connected as shown in Figure 1, act as isolation transformers. (No pad is necessary, as shown in the previous article, and should not be used.) The transformer at the remote end acts as a bridging transformer and will not load the low impedance secondary winding of the amplifier output transformer, used to feed the speakers of the PA system.

It should always be connected to the same terminals as the speakers. Either use the primary winding in series (for 600 ohms) or in parallel (for approximately 250 ohms) to bridge the taps used for the speakers. The 600 ohm connection will reduce the gain to the station. In case of a powerful amplifier and a greater reduction of gain is re-

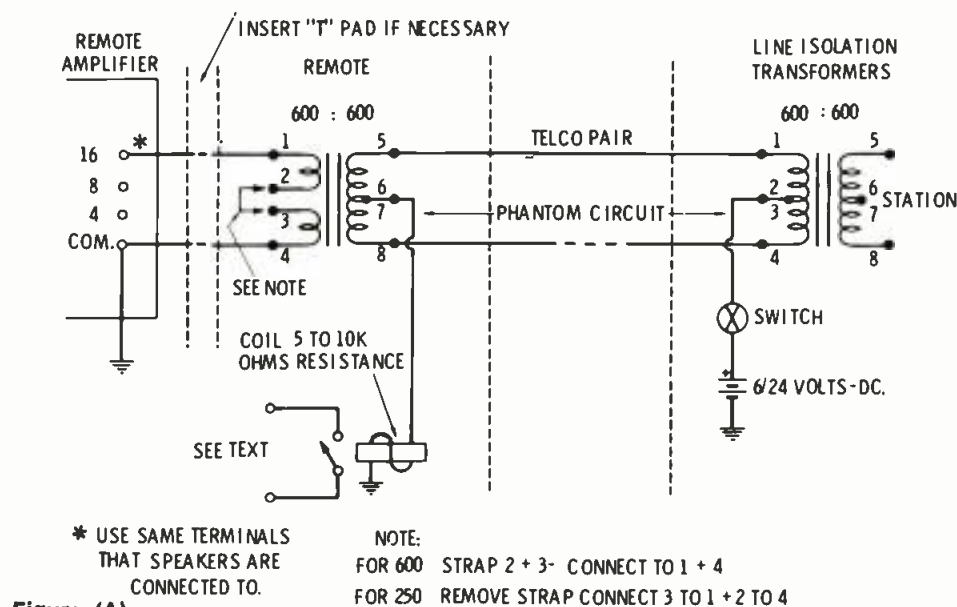
quired use a 200 or 600 ohm variable "T" Pad, between the output of the amplifier and the primary of the line transformer and set accordingly. Do NOT put the pad in the secondary or line side of the line transformer, as it would interfere with the control circuit which is explained next.

Using the center tap of the 600 ohm windings, as shown in Figure 1, is called a phantom circuit and is now widely used throughout the telephone system and some network radio stations. Due to the balanced windings of these transformers, no switching clicks, or even speech used over the phantom circuit, is ever heard over the regular radio line. Try it, you will be greatly surprised.

Any relay with a winding of approximately 5,000/10,000 ohms may be used and will draw very little current, when used with a DC voltage from 6 to 24 Volts.

For those unfamiliar with impedance matching, let me explain, you can always bridge a low impedance value output, with a high impedance up to 25 times or more its value, with the result of nothing more than a loss in gain. It is when you try to feed a high impedance output into a low impedance load that you get a mismatch.

Warren T. Abbott
Engineering Consultant
San Diego, Calif.



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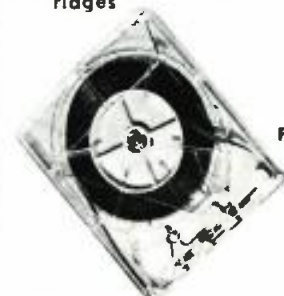
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LONGER
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20 or more cartridges SHIPPED PRE-PAID

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NEW PRODUCTS

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

Chromium Dioxide Cassettes

Memorex audio cassettes containing high performance chromium dioxide tape are now available on a nationwide basis.

According to Memorex, chromium dioxide cassette tape prom-

ises dramatically higher recording output over conventional ferric oxide tapes at high frequencies. These tapes offer better signal-to-noise ratio, lower print-through, and greater recorded signal stability.

Especially suited to slow speed

audio tape recording applications, Memorex chromium dioxide cassette tapes, in 60 and 90-minute configurations, not only have inherent advantages in sound performance, but also possess the same standards of reliability and convenience as Memorex gamma ferric oxide cassettes.

At least six major equipment manufacturers are currently marketing cassette recorders specially designed for use with chromium dioxide cassettes. These machines usually provide a switch which allows the consumer to set the bias and equalization for either chromium dioxide or ferric oxide tapes. On conventional equipment, chromium dioxide is "underbiased" and, therefore, will not deliver its full potential.

Chromium dioxide can support a 30 percent higher magnetization and the particles are considerably more needle shaped than iron oxide particles. They are single crystals and free of the defects common to all ferric oxide such as porosity and the formation of branches.

Circle Number 60 on Reader Reply Card

Three-Speed Turntable

LPB, Inc., Frazer, Pa., introduces its model S-7 three-speed turntable with hysteresis synchronous motor and heavy 6-pound platter for minimum wow and flutter.

The new LPB S-7 Turntable is designed for radio, television, CATV, recording studios and other applications. The LPB S-7 limits vertical and lateral rumble to -36 dB reference standard NAB level. Wow and flutter is less than 3/10 of 1%.

Instant start with minimum rum-



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for you, the professional...

The Gray Model 303 Micro Trak® Tone Arm

Tracking capabilities as low as 1/10 gram, resonance less than 10 Hz. Absolute simplicity and yet incorporates a plug-in memory balancing head, sapphire jewel bearings to provide virtually frictionless vertical rotation. We'll be pleased to forward complete specifications on micro trak at your request. . . . You'd probably worry about it if it wasn't from Gray.



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2 NEW
Low Cost

AM FREQUENCY MONITORS



MODEL 520
DIGITAL

MODEL 510
ANALOG

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- Solid state design.
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- Fits standard relay rack.
- Remote metering available — Model 510



METRON INSTRUMENTS, INC.

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Circle Number 42 on Reader Reply Card

ble is achieved by rim drive with full speed being attained in 1/16 revolution.

The heavy duty motor of the LPB S-7 is housed in a 16 pound solid cast aluminum chassis with attractive Royal Blue finish of textured Armorphide and bright yellow felt platter cover. The chassis is adaptable to any 12" tone arm.

Circle Number 61 on Reader Reply Card

Macro Zoom Lens For One-Inch Vidicons

A new zoom lens with macro-capability for institutional/industrial television is available from Canon U.S.A., Inc.



Designed for use on 1" vidicon cameras, Canon V10X15 TV macro zoom has a focal length range of 15-150mm. And a speed of f2.8. Achieves ultra-close up effects by rotating the macro ring. As close as 1mm away from the vertex of the front lens element.

Optical back focal distance is 25mm. With an overall length from focal plane to front of lens of 193.8mm.

Circle Number 62 on Reader Reply Card

Broadcast Color Video Film Recorder System

Availability of a complete broadcast quality tape-to-film transfer system is announced by Teledyne Camera Systems.

Designated Model CTR-2 (Color "Telefilm" Recorder), the system includes a special display tube, complex signal processing, complete built-in test facilities, pneumatic-transport camera, and a new Teledyne closed-loop phase-locked camera drive system. Special consideration has been given to human factors in the system's operation.

Prior to photographing program material from the face of a high

resolution, high-light-output, state-of-the-art 19" display tube, the video signal undergoes extensive processing. Both horizontal and vertical aperture equalizers are used to provide optimum detail resolution. The composite signal is routed to a comb filter decoder to completely separate chrominance and luminance. Maximum chrominance information is obtained with minimum degradation of the luminance signal. A built-in vector scope permits accurate analysis of the demodulator output. The signal is applied to an electronic mask in the gamma amplifier and is gamma corrected to best match the transfer function of the film. The CTR-2 is suitable for both negative and reversal color film. Scan reversal is available.

Test facilities built into the CTR-2 are usually complete. No external test equipment is needed beyond that which is normally available in a modern TV studio. A built-in wave form monitor is switchable to all major subsystems. Independent brightness and gain controls for each gun allow high exposure levels. A built-in ten-step gray scale generator and a photometer with high and low level scales and digital readout permit setting correct relative level of each color prior to recording. Exposure repeatability is within 2% at two light levels. The test generator is also used to record a standard color test signal at the beginning of each reel of film for quality control in processing.

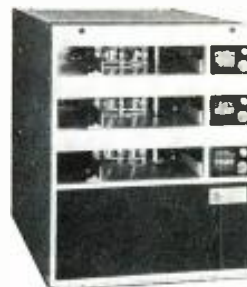
Camera is Teledyne Camera Systems' Model DBM-64B equipped with a 35 mm f/1.3 lens. A burst of air advances the film. Pulldown and stabilization occur well within the standard TV blanking interval. A fixed register pin assures accurate registration. All moving parts are completely rotary—no cams, claws, or reciprocating parts to wear and require adjustment and replacement. Vibration is eliminated. Picture steadiness and overall picture sharpness are superior. Maintenance time and costs are insignificant.

Circle Number 63 on Reader Reply Card

(Continued on page 56)

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to
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THREE FOR THE PRICE OF TWO



3D SERIES REPRODUCERS 3D-0001 \$1395

- Three Rugged Cartridge Machines in One Small Package
- 450 RPM Common-Capstan, Direct-Drive Motor
- Independent control and Audio for Each Deck

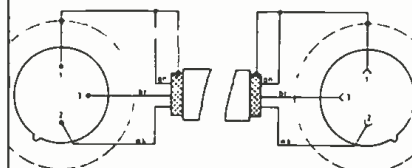


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A "simple" microphone extension cable isn't so simple. Not if it's going to match today's phase accuracy and continuity requirements!

At Gotham, we start with double RF shielded, 3-conductor cables made to Neumann's tight specifications. And we attach Switchcraft "Q-G" (XLR compatible) connectors with a special technique, so the connector shell is grounded.

Our price? Practically what you'd pay for cable and plugs alone. Ten feet, \$7.50. Twenty-five feet, \$10.50. Fifty feet, \$16. One hundred feet, \$27.

Order through your Neumann Microphone Dealer. Or from Gotham directly.

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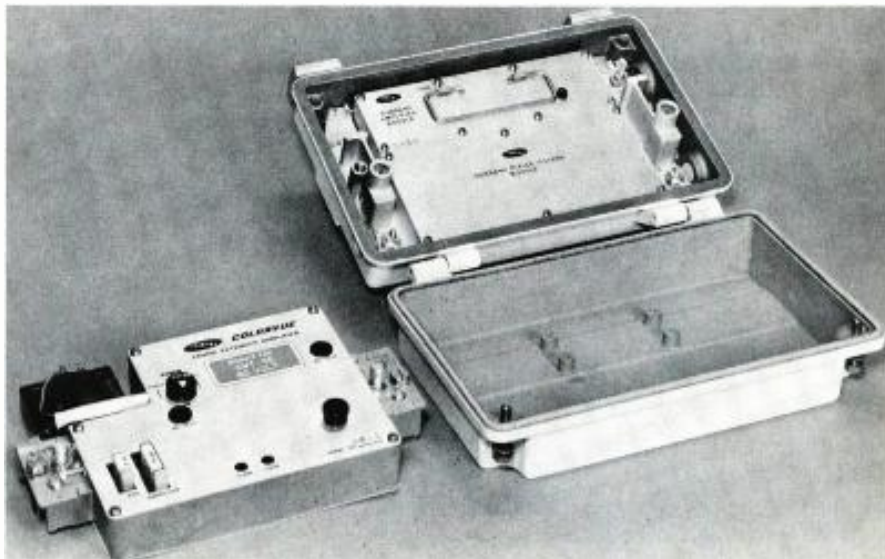
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(Continued from page 55)

Maximum Channel Extender Amplifier

The new Super-Band Challenger CVT-5E extender amplifier by **AEL Communications Corporation** (AELCC), accommodates maximum channel capability by provid-

Consisting of a separate forward and reverse amplifier module and DC power supply integrated into a single plug-in module, the CVT-5E extender amplifier provides greater stability by utilizing plug-in type attenuators and equalizers.



ing an extended bandwidth of 50-270 MHz forward and a sub-amp bandwidth of 6-26 MHz with optional 6-32 MHz in the reverse direction. This new extender amplifier is available for AEL's Super-Band Challenger Mark II and Mark III series of equipments.

For easy accessibility, the housing requires two bolts to open and close while interior parts are removed. Other features include high level output capability and a low noise figure. Also available is the AGC version, Model CVT-5EA.

Circle Number 64 on Reader Reply Card

Musicians Mike

A rugged, modern-styled cardioid dynamic microphone, which comes in a personal carrying case for professional musician's use, has been announced by the Turner Division of **Conrac Corporation**.

The new Turner microphone, Model 2250, is a relatively low-priced unit with a high directional cardioid pick-up pattern, making it ideal for live situations requiring

elimination of audience and background sounds.

The 2250 has a slim steel case and a black Cyclac head, an on-off switch and a 20-foot removable cable. Front-to-back discrimination is typically 16-18 dB over the entire frequency range of 70-13,000 Hz. For field maintenance the acoustic cartridge is easily replaceable.

Circle Number 65 on Reader Reply Card

High Band Color Video Tape

A new high band color video tape which substantially reduces head wear on all transverse-scan broadcast videotape recorders has been placed on the market by **Ampex Corporation**, it was announced by John L. Porter, vice president-general manager, magnetic tape division.

The new two inch-wide 175 Series video tape was developed for use with high band color four-head

broadcast videotape recorders.

A new binder formula incorporating smaller oxide particles than previous tapes and an advanced tape coating process result in reduced head wear and greatly increased head and tape life.

The new tape results in head-wear of less than 2 micro-inches per hour, half that of tapes now on the market, Porter said.

In addition, Ampex claims the 175 Series tape is longer lasting

and has signal-to-noise and dropout characteristics equal or superior to other tapes on the market. A single reel of tape has achieved more than 2,500 head passes without serious loss of signal quality, Porter said. Most tapes begin to show picture degradation after several hundred passes.

"Color reproduction down to the 12th generation is almost indistinguishable from the first generation master using 175 tape," Porter said.

The back-coated 175 Series tape reduces cinching and static attraction common with standard tapes. Back coating is particularly valuable to users in videotape production, where fast stops and starts during editing and rewind often result in cinching, or tape overlap. Also, the back coating—a thin layer of carbon black in a binder system—acts as a shield that reduces the electrostatic attraction of dust and particles that leads to dropouts and picture degradation.

Circle Number 66 on Reader Reply Card

Stereo Headset

Revox Corporation is now introducing the Eugen Beyer audio line that includes several types of microphones, microphone-headset combinations, and a wide variety of stereo earphones.

Dynamic stereo earphone set

DT-480 is a professional type unit with a frequency response from 20 to 18,000 Hz. The output level at 400 Hz and 1 mW is 115 dB over 2X10⁻⁴ uBar. Impedance is 200 Ohms, but lower impedance models are available.

Peak power limit of the DT-480 is 1 Watt. Rated input at approximately 350 mVolts per cartridge.

As the picture shows, even the headband is cushion supported for



maximum comfort. The entire unit is light enough to allow constant use for prolonged periods without operator discomfort. BE tested the DT-480 and a companion set, the DT-100, and found them comfortable and capable of meeting the manufacturer claims in specifications.

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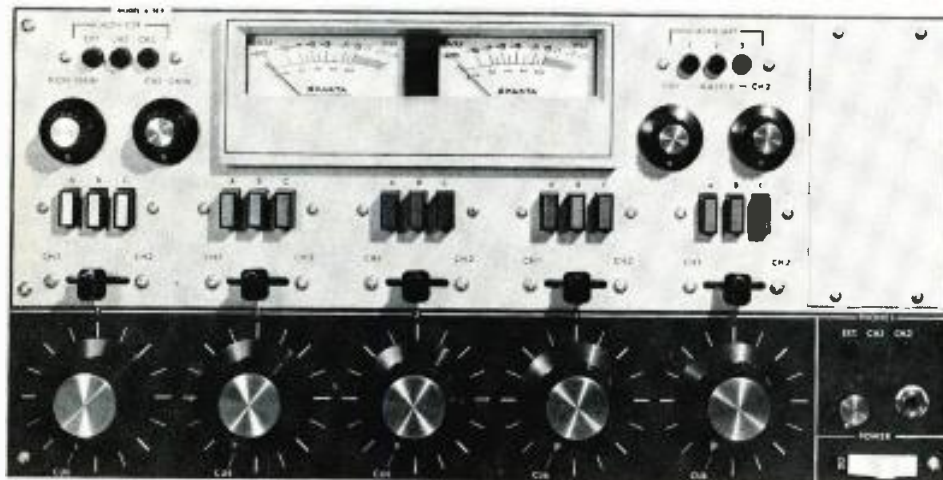
15 Input Dual Channel Audio Console

Fifteen inputs with two separate program outputs hi-lite the A-16R. It's Sparta Electronic Corporation's new dual channel audio console.

Designed for TV and CATV, its independent VU meters permit

simultaneous program airing and production work.

Spare controls, a removable front panel and spare terminals are provided for custom needs. It uses only 8¾" standard rack space or comes with an optional walnut finished cabinet. \$995.



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- Precision, Micro-Adjust Head Assembly
- Three Independent Tape Guides
- 450 RPM, Direct-Drive Motor
- Monophonic, 1 KHz Cue
- Economy with Quality



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D-1500 TV CHARACTER GENERATOR



\$4000

The D-1500 portable character generator is completely contained within its keyboard package. Meets highest broadcast standards for studio use. Also ideal for remotes, tape editing, transmitter standbys, and for preparation and display of election returns.

- Store and readback page after page of display on your standard audio cartridge tape recorder with Audiotape Interface Option D-1500-3.
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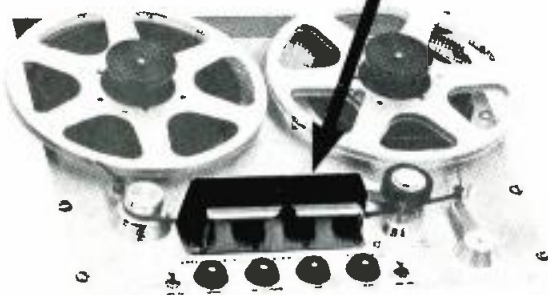
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Vertical interval switching

Switching — The TSFE-4 features all electronic switching, with vertical interval program buss, for completely glitch free signal. Silent, illuminated buttons show program set up at a glance. Full tally light circuit.

Fader Section — Dissolves, Superimposition, Fade to Black, or any combination of these effects.

Special Effects — Horizontal and Vertical Wipes, Corner Inserts from any corner. Split Screens and Corner Inserts easily preset and switched onto the program line. Individual control bars adjust horizontal and vertical components of the corner inserts.

Fully transistorized. 19" W x 5 1/4" H x 10" D rack. Priced for CATV and Educational Applications at \$975.

For complete details and specifications, write . . .

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Circle Number 50 on Reader Reply Card

bookreview

The **COS/MOS Integrated Circuits Manual** has been prepared to provide an understanding of the basic principles involved in the design and application of COS/MOS (Complementary-Symmetry/Metal-Oxide-Semiconductor) devices, monolithic integrated circuits containing p-channel and n-channel MOS transistors.

The Manual includes a brief introduction to device physics as well as descriptions of construction, theory of operation, and important ratings and parameters for each type of device. Specific design criteria and procedures are presented for applications involving counters and registers, astable and monostable oscillators, adders, linear biasing for COS/MOS inverters, and low-voltage crystal oscillators.

Consideration is given to noise immunity, power supplies, and the interfacing of COS/MOS devices with other logic forms.

Design examples are given and typical practical circuits are shown and analyzed.

This book is available through RCA/Solid State Division, Somerville, N.J. 08876.

The **Handbook of Transistor Circuits** is a collection of more than 200 practical transistorized circuits for use in counters, power controls, timers, indicators, photoelectric devices, power regulators, amplifiers, power supplies, oscillators, power converters, and other applications. Schematic diagrams, parts lists, and description of operation are included for each circuit.

This Handbook was written by Allen Lytel as a supplement to his previous book, **Transistor Circuit Manual**. The book is a handy source of information on the design, operation, and application of a wide variety of transistorized circuits.

This book is available through the Howard W. Sams & Co., Indianapolis, Ind. 46206.

Understanding Digital Computers, written by Ronald M. Benrey, is an introductory guide for everyone who wants an understanding of digital computers and their operation without trudging through an excess of technical detail. It is intended to bridge the gap between college level textbooks and the over-simplified treatments of computers in print.

Digital computers are discussed here in terms of similar, and simple, building blocks that make up the system. The function of these building blocks is stressed, rather than their actual electronic construction.

The reader is first introduced to computers from the viewpoint that they are machines that do arithmetic. He is then shown how electronic circuitry is designed to do arithmetic, and how these arithmetic circuits are eventually combined, with suitable control circuits to produce a computer. Programming, binary numbers, logical design and other vital aspects are fully covered.

This book is available through the Hayden Book Company, Inc., New York.

Freeze Policy

duces a special news program. Prior to July 1, 1971, it sold advertising spots at its spot rate. On July 1, 1971, it announced to all advertisers a change of policy and practice effective September 1, 1971, that it would sell the program under a restructured "sponsorship" basis. Sponsorship rates are higher than spot rates.

Q. When a change of method of sale has been announced prior to August 14, 1971, may that method of selling a program be made effective during the freeze period?

A. The method of sale may be changed but no transaction may take place under the new method at a price higher than the ceiling price for that program.

7. Advanced Arrangements: The stabilization order states that prices shall be stabilized "at levels not greater than the highest of those pertaining to a substantial volume of actual transactions . . . during the 30-day period ending August 14, 1971, for like or similar commodities or services" (but presumably not less than the prices on May 25, 1970, in accordance with the actual terms of the law under which President Nixon issued his executive order). Advertising agencies regularly place orders to advertising media in advance of delivery (broadcast or publication) dates and generally there are no payments due until after delivery.

Q. Do these advance arrangements nullify the freeze, thereby sanctioning the price increases which were part of these advance arrangements?

A. No. Ceiling prices for TV-radio advertising charges are calculated only from advertising services delivered during the base period. Advertising services may not be delivered during the freeze at prices above the ceiling price. A service contracted for delivery during the freeze period at a price above the ceiling price may not be delivered at the higher price. The seller has the option of delivering at the ceiling price or not delivering at all. If delivery is made, the buyer is obligated to pay only at the ceiling price.

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- Precision Head Assembly
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- 450 RPM Direct-Drive Motor
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Circle Number 51 on Reader Reply Card

Late Breaking News From Washington

Blind operators are now permitted to qualify for any class of operator license, including radio-telephone first class . . . The Commission has proposed rules to govern the incidental RF radiation from home video recording and reproducing devices but the Office of Telecommunications Policy (OTP) has urged the Commission to take no action which might stifle their development . . . The Commission has asked for comments on the use of digital modulation methods for

microwave transmissions . . . Final Commission rules have been adopted permitting 1 kW for UHF translators, but only for those operating on channels regularly assigned to a community . . . The Commission has "clarified" the rules governing painting of towers higher than 700 feet above ground (See December, 1970 D.C.); the "clarification" was needed because the rule itself still doesn't tell what to do. FCC, why not adopt rules that say what they mean?

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

RCA TM-6C Video Master Monitor \$150.00; Four SARKES TARZIAN VMP-2D Video Picture Monitors \$100.00 each. \$500.00 Takes all. Working when removed from service. Power supplies and cables included. Shipping not included. WITB, 1600 E. Washington Blvd., Fort Wayne, Indiana 46803. 11-71-1f

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Sale—50% off on all factory new RS Coils, Contactors, Chokes, Switches, Sampling Transformers, Loops, etc. Stock items. Quick delivery. Geleco Electronics, Ltd., 2 Thorncliffe Park Drive, Unit 28, Toronto 17, Ontario. Phone (416) 421-5631. 11-71-2f

Services

ADVISORY & INSPECTION SERVICE for the CONSTRUCTION & MAINTENANCE of TALL TOWERS. Dept. 257, 1014 Wyandotte St., Kansas City, Mo. 64105. 11-71-2f

TAPE CART REWINDING our specialty. Carts cleaned, lubricated, wound to lengths you specify all for one low price per cartridge. Workmanship guaranteed! For details and price list write: VFE CART SERVICE, Box 1355, Madison, Wisconsin, 53701. 11-71-1f

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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, 11661 San Vicente Blvd., Suite 300, Los Angeles, Calif. 90049. Telephone: 213-820-2678. By Broadcasters — For Broadcasters. 11-68-tf

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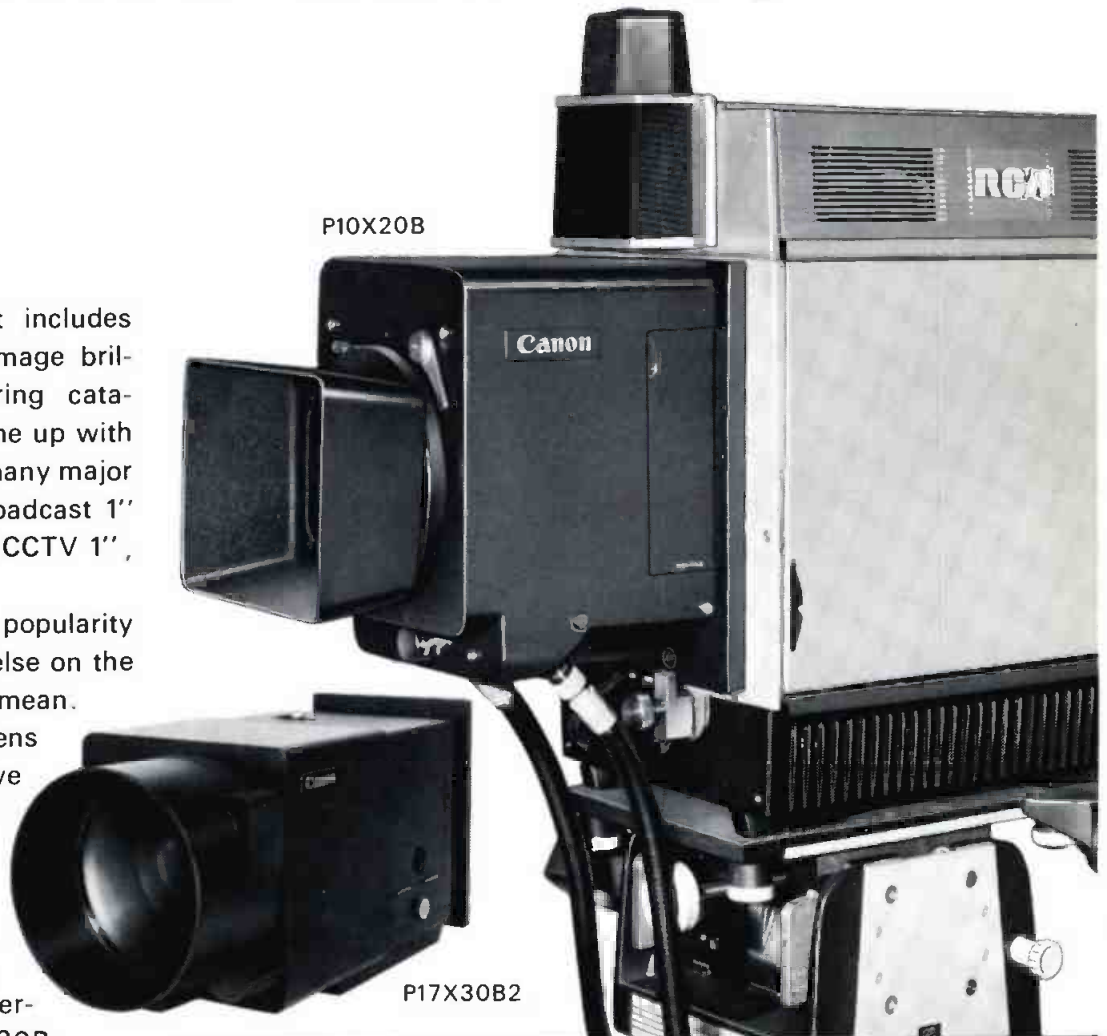
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Stack these two Canon popularity favorites against anything else on the market and see what we mean.

The Canon TV Zoom Lens P17X30B2 has an impressive 1:2.5 relative aperture at focal length range (440-500mm), in spite of its 17X zoom ratio. At 30—440mm it's a remarkable 1:2.2, offering the same performance as our P10X20B, specially designed for maximum versatility with three different range extenders.

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Here are some other examples of the wide Canon line:



Manual				
	Name	Range of Focal Length	Zoom Ratio	Maximum Relative Aperture
1 1/4" PLUMBICON	P17 x 30B2	30—500mm	1 : 17	F 2.2
	P10 x 20	20—200mm	1 : 10	F 2.2
1" PLUMBICON	PV17 x 24B	24—400mm	1 : 17	F 1.8
	PV10 x 16	16—160mm	1 : 10	F 1.6
	PV10 x 15B	15—150mm	1 : 10	F 2.0
1" Vidicon	V10 x 15	15—150mm	1 : 10	F 2.8
	V6 x 16	16.9—95mm	1 : 6	F 2.0
	V5 x 20	20—100mm	1 : 5	F 2.5
	V4 x 25	25—100mm	1 : 4	F 1.8
2/3" Vidicon	J10 x 13	13—130mm	1 : 10	F 2.8
	J 6 x 13	13—76mm	1 : 6	F 1.9
	J 5 x 15	15—75mm	1 : 5	F 2.1
	J 4 x 12	12.5—50mm	1 : 4	F 1.8
Servorized/Motorized				
	Name	Range of Focal Length	Zoom Ratio	Maximum Relative Aperture
1 1/4" PLUMBICON	P10 x 20B4	20—200mm	1 : 10	F 2.2
1" Vidicon	V10 x 15R (DC)	15—150mm	1 : 10	F 2.8
	V6 x 16R (AC/DC)	16.9—95mm	1 : 6	F 2.0
	V4 x 25R (AC/DC,EE)	25—100mm	1 : 4	F 2.5

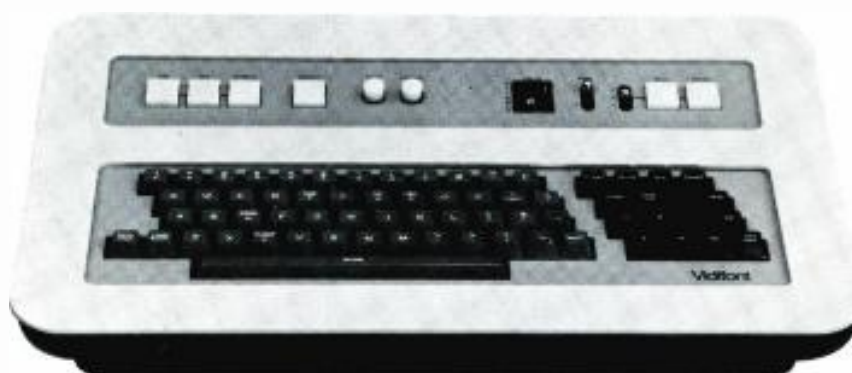
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