October, 1972/75 cents

BROADCAST ENGINEERING®

the technical journal of the broadcast-communications industry

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Applications	Image Format	Pick-up Tubes
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PV	16mm⌀	1" Plumbicon

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October, 1972 • Volume 14, No. 10

BROADCAST ENGINEERING®

The technical journal of the broadcast-communications industry

in this issue...

ABOUT THE COVER

You see typical errors on the cover. Read the article on page 14 by an Ampex engineer who will help you understand what's involved and how to eliminate errors. Cover photos by Ampex, design by Webb Streit.

DEPARTMENTS

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Robert E. Hertel, Publisher
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```
10:37:13 AM                          COUNTING

             VIDEO    AUDIO
  TIME   SRCE   TR   SC TR     PROGRAM
AIR
  0:03   VT1         VT1      HAPPINESS HOUR

NEXT
  0:20   F1A                  VARIETY PROMO

  0:10   F2S   IWSA C2 FO  TOPICAL MSG.
 02:45   STA    DM      D   MORNING NEWS
 -MAN-   REM    FS      F   PARADE
10:45:00 <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<AM
  0:10   F2B    DF          KETCHUP COMM'L
  0:30   VT2                 WRIGLEY'S
  0:20   F4A    RMB         NEWS PROMO
  0:05   F3S   C     AN      PUBLIC ANNOUN.
  0:03   ---         C1 DU
  0:02   F3S         C2  0
 -CLK-   NET                 COMEDY HOUR
10:58:30 ----------------------------AM
  0:10   F2S   I              DISCLAIMER
  0:20   VT1   UDF   AN       CHEVROLET
```

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DIRECT CURRENT FROM D. C.

OCTOBER, 1972

by Howard T. Head

Field Strength Measurements Ordered in CATV Hearing Case

In a case involving priority of carriage of broadcast signals by a CATV system in the mountains of Pennsylvania, the Administrative Law Judge (see below) hearing the case has ordered a joint field strength survey to be made by the cable system and by the television broadcast station claiming carriage priority. This unusual step was taken after consulting engineers for the cable system and the television station submitted independent field strength surveys reaching diametrically opposite conclusions as to the actual grade of coverage provided by the station to the community.

The controversy arose from the fact that the measurements taken on behalf of the television station showed significantly higher field strengths than those taken by the cable system. Both consulting engineers employed a technique proposed by TASO (the Television Allocations Study Organization) for scientific purposes but the use of the TASO method leaves considerable judgment to the engineer making the measurements, especially in rugged terrain.

The results of the joint survey should prove interesting. The TASO method is specific with regard to equipment and techniques, but there may be some difficulty in obtaining agreement between two competing engineers as to the actual locations at which the measurements are to be made.

Short-Spaced VHF Television Application Filed for Washington, D.C.

The licensee of the Washington, D.C. educational television station on Channel 26 has filed an application for "experimental" operation on Channel 12. The operation would involve co-channel mileages of 97 miles and 123 miles to the two nearest stations on the channel, compared with a minimum requirement of 170 miles in this zone. Adjacent-channel mileages of 35 miles (60 miles required) to the Ch. 11 and 13, Baltimore, Maryland stations are also involved.

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Circle Number 6 on Reader Reply Card

(Continued from page 4)

The use of a directional transmitting antenna with precise carrier offset is proposed in an attempt to minimize interference to the co-channel stations. Neither of these techniques is effective, however, in the case of the adjacent-channel Baltimore stations, which are regularly viewed in the Washington area and whose city grade contours extend past the Ch. 12 transmitter site.

The application for an "experimental" license bypasses the usual two-step process of first assigning the channel and then selecting a licensee, thus effectively foreclosing any other applicants who might find Ch. 12 in Washington, D.C. a good channel to "experiment" with.

Composite Week Announced

The Commission has announced the following "composite week" for broadcast stations whose licenses expire in 1973:

Sunday	October 17, 1971
Monday	August 16, 1971
Tuesday	February 1, 1972
Wednesday	December 1, 1972
Thursday	January 27, 1972
Friday	April 28, 1972
Saturday	March 18, 1972

Short Circuits

The Commission has granted several waivers of the Rules to permit unattended operation of single-hop STL transmitters; unattended operation of multiple-hop STLs is already permitted by the Rules... A "wireless microphone" vendor has requested authority to use frequencies in the VHF television broadcast band...The Commission has authorized a 10-Watt VHF television translator east of the Mississippi River...The Commission is doing a brisk business in FM translators...The Commission has defined "prompt" suspension of the operation of translator stations (Sections 74.734(a)(4) and 74.1234(a)(4) of the Rules) as being within 30 minutes time... The Civil Service Commission has decreed that the approximately 600 Hearing Examiners in Federal Agencies, including the FCC, shall be known as Administrative Law Judges ("We can't give you any more pay, but....").

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(Continued from page 4)

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LETTERS TO THE EDITOR

Low Power Station Needs Help

Dear Editor:

We had a terrific problem with our 250 Watt AM transmitter with respect to arc-over in the PA section, and also in the driver (the driver problems were probably feed-back from the PA). We have done many things, checked all connections for good contact, installed parasitic suppressors in the PA and driver section, sprayed the tuning capacitors with anti-corona lacquer, neutralized, retuned, installed new antenna transmission line, etc. The arc-over problem is greatly improved although not completely solved. Now we find that the PA is overheating and drawing too much current, and also we are not able to get up to full antenna current.

I would appreciate hearing from other engineers who have solved this problem and can give us some ideas.

Albert K. Nielsen
WORM
Savannah, Tenn

Equipment Needed

Dear Editor:

We are a new organization in Amherst Central High School, that has formed a broadcast station. Our signal is going to be carried over Amherst's Cablevision's (cable TV) weather station's aural carrier (Ch. 12 on the TV band). We will be serving the cable audience in Amherst. Our big problem

that we are in need of audio oadcast equipment. For exam-: cart machines, audio control ard, turntables, reel to reel tape cks, patch panels, etc. If anyone uld donate this equipment we uld appreciate it.

Tom Atkins, Pres.
Amherst Central Bcstg.
4301 Main Street
Snyder, N.Y. 14226

larm Plans Needed

ear Editor:

We are in the process of building Carrier Interruption Alarm which ill provide both audio and visual tice when our carrier fails.

Although many sources have ans for building a tube-type unit hich will provide this function, e are interested in a solid-state arm.

If any one has such a unit they ve built, we would like to "bor-w" the plans.

Dean Sorenson
Gen. Mgr.
Radio Station KCCR
Pierre, S.D. 57501

quipment Stolen

ear Editor:

We have recently had a piece of quipment stolen and would appre-ate it if anyone spots the equip-ent to contact us.

The equipment was a QRK 8-S nsole, serial 003030. It is an eight t mixer in a blue metal cabinet. ne modification was made to the ard; the earphone selector vitch was wired into the monitor np circuit.

Richard N. Cochrane
Chief Eng.
Pennsylvania State Univ.
304 Sparks Building
University Park, Pa.16802

n Comments

ear Editor:

I have been reading for many onths in BE the comments re-arding the term "Engineer", and ould like to make the following bservations.

Generally, all technical person-el in Radio and TV facilities fall in ne of two classifications. Either they are concerned with the "Operation" of technical equipment or they are concerned with the "Installation, Maintenance, or Modification" of technical equipment relative to FCC or Engineering Standards.

Personnel who are employed to "Operate" equipment are not expected to install or maintain, or Modify" equipment. Personnel who are employed to "Install, Maintain, or Modify" equipment are more concerned with the "Why" of the equipment. Hence, the "Engineer" who must know the "Why" of equipment are, by this requirement, more highly trained than the operator.

The FCC examines an applicant, in my view, on his ability to "Operate" equipment, thus the "Operators License". If the Commission were to examine an applicant to determine his "Engineering" ability an entirely new examination will be needed. I would like to see the Commission devise a "Broadcast Engineers" examination of this

(Continued on page 10)

nature, perhaps the IEEE broadcast section could set-up a committee to devise an examination that the FCC would adopt. May I also point out that an "Engineer" in addition to his detailed technical knowledge of complex equipment must also be a skilled mathematician.

Arthur P. Dietl
Technical Supervisor
Georgetown University
Washington, D.C

Seeking Information

Dear Editor:

I would like some information on using an older modulation monitor to read the new higher positive peak AM modulation now permitted.

I know from experimenting what I can do with one I have. By offsetting the "carrier" to 80 percent instead of 100 percent, the percentages are actually 100 when reading 80, 110 when reading 90, etc.

Name withheld by request

Editor's Note

If you have any information and would like to help, write to Ron Merrell, Editor, 1014 Wyandotte St., Kansas City, Mo. 64105 and the letters will be forwarded.

TK-30 Modifications

Dear Editor:

Our school district has acquired two used RCA TK 30 Image Orthicon Cameras. They are in working order, but I am sure that there are modifications that can be made on the units to improve their performance.

I would appreciate receiving ideas from other engineers.

Commercial television station are beginning to make this type of camera available (either free or at a low cost) to educational institutions.

Robert W. Hamilton
Television Engineer
Beverly Hills Unified School Dist.
255 So. Laksy Dr.
Beverly Hills, Calif. 90212

ndustrial Television Societies Merge

The Presidents of the Industrial levision Society and the Nation- Industrial Television Associa- n jointly announce agreement s been reached in principle on e following:

1. The two professional industri- television user groups will merge o a single new organization.

2. The effective data for the erger will be January 1, 1973.

3. A joint merger committee has en established to work on a new nstitution, bylaws and organiza- n.

4. A new name has been agreed on in principle for the emerging ganization. A clearance search is ing made. The announcement of e new organization's name will made in the near future.

5. The first national conference of the new organization will be held next March 28, 29, 30 in Washington, DC at the Shoreham Hotel in coordination with the equipment exhibition of the National Association of Broadcasters. Regular meetings and seminars by individual ITS and NITA groups will be held at regional and local points throughout the US and Canada this summer and fall.

6. The current presiding officers of the two organizations - ITS President Joe Gorman, Moore Business Forms, Niagara Falls, NY and NITA President Ed Palmer, New England Telephone Company, Boston, Mass - will be working together on all aspects of the merger.

7. The agreement for the merger will be communicated to the individual, service company, and sustaining members of both organizations and is subject to ratification.

Following the meeting of the principles of the two organizations on June 19 in Chicago, the announcement of the merger was simultaneously made on June 20 by NITA President Ed Palmer in Boston and ITS President Joe Gorman during the banquet of the ITS International Conference then in session in Chicago.

Commenting on the merger, Ed Palmer said, "One of the immediate steps we will take is to have NITA and ITS members begin to meet with each other in their re-

(Continued on page 12)

spective locations." Joe Gorman said, "At this point forward we no longer think of ourselves as two separate organizations - Ed and I are in complete agreement on this."

The Industrial Television Society (ITS) and the National Industrial Television Association (NITA) were established to meet the professional needs of business, corporate, and industrial television specialists.

The ITS was founded in 1968 in the San Francisco area and has developed an emphasis on strong local chapters of which the most active include San Francisco, Tulsa, Denver, Chicago, Philadelphia and Western New York state. The ITS has held national and local meetings, published a newsletter and has become particularly noted for its annual International Videotape Competition now in its fourth year.

Until such time as the new name and organizational structure is announced, contact may be made with the organizations through Joseph A. Gorman, ITS President Moore Business Forms, Inc., PO Box 542, Niagara Falls, NY 14302 (716-285-7891) and Ed Palmer NITA President, New England Telephone Company, 185 Franklin Street, Boston, Mass 02107 (617-743-5310).

Fairness Doctrine Getting Another Smoke Test

In its first action in the Fairness Doctrine Inquiry, the FCC has declined to apply the equal opportunities policy to Presidential broadcasts not covered under Section 315 of the Communications Act (use of broadcast facilities by candidates for public office) (Docket 19260).

The Commission also suggested revision of the equal opportunities requirement so as to make it applicable only to major party candidates. It would include in this category, any candidate with significant public support. It urged Congress to adopt a proposed amendment to Section 315 which would limit the applicability of the equal time provision in partisan general election campaigns to major party candidates.

The action by the Commission was in connection with Part IV of the Commission's overall inquiry into the Fairness Doctrine, Part IV is concerned with the application of the Fairness Doctrine to political broadcasts. The purpose of the overall inquiry is to determine whether policies derived from the numerous case-by-case rulings in the fairness area should be retained or modified.

The Commission said that it would ordinarily have considered the issue of the Fairness Doctrine as it relates to political broadcasts in the context of revisions made in the general fairness area, but that it had expedited its consideration of this part of the inquiry in order to dispose of it well before the start of

general election period. It said at, if necessary, it would re-exine the report in light of later cisions in the other parts of the iquiry.

Spokesman Selection

In applying the Fairness Doctne, the Commission pointed out, has traditionally required licenes to afford reasonable opportunfor the presentation of contrastg views on controversial issues of blic importance. The licensee s been given "wide discretion" uselecting the appropriate spokesn, format and time for the prestation of opposing views, with o exceptions, the Commission ted.

Under Section 315 of the Comnications Act, licensees are quired to afford equal time to gally qualified candidates, and der the political editorializing les, the licensee must afford a asonable opportunity for a candite or his spokesman to respond nen the licensee has opposed him supported his opponent in an itorial.

Under the so-called **Zapple** rulg, the licensee's discretion was rther limited. In that ruling, the ommission held that when a linsee sells time to a candidate's pporters or spokesmen, during a mpaign, to urge the candidates ection, discuss the issues, or critze an opponent, then the licene must afford comparable time to e spokesmen for an opponent. ee time need not be afforded to spond to a paid program.

Welcome To All Views

With respect to a contention that quasi-equal opportunities should be applied to Presidential broadcasts not involving Section 315, the Commission observed that the issue is not whether the American people shall be reasonably informed concerning the contrasting viewpoints on issues covered by Presidential reports, since the Fairness Doctrine applies in such situations, but rather "whether something more—something akin to equal time—is required." It said that it welcomed all efforts by licensees to present contrasting viewpoints on issues covered by Presidential addresses, but the issue "is not what programming judgement the licensee makes in this area, but, rather, whether there should be an FCC requirement."

Minimizing picture errors in television recordings

By Daniel D. Esterly*

When we observe picture errors or instability during quadruplex transverse rotary head operation, there are often ways that we can minimize their effect. Also, by knowing more about how they are created, we can sometimes take the necessary steps to avoid their appearance.

Errors such as once-around, S band, one-line hue shift, engagement and height errors all remain stationary in the picture. Another group of errors appear to move—waterfall, worming and microphonics. Others produce record and playback instability such as jitter and chroma flutter.

The purpose of this report is to discuss these imperfections and to describe what we may do about them.

†*Amtec Corrector Error Signal, Engagement Error, Guide Height Error*

A good way to observe these errors is to run the Amtec corrector error signal into a scope and set the sweep speed to display all four bands on the screen (see Figure 1). Four bands are best to start with, since they represent one revolution of the drum (head wheel) and the passage of all four heads tips is represented*. With the vertical gain set to 50 millivolts/centimeter, we see 60mV of an engagement error. Since one volt of this signal is equivalent to one microsecond of error, 60 mV represents an error of 60 nanoseconds (ns). To correct the error shown in Figure 1 we would move the female guide (guide block) in until the scope presentation looks like Figure 2. If the right end of each band is lower than the left, the guide must be moved out to correct the error.

Figures 3 and 4 show a playback condition where the female guide is too high and too low, respectively. The guide height control is adjusted to correct these errors.

Repositioning the female guide, as described above, is standard procedure when we are getting ready to play back a pre-recorded tape or when we are setting up a head with an alignment tape.

What if we have set up our video head and machine carefully t make a new recording, and upo completion of the recording an rewind, we observe height an engagement errors on immediat playback? Well, up to three kinc of things may have happened.

First, if the video erase head o the recorder was used to erase th tape during this recording, the tap was heated up. During the recor mode, the erase head current be gins to heat up the video erase hea until an equilibrium temperature i reached in approximately five mir utes. While the erase head is on, portion of this heat is transferred t the tape where, under the influenc of the tape tension, the tape begin to stretch a little more than usua Stretching along the tape lengt causes a shrinkage across its width compressing the video informatio recorded on the tape. This actio apparently continues until the tap is stored on the takeup reel. Upo playback, the time relationship ha been changed, causing engagemen and height errors to appear. Th female guide must be moved in an up to correct this 50-100 ns of er ror. To avoid this problem you ma disconnect the video erase hea

*Senior Engineer, Sustaining Engineering Section, Video Engineering Dept., Ampex Corp., Redwood City, Calif.

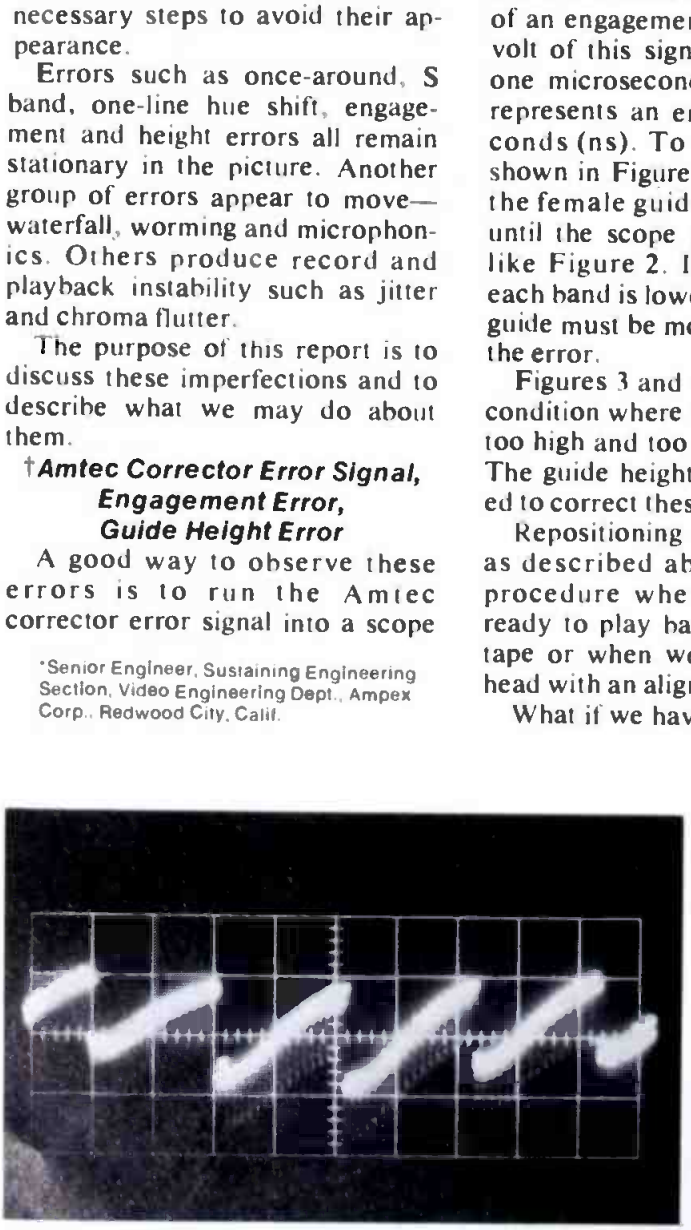

Fig. 1 Engagement error of 60 nanoseconds. The female guide must be moved in to correct this error.

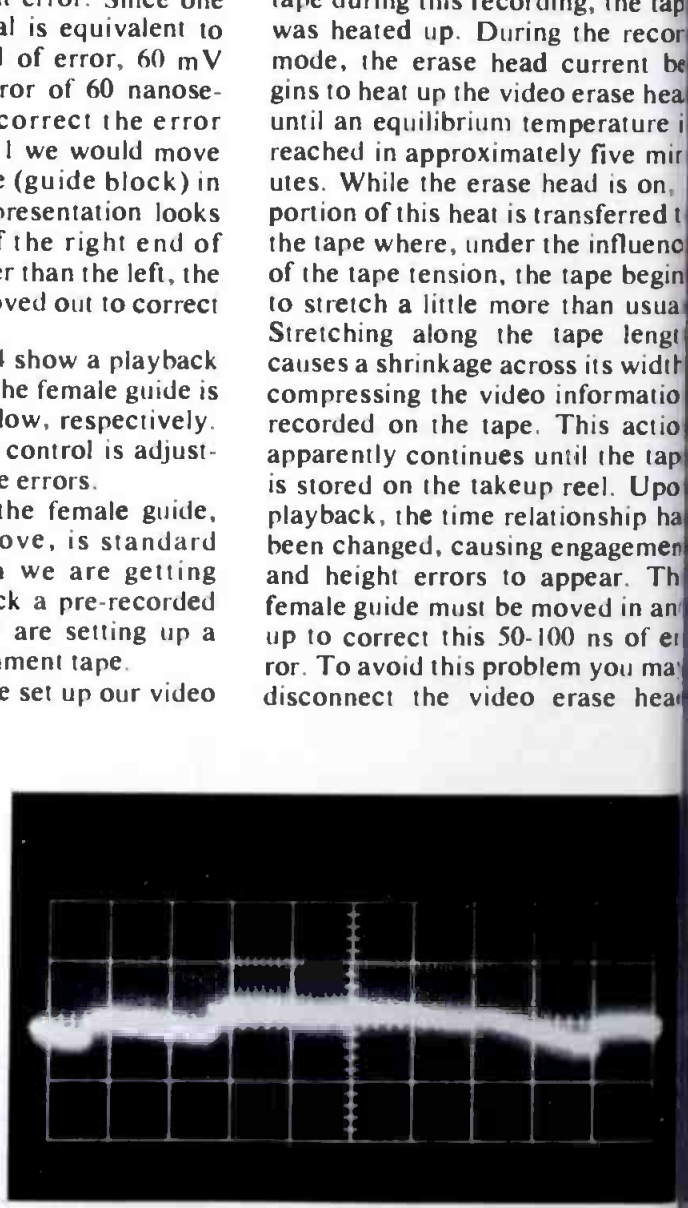

Fig. 2 Negligible geometrical error is observed here on Amtec error signal.

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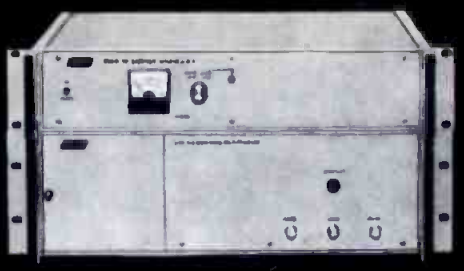

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City _____ State _____ Zip Code _____ Tel. _____

TRACOR Tracor Inc., Industrial Instruments, 6500 Tracor Lane, Austin, Texas 78721

and use bulk erased tape during record.

Second, if the rotary head is cold when the recording is started, the playback of a 30-90 minute recording will show a combined height and engagement error of approximately 130 ns. This will be observed if the recording made with the cold head (at the beginning) is played back with the warmed up head.

The problem here is that early model rotary head motors operate at a temperature 20° F higher than ambient. While the motor is heating up, over a period of 20 minutes, the dimensions of the rest of the head assembly are changing. The motor increases in height, effectively lowering the guide, and the base plate grows, moving the guide out, away from the tape. These changes may be corrected by increasing the height and engagement. Warming up the head for 15-20 minutes prior to recording will reduce these effects. More recent head designs have eliminated this motor problem.

Third, if during the playback of a prerecorded tape the engagement error observed on the scope changes when the tape is stopped and then played again, the female guide is not returning to the same position. Frequently, this problem is due to the female guide parts in sliding contact with those on the base plate. A small amount of lubricant spread over the contact surfaces usually corrects this defect.

Once-Around Error (Four Band)

A once-around error is the kind shown in Figure 5. Notice that all four bands are involved, indicating that this occurrence takes place over one complete revolution of the drum. The error is shaped like a sine wave and may or may not have other errors superimposed upon it. The once-around error rate is the head motor rotational frequency, 240 Hz, and may appear as the result of head motor used and the mechanical or electrical balance of the rotor.

Mechanical unbalance may result from adjusting the balance screws, resoldering the rotating terminals or striking the drum during rotation. A recording made with an unbalanced rotary head will show a once-around error when it is played back with a different head.

If the unbalanced head described above uses a hysteresis synchronous head drum motor a recording made and played back with the motor kept running will show virtually no once-around error. If the motor is stopped before playback, however, a once-around may appear. The reason for this is that the rotor becomes magnetized and locks in at a different point each time the motor is started. The unbalance causes a 240 Hz vibration to be superimposed upon the information laid down on the tape during record. During playback, if the 240 Hz generated by the unbalance is in phase with that recorded on the tape, no difference or error appears. If the motor has been stopped before playback, the phase of the 240 generated during playback may be different and a difference will appear as an error.

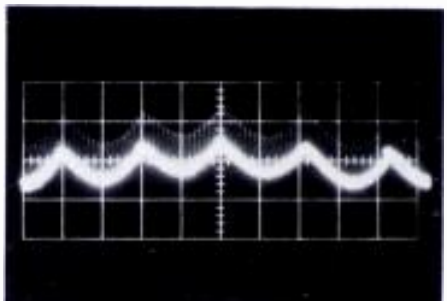

Fig. 3 Guide height error of 30 nanoseconds is produced when guide is too high.

Now, if you continue stopping and starting the motor, lock-up will eventually occur close to the point where the original recording was made and the error will again be minimized. The once-around error observed upon playback may also be minimized by stopping and starting the motor during the playback of tape recordings made on other machines and heads of the same type.

Severely unbalanced heads should not be used because of the error produced and the possibility of damaging the motor bearings.

Unbalance of the three phase excitation running the motor contributes to once-around error. Some video machines (VR-1000) permit the overall amplitude and each phase amplitude to be varied. During a troublesome playback you may watch the Amtec corrector signal and try adjusting these amplitudes for a minimum error.

Other machines have horizontal stability controls. Once-around can be minimized by tuning these (VR-1200, VR-2000).

Band Error, S Band

Band error refers to irregularities observed in the Amtec error signal within one band or head pass. (See Figures 6 and 7.) With the engagement and height controls adjusted for minimum error, a peak-to-peak measurement is taken to describe this error.

S Band Error

An error within one band having a sine wave shape or appearing as an S upon its side in the Amtec corrector signal is an S band error.

S band error becomes troublesome above 40 ns when playing monochrome recordings without time-base error correction. The vertical lines in the picture look like worms, since the S shape of each head pass joins with the other bands to form continuous wavy lines. This error is more serious during a color playback when no velocity error compensation is available. Playback of a color bar recording shows each band of the magenta bar with hues that vary from blue through magenta to red. As the amplitude of the error increases, the hue shift gets worse.

In addition to those parameters controlled by the factory, there are a few things that may be done to help reduce the magnitude of this error.

The first of these is to keep the female guide surfaces clean. Merely rewinding and playing back

*See appendix 1, for glossary of terms used in this report.
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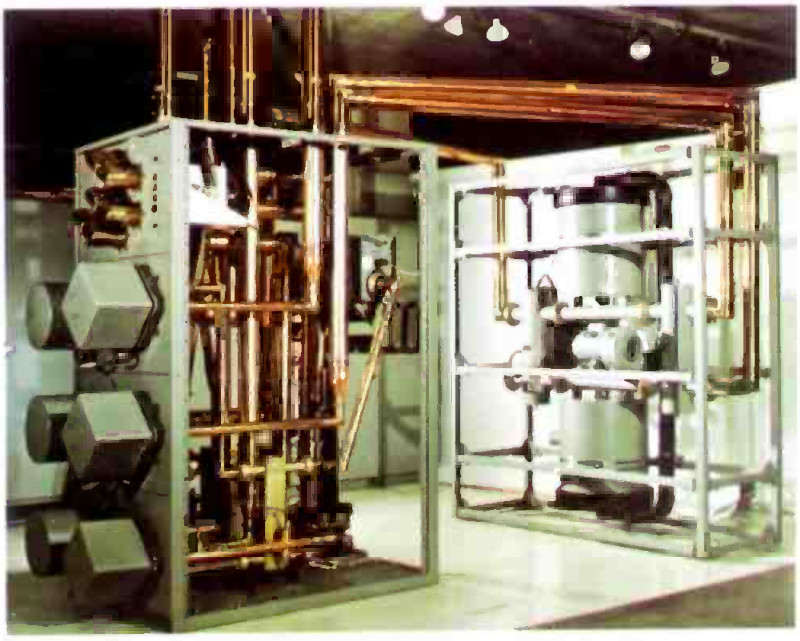

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tape just recorded is often enough to cause an S band error of 10-20 ns. The error appears because of a minute tape oxide buildup on the guide surfaces, collected during tape motion. Dirty tapes, or those that have been heavily used, tend to cause greater accumulations on the guide.

Several broadcasters re-certify each roll of tape before using it for program recording. This inspection and the subsequent tape cleaning or at least the rewinding helps to clean some of the loose material from the tape. If you do not re-certify your tape, a quick wind and rewind, together with a careful cleaning of the guide before recording will help. If your operation does not permit this, cleaning the guide before each recording or playback will reduce the problem.

Accumulations of dirt and oxide on the guide surfaces change the shape of these surfaces and produce the S band error. If the female guide vacuum level decreases, the effective guide radius will change and this will produce both S band and engagement errors. The playbacks will also be less stable, if the vacuum level is low enough. The machine and head vacuum lines should be blown out and the filters cleaned at regular intervals.

Third, the tape path on the machine is important. If the path is changed by changing the stationary head positions (video erase head, audio/cue head assembly) the interchangeability of recordings between machines will be jeopardized. Typically, moving one of these heads 0.060 inch for greater or less penetration into the tape will produce a 30 ns S band error.

If a change to the recorder tape path is contemplated, it would be useful to make "Before and After" recordings to insure that errors are not produced by that change.

Hook Error
One-Line Hue Shift

When one end of each band in the Amtec corrector signal is bent away from the rest of the band, we have a hook or one-line error (Figure 7). In a black and white picture, the vertical lines are interrupted by a hook on each band. In a color bar picture, one end of each band of the magenta bar is shifted to a red or blue hue. Normally, only one line is affected, making this a one-line hue shift.

There are three sources of this error that are under your control: One of these factors is the difference in tip projection (TP) between the rotary head that makes the recording and the one that plays it back. A one-line error begins to appear when this difference in TP exceeds one mil (0.001 inch) and becomes more objectionable if the difference becomes greater.

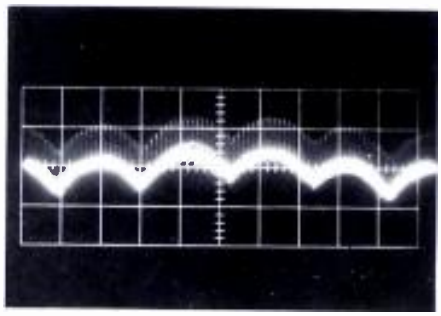

Fig. 4 Guide height is too low, producing 30 nanoseconds of scalloping error.

Fig. 5 Once-around error of 60 nanoseconds shown here is caused by mechanical unbalance of the rotary head.

If a one-mil head is used to play back a recording made with a three-mil head, a blue line error will appear in the picture on each band of the magenta color bar. If the above heads are exchanged in record and playback, a red line error will be observed.

Second, as the rotary head is used, both the tips and the drum holding the tips wear down. The drum wears more in the region just preceding each tip than in oth areas, and wear up to 0.3 mil is unusual during the life time of existing head. Since the drum, ti tape and the female guide are involved in preserving interchan ability, a recording made with new drum and played back wit worn drum will exhibit a blue-li color error.

While the hook or one-line er is not usually objectionable in monochrome picture because of relatively low amplitude, it m become a problem of the first ma nitude in color. Neither time-ba nor velocity compensation can co rect this error.

However, there are two thin that we can do to minimize th problem. First, we may be able switch down to the second li (using the Tac Phasing or Switch controls). If the hue-shift is r stricted to the first one or two line we can reduce the effect in the pi ture substantially.

Second, we can use heads havi about the same tip projecti (within one mil) for our work. Ty ically, heads with the same TP w have about the same drum wear. a bad case is observed, we may t interchanging heads. For exampl if there is a bad blue-line error, w might try a playback head having higher TP.

So far, the one-line errors d scribed are those that have the di turbance at the beginning or le end of each band shown in the e ror signal. It is also possible have a hook error originating at t end of each band. This error produced by a difference control-track head penetrati between the record and playba heads. Normally, the penetrati difference must be unusually lar to observe an error and if the pen tration is too light, the playba control-track signal is usually low that playback is difficul Readjustment of the control-tra head penetration will remove reduce this error, but the longitu nal control-track head position w be changed in the process and w require resetting.

turation Banding, Low Tip Projection

Although the Amtec corrector ror signal appears flat across ch band (see Figure 2), there y be a color error in the picture. the recording has been made at ndard engagement with a head ving a tip projection of less than hil, saturation banding may be served, Figure 8. As the head ars down, nearing the end of its , a point may be reached where tip-to-tape pressure is inadeate to prevent a spacing loss er part of each band. These ow up as dark areas within each nd. If saturation banding is recded into the tape, playback with igher TP head or the use of Auatic Chroma will restore most the picture. If saturation banding pears as a result of playback with ow TP head, engagement may be reased slightly and the banding ll disappear.

Moving Errors

When periodic vibrations or ranom disturbances are present, oving errors may be produced in picture. Two kinds of these rors are discussed below.

Periodic

A periodic error repeats itself at constant rate. To be observed as moving error in the picture, this riodic disturbance must have ree characteristics: First, it must non-synchronous with multiples the 30 Hz vertical framing rate. cond, it must be of sufficient plitude to be observed; and ird, it must remain at this high plitude long enough to be obrved as more than a momentary .

A synchronous vibration freency produces a stationary disrtion. Two-hundred and forty rtz is an example of this, producg a steady once-around error.

A vibration that differs from the arest 30 Hz multiple by 2 Hz oduces a slow moving error that orms its way up or down through e picture. When the difference is aximum at 15 Hz, the disturbce flutters through the picture pidly (waterfall).

The relationship of this vibration to the nearest 60 Hz multiple (field rate) determines the direction that it moves. For example, a vibration frequency of 1202 Hz is 2 Hz above the nearest 60 Hz multiple, making it worm up through the picture. A frequency of 1185 Hz produces waterfall that flutters down.

When a rotary head produces vibration having the required characteristics, the vibration is recorded on the tape with the video information as a time displacement error. When the defective head plays

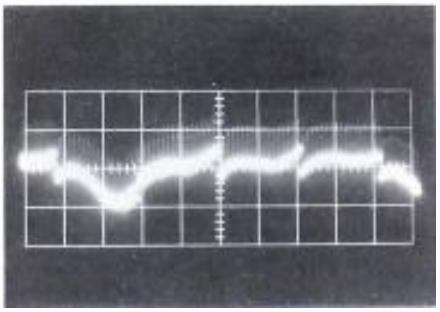

Fig. 6a S band error of 25 nanoseconds shown is within the 40 nanoseconds of error allowed.

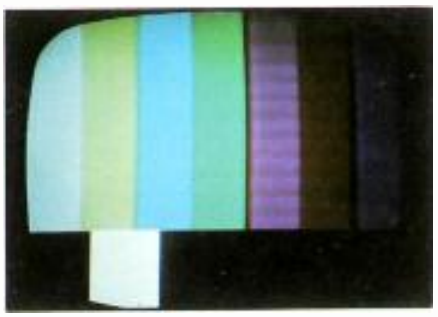

Fig. 6b S band error shows the transition from blue to magenta to red to magenta to blue in the magenta color bar when velocity compensation is not used.

back its own recording, the effect in the picture appears and disappears as the error produced during playback changes phase with that on the tape. When the above tape is played back with a good head, or a good recording is played back with a bad head, the error is steady at one-half of the amplitude observed during the peak picture disturbance noted above.

Microphonics

The rotary transformer used on more modern rotary heads provides a substantial improvement in video recorder performance. By eliminating the slip rings and brushes, you eliminate the problem of brush noise, the necessity of brush replacement and a potential source of once-around error. Occasionally, however, a subtle problem does appear during transformer operation.

Microphonics is a waterfall type of error that originates within the rotary transformer. It is caused by the accumulated wear between the contacting surfaces of the ball and thrust screw (transformer inductance is adjusted by turning this spring-loaded thrust screw). When microphonics is present, operation of the head causes a vibration frequency to appear large enough to produce moving error in the picture. Because the frequency is slightly different each time the head rotation is started, it is considered different from waterfall error, even though it may sometimes produce a waterfall effect in the picture. The next start may produce a worming error, because of the frequency change. At times the frequency may change while running and error moving down through the picture may reverse and start moving up.

Microphonics move back and forth through the Amtec signal as it changes direction in the picture. Audible sounds may be heard issuing from the transformer, similar to those heard years ago with transceivers using vacuum tubes—hence the name. By replacing the transformer ball and thrust screw and resetting the inductance, the microphonics will disappear.

Other Periodic Instabilities

Bad rotating idlers, bent supply and takeup reels, and pulsations in the female guide vacuum will cause periodic errors. Other defects that perturb the tape or modulate its motion will do the same.

Rotating Idlers

Ideally, the tape moves smoothly along from the supply reel, past the head and on to the takeup reel. We might compare this

to the laminar flow of a fluid. The tape motion is of principal concern in the region of the rotary head. Turbulence of motion here may produce turbulence or instability in the picture.

By arranging to highlight the surface of the tape in the region where it leaves the last tape guide on its way to the rotary head and by pinching the rotating tape idlers in the path with our fingers to stop their rotation, we can see what effect this has on the tape flutter. If the turbulence decreases when the rotating idlers are stopped and examination of the Amtec corrector error signal shows a distinct change to a more stable condition, an improvement in performance will be obtained if the idlers are replaced or rebuilt.

Bent Tape Reel Flanges

Most of us have observed the jolt in the picture with each tape reel once-around due to a badly bent flange so this will only be mentioned. Because of the potential for damaging the edges of the tape, these reels should be retired from service as soon as they are detected.

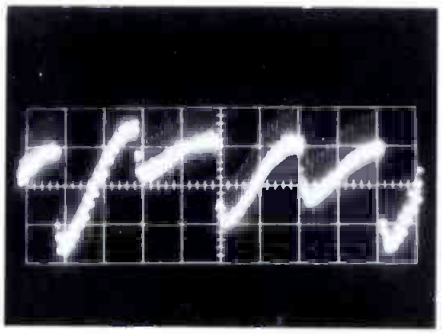

Fig. 7a One-line hue shift error (hook) is more clearly shown by introducing the magenta error. The hook shown here produces a red line error in the picture.

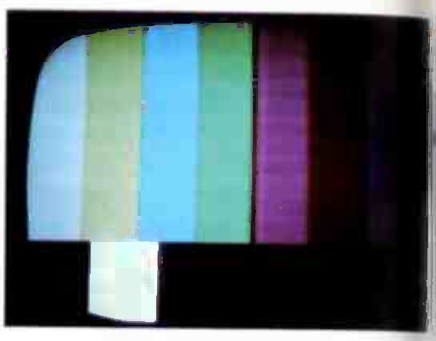

Fig. 7b One-line hue shift error in the picture. A blue-line error appears at the beginning of each head pass.

Guide Vacuum

During the discussion of S band error, it was mentioned that a change in the vacuum level supplied to the female guide would produce an engagement and S band error. A small increase in guide vacuum effectively produces a decrease in engagement. If the vacuum pulsates at the pumping rate, a pulsating engagement error will be observed. These pulsations may be made to disappear if a longer vacuum hose or small tank is temporarily installed in series

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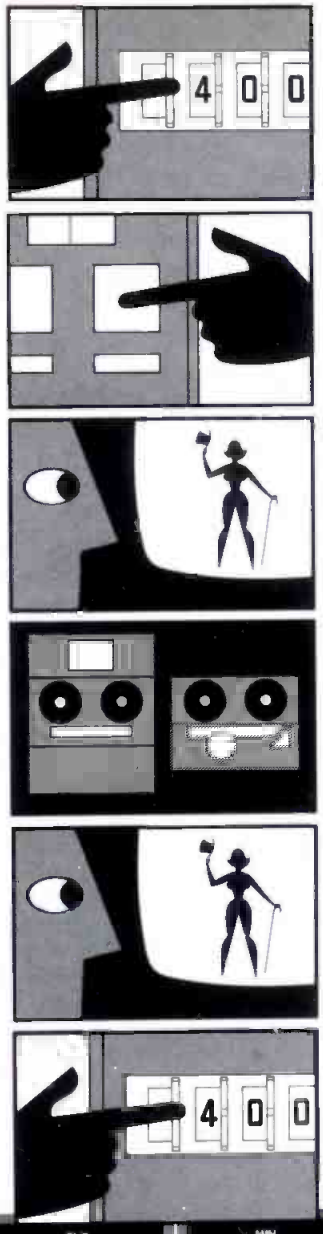

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with the line. The presence of this problem indicates defective operation of the vacuum pump. This should be corrected to obtain a permanent cure.

Irregular or Non-Periodic Instabilities: Jitter, Chroma Flutter

Other instabilities noted during playback occur once in a while at various amplitudes or are present almost constantly, but at no regular rate. Among the sources of these instabilities are the tape used, the female guide vacuum level, the head tip-to-tape engagement and the tip projection.

Tape

We have all observed the shudder in the picture when a bad splice or a crushed tape section passes by the head. When severe hard banding exists on the tape or when the tape has a curled or creased edge (especially over the control track), the instabilities observed may not be momentary but extend over long lengths of the tape. When these situations are encountered, we can only retire the tape or cut out the damage and carefully splice in new tape. Removal not only improves the stability, but also decreases the likelihood of further tape damage, because of the tendency to pickup oxide loading on the tips and drum. The life expectancy of the head is also increased if the head tips do not have to pass over broken oxide surfaces.

If the tape is stopped and started at intervals during rewind or if recordings are played only part of the way through and then are rewound, stresses are stored in the tape at those locations. When this roll of tape is played back, instabilities lasting only a few seconds will be observed when these stressed areas pass by the head. Where these stresses are severe enough, a pernament deformation takes place and instabilities will be seen each time the recording is played. If a roll of tape having stressed sections is re-recorded, the influence of the stresses will be preserved permanently in the recording.

For those tapes having this problem, where the recording must be preserved, we may play them back with heads having a TP of two mils or less. We may also decrease the playback engagement 0.1 or 0.2 mils and use electronic correction. Under these conditions the playback will appear more stable.

Where tapes may be erased and are to be re-recorded, they should be wound to the end and then rewound without stopping them until the end is reached. This will remove all of the elastic stresses and leave only the deformed areas. If a tape conditioned in this manner exhibits objectionable instability at certain locations each time it is played, it should be repaired or retired.

Vacuum Level

Aside from the geometrical errors noted before, a reduced vacuum level at the female guide will also produce an unstable condition. Periodic cleaning, the blowing out of the vacuum lines in the machine and head and a check to see that the vacuum level is set to 40 inches of water will take care of this potential problem. When the vacuum level falls below 20 inches of water, the tape is no longer as secure or stable. Fast forward and rewind modes tend to pull the tape out of the guide.

Fig. 8 Saturation banding due to a loss of response appears as a dark area within each band.

Engagement, Tip Projection

A new or rebuilt rotary head is very susceptible to producing picture instabilities due to its high tip projection. With a TP of 2.7-3.0 mils and marginal rotating idler operation or other tape path problems, or with the use of defectiv or stressed tape or a low vacuu level, the stage is set for playbac instability such as chroma flutter.

If excessive engagement is als introduced, instability is almos certain to appear. Increases of onl 0.1 or 0.2 mils are sometime enough to produce a significan change in stability. Larger in creases produce more. Con versely, reducing the engagemen used (either in record or playback will reduce the amount of insta bility observed.

We commonly use "Standard" tapes to set up the head for opera tion. Most of us are aware of th changes that take place with th "Standard" tape as it is used. W have only to play it back and ob serve the changes in engagemen error displayed to note that th "Standard" changes with repeate usage. The tape stretches in lengt each time it is used, compressin the video information across th width of the tape. This means tha an ever increasing engagement i required to "Correct the Error".

If you use the "Standard" tap only long enough for the setup an then rewind it, you will observe th changes noted above. If you pla your "Standard" tape all the wa through each time that it is used you will not. The only clue that you will have is when you try another "Standard" tape and find it to be different. The point is that it is dif ficult to stay at standard engage ment over a long period of tim without recalibration. If playback instability is one of your problems this may be one of the reasons.

As the tips wear down below 2.7 mils, the situation becomes less critical. At tip projections of two mils or less, stability should be excellent and tapes with stresses may be played back satisfactorily as was noted before.

Automatic Error Correction

Third generation video tape machines such as the AVR-1 or others having automatic chroma time-error and velocity error correction are able to remove many of the errors described. With the exception of one-line hue shift and saturation banding, all of the sta

ary errors may be corrected. moving errors, including those ed by instability, are removed onochrome. Moving color er- remain, although in some s their effect may be reduced. would like to take this oppor- ty to thank Mr. Peter Skalon roviding the photographs for report.

APPENDIX

Definitions and Limits

tationary Picture Error:

Band S Band, Interchangeable S Band (40 ns)
The peak/peak periodic time displacement errors confined to a single band. A band is recorded by a single head pass across the tape.

Band to Band (50 ns)
The maximum periodic time displacement error occurring between adjacent bands.

Engagement, Skew, Venetian Blind (Adjustable)
An error produced when the female guide is misadjusted in a direction perpendicular to the tape surface.

Four Band, Once Around (200 ns)
The peak/peak periodic time displacement error of four adjacent bands not corrected by television picture monitors employing AFC circuits with time constants of four milliseconds.

Height, Scalloping (Adjustable)
An error produced when the female guide is misadjusted in a vertical direction, parallel to the tape surface.

One-Line Hue Shift, Hook (8 ns)
When viewing the Amtec error signal, hook is the time displacement error between any single line of the first three lines, at the beginning or end of any band, and the smooth curve formed by the remaining lines.

Quadrature, Quad (50 ns)
The maximum time displacement error between adjacent bands resulting from the angular misalignment of the transducer pole tips.

Saturation Banding
Dark areas within the band due to a loss in short wavelength response.

loving Picture Errors:

Bearing Squeal
A squealing noise associated with the cage or ball retainer in the drum motor ball bearings, producing picture instability that appears and disappears with the noise.

Chroma Flutter
Abrupt and erratic amplitude changes in the 960 Hz head pass frequency produce this unstable condition in a color picture.

Jitter (50 ns)
A periodic or non-periodic horizontal time displacement error occurring at random amplitudes that produces instability in the picture, usually at low amplitudes.

Microphonics
A random horizontal time displacement error occurring at a rate of approximately 1.2-2.0 kHz, producing a fluttering effect which moves up or down through the color picture at different speeds. An audible noise may also be produced that resembles that produced by microphonic circuit components.

Waterfall
A periodic horizontal time displacement error, non-synchronous with the vertical framing rate of the picture monitor, which produces fluttering effect that moves rapidly up or down through the picture

Worming
Same as waterfall, but moves up or down through the picture at a slower rate.

3. Head Assembly Terminology.

Azimuth ($\pm 20\mu$"/Track width)
The tangent of the angle between the pole tip gap centerline and a line parallel to the direction of tape motion, expressed in terms of micro inches/track width.

Contour
The shape the entire surface of each tip assumes after having been run against tape to provide an intimate tip-tape contact during drum rotation.

Control-Track Lateral Position
The straight line distance from the edge of the control-track head gap most distant from the head drum, to the mean centerline of the tips.

Coplanar, Coplanar Error (0.0003 in.)
During drum rotation, the maximum axial spread observed between the reference surface of the tips.

Drum, Head Wheel
The rotating two-inch diameter disc holding the four magnetic head tips.

Drum TIR (0.0001 in.)
The total indicated run out of the drum.

Female Guide, Guide Block Vacuum Guide
The curved tape guide that cups the tape against the rotating head drum during operation and holds the tape in position with vacuum.

Tip, Head Tip, Transducer, Transducer Pole Tip
One of the four tape contacting magnetic recording heads mounted on the drum in quadrature with the others.

Tip Projection, TP
The difference in radial distance between the tape contacting surface of the tip and the outer circumference of the drum surface following the tip.

TP Differential
The maximum difference in tip projection between the tips on a given drum.

Track
That area of the tape magnetized by a tip during the record process.

Track Spacing
The center-to-center distance between adjacent video tracks.

4. Head Performance Terminology:

Noise
The rms output voltage from a properly adjusted demodulator while reproducing unmodulated recordings.

Noise Differential (2.5dB)
The maximum difference in noise between channels.

Output, Transducer Sensitivity
The peak/peak voltage recovered from the transducer while producing a gray level recording made with the record current adjusted to provide minimum reproduce noise.

Output Differential (6 dB)
The maximum difference in output level between channels, expressed in dB.

Rotation Stability
The degree to which the instantaneous position of the head drum corresponds to the phase of the drum motor driving signal, expressed in terms of the time displacement error rate and magnitude.

Signal-to-Noise Ratio
The video signal-to-noise ratio is the ratio of the peak-peak video signal voltage to the rms noise voltage.

$$S/N = 20 \log \frac{V_{sig\ (p\text{-}p)}}{V_{noise\ (rms)}}$$

Timing
The relationship that exists between the rotary head timing signal and the vertical synchronizing pulse recorded by channel 4.

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Circle Number 16 on Reader Reply Card

William G. Harley. . .in a pensive mood these days as he considers recent CPB and educational Television problems.

NAEB Goes to Las Vegas For 48th Annual Convention

By Ron Merrell

NAEB

On October 29th the National Association of Educational Broadcasters will gather in Las Vegas for their 48th annual convention. And they will be betting. . .betting that the CPB will find the leadership it needs and that the Congress will take the pressure off funding.

While the chances for early permanent funding legislation are doubtful for 1972, the odds have never looked better for educational broadcasting.

There has been a steady growth in new FM stations and in stations greatly increasing their power. On the closed circuit side, there have been many sophisticated improvements. And that includes cooperation with Cable TV.

It does seem that this convention has always been tied to the CPB and their success or lack of it. And just at a time when this convention might have been more concerned with radio and closed circuit side of its membership, the CPB loses its leadership and is once again the major concern.

The NAEB's annual convention each year attracts 5,000-6,000 persons engaged in or concerned with educational telecommunications.

Convention planning has produced a still growing list of sessions, topics and activities which will be occupying public broadcasting and allied personnel in October.

Convention Highlights

Exhibits: A large number of major electronic equipment manufacturers will show and demonstrate a wide range of gear during the convention.

Programming: "Storefront" programming via cable; media anthropology; case study on bilingual education; women in broadcasting; children's programming.

Engineering: Video cassette developments; satellite projects; "TV Experiment for the Deaf: Subtitles"; computer editing; cable update; quality audio.

Instruction: Opening up the university with technology; higher education for more people; legislation for instructional system development: WNET: "Project Earth"; National Center for Educational Technology; utilizing "The Electric Company"; school applications of cable; the future on educational radio.

Development: Long range financing report.

Broadcast education: Federal Communications Commission regulatory briefing; minorities and broadcasting careers; international programs.

Business meetings: NAEB; Educational Television Stations; National Educational Radio; Corporation for Public Broadcasting; Public Broadcasting Service; National Public Radio.

NAEB President William G. Harley recently made the following observations concerning the condition of public broadcasting in letters to managers of NAEB-member public television and radio stations:

"As difficult as recent events have been, they do provide an opportunity to take stock, to consider where we are compared to where we've been, where we are going and what we're doing to get there.

"Public broadcasting, overall, is in a healthier, better-supported, and better-established position today than ever before in its history. The President's veto of the Public Broadcasting Act authorization was a disappointment in terms of our expectations, of course; but, in fact, the legislation which has emerged from this congressional

One of the very best broadcast color monitors is on the shelf...waiting to brighten your day.

It's known as the TCB-19, from the Miratel Division, Ball Brothers Research Corp. We call it one of the very best because TCB-19 users report a consistently high level of performance.

Dual regulated power supplies hold picture stability with wide input voltage variations. Solid-state circuitry insures low maintenance and consistent performance over the long haul. Switchable long or short time-constant AFC adds to monitor usefulness for VTR alignment, and a front panel switch allows for selection of two video inputs. All critical set-up and adjustment controls are front-mounted for convenience.

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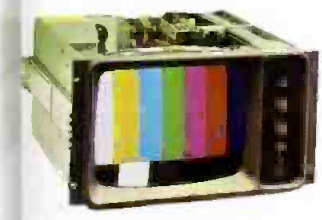

And it's a large one. Color and monochrome monitors from 9 to 25 inches. Rack-mounted, frame-mounted, broadcast or information display. All Miratel monitors feature over-design of critical circuitry for exceptional long-term performance. Each unit is power aged, and subjected to quality control checkout before shipping. Miratel monitors are designed to serve as your single best check of signal quality.

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Circle Number 13 on Reader Reply Card

Lloyd Kaiser is Chairman of the Board of Directors and president of WQED-WQEX in Pittsburgh, Pa. will preside over the keynote session on Monday, Oct. 30, for presentation of Distinguished Service Award.

session will still authorize a substantial gain.

"The resignation of Mr. Macy and other capable and dedicated senior staff members at the Corporation for Public Broadcasting is a heavy loss but is an understandable consequence of the veto and should be seen as a temporary readjustment. The search for a new president, in which NAEB will be active, is underway. When in place, the new leadership for CPB, both in the Chairman and Presidency, will have an appropriate relationship to the Administration, which for the first time has the majority of CPB Directors from its party. Consequently, the White House must now assume public responsibility for what happens to CPB and the public broadcasting stations.

"Clarifying the veto message, Dr. Clay Whitehead, director of the Office of Telecommunications Policy, has recently reiterated the administration promise to work for a multi-year authorization-appropriation plan once certain questions have been answered.

There are a number of indices that point to the very considerable progress made recently.

A. Within three years CPB, NPR and PBS were established, and are now going mechanisms. The latter two have station management-governed boards and CPB, OTP and the Congress have now recognized by deed and writing the importance of the stations and the principle that an increasing amount of any federal funds authorized for CPB must go to stations. B. The growth in overall support since the Public Broadcasting Act of 1967 (which the stations through their association brought into being) has been very substantial. 1. Federal funds for station facilities have tripled, and for station operation, programming and distribution have grown in five years from zero to $45 million; local support has grown to $150 million. (Authorization for FY '73 calls for $10 million more for CPB and the stations as well as $10 million more for facilities over FY '72.) 2. There is a national interconnected television system being utilized 54 hours per week. 3. The quality and variety of programs, the size of the audiences, and the degree of public awareness and appreciation of public television have never been so high.

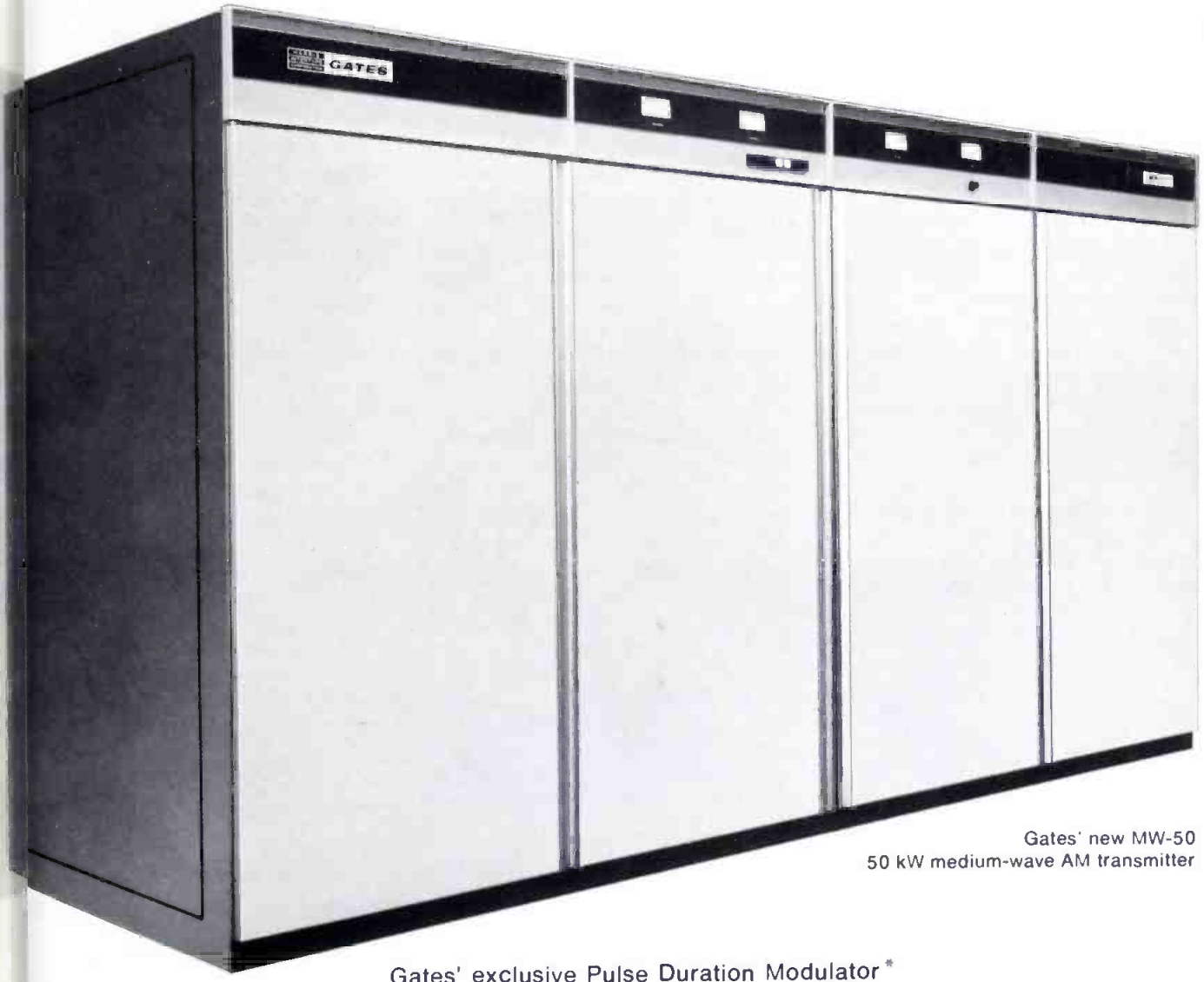
C. We have learned some lessons. As the result of the veto we realize that any legislative proposal to succeed must have both bipartisan support in the Congress as well as backing from the administration. Moreover, the debates on public broadcasting in this session of Congress clearly signal congressional insistence upon responsible stewardship, conviction as to the paramountcy in the system of the local station, and the need for a much stronger emphasis on the educational and instructional aspects of public broadcasting. D. The interest in the well-being of public broadcasting and its future course is now a concern of more people of consequence than ev before: in the press, in Congress, i Government agencies, industry civic groups, education, and politi cal parties. Public broadcastin matters! E. Finally, there is a ne sense of unity and determination— possibly stimulated by the veto— for everybody concerned to ge together and really **do something** about public broadcasting; to put i altogether in a concerted drive tha will once and for all establish pub lic broadcasting as an important viable, and necessary enterprise i our society.

"The evidence of immense prog ress can be documented at greate length. Clearly there is much to b encouraged about—though w have a long way to go.

"We continue to work throug the stresses and strains of systen structure, responsibility, and fu ture goals. We are refining mecha nisms to enable thorough participa tion in decision-making processe while at the same time vesting con fidence and support in nationa agencies which allow concerte action to be taken once the will o the majority is known. Organiza tions and procedures have bee established and continue to operat and improve. Momentum has bee generated and will grow.

"We at the NAEB vow and reaf firm our commitment to a fully developed public broadcasting en terprise dedicated to the service o the American public, and pledge redoubled effort to assist that effor at this especially critical time."

We threw away the 50 kW modulation transformer and reactor... With PDM*, who needs them!



Gates' new MW-50
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Circle Number 18 on Reader Reply Card

We were *blown* off the *air!*

A continuing coverage of station burglaries. In this report we see how important it is to ward off offenders.

By Donald L. Littleton*

The Kentucky Educational Television Network operates 13 transmitters and 5 translators throughout the state. All programming originates from a full color complex in Lexington supplemented by a mobile van and demonstration units. With this amount of "hardware" the possiblity of break-in, theft and willful damage was always a spector on the horizon.

Four transmitters and our studio had been burglarized with varying degrees of loss and a commercial TV station just across the road from our educational outlet in Bowling Green, Ky. had its tower ripped from the base by a dynamite charge. But it was not until March 19, 1971 that the full impact of these fears was felt by our Network.

It started out as an ordinary Friday as the transmitter chief of WKGB, Channel 53 in Bowling Green drove slowly up the hill to begin his transmitter shift. He noticed dark, ominous clouds on the horizon which were an omen of things to come.

As he approached the transmitter building he was startled suddenly into disbelief. The gate was completely missing and sections of the fence were leaning at a 45° angle. Where the gate post had been was now a hole 6 feet in diameter and 2 feet deep. No doubt about it, we were the victim of a dynamiting.

The gate side of the building had a sickening, twisted, concave appearance as though it had been rammed repeatedly by a tank. Outside wall panels flapped in the breeze and the rear of the building had a noticeable bulge from a concussion. The gate was lying over the edge of a bank nearly 12 feet away.

The interior was in a complete state of disarray. Nearly all ceiling tiles had been blown out, the inner wood paneling was splintered and broken, and the Telephone Company power panel had been blown from the wall, meaning no microwave from Lexington. What had not been dislodged by the blast had been removed from shelves and cabinets and either strewn about or smashed.

It was quickly determined the Tektronix 543 scope, color monitor, all tubes and miscellaneous tools had been stolen. A check of the transmitter cubicle revealed the culprits had smashed some high power ceramic resistors used as a voltage divider for klystron modulating anode, but no damage to the klystrons themselves. . .thank heaven!

Suddenly, the transmitter chief remembered the previous blast at the tower of the nearby commercial station and he ran out to check the tower base. It had not been affected by the blast. This brought a sigh of relief and the thought that he might get this rig on the air after all.

A parts list was hastily drawn up and within an hour these items had left RCA emergency parts department in Camden. The State Police and the FBI converged on the scene. Area supervisors borrowed spare parts from other transmit-

*Asst. Dir. of Engineering,
Kentucky Educational TV Network

A Kentucky State Patrolman dusts for prints in the aftermath of bombing at WKGB.

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An example: the AMPOMATOR, a fully automatic stripper-crimper machine for cable lugs (*) on a (continuous) band (**).
This machine cuts and strips the wires and clamps the cable connectors on it at a speed of about 11,000 pieces an hour! Result: the lowest possible cost of work up imaginable.
Some more examples of AMPECONOMATION: a Pantograph to apply AMPMODU bus connector (***) on print plates (Max. 4,000 an hour) and the FFC machine, a semi-automatic machine for putting the bus connector on a cable.
Finally, we also mention the TAPEMATIC, a machine that handles the semi-automatic cable connectors that are applied on a plastic carrier.

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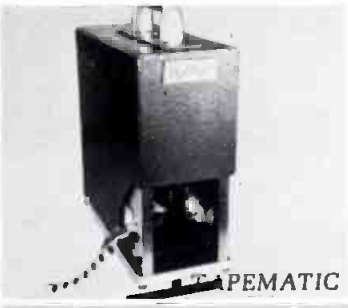
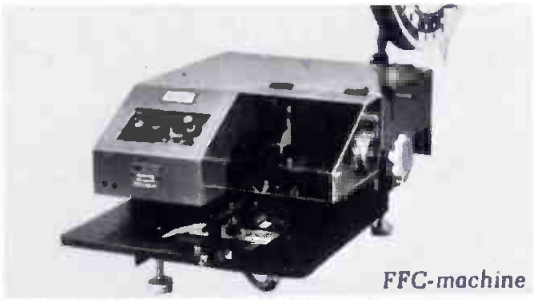
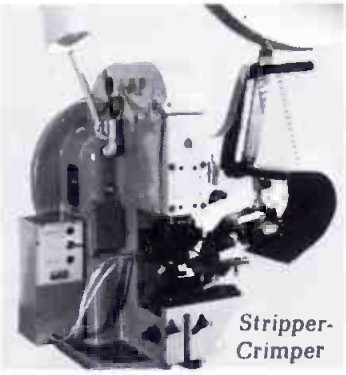
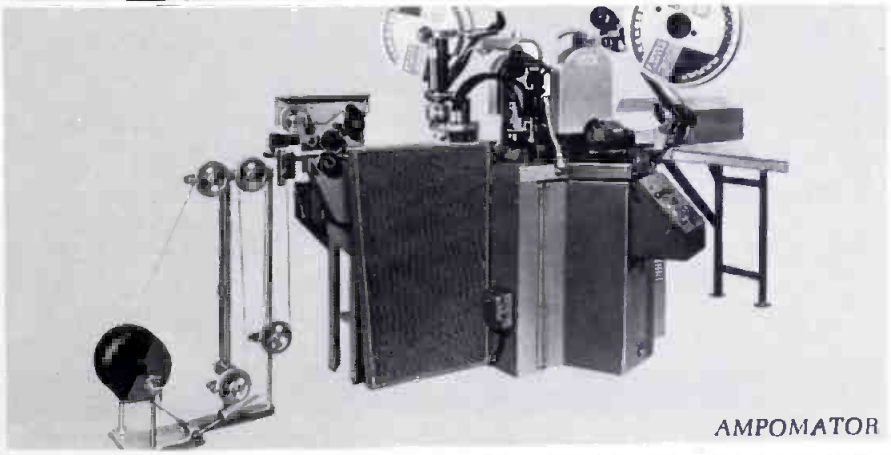

TAPEMATIC


FFC-machine


Stripper-Crimper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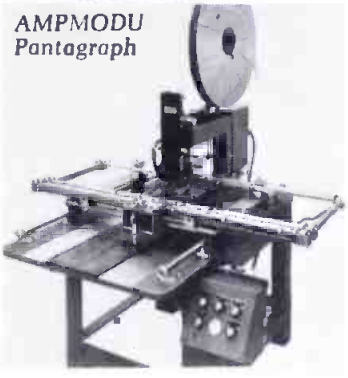
AMPMODU Pantograph

AMP at the FIAREX (Convention)

The machines shown here are on demonstration at Booth No. 95 during the FIAREX. Our experts will be glad to give you any information about all the other AMP products and applications.

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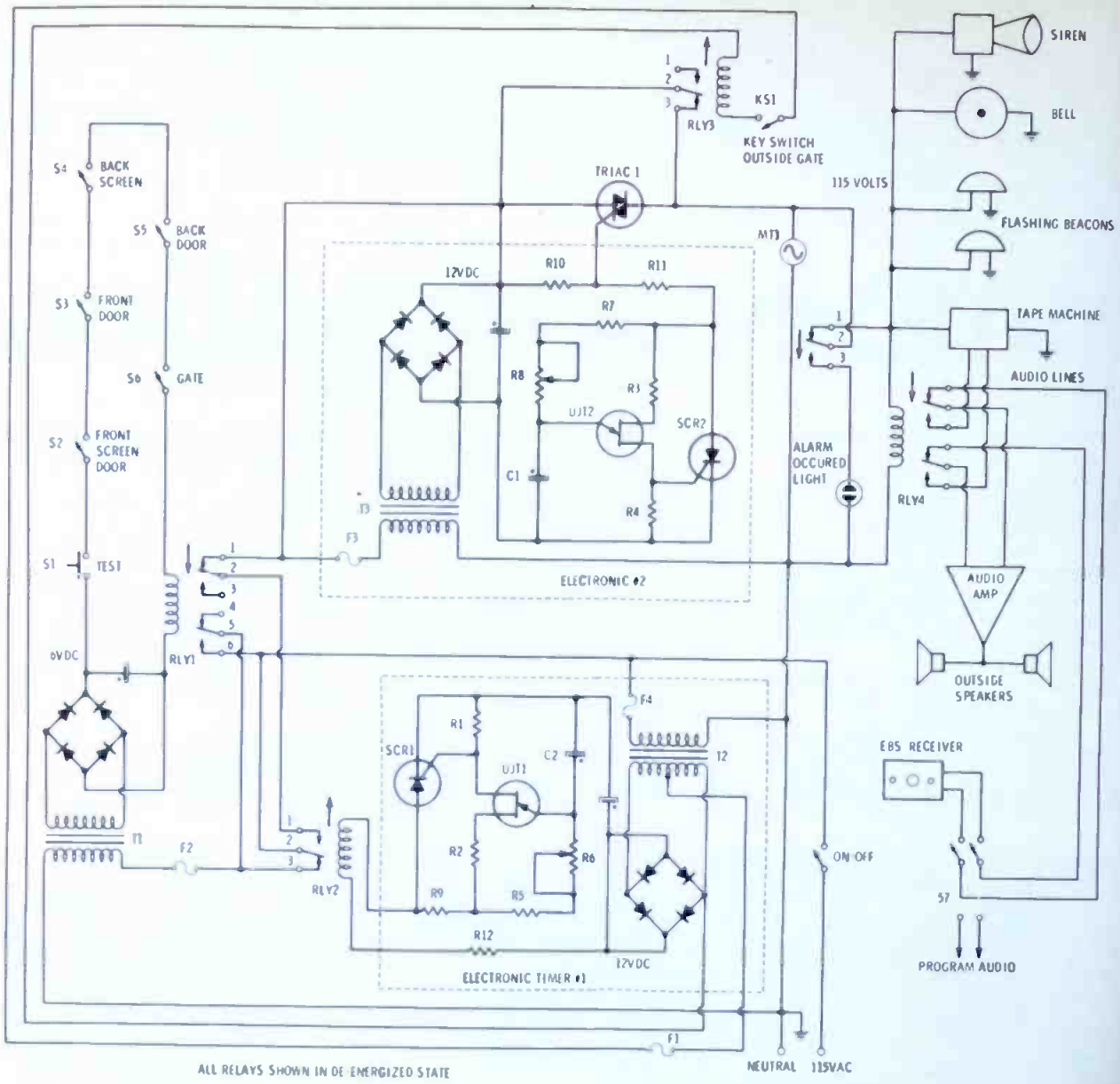
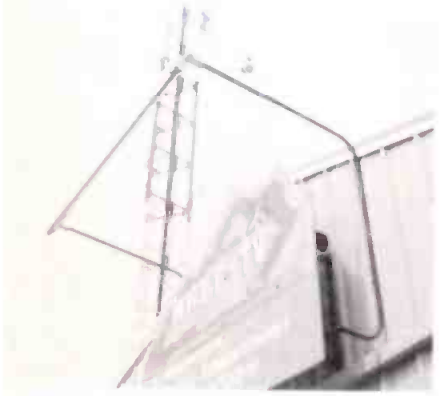


Schematic for station warning system.



Rotating red beacon atop building can be seen from a great distance. Note that siren is hid behind sign.

ters, and through a concerted effort the transmitter was turned on at 11:15 am., the same day of the blast. (A prime suspect in this crime was later shot to death by State Police in an unrelated incident.)

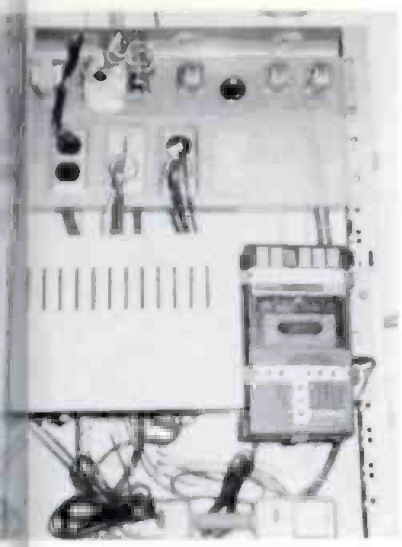
New Security System

The following is typical of the security systems now installed at the majority of our transmitters. It was designed and installed by the engineering division of our network and has doubtless scared the daylights out of some innocent and unsuspecting souls and perhaps even a few prowlers. We admit, however, that the most elaborate security system in the world is no match for a case of dynamite.

Theory of Operation

The main arm-disarm function of the system is the on-off switch located within the control box which interrupts the hot side of the 115 VAC line. When power is turned on, voltage is applied to T2 directly and to T1 via relay 2 contacts 2 and 3. Six VAC from the secondary of T1 is rectified to provide DC holding voltage for all interlocks and to relay 1 which will energize when the system is "happy" or all interlocks closed. Interlocks are magnetic switches on doors and weather proof limit switches on gates.

After relay 1 is energized, voltage is then applied to T1 via relay 1 contacts 5 and 6. Electronic timer #1 has an adjustable time period from 30 seconds to 3 minutes, de-



...ior of system enclosure, showing ...t and associated circuitry.

...ling on the RC time constant of ...and C2. The purpose of this ...r is to allow personnel to arm ...system, leave the building and ... the gate before an alarm goes ...action.

...t the conclusion of this pre-...rmined time period, relay 2 will ...rgize and provide the latching mode for the system. The system is fully armed when key switch SK1 is opened at the gate, thus de-energizing relay 3. Should one of the interlocks be opened or test switch S-1 be depressed, relay 1 will de-energize and 115 VAC alarm voltage will be applied to relay 2 via contacts 1 and 2 and relay 1 also via contacts 1 and 2. The alarm voltage is next applied to relay 3 contacts 2 and 3, bypassing electronic timer #2 whose function is to provide a time delay of 1 minute for personnel to re-enter the building and disarm the system before an alarm can occur. KS1 must be closed and relay 3 energized for this function.

The alarm voltage is next applied to mechanical timer MT1 and simultaneously to its contacts 1 and 2, providing a 115 VAC path to energize a siren, bell, two flashing beacons and a tape recorder with a pre-recorded message (not meant for the ears of ladies) and will also energize relay 4. This switches audio from an EBS receiver to the tape machine for routing to the audio amplifier. The theory of having EBS audio on the outside speakers is to discourage prowlers at the outset. Just hearing voices, music, etc., may prevent a break-in. It is also possible to switch program audio outside.

Timer MT1 will run for about 10 minutes at which time contact 2 will swing to #3 thus removing all alarm voltage from the alarm devices and will light a neon bulb indicating an alarm has occurred. Should the timer be re-set the alarm cycle would begin again meaning the fault must be found before the system can be armed again.

Alarm Advantages

A few advantages of this type system are as follows: 1. The alarm must be disarmed from inside the building; 2. Tampering with switches outside the gate cannot prevent an alarm; 3. All door switches are mounted inside the doors; 4. Due to the latching feature, the alarm can only be stopped by disarming the system in the enclosure or by MT1 cycling; and 5. It makes enough noise to discourage even the most courageous burglar.

Quality in the booth

By Pat Finnegan*

With so much material being recorded on audio tape at the station today, a recording booth becomes a valuable asset. Not only does the booth free the control room equipment, but it also removes much of the control room time pressures and thus allows an announcer to record announcements in a more relaxed atmosphere. Should the station also operate an automated FM sister station, the recording booth becomes almost a necessity. As far as tape recording is concerned, this booth should become the quality control center of the station.

Booth Equipment

What equipment to install in the booth will depend upon where its output is going. The booth can do double duty as both a monaural and a stereo facility. This article will consider the booth in dual capacity.

Cartridge Tape Master recorder: Two units will be required—one monaural, one stereo. These recorders should be capable of recording the 150 Hz auxiliary switching tone if the tapes are to be used in other equipment which makes use of the tone. Most automation systems do use this tone.

Single playback units for cartridge tape—one for stereo, one monaural: Production will often require that material from one cartridge be mixed with other material and dubbed onto a new recording.

Reel to reel recorder: This should be a two track stereo unit which also has a four track stereo playback head. Tape speed of 3¾ and 7½ ips will satisfy most of today's tape speeds. Where a music service is used on the FM automation system, this machine should be able to handle at least 10½-inch reels.

One or two turntables will handle most of the production music intros, jingles etc. The tone arm pickup should use a stereo cartridge, even if the system is monaural. A stereo cartridge will play both monaural or stereo discs, but a monaural cartridge can damage a stereo disc.

A production type consolette will allow smooth switching and mixing. The station may build its own or purchase one of the small commercial models. There are a number of small commercial models available, and some of these also include one or two turntables and a desk as an integral unit. These can serve the purpose so long as their limitations are consid-

An ACE amplifier should follow the consolette to provide the announcer with assistance in riding levels. In a dual purpose booth, this should be a stereo model which can be switched to feed either the monaural or the stereo recorder.

Electronic Considerations

As a quality control center, these master recorders should not only set the standards for other equipment, but also be set to standards Whenever a tape produces poo quality or fails in other equipment it should be checked out on th booth machines. This simple proc ess will quickly isolate many out side machine problems or tap problems.

The booth recorders to be stand ard setters must be kept optimize both mechanically and electroni cally. The heads and equalizer should be kept optimized. Use o standard alignment tapes is recom mended. While standard alignmen for reel type test tapes have been around for some time, up-to-dat versions should be used. That is these should conform to the latest NAB standards.

A standard monaural test and alignment cartridge tape is availa ble from the NAB. Unfortunately a stereo version is not yet available (the NAB has one under developement). Many of the cartridge ma chine manufacturers have developed stereo cartridge alignment tapes, these can produce acceptable results, but all are not necessarily on industry standard.

Levels

Recording and playback levels of the master recorders should be standardized. Feed a 400 Hz tone into the console at normal input levels, feed both channels of a stereo consolette. On some small consolettes for stereo, the meters may not track. The AGC levels, and the input to the recorder should be

*Maintenance Editor

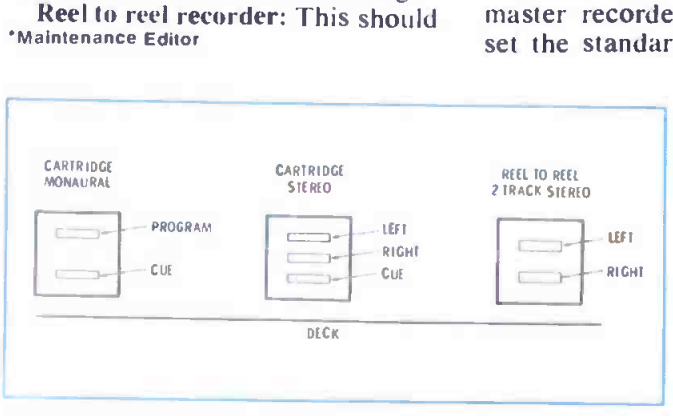


Fig. 1 Track position on broadcast recorder heads for monaural and stereo.

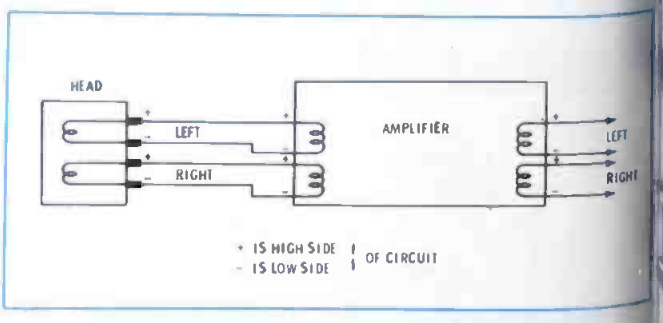


Fig. 2 Correct phasing is important in a stereo recorder. Not only left and right channels in correct positions, but also high and low sides of circuits should be maintained.

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properly balanced. Once the levels into the recorder are properly adjusted, the recorder controls should be locked or the knobs removed. Normal level setting should thereafter be done with consolette faders.

On a dual system, the output of the AGC amplifier should be switched completely to either the monaural or stereo recorder. Each should provide a proper 600 Ohm load to the AGC amplifier, but both recorder inputs should not be across the circuit all the time at the same time. To maintain the proper impedance match, the stereo output of the AGC should not be strapped together. Instead, a simple 3-resistor pad can be used to properly match stereo to monaural, maintaining the impedances. There will be a 6 dB loss that can be made up in the recorder.

Standard Levels

Station standard level tapes should be made, one for monaural and one for stereo. Use a good cartridge, preferably a new one or one with new tape. Record at least 2 minutes of 400 Hz tone at NORMAL PROGRAM RECORDING levels. On the stereo cartridge, record first the left channel only, then right channel only, and then both channels at the same time. Voice announcements can be added to the tape for identification, if desired. Make sure the tapes are properly labeled.

The standard tapes then should be played back on the master recorders and playback levels set and locked. A tape head meter is recommended here for measuring the levels right out of the head. A notation of this level should be made and preserved for future reference. The test tape and head meter will quickly isolate other machine or amplifier problems.

Station test tapes of the auxiliary and tertiary tones should also be made. While the NAB test tape does have these as well as level tones on it, they are too brief for testing and adjustment purposes. Once the test tones have passed, it takes a few minutes before the tape runs all the way around to them again. The head meter will again prove an invaluable device for isolating problems. The meter has an earphone outlet, so you can listen to material directly off the head. Again, these levels should be noted and preserved for future reference. If a head meter is not available, there is an alternative test you can do. Simply switch the cables so the cue head feeds the program amplifier. Now the tone levels can be observed on the recorder output meter. This method is less exact since it introduces the playback amplifier and equalizers into the scene, but still has relative validity.

Tape Heads

When head replacement is necessary, be sure to use the correct heads. While recording and playback heads may appear to be identical, they have different impedances due to the different levels they carry. Incorrect heads will produce very poor results. Check the numbers on the head carefully before installation.

The tracks on mono cartridge heads have the program track furtherest from the deck and the control track is closest to the deck. The head number or color dots, or other identification will help in correct installation. **Observe the old head markings before removing it.** Two track stereo cartridge heads have the left channel furtherest from the deck, right channel in the center, and cue track nearest the deck. Again, check the old head markings before removing and compare the new head markings. Two track stereo reel-to-reel heads have the left channel furtherest from the deck and the right channel closest to the deck.

Phasing is as important when changing stereo heads as it is throughout the booth and system wiring. When changing heads, it is important not only that left and right channels are correctly connected to the head pins, but also the high and low side of the circuit should be maintained. Watch the color coding on the wires to the head, and by the same token, when a machine must be removed to the bench for repairs. Always replace the wiring color coding so that left and right channels are connected properly and the high and low side of the circuits maintained.

Mono Into Stereo

When feeding the output of the mono units into the stereo consolette, maintain impedance by the use of the simple 3-resistor pad. The pad can be worked both ways. That is, a single 600 Ohm output to two 600 Ohm inputs, or two outputs to one input. There is a 6 dB loss across the pad which can be made up in the equipment.

Cartridges

So many poor recordings or failures in the system can be traced to negligence on the part of the announcer in not recognizing defective cartridges before they are recorded. A simple visual inspection will often detect many problems such as worn or wrinkled tape, tape too loose or too tight, bent or missing pressure pads, parts missing from the cartridge, broken case, etc. As a matter of procedure, a quick inspection should be made of each cartridge before recording on it. For that matter, it is also a recommended control room procedure and takes but a few moments for an experienced eye. Even a good recording can become defective from repeated control room playing.

Summary

A recording booth should be the quality control center for the station tape recordings. The equipment should be maintained in an optimized condition. Once a booth has been put into service, it will soon get a high degree of usage. Equipment selected for the booth should be rugged production models that can stand up under this usage; otherwise, it will be a constant daily maintenance grind trying to keep the equipment together. And at the same time, many inferior recordings may pass into the system.

Editor's Note: If you would like to see more information on the recording booth, let us know. For that matter, if you have been redesigning or rebuilding yours, write it up, include a few snap shots and send it to the editor. Yes, we pay for all material used.

Old Receivers Are Still Important

Those Old Receivers

member the SX-42, the S-40, the Q-129X? Many of these old mmunications receivers worked ir way into radio stations. They re used for a variety of reasons, en occasionally for monitoring time signals of WWV. By the y, that's more meaningful than er now. The WWV time is given voice every minute. What's re, their new format includes rm warning information.

But that was only part of it. mmunity services were moni-ed as well as foreign news oadcasts. But as frequency allo-tions changed, these receivers quired converters to pull them o the new operating frequencies. fact, most were simply used as ter station monitors, converted o EBS monitors, or left to col-ct dust on the floor under the test nch.

In the small market stations it ght be just as well to take on the P or UPI and then rip and read. is easy and fast. But sooner or her your audience will pay more ention to a station that offers full rvice information. Of course, u can tie into the network news d let it go from there. But. . .the deoff is local identity.

We can't cover all the methods re that you could use for gather-g the kind of news that is mean-gful to your audience. Instead, e offer the thought that you can mp immediacy into your news ne by checking over what is ailable on the frequency charts.

The history of broadcast news porting is respectable. And oadcast emergency communica-ons has revealed heroics. But sel-m today do we see the station at is totally committed. It takes a ir amount of work to be average. takes a tremendous amount of ork to be excellent. There are al-rnatives. . .like feeling your oes fill up with sweat during a saster and all you can do is drop e needle on another top 40 rec-d.

Emergency Warning. . .

There Is Another System

Part 1

*By Stephen A. Russell**

The Department of Defense is currently implementing a plan to build 10 government transmitters that would broadcast directly to American homes, and eliminate a service that could be provided by the existing broadcast industry.

The February issue of **Broadcast Engineering** carried a comprehensive summary of this plan, entitled "The status of radio warning systems in the United States". Written by Charles Joyce, Assistant Director of the Office of Telecommunications Policy (OTP), it was the first public report by a top agency official on the nature and direction of government plans for a national home warning system. Mr. Joyce focused on the importance of automatic home warning. He made clear the final warning system will not only influence the cost of the public's future radios and TVs, but affect the security of the nation.

The United States will be the first country in the world to adopt automatic home warning. With no existing system from which to learn and only unproven prototypes from which to choose, the need for full and open debate in all phases of the decision-making process is vital.

It is with this need in mind that this two-part article challenges the major conclusions of the Joyce Status Report on radio warning systems. In that report three systems of automatic home alerting developed by three Federal agencies were reviewed:

1. The OCD's Decision Information Distribution System (DIDS).

2. The National Oceanic and Atmospheric Administration's (NOAA) VHF radio system.

3. The FCC and its National Industry Advisory Committee's (NIAC) Emergency Broadcast System (EBS).

Mr. Joyce reported the OTP had studied all three systems to determine their compatibility with the following OTP established goals:

1. The system must be capable of automatically turning on home radios and T.V.s within 30 seconds.

2. The system must be operative 24 hours a day.

3. The system must be capable of selectively warning only those areas affected in weather and natural disaster emergencies.

4. The system must be reliable and lend itself to unobtrusive testing.

Since both the OCD's DIDS and NOAA's VHF may be termed "government operated" warning systems, the choice of three systems facing the OTP was narrowed to a choice of two systems. This was a choice between DIDS system (since it was believed to be superior to NOAA's VHF system) and the EBS, a broadcast industry operated system. In this context the word "operated" refers to whether the government or the broadcast industry has the responsibility for automatically demuting home receivers.

The OTP maintained that only DIDS met all the OTP warning system goals. The alternative, broadcast operated system was rejected by the OTP based on two reported defects:

1. Mr. Joyce claimed a considerable loss of selectivity would be experienced. A broadcast station with a single addressing code for its 40 mile radius would be less selective compared to a DIDS station with 5,000 addressing codes, enabling DIDS to signal an area 1/10 the size.

2. Mr. Joyce claimed a loss of reliability due to homeowners failing to re-tune a variable tuned broadcast receiver to a 24-hour station. Homeowner willingness to "re-tune" to a 24-hour station before turning a home radio off at night seemed to Mr. Joyce to be "expecting too much of human nature."

Mr. Joyce concluded that DIDS was the only system able to satisfy the technical requirements of a home warning system.

The problem that he did consider unresolved was the high cost of the DIDS LF warning receiver. Mr. Joyce suggested that this cost problem could be hidden, by placing a warning receiver inside a TV.

In summary, Mr. Joyce pictured the DIDS system as being superior to other available options. Consequently, he indicated the OTP has been able to gain the agreement of the FCC to remove the function of automatic warning from the EBS. Two reasons were given to support this decision. First, it was claimed that only DIDS was technically feasible. Second, it was claimed DIDS receivers could be made economically acceptable.

Relying upon these two reasons for eliminating the broadcast industry from a responsible role in automatic home warning reflects a serious weakness in the methodology used to support the DIDS policy.

A Reason For Being

This logic for rejecting the broadcast industry in favor of DIDS breaks down when it is remembered the primary reason for developing a home warning system is national security.

Following the Cuban missile crises, the public recognized that a nuclear disaster could occur. In 1963 President Kennedy ordered all agencies to, in effect, consider two questions:

1. How to deter an enemy from attacking.

2. How to prepare, as best we could, both aggressive and defense measures to survive a war.

By answering the second question, we would hopefully have a solution to the first.

To let an aggressor nation know the U.S. is preparing a bona fide warning system is a key part in a sound plan of deterrence. DIDS is not a bona fide war warning system. Yet this is supposed to be its principal function. With emphasis

*International Electric Corp., Minneapolis.

he description of DIDS multi-address capability for local dis- r warning, it is easy to lose t of that fact that DIDS is g built to transmit primarily one address - national attack. ather warning has been added nake the ten DIDS transmitters re than a single use system. n though DIDS will not be able eplace what broadcast stations best perform. . .decentralized. ely, accurate, local weather ning information from a source public knows personally and ts.

Once it is recognized that the ncipal job of the ten DIDS nasmitters is to transmit an attack rning message, it is necessary to sider how a potential enemy l view the DIDS system. ether the international situation nding toward peace or war, a rning system must be highly dible from the start and believa- maintained. The system must capable of functioning regardless of enemy action since the future nuclear arsenal and strategy of an enemy cannot be predicted.

Vulnerable Towers?

DIDS violates this principal. The OCD has made the assumption that ten DIDS transmitters will be sufficient for attack warning since its facilities "are not considered to be potential targets". This assumption is unsupportable and dangerous. A study of the DIDS history reveals this assumption was made because there were no technically feasible and economically reasonable ways to secure DIDS antenna towers from sabotage or attack.

Rather than scrapping the idea of such a highly centralized and highly vulnerable system, the OCD argued that there were virtually thousands of military targets and therefore the odds of the DIDS antenna towers being subject to attack was only ten in thousands. At the same time, however, they claimed DIDS warning would save up to 27 million lives. How many other targets does this country have with this life-saving potential?

In short, the reasoning that (a) 10 DIDS stations will give immediate warning that will save 27 million lives; and (b) yet the enemy will not be interested in attacking them, is incredibly naive. Unfortunately, once an idea, such as DIDS, is committed to writing, it is too often assumed to be fact. The logical way to discourage the enemy's interest in destroying the warning system antennas is to multiply, disperse, and overlap the number of antennas.

This rationale is the principal reason for incorporating into the DIDS system one of our most valuable existing resources, namely, the 6,000 broadcast stations now in operation throughout the United States.

The technical and economic judgments described in the Joyce Status Report raised other prob-

lems with the DIDS system. These problems would have been recognized if the method of system investigation corresponded to a set of priorities that more accurately reflected the primary purpose of a national warning system. Of first priority is an investigation of the policy's effect on the national security. Second, the direct and indirect costs the general public will bear in the form of new home receivers and transmitters must be examined. Third, it must be considered how the technology of a system interrelates with the first two priorities.

With this re-ordering of priorities, the OTP would have arrived at a new warning policy. This article projects what this new policy might be and describes a system that will conform to it.

National Security Objectives

For a public warning system to work, warning equipment must be reliable. However, the general public's familiarity with and knowledge of a warning system as a result of media education and training is equal to or more important than the equipment itself.

In this respect, a government warning system is analogous to a computer system. "Software" is as essential to system success as "hardware". Without computer programs, a developed computer language, personnel trained to know computer operations and capacity, the hardware is virtually worthless.

On February 20, 1971, only 452 out of over 5,000 broadcast stations relayed to the public the OCD originated false EBS warning message. The lack of training exhibited by some broadcast personnel resulted in subjective judgments that could have cost countless lives in an actual emergency. Those stations that did relay the warning found their listening audiences to be unbelieving and confused.

A New Direction

In response to the EBS failure, Mr. Joyce indicated the plans for automatic home warning via the broadcasters have been terminated. Unfortunately, this turning away from the broadcast industry only serves to increase the country's unpreparedness. This conclusion stems from the earlier observation that reliance on only ten DIDS transmitters for attack warning is liable to make them targets of an attack. Once it is recognized that the 6,000 broadcast stations distribute the danger from attack, it is clear that the OTP should be turning to, not away from, a broadcast operated warning system. If necessary, broadcast station equipment and broadcast personnel training should be subsidized. This would lead to better coordination between the government and the broadcast industry.

To create the necessary "software" between the industry and the public, the broadcast station should use local and natural disaster situations as a test of the total system. Once the public recognizes the need for training and cooperation, warning receiver dissemination will be expedited. "Software" throughout the system can only exist when there is mutual trust between the government, industry and the public, that has been reenforced through experiences in a variety of natural and local disasters.

Minimizing the Public's Economic Burden

Mr. Joyce reported that the cost of DIDS receivers could be minimized by building them into new home TVs. Sold as a separate receiver, he conceded that the market for a high price DIDS receiver would be very small. (My company estimated the retail cost of a DIDS receiver to be $60.) Building this cost into a TV, according to Mr. Joyce, would make the warning receivers "percentage impact" on the overall cost of a TV relatively low. For example, a $300 color TV would be increased by "only" 20 percent to $360, when a $60 DIDS radio receiver is built into it. Whereas, a $20 AM-FM radio would be increased by 400 percent if the $60 receiver were added to it.

DIDS receivers are expensive for a number of reasons. First, very few parts of an existing entertainment TV or AM-FM radio are useable. A DIDS receiver requires a long wave antenna, a long wave receiver, a digital decoder for multiple addressing, a DC voltage stabilizer, and a separate audio amplifier and speaker. The TV amplifier and speaker cannot be used since the DIDS signalling technique features a "driven" signal to hold receivers open. This signal must be muted to prevent the emergency message from sounding garbled. Permanently cutting off the low frequencies in the regular TV speaker would reduce audio quality. A separate speaker is required or the public must be convinced that poor quality every day is the price of occasional warning. The only functions an existing entertainment receiver would provide a DIDS receiver is a power supply and a decorative cabinet.

An Alternate System

An alternative system that would dramatically reduce warning receiver costs is available. It is a signalling system operated by broadcast stations. Though the highly centralized warning by DIDS for attack warning is sacrificed, the broadcaster method of distribution, as noted earlier, is far more secure. The danger of sabotage is distributed over 6,000 transmitters.

Receivers demuted by broadcast stations could be simple and low cost. The warning function would add on an estimated $10 (retail) to an existing entertainment receiver. A low cost tuning fork filter and a single address decoder would be the only major changes necessary to add the warning option to a TV or radio.

Only the broadcast receiver meets Mr. Joyce's criteria, namely, "The price of such a receiver should be so low that every household can afford one. Economic discrimination in the distribution of warning receivers would undoubtedly be recognized as grossly unfair." Given this fact, why is the current DIDS being favored? I believe the answer rests on serious technical misinformation, in addition to the aforementioned failure to confront the national security implications.

A New IC Approach To Audio Power

By Walt Jung*

ntil recently, IC audio power lifiers have left much to be de- ird for high quality performance roadcast applications. IC op- s will meet most of the per- hance requirements, but need ster stages for line driving ap- ations, and certainly when used ive loudspeakers.

new IC has been introduced ch by itself will satisfy the 600 n line driver amplifications, and a pair of external transistors, vide up to 35 Watts of power an 8 Ohm load.

he unit to which we refer is the netics NE540L. The 540 has a mber of features which (by de- g) make it highly suitable as a h quality audio power amp. se are:

. A power bandwidth of 100 z and a small signal bandwidth of greater than 100 MHz, both very important for low distortion at high frequencies with high gain.

2. A high current output capability (100 ma typical) which is also internally self limiting for built in chip protection.

3. A wide operating voltage range of 10 to 50V (or ±5V to ±25V).

4. Adjustable quiescent current control for the external power transistors—this current control is also temperature tracking for bias stability.

5. A class B design which simultaneously provides relatively low idle current (13 ma typical) with highly linear operation.

6. Built in sensing transistors for use as power limiters for the externally connected booster transistors.

The 540 is quite complicated internally, as the schematic in Figure 1 shows. In spite of this rather overwhelming array of transistors, it can be likened in many regards to the op-amp configuration with which we are familiar. Reduced to this, we have drawn a symbolic equivalent in Figure 2. It has a pair of differential inputs, pin 2 (positive) and pin 4 (negative). A single V+ line connects to pin 10. This pin and pin 1 are the base and emitter terminals of PNP transistor Q23 and are used to sense positive load current in an externally connected resistor.

When power limits have been exceeded, the chips will shut down and serve as a protection device. A single V- line connects to pin 6. This pin and pin 5 connect to the base-emitter terminals of NPN Q30, which serves a function similar to Q23, limiting power from the negative supply.

*Solid State Editor

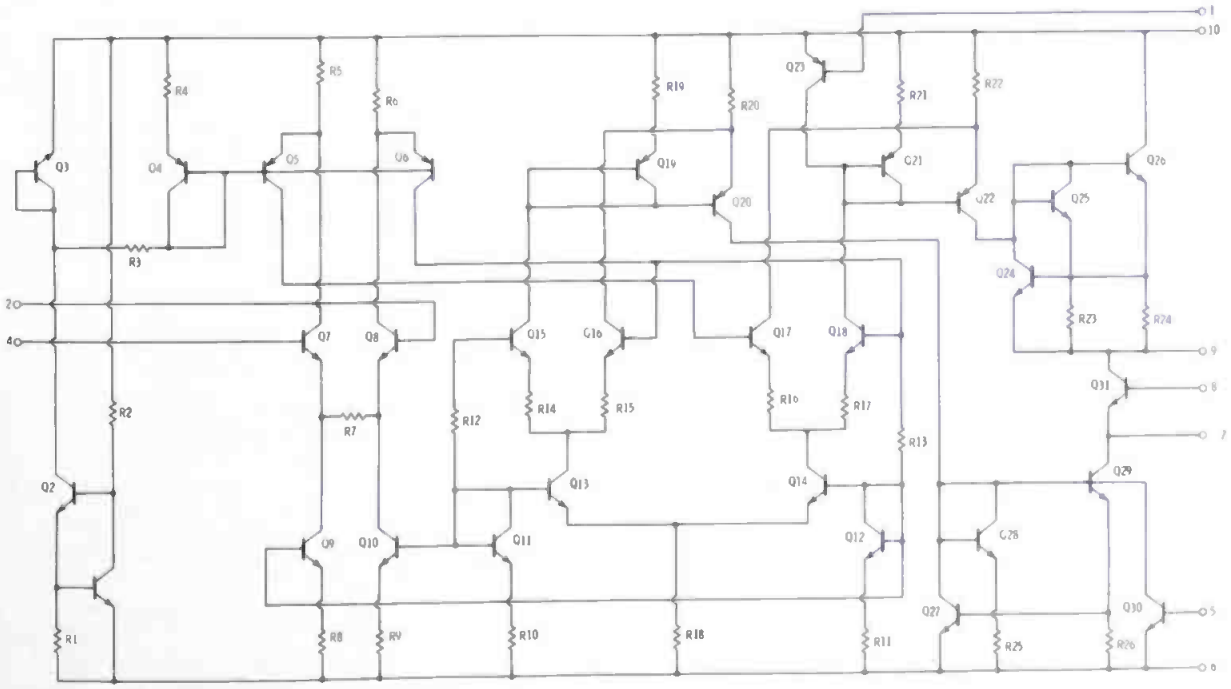


Fig. 1 Schematic of the NE/SE 540L.

Unique Differences

A major difference from that of a conventional op-amp is the output design. Note the connections to the emitter, base and collector of Q31. Q31 is the transistor used to set the idle current in the external boosters. It is hooked up as shown in Figure 3 with the pot setting the total drop across Q31 to match the Vbe's of the external boosters at the required idle current.

A major design difference which may not be obvious from the schematic is the type of amplification used within the 540. Conventional op-amps such as the 301A or 741 are voltage amplifiers, and voltage amplification often has it's limitations—notably slow rate problems and Miller effect.

The 540 design overcomes these problems with inherently wide-bandwidth current amplification, which provides the excellent frequency response mentioned above. As a result, the open loop voltage gain of the 540 will be in proportion to the load resistance it sees. This is not really a drawback, as in most applications the feedback will swamp the effect of the high output impedance. This high impedance is a great asset in eliminating crossover distortion. A current drive to the output transistors is the ideal method to minimize the annoying distortion products generated by this type of distortion. To appreciate the 540's advantages fully, let's look at a few circuit applications.

Circuit Uses

The first circuit to be discussed is the most basic configuration used with the 540, shown in Figure 4. This is a non-inverting circuit with gain being determined by R2 and R1. Input impedance is set at 10K by R3, making it useful for bridging applications.

A number of tests were run on this circuit under various conditions to determine its suitablility as a line amplifier and as a general purpose low power driver for headsets, cue amps, etc.

First of all, the circuit was tested in a 40dB gain configuration, using the recommended R2 and Cc values (see table). Since the 540 is advertised as being able to deliver

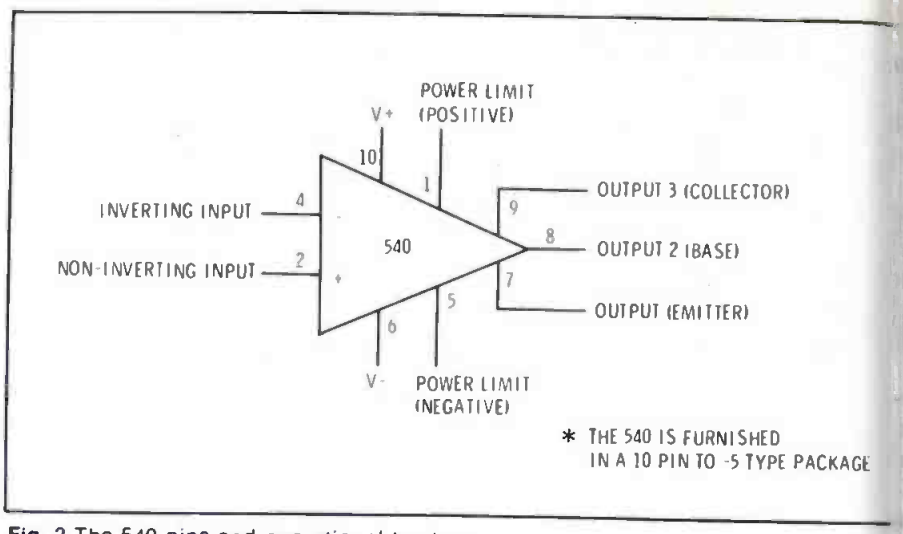


Fig. 2 The 540 pins and operational hookup.

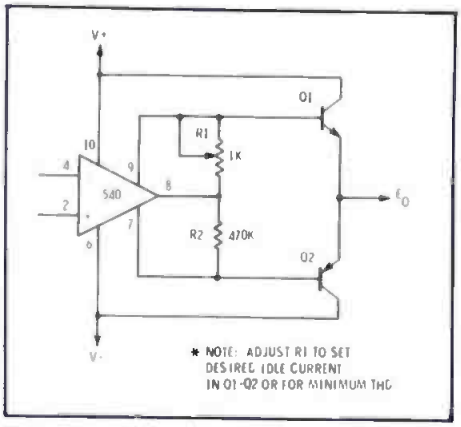


Fig. 3 A method of idle current adjustment with the 540.

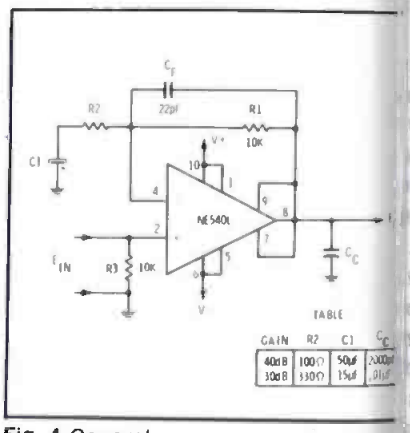


Fig. 4 General purpose 540 amplifier.

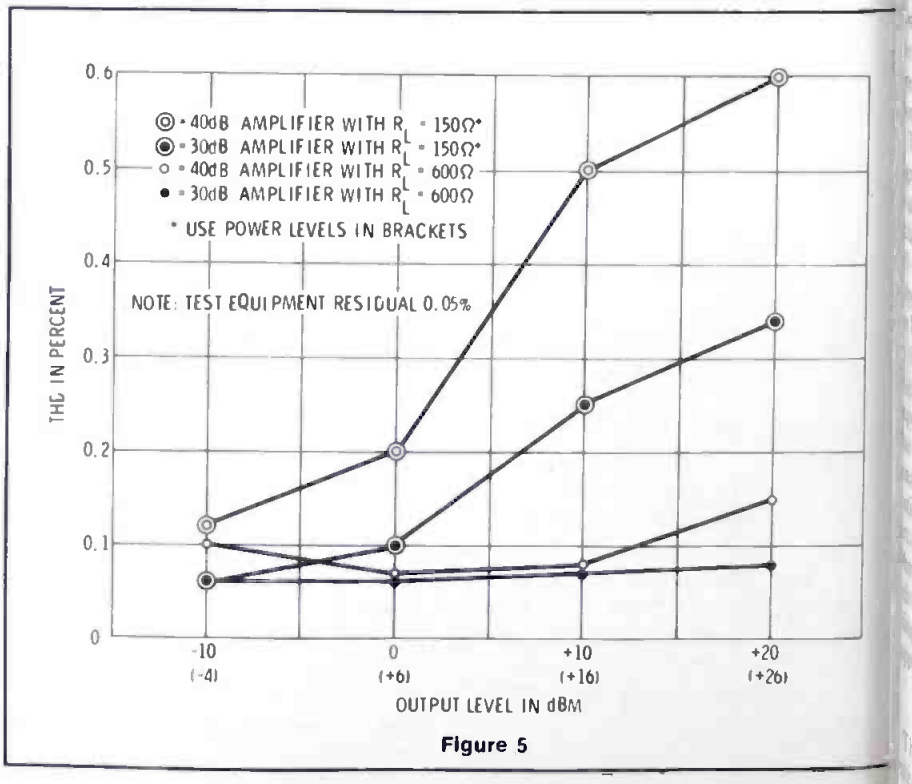


Figure 5

e Watt under these conditions, it s tested with both 600 and 150 m loads. The results of these ts are shown in Figure 5.

The 40dB gain amplifier has a atively large amount of distor- n when loaded with 150 Ohms, ich would prevent its use in a gram channel. It would be ade- ate for use as a cue amp, small nitor amp, or some other non- ical amplication. But this same plifier loaded with 600 Ohms only 0.15 percent distortion at 0dBm. As a line amp, this could satisfactory, depending upon ur individual standards; i.e., rating levels, headroom, degree compression and so forth.

The 40dB curves were taken th the manufacturers recom- nded values and the distortion els are slightly better than data luded on the 540 data sheet hich appears to be conserva- e).

An additional configuration was ted at a closed loop gain of 30dB e table with Figure 4), and its ults show substantial improve- nt. This amplifier's performance also shown in Figure 5 for com- rison. Note that at any level up +20dBm the 600 Ohm circuit s less than 0.1 percent THD. is data was taken with a residual t equipment distortion of 0.05 rcent. The distorion of 150 Ohm eration is also reduced in propor- n.

The power figures shown do not present the maximum output ailable from the 540 as Figure 5's ta was taken with standard sup- y levels of ±15 Volts. Raising the pplies to ±20 Volts would enable NE540L to deliver very close the 1 Watt level into 150 Ohms. ghtly more with reduced load pedance. However, it appears at the 150 Ohm loading is a rea- nable compromise between dis- tion and power output. Thus the cuit of Figure 4, with a 150 to 8 m matching transformer, could liver just about a Watt of power ing an NE540L and ±20 Volt pplies.

Frequency Response

These two circuits were also sted for square wave response.

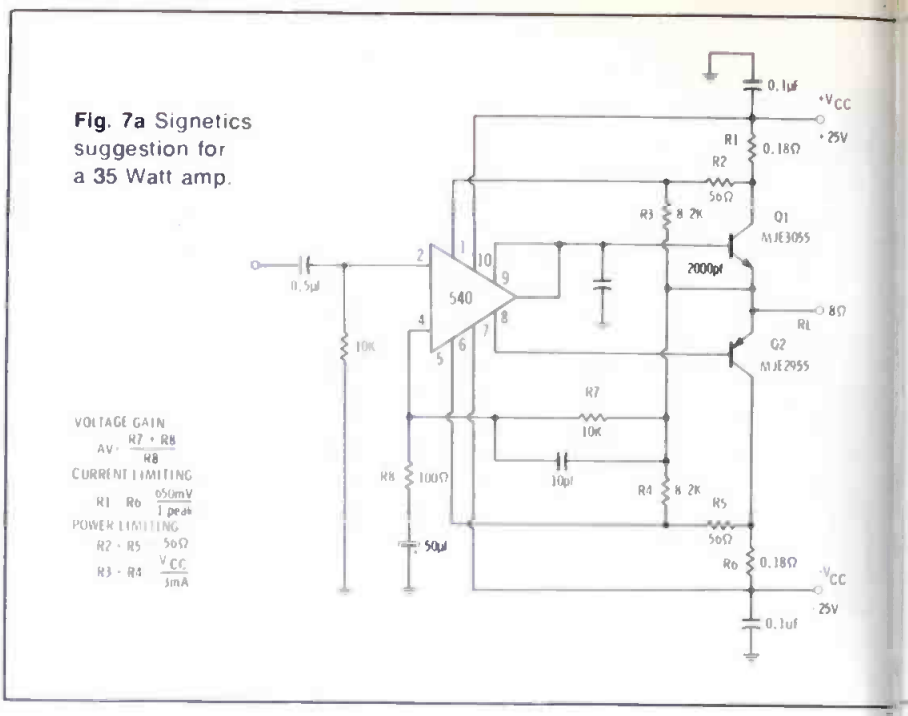


Fig. 7a Signetics suggestion for a 35 Watt amp.

This is where the 540's wide frequency response really shows up. The 40dB amplifier has a rise and fall time of less than a microsecond, and the 30dB circuit measures slightly over 2 microseconds rise and fall. The slightly increased feedback capacitance (22 pf) corrected an overshoot on the square wave step.

Noise performance of the 540 is interesting, too. Noise measures at around μV R. S with a 600 Ohm source and a 20 kHz bandwidth. Don't be misled by the 540's wide bandwidth when making a noise measurement. If you don't filter the test setup down to the audio spectrum only, you'll measure a lot of out of band components. Other types of noise sources (such as power supply ripple) are also well taken care of in the 540. Both positive and negative supply line rejection is typically 80dB for an NE540L. In most cases, unregulated supplies can be used.

Distortion vs. Frequency

No data on distortion vs. frequency is presented because I found no significant variation in the audio band. And this is significant! Typically, audio amplifiers will show a distortion vs. frequency plot which is essentially the inverse of their open loop gain; that is, distortion corners upwards at some middle frequency and starts rising until 20 kHz it may reach 0.5 percent. At 1 kHz it may have been below measurement residual.

In the 540 the open loop, response doesn't start dropping until nearly 50 kHz (the exact frequency depends upon loading), so there is no rise in distortion. As far as the audible spectrum goes, the 540's open loop response is flat! And that makes for a good feedback amplifier.

In most signal processing applications for broadcast consoles etc. there is really no need to terminate amplifiers with 600 Ohms. Using the circuits discussed here in this manner, distortion levels will be at a minimum right up to the clip level, since the amplifier is providing voltage output and the power level is relatively small. Thus distortion will be even better than the curves of Figure 5 indicate.

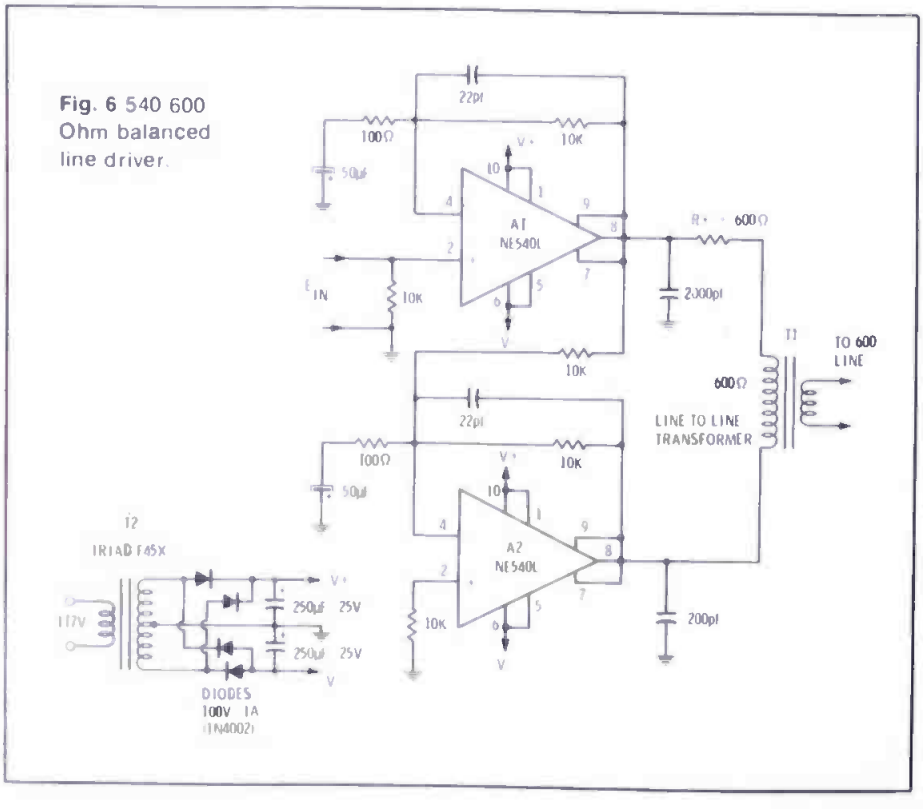
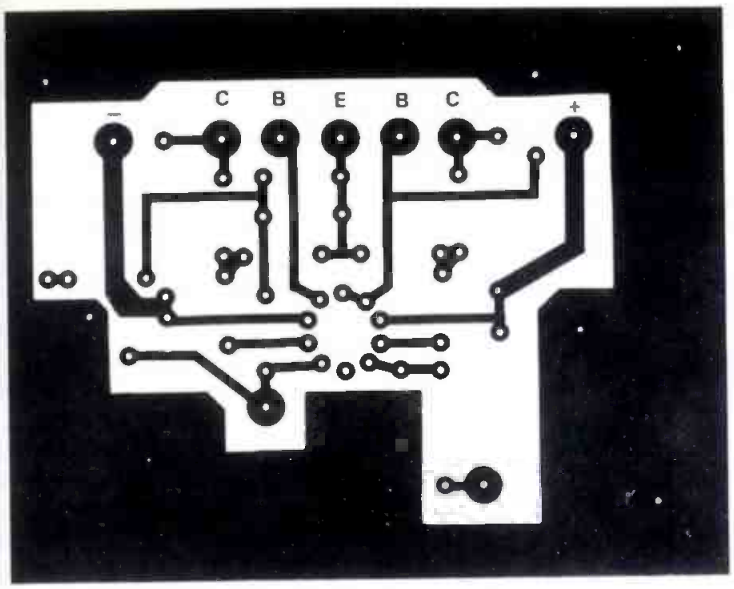


Fig. 6 540 600 Ohm balanced line driver.

Driving Telco Lines

One very common broadcast application of a line amp is driving a 600 Ohm Telco line. In these cases it is mandatory to provide source impedance to terminate the line correctly. This usually takes the form of a pad on an amplifier to "build out" to the required line impedance. The penalty for this is



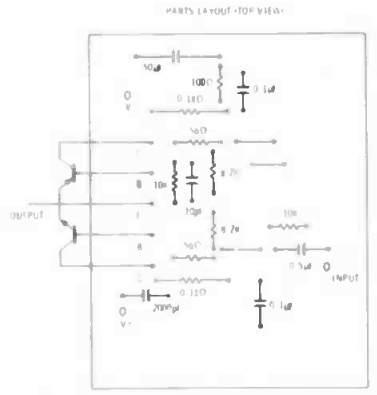


Fig. 7b PC board layout and component hookup.

power loss associated with the , typically 6dB. This takes 6dB headroom right off your amplifie's output which, at times, may painful (if it clips).

nifty way to get around this is use a bridged output stage to ply an extra 6dB of output be- the pad. You end up with the me net power after the termina- loss. A simple and workable uit exploiting the 540's virtues his application is Figure 6.

A1 is a 40dB non-inverting stage before, driving one end of T1's mary with an in-phase signal. At same time, A2 inverts this sig- and supplies a mirror image of it opposite end of T1's primary. us the drive to T1 is doubled prior to the source termination resistor Rt1.

The circuit is reasonably clean THD being 0.1 percent up to +10dBm and reaching a maximum of 0.17 percent at +20dBm. The +20dBm level is the maximum which can be achieved with ±15 Volt supplies, but if needed, you can squeeze a few extra dB of level beyond this is you use higher voltages.

High Power Stages

Now having just said all we can say on the 540 by itself, we will look at it with booster stages. Signetics is kind enough to supply a PC layout for a 35 Watt amplifier along with their 540 data sheet. The schematic of this amplifier is shown in Figure 7A, and 7B is the PC layout. Some comments are order on the circuit.

This is a 40dB gain circuit as the feedback network (R7-R8) is exactly the same as before. Emitter follower boosters Q1 and Q2 are included within the feedback loop. An important feature of the circuit is the power limiter protection networks used R1, R2, R3 and R4, R5, R6. These networks sense a combination of the current and voltage applied to their respective transistors and when it exceeds either a predetermined voltage or current limit, shut off the drive by

(Continued on page 48)

PEOPLE IN THE NEWS

I. T. Saldi has been named Manager of Imaging and Display Devices Business Section (IDD) for General Electric's Tube Products Department. . .**C. David Batalsky** has been named Manager of Marketing Communications at Jerrold Electronics Corp., according to Joseph D. Romasco, Manager of Marketing Services of the Philadelphia headquartered firm. . .Appointment of **James C. Morrison** as marketing manager of the Fernseh division of the Robert Bosch Corp. was announced in Chicago by Rupert F. Goodspeed, Fernseh division manager. . .Electronic Engineering Company of California (EECO) has appointed **Michael Campo** to the newly created position of Manager, International Sales. Mr. Campo will open his office in London, England . . . .

Berkey Colortran, Inc., a division of Berkey Photo, Inc., has announced the appointed of **Phillip H. Stidham** as Manager, Representative Sales. . .The board of directors of Switchcraft, Inc., Chicago, has elected **Clyde J. Schultz** as vice president-marketing. . .Leon Berman, President, AEL Service Corp. (AELSC), a subsidiary of American Electronic Laboratories, Inc. (AEL), has named **R. K. Swieter** Vice President of AELSC . . . .

GTE Sylvania Inc. has added **Louise B. Quinlan** t the staff of the Electronic Systems Group of GTE a Public Information Editor. She succeeds **Joan P Shanks** recently named to head Project Transition fo the group. . .**Peter W. Smith** has been appointed Presi dent of the Western Gold & Platinum (WESGO) Sub sidiary of GTE Sylvania. . .The appointment of **John J. Davin** as Vice President-Materials and Facilities fo GTE Sylvania Inc. was announced by Douglas L Hamilton, Senior Vice President-Finance . . . .

Charles A. Steinberg, Vice President-General Manager of Ampex Corporation announced the ap pointment of **Donald V. Kleffman** as marketing manag er of the audio-video systems division of Amp ex. . . .**Paul G. Hansil** has been named southeas regional manager for the Ampex audio-video system division. It was announced by Richard Sirinsky, na tional sales manager. . .**Leon A. Wortman**, forme manager of corporate marketing services for Ampe Corp., has been appointed to the newly created posi tion of manager of distribution planning and nationa accounts for the Ampex audio-video systems divi sion. . .**John B. Hatch** has been named a product news manager for Ampex Corp., it was announced by Gregg W. Perry, director, public relations . . . .

Neal McLain has been elected president and **Charle Whitcomb** vice president of the newly formed Medi atech, Park Ridge, Ill. . .**Murray O. Cunningham** ha joined L-W Photo, Inc., Van Nuys, Calif., in the new ly created position of director of marketing . . . .

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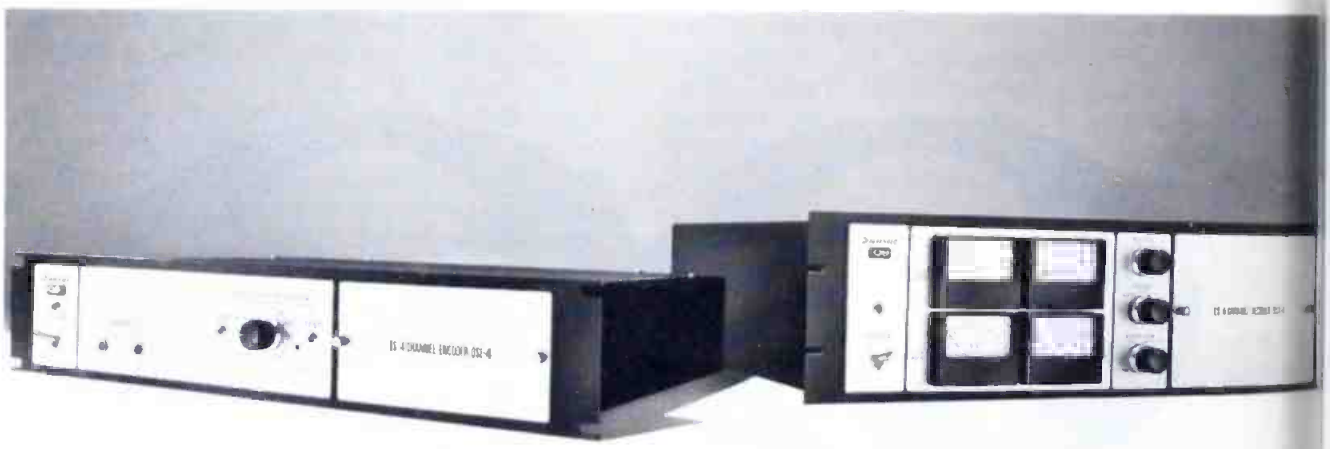

THE PAIR PAR EXCELLENCE

THE SANSUI QSE-4 ENCODER

THE SANSUI QSD-4 DECODER

It took a large investment in effort, time and money, a great deal of experimentation and devotion, of testing and ingenuity. But it's here now: the QSE-4 Encoder and its complementary QSD-4 Decoder are ready for your ears. Are your ears ready for them? Are you prepared to make A-B comparisons between a discrete four-channel original and the QS-encoded and decoded version of the same material—*without being able to tell the difference?*

Sansui's QS Regular Matrix System, from the beginning, was the only matrix that could accurately pick up and reproduce sound from any direction of the sound field and at any point within the sound field, including dead center, in the same way that could be done with a discrete source. It fell short only in not being able to offer optimum separation.

Today, with the exclusive j-shift technique and all the other original technology of the symmetrical system faithfully retained, the addition of the totally new Vario-Matrix technique now provides that separation. Full four-channel separation. The complete psychoacoustic effect, to match any other four-channel medium. With none of the complication or obsolescence inherent in so many other systems.

Tool up with the new QSE-4 Encoder and QSD-4 Decoder. If you want to get started in four-channel recording, why not start at the top?

our ears.
inally sounds
-channel.

Advantages of the Sansui QS Coding System:

1 **THE QS SYSTEM** prevents directional error or the loss of any information in the encoding process. It therefore places no limitations on the right of the recording or broadcast engineer to experiment freely with new studio placement of performers.

2 **THE QS SYSTEM** is the only matrix system that permits, at the decoding end, reproduction of sound anywhere in a full circle and at the dead center of the sound field. There are no weak locations in this completely symmetrical system.

3 **THE QS SYSTEM** does not in any way degrade any current standards of high-fidelity sound reproduction, whether they involve noise, distortion, dynamic range, frequency response or anything else.

4 **THE QS SYSTEM** offers dual compatibility with existing two-channel stereo equipment. On the one hand, when an encoded recording or program is played back on standard two-channel stereo equipment, the depth and dimension of the normal stereo presentation are enhanced. This makes it possible to produce a single version of any recording—one disc serves as both the four-channel and enhanced two-channel version. On the other hand, when a standard two-channel disc or other source is played through the decoder, a superb four-channel effect is synthesized.

5 **THE QS SYSTEM** avoids the use of a high-frequency subcarrier. Resultant encoded material can thus be reproduced effectively even by a simple speaker matrix. The system is therefore easily and economically popularized.

6 **THE QS SYSTEM** is a complete, all-purpose, all-media encode/decode process, with total compatibility with all equipment and standards. That applies to disc recording and broadcasting. Even to tape recording.

For full details on obtaining the new Encoder/Decoder or more background literature, contact your nearest Sansui office.

QS
REGULAR MATRIX

Sansui

For full details,
contact your nearest Sansui office now.

SANSUI ELECTRONICS CORP.

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Sansui Electric Co., Ltd.	Los Angeles Tokyo	333 West Alondra Blvd Gardena Calif 90247 Tel (213) 532 7670 14 1 2 chome Izum Sug nam ku Tokyo 168 Japan Tel (03) 323 1111 Cable SANSUIELEC Telex 232 2076
Sansui Audio Europe S.A.	Belgium	Diacem Bu ld ng Vest ngstraat 53 55 2000 Antwerp Tel 315663 5 Cable SANSUIEURO ANTWERP Telex ANTWERP 33538
	Germany, W.	6 Frankfurt am Main Reute weg 93 Tel 33538

Circle Number 56 on Reader Reply Card

We'd like to sell you a product that isn't working.

Color television took years to perfect. But the potential was there.

We have a product with great potential. Perhaps you've heard our name, but not known what we do. We're the National Alliance of Businessmen. We're in business to help America's disadvantaged citizens. Products of the ghetto, poverty, poor education and life's bad breaks. Our purpose is to make the American system work, by seeing that everyone who wants to work can become a fully participating citizen.

If you read on, you'll see why 30,000 NAB participating companies have found it good business to employ and train a million disadvantaged persons. Why thousands of talented executives have been loaned to us by America's leading corporations.

We were formed by presidential mandate to serve as a catalyst between government and business. Business provides the jobs and government finds the persons to be hired and trained. Most companies pay the training cost themselves. Companies that cannot afford to take on the task of employing and training the hard-core unemployed can be given financial support by the government. We think this partnership between business and government is a good way for our society to deal with its problems.

We have programs that deal with the hard-core unemployed. Hiring, training and retraining the disadvantaged across America. Transforming the disadvantaged into full citizens —people with hope, training and the experience that helps them move within our society.

Our youth programs represent the preventive side of the Alliance. If we can keep kids in school, they'll be less likely to fall into the continuing cycle of poverty. So we have programs to give disadvantaged youth summer and year-round employment and training, and others designed for career guidance, motivation and practical business education.

And because thousands of Vietnam-era veterans are having trouble finding jobs, we have responded to a presidential request to find jobs for hundreds of thousands of Vietnam-era veterans.

With 500 full-time loaned executives manning offices in 164 cities, we are fully committed to helping the nation solve one of its most pressing problems.

As President Nixon has said:
"The National Alliance of Businessmen has displayed a remarkable capability to mobilize the American business community in response to a national problem."

We have a product to sell. And programs that make it easy to buy. Contact the National Alliance of Businessmen. Help us get our product and our country working.

The National Alliance of Businessmen.
The Jobs People
1730 K Street, N.W., Washington, D.C. 20006

bookreview

FM-Stereo Broadcasting

The continued popularity of FM broadcasting leads any interested technicians, audiophiles, and laymen ask such basic questions as: How are stereo broadsts different from other FM broadcasts? What type equipment is needed for stereo? What is multiplexg? How does it work? These questions and many hers like them are answered in the book **FM Multiplexing for Stereo** written by Leonard Feldman.

Chapter 1 starts with an analysis of the FM stereo gnal and follows in Chapter 2 with some of the reirements for FM stereo receivers. These include ch topics as sensitivity, de-emphasis, and frequency sponse of demodulators.

Chapter 3 discusses multiplex decoder circuits and hapter 4 discusses such refinements and convetence features as stereo indicator lights and automatic ereo switching. Chapter 5 takes up the servicing of ultiplex circuits. Test equipment and alignment produres are discussed in Chapter 6. A number of mulplex circuits by various manufacturers are covered in hapter 7.

This book is available through the Howard W. Sams o., Indianapolis, Indiana.

Solid-State Electronics

Today, the technician is expected to assume technial responsibilties that formerly were controlled by gineers. As a consequence, the valuable electronics chnician, often called an Associate Engineer, must ave more than a superficial knowledge of the popular olid-state components now in use. The main objecve of the **Comprehensive Guide To Solid-State Elecnonics,** written by George B. Rutkowski, is to help chnicians meet this challenge. The author not only scusses the fundamentals, but also develops the stunt's ability to select proper design components for olid-state electronic circuits.

The book begins by explaining common semiconuctor materials. Other chapters discuss the zener iode, the junction transistor, the silicon-controlled ctifier, the field effect-transistor and integrated ciruits.

A modified programmed style is used throughout he book. Each point discussed is followed by at least ne worked example. The student is encouraged to ork each sample problem before referring to its soluon. The answers to the odd-numbered end-of-chapter roblems are provided at the end of the book. These roblems, with the examples, make this book a highlyecommended source for either self-study or classoom use.

This book is available through the Howard W. Sams o., Indianapolis, Ind.

IC Approach

(Continued from page 45)

turning on the IC's internal sense transistors (Q23 or Q30). A slightly forward (1Vbe) bias is applied to Q1-Q2 by operating the IC's Q31 as a diode.

Although this amplifier will deliver 35 Watts with ±25 Volt supplies, these voltages apply to the SE540L, a more expensive version of the 540. The NE540L will develop about 17 Watts with ±20 Volt supplies, its maximum voltage rating. In this amplifier Q1 and Q2 will both need a heat sink-a solid thermal connection to the chassis or other large metallic radiating surface is recommended.*

Don't forget the 0.1 μf by-pass capacitors from each supply line to ground-without them the circuit will almost certainly oscillate. For those who may wish to improve upon the circuit, a bias adjustment pot may be added (Figure 3) to minimize crossover distortion. Or going a step further, Darlington pairs may be substituted for Q1 and Q2, such as the Motorola MJE1100 and MJE1090. This allows the 5 to see a higher load impedance a minimizes distortion at high outp levels.

The 35 Watt power level is n the maximum power obtainab from a 540 circuit either. Mere halving load impedance to 4 Ohn will double power output, assur ing adequate transistor power ra ing and heat linking. And bridge power configurations are also po sible with the 540, one such exan ple is listed on the data sheet.

Summary

What we have described here by no means all that may be dor with the 540. All of the popular o amp circuits are possible using th 540 with the bonus of increase power and bandwidth. After yo have armed yourself with the back ground data and a hot solderin iron, we refer you to your ow imaginative innovations using thi new audio IC.

*See: "Air! Give Me Air!" April, 1971 BROADCAST EN GINEERING.

SPSE Sets Dates For October, February Meetings

"Photo-Technology Trends in the Graphic Arts" and "Micrographics Science-1973" are forthcoming Society of Photographic Science and Engineering symposia.

Information Storage and Retrieval, COM, Micropublishing and Future Directions are four sessions suggested by the call for the New Orleans micrographics meeting, February 1-2. Topics will include materials, apparatus, and systems. General Chairman is M. G. Anderson and papers Chairman is Vernon L. Wagner, Jr.

A familiar pattern will be followed for "Photo-Technology Trends in the Graphic Arts," subject of the annual SPSE Washington symposium, October 25-27: (1) invited papers commencing the program will critically and extensively review the state of the art (including reference to commercial equipment) (2) the main part of the program consisting of contributed papers will cover current photo science and engineering (3) a "Rap" session under the guidanc of selected leaders to ensure focu will provide an opportunity in cor clusion for an informal give an take. General Chairman is Ir Kohlman.

If you would like information o the SPSE or how to obtain a mem bership write to: Russell P. Cook Polaroid Corporation, 730 Mai Street, Cambridge, Mass., 02139.

"ENGINEER SAYS WE SHOULD TAKE TWO ASPIRINS AND CALL HIM IN THE MORNING."

Eliminating Dead Air On Tape Reversing

Most commercially available tomation systems do not rely on reversing ability of a tape deck perform properly. However, ch is not the case for home-brew ye systems which often consist of y two decks wired to sequence ntinuously. For these systems, e often finds decks such as the ully 270 series which is a very ged series of decks. A tape deck pable of using 14 inch reels and ning at 3¾ ips can provide up to hours playing time with 7200 t of tape.

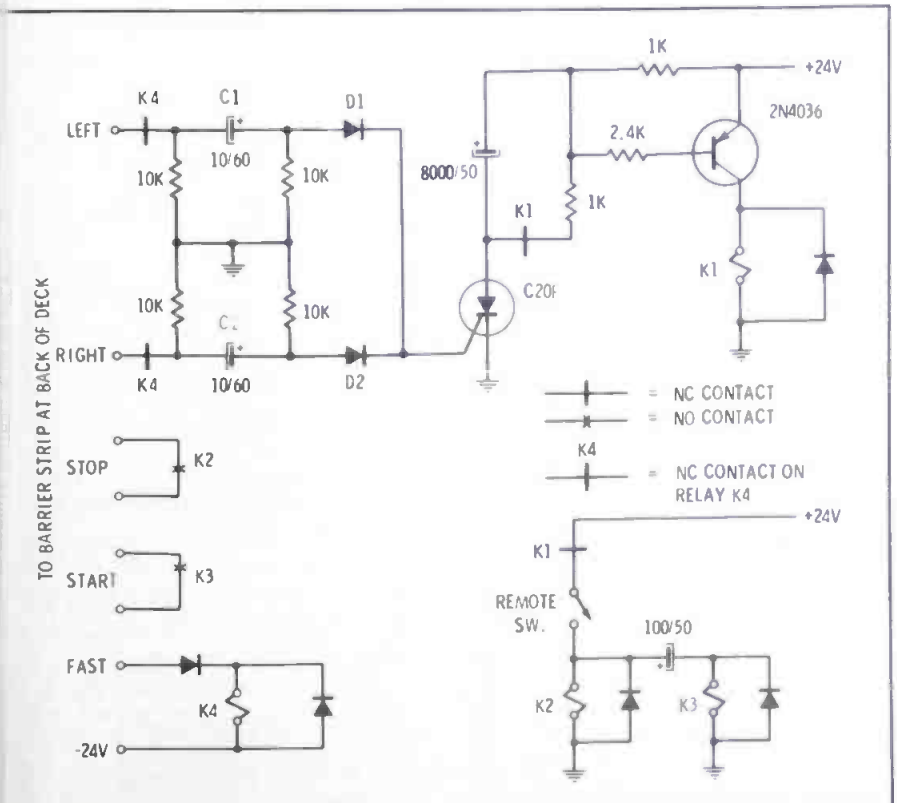
For ease of changing programng, however, often smaller reels used. This means that the deck l have to reverse more often, d it must provide the necessary que for reversing each time. ese and other professional decks t use 1800/3600 rpm motors with y small capstan shafts that proe relatively little reversing que when compared to the iner- on the reels. The net result is en extended periods of dead air ht at the end of a tape. This is especially noticeable if the deck is not cleaned regularly.

Neutral First

The motors themselves are capable of reversing quite quickly, generally in a few seconds. Thus, it would be desirable to have a device which would drop out the transport and wait for the motor to be fully reversed and then re-engage the transport. A timing device will do the trick since the next step up would be a tachometer on the motor flywheel.

The necessary circuitry consists of an RC timeout, control relays and a triggering section. The timeout is set to a nominal ten seconds, and, in general, is a trial-and-error procedure. The values given provide a fairly consistent ten second delay. The charging current for the capacitor operates the main relay.

Two more relays provide start-stop control for a two-wire remote control switch. One of these relays is used to hold the stop link while the other pulses to start the deck.



Number 91 in a series of discussions by Electro-Voice engineers

SON OF 642

ROBERT C. RAMSEY
Chief Engineer,
Professional Microphones

When the Electro-Voice Model 642 was first introduced over a decade ago it proved a major advance in distant-sound pickup technology. In fact it won an Academy Award in 1963, the first such certificate awarded a microphone design since 1941. With the intervening years, new technology has made possible a major redesign of the basic line microphone to achieve superior performance and a more useful form factor.

The Model 642 was a combination distributed front-opening (line) microphone at high frequencies and a cardioid pattern below 500 Hz. The new Model DL42 combines a refined line concept for the highs with a hyper-cardioid pattern that better matches bass directivity and sensitivity with the high-frequency pickup pattern. Overall the directivity index of the DL42 is usefully greater, with less variation with frequency, and improved rejection at the sides. Careful consideration was given in the design to the most probable angle of incidence for noise when used in typical studio and remote environments.

While the improvement in directional characteristics is significant, it is overshadowed by major reductions in size and weight. The DL42 is just ¼ the weight of the 642. Even with shock mount and cable it weights only 1 lb., 11 ozs. It is also smaller in diameter, but our present understanding of the laws of physics has not permitted any substantial reduction in length.

This elimination of mass was possible despite maintaining output level within 2 dB of the 642. And the DL42 weighs even less than most highly-directional condenser microphones. Because microphones of this type are most often used on fish-poles and studio booms, a special shock mount was developed to meet the problems. Mass of the DL42 is equally distributed on either side of the shock mount pivot to reduce both lag and over-shoot when pivoting between two performers. The 3-stage shock mount effectively isolates the DL42 from external mechanical shock, while an integral windscreen reduces noise from ambient wind or high-speed panning. Low frequency response, which must be rolled off to maintain subjectively-flat response, also aids in suppressing wind noise.

The final design stage, as is true of all E-V professional microphones, involved extensive testing under actual field conditions, with many of the design parameters modified by feedback from operating sound engineers.

For reprints of other discussions in this series, or technical data on any E-V product, write: ELECTRO-VOICE, INC., Dept. 1023V 638 Cecil St., Buchanan, Michigan 49107

ENGINEER'S EXCHANG

Many FM transmitters around the country now use solid state exciters such as the RCA direct FM exciter manufactured by Moseley. And by now, many stations also have available one of the new generation of counters similar to the Heathkit shown in the illustrations. These counters can be very convenient for checking the frequency of the 19 kHz pilot frequency broadcast as part of the stereo composite signal. This frequency is required to be checked at least once a day, and most stations now have frequency monitor which will do the job.

The accuracy of the monitor can be checked quickly with the method shown here. All that is required is a BNC connector, a few inches of wire, and some very careful drilling. Use great care in drilling to avoid getting chips of metal inside the stereo generator, where th are definitely not wanted. The w should be flexible, and should terminated with a prod to fit t test point mounted on the print circuit board just inside the rig front of the stereo generator pane

You will make a connection the blue test point TP 304. At th point you will get +4.5 Volts D and you'll also find 8 Volts, peak peak of the 19 kHz pilot frequenc If desired, a small capacitor cou be used to connect the BN connector to the test point, but the case of the Heathkit counter, is not needed.

The pilot frequency can checked quickly here whenev desired without plugging in the e tender board supplied with the ste eo generator. This test point c also be used to synchronize th

---

(Continued from page 49)

A fourth relay bypasses all auxillary functions during fast wind.

Reverse Control

Looking at the schematic for the deck, you'll find two places where direction change signals are available. One place is at the direction lights and the other is at the reversing relay coils. These are marked LT and RT. This latter choice is preferable because it has positive going logic, i.e. it switches from -24 Volts to O Volts. The direction light switches from open to -24 Volts, which is a negative-going logic. Positive logic allows a wider choice of control devices.

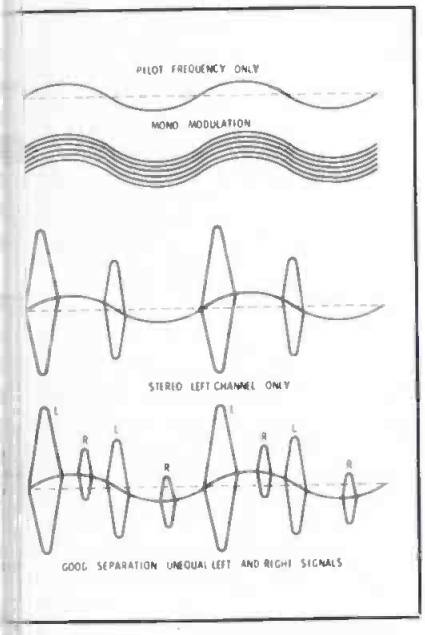
This design used relays simply because they were easy to use. A little thought will allow the elimination of these for completely solid-state logic. However, the prototype model works quite well. Note that all interface connections are made to a barrier strip at the back of the deck. No modification to the internal circuitry is necessary.

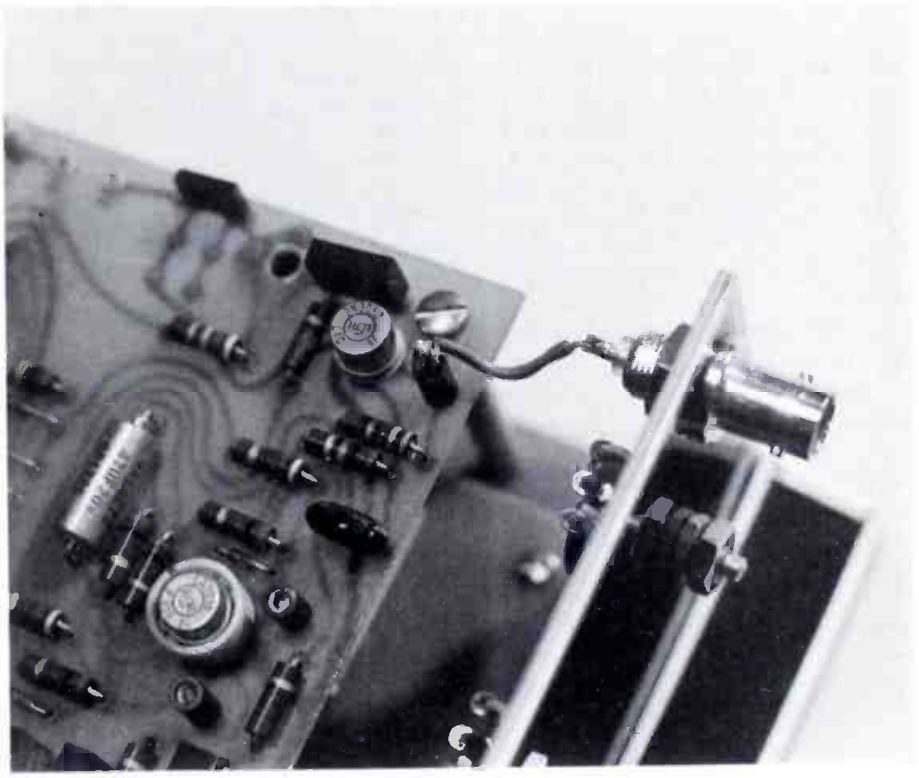
C1, C2, D1, D2 form a differentiating network for the direction reversing pulse which occu whenever a direction change bu ton is pushed. The exact shape the pulse does not matter; the tot energy in the pulse is determine by the capacitors. The diodes allo only one edge of the pulse to pa through. The 10K resistors are f discharging the capacitors to insu triggering reliably.

The 8000/50 capacitor is the chi timing element. Its charging cu rent maintains the SCR in condu tion until this current drops below ma. This is the figure related f this SCR. A small unit such as th C106 could have been used, but th current for holding is only 0.3 m which makes the last part of th timing process difficult to control.

As designed, approximately ma of base current will flow in the transistor just at the end of t timing interval. With a moderat high Beta transistor, probably a kind of relay could be used.

All relays used were KHP17D (24VDC) type but others shou work also. Selection of diodes not critical, neither are most of t parts.





...eep generator of a typical ser-...ie type scope in order to give a ...cy useful stereo display.

With a wide-band signal fed into ...h vertical amplifier of the scope, ...d with the sweep running at 19 ...lz, or at 38 kHz, you can imme-...tely see whether or not you are ...oadcasting in stereo, how good ...ur separation is. Monaural trans-...ssion shows up at once with this ...pe of display. If you are using a ...gnal generator to supply tones to ...e channel at a time, you can ...entify left and right channels. ...his display is probably familiar to ...ost of you, but a glance at the ...etch will show the advantages.

The audio is superimposed on ...e base (pilot frequency) in quad-...nts, and separation, or lack of it ...quickly evident. In fact, a mono ...gnal will show no quadrants; the ...hole base line will swing up and ...own with the modulation. To ...entify channels, remember that ...e left channel should coincide ...ith the pilot frequency as it cross-...s the base line in the upward ...irection.

We feel that this is quite a bit of ...formation to be made available ...ll for the price of a BNC connec-...or, and a few minutes of work.

Roy L. Gallagher
Transmitter Supervisor
WFTL AM-FM
Ft. Lauderdale, Fla.

NEW PRODUCTS

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

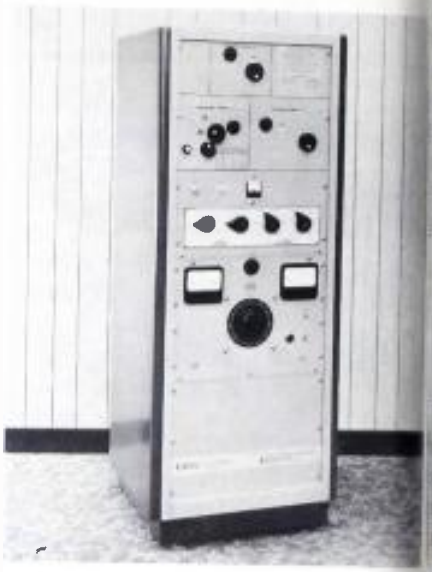
High Power RF Source

The new time-saving **BIRD** High-Power RF Source consists of three independent oscillators and one common power supply mounted in a mobile rack, which rolls right up to a test station.

The power oscillators are individually tunable over a wide frequency range or may be set at three fixed frequencies. Their output can then be repeatedly selected by switching for easy observation of your design changes in components tested.

The inconvenience of removing and inserting RF heads for various frequency bands, the waiting time for warm-up and output stability, and the changing of harmonic filters are all eliminated in this new Instant-Output Signal Source. (No waiting required when switching between oscillators—after initial warm-up period at turn-on in the morning.)

BIRD model 7000 features common metering for DC power supply and RF power output as high as 150 watts CW. This higher power rating permits extensive component and system testing, meter and attenuator calibration, EMC investigation, etc. at full design power. Level is controlled down to ¼ watt by a coarse and fine-adjust knob. A small meter indicates relative output power over the entire 25-1000MHz range with ±15 percent accuracy.



Adding a THRULINE® model 4340 RF precision Wattmeter and a model 8135 TERMALINE® 150 watt Load creates an instant, mobile RF testing laboratory with 3 percent measurement accuracy, unsurpassed in power level, frequency range and time-saving convenience at its price.

Circle Number 60 on Reader Reply Card

Dropout Resistant Video Tape

Memorex Corporation has announced availability of new Vidichrome video tape which offers substantial noise-resistance and an extremely low dropout rate for one-inch Ampex helical recordings.

"Vidichrome has a dropout rate of less than 10 per minute on an Ampex VR 5100, as well as the industry's highest signal to noise ratio of over 42 dB," said Russ Parker, video product manager.

"The tape has an extremely high resistance to the detrimental effects of heat and humidity because it is made using a unique binder formula," said Parker. "It also reduces head wear and cinching, extending tape life to more than 500 passes."

"The possibility of static charge build-up which attracts foreign particles and causes dropouts is significantly reduced with Vidichrome because it is also back-coated," he said.

Capable of recording both color and black and white values, Vidi-

ome is available in lengths of 0 feet (½ hour) and 3000 feet (1 r). Users may also select either unctional plastic shelf box car- or a durable new plastic ship- at a slight additional charge. ces of the new tape depend on quantities and package or- ed, and are quoted on request ough local Memorex distribu- s.

Circle Number 61 on Reader Reply Card

FM Monitor Receiver

The Heath Company has veloped a revolutionary FM er that has applications in the oadcast, cable, and home enter- mment fields.

This new approach to FM tuning olves the digital readout tech- ue for frequency monitoring and ing. And, all controls are push tons.

Called the AJ-1510, the tuner s the age old knob twisting band nning technique. Now, band nning can be accomplished by ching the auto sweep button. e unit will stop at each signal ere a broadcast can be received. uch the by-pass button, and the n continues to count down from top of the band.

Circle Number 62 on Reader Reply Card

Broadcast Color TV Camera

A new broadcast color television mera for studio and remote use well as closed circuit and cable evision applications has been oduced by **International Video rporation.**

The IVC-500A offers significant w features compared to previous C broadcast cameras but incor- rates the successful tube combi- tion used in the IVC-500—a sili- n diode tube in the red channel d Plumbicon tubes in the blue d green channels, he said. The sult is the best rendition of reds d the most sensitive color cam- a available today, Moscarello ded.

Major new features in the IVC- 0A include:

- new preamplifiers have a great- dynamic range without clipping an previous models, and at the

same time provide an excellent signal to noise ratio.

- an external video feed can be displayed on the nine-inch viewfinder.

- a new focus current regular adds improved stability.

- full horizontal and vertical contour enhancement permit sharper pictures.

- structural improvements have significantly increased the camera's mechanical strength without adding appreciably to its weight.

Circle Number 63 on Reader Reply Card

Amplifier/Modulator

Acrodyne Industries, Inc., has announced the introduction of its A-2028 Amplifier, a totally solid state unit operating in the frequency range of 950 MHz to 1250 MHz.

This unit is usually combined with a built-in Acrodyne Gaussian Pulse Modulator. The Amplifier provides a peak power output of 50 watts across an instantaneous 3 dB bandwidth of 175 MHz, at a 2 percent duty cycle. The modulator generates a pulse shape and spectrum which complies with the requirements for UHF Distant Measuring Equipment as defined by the U.S. Federal Aviation Administration and the International Civil Aviation Organization.

Circle Number 64 on Reader Reply Card

Automatic Tape Cartridge Winder

A digitally controlled tape cartridge winder featuring automatic tape length determination and exclusive tape tension control is in-

(Continued on page 54)

troduced by **Ramko Research.**

Utilizing integrated digital circuitry and a variable tape tension control the ACL-25 provides proper tape tension for various size cartridges and eliminates time consuming operator monitoring. Provisions are also included to automatically adjust tape lengths for either 3¾ IPS or 7½ IPS cartridges. Thus no mental calculations are required of the operator.

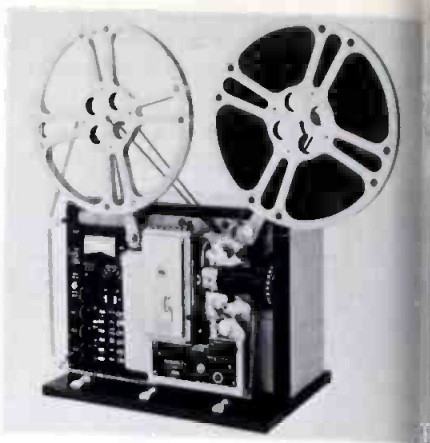
Use of the ACL-25 is quite simple. The user simply dials in the minutes and/or seconds desired, selects the size of cart on the tension control and throws the switch to run. The unit then feeds the exact amount of tape into the hub and stops automatically.

The unit accepts all sizes of cartridge hubs and tape supply reels.

Circle Number 65 on Reader Reply Card

TV Film Chain Sound Projector

A new 16mm stop-motion telecine sound projector, the **L-W Athena** 4000-TSM, offers broad versatility for multiplex and other television film-chain applications.



Standard features include instant still/run capability for both picture and sound, flickerless projection at all frame rates, optical and magnetic sound with magnetic record, slow motion, stop motion, instant forward/reverse direction change at any frame rate, and unlimited hold on single frame.

In the still mode, there is no damage to the film or loss of light.

Features also include a heavy-duty base for stability in multiplexing, pushbutton control, remote control of all functions, and precise frame rates of 1,2,4,6,8,12 and 24 fps. Operation is fully compatible with the 60-scan rate of TV broadcast. The case can be removed by a single thumbscrew for servicing or for installation of an interlock motor.

The 4000-TSM is capable of being programmed for fully automatic operation. When equipped with a cueing device, which is available as an accessory, it will also stop at preselected frames. A projector-to-camera lens/optical assembly is also available, and provision is made for the plug-in addition of a Variac lamp control. Reel capacity is 2000 feet.

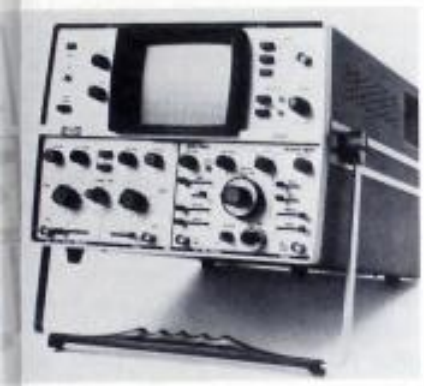
Circle Number 66 on Reader Reply Card

Wideband Scopes

Two new cathode ray oscilloscopes were introduced by **Raytheon** at the annual conference of the Institute of Electrical and Electronic Engineers (IEEE) in New York. The new large-scope instruments have bandwidths of 35 and 75 megahertz and feature calibrated sweep delay.

The Model 3100 oscilloscope has a bandwidth of 35 megahertz and a

e time of 10 nanoseconds. Sensi-
ty is 5 millivolts per division at
bandwidth. Sweep speeds to 20
noseconds per division are of-
ed.



The Model 4100 oscilloscope's
ndwidth ranges from DC to 75
gahertz. Rise time is 4.7 nanose-
nds and sensitivity is 5 millivolts
r division at full bandwidth.
weep speeds range to 5 nanose-
nds per division.

The two new Raytheon oscillo-
pes have unusually large dis-
y tubes. The 8 by 10 centimeter
thode ray tubes feature high
ghtness (20 kilovolts) for easy
d accurate viewing. Plug-in sem-
nductors and modular printed
cuit cards contribute to ease of
rvice and calibration.

A variable hold-off delay for dig-
l applications increases the capa-
lity of the scopes for either digital
analog applications in the lab-
atory or in field service use. Of-
red for bench and portable use,
e scopes can be supplied in rack-
ounted configuration where nec-
sary to meet customer require-
ents.

Circle Number 67 on Reader Reply Card

Multichannel Audio Recorder

Ampex Corporation has begun
eliveries of a new compact multi-
annel professional audio recor-
der.

The new Model MM-1100 is priced at $16,500 in its standard 16-track version and features a servo capstan not usually included in recorders in this price range.

The MM-1100 is designed for heavy duty studio or remote recording use by master recording studios, rock and other musical groups and production houses. It will allow studios small and large to enhance their multichannel capability economically.

The MM-1100 has a removable control box for remote control operation. Additional remote control units can be accommodated. The MM-1100 can handle up to 16-inch reels, which permit more than two hours of recording at 15 ips, largest capacity of any standard audio recorder currently on the market.

An automatic tape tensioning system permits fast conversion from 1-inch to 2-inch tape widths. Tape tension is automatically adjusted when head assemblies are changed. Full digital control of all transport functions virtually eliminates the possibility of tape damage or spillage caused by operator error or power failure.

The recorder features improved Sel-Sync performance, which enables recording artists to listen to a previously recorded track while recording in perfect synchronization on another track.

Circle Number 68 on Reader Reply Card

Dual Audio Delay Device

United Recording Electronics Industries (UREI), North Hollywood, California, now offers the professional recording industry a new tool for sound processing, call "The Cooper Time Cube."

Applications include: Creating "synthesized" quadraphonic 4-channel tapes and records from 2-channel stereo originals; loudness enhancement; spacial enhancement, delaying "feed" to reverberation chambers or devices for added dimension; improving optical film recording by delaying audio to light valve or galvanometer (applicable to Westrex, RCA, Maurer or other film recording systems).

Created specifically for recording studios and motion picture

(Continued on page 56)

sound applications, the dual acoustical delay line provides two electronically independent delays of 16 MS and 14 MS. Frequency response is ±2 dB 40 Hz to 10 kHz (typically ±1.5 dB); distortion is less than 1 percent (typically less than 0.5 percent) at all program VU levels up to +4 dBm output; and signal-to-noise is greater than 70 dB (15.7 kHz noise bandwidth).

Circle Number 69 on Reader Reply Card

Reader/Spooler

Designed to hold up to 1200 feet of tape, EECO's 7½" reel punched tape Reader/Spooler reads tape in a standard search/re-wind mode at 800 characters a second. It can stop on character bi-directionally at 300 characters per second and can be operated manually or by remote control.

The TRS9300B Reader/Spooler reads all standard 5, 6, 7, and 8 level tapes without adjustment, even with tape opacity as low as 40 percent. It is compatible with DTL, RTL and TTL logic.

Stepping motor drive is the onl moving assembly and eliminate need of belts, clutches, gears, ca pacitors or mechanical brakes. A fully proportional servo, a sel cleaning read head and phototran sistor sensing offer minimum tap strain and wear. Unit is 8.72 inche high, 19 inches wide and 11 inche deep.

Circle Number 70 on Reader Reply Card

Environment-Resistant Oscilloscope

An oscilloscope to use wher 'scopes ordinarily couldn't go i new from **Hewlett-Packard.** Mode 1700E (for Environment-resistant can be used on shipboard, for ex ample, with no concern for wha salt spray may do. Or it can b used in dusty environments, or in chemical plant, refinery, or an other place where adverse atmo spheres abound. It's going to b very difficult for contaminants t get inside this instrument.

The new Model 1700E is able t go beyond the capabilities of earlie ruggedized scopes mainly becaus of the low power c7nsumption o HP's series 1700 Oscilloscopes On AC line power, these oscillo scopes consume less than 25 watts when on their optional internal bat tery pack on DC line, power con sumption is only 18 watts. Thus ne vent holes are required. The instru ment can be sealed up tight as a drum with no concern for heat buildup within. Actually, the ma jority of components within the oscilloscope operate at only 10-20 percent of their rated power maxi mum, which assures low heat buildup and favors reliability.

The Model 1700E has the capa bilities normally associated with lab-type instruments. The ampli fiers have 10 ns risetime (35 MHz response), and 10 mV/div mini mum deflection factor. It is a dual channel instrument with time base capabilities suited as well for digital testing as for analog measure ments. Maximum sweep speed is 10 ns/div.

Circle Number 71 on Reader Reply Card

For more details about products in this issue use free readers service card in the back of this issue.

Operator Rules Correction

What a difference a line makes! I left out a line in our AM-FM Operator Rules Chart in the August issue of BE. And that line makes make a difference. Below is a corrected version.

The problem came when we didn't notice that our artist had failed to section off non-directional (1kW or less) and Directional Restricted Licenses (when you look across the "Supervisory Operator" line). The correct chart here shows that if you work for stations in these two categories you need not be designated.

In some instances, an engineer may be working as a Chief Operator for more than one station. Call him a Chief Engineer or whatever, if he is working for stations in the two categories mentioned above, he is not violating the Rules. However, he cannot be designated as Chief Operator concurrently for two stations that are either above 10 kW and are non-directional or Directional but restricted. On the other hand, the engineer may be designated as a Chief Operator at one station in these two types and as a duty operator in another.

In the Directional categories, please note the requirement under "Inspections". It should be understood here that the inspections as listed are required unless otherwise specified in the station license.

	STANDARD BROADCAST			
	Non-Directional (Transmitter 10 kW or less)	Non-Directional (Transmitter over 10 kW)	Directional (Unrestricted)	Directional (Restricted License)*
Minimum Grade Duty Operator	3rd Class Permit Broadcast Endorsement	3rd Class Permit Broadcast Endorsement		First Phone
Operator Instruction	Licensee Responsible to Insure That Duty Operator is Properly Instructed Printed Step-By-Step Instructions For Reduced-Grade Duty Operator, Including Table or Chart of Permissible Parameter Values, Must Be Posted at Operating Position			Licensee Responsible To Insure that Duty Operator is Properly Instructed
Supervisory Operator		Chief Operator (First Phone License) Must Be Designated		
Operating Log	Routine Entries By Duty Operator If Remote Antenna Ammeter is Defective Base Current Reading By 1st Class Operator	Routine Entries By Duty Operator If Remote Antenna Ammeter is Defective, Base Current Reading By 1st Class Operator, Chief Operator Must Review and Sign Oper. Log Daily		All Entries By Duty Operator
Maintenance & Maintenance Log Performance Measurements Field Strength Measurements	Maintenance & Maintenance Log: First-Class Operator Performance Measurements By a First-Class Operator		Maintenance and Maintenance Log First-Class Operator Field Strength Measurements At Monitoring Points Monthly (More frequently if required by license) by a First-Class Operator; Annual Partial Proof of Performance by a First-Class Operator; Performance Measurements By a First-Class Operator	Maintenance and Maintenance Log First-Class Operator Field Strength Measurements (Where Required) By a First-Class Operator. Performance Measurements By a First-Class Operator.
Inspections	Daily, 5 Days Each Week By A First-Class Operator		• Daily, Five Days Each Week By a First-Class Operator And Record in Maintenance Log For Each Pattern: (i) Common Point Current, (ii) Antenna Base Currents, (iii) Sample Loop Currents or remote antenna base currents & Phase Monitor Indic., (iv) Antenna Base Current Ratios, etc.	• Daily, 5 Days Each Week By A First-Class Operator

*Restricted License: Requiring Maintenance of current ratio tolerances to less than 5% or phase angle tolerances to less than 3°

• The Inspection Requirements for a Directional Antenna operated by Remote Control are Unchanged: Daily, Seven Days Each Week by a First-class operator for each pattern, within two hours of commencement of operation for each pattern

TECHNICAL DATA

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

100. AEL COMM.—"Price and Ordering Information" is a new catalog for AELCC's Mark V Single and Dual Cable Bi-Directional equipment. The eight-page list provides trunk, bridging and extender station module matrixes (including module as well as station prices) for Model CVT-V equipment. Bridger output splitter information and prices are also included. A module matrix station coding explanation and a list of abbreviations are supplied for ease in use. AELCC'S "Price and Ordering Information" allows the easy choice of the components necessary for a CATV system "made to order."

101. AMPEX CORP.—A new four-page brochure describing features and specifications of the Model CC-500 color television camera system is now available. The professional quality camera is simple to operate and maintain and is designed for closed circuit television use in education, business, industry, medicine and the government.

102. ATLAS SOUND—The first eight-page color brochure exclusively devoted to its catalog of loudspeakers has been released by Atlas Sound. Subdivided into individual sections detailing paging and intercom speakers, projector horns and drivers, mobile and industrial communication units, hi-fi and sound columns, the new catalog provides complete information and technical data for more than 100 individual models of loudspeakers and accessories.

103. CLARE-PENDAR—A new eight-page short form catalog "Snap-In Switchlights" is now available. Photos and drawings show snap-in pushbutton switch lights available from stock, three lens cap sizes-⅝ sq.-¾ sp.-¾ x ¾ rectangular, two pole or six pole momentary or alternate, and introduces the new Monoform series. Choose flat bezel or raised barrier style to separate adjacent switches. Snap-in gangswitch assemblies show how to eliminate alignment problems, reduce stock requirements, simplify mounting and panel fabrication, up to 8 stations in a group. Three matching indicators

luding one "press-to-test", are own.

104. DIALIGHT CORP.—Dialight makes available a 52-page LED Product Selector Guide," designated as SG721. The brochure details the company's broad e of light-emitting diodes, indicas, switches and related readout vices. The guide is basically diided into eight product egories—Light Sources; Ultranature Indicators; 0.625" Readuts; 0.125" and 0.205" Readouts; 70" Readouts; 0.300" Readouts; coder/Drivers; and Switches. l the units described work with contain light-emitting diodes. r each product category, the mpany gives complete specificans, curves, applications, and unting details, where appropri-

105. DYNASCAN CORP.—Dynascan announces the release of its est catalog of B & K test instruents. Catalog No. BK-73. The -page catalog is in two colors oughout and its listings include 8 w items, 3 of which are oscilloopes. Two full pages are devoted probes and other accessories. he items include the 1470 Dual-Trace Triggered Sweep Oscilloscope, and features dual-display of waveforms for fast comparison in industrial, lab, school and service applications; the 1465 Triggered Sweep Scope with B & K's new exclusive "Cali-Brain" feature for faster, more accurate amplitude measurements; the 1440 "Cali-Brain" Recurrent Sweep Scope; the 281 Solid-State Digital Multimeter, with positive over-range and wrong polarity indication; the 277 Solid-State Electronic Multimeter, with high- and low-power Ohms ranges; the 12 OP VOM, with resettable electronic overload protection; the 501-A Curve Tracer for testing semiconductor circuits with an auxiliary scope.

106. DYNASCIENCES CORP.—Dynasciences Corp. is now offering a "Quick Reference Catalog." The brochure covers their complete line of Video products with photographs, description and applications.

107. ELECTRONIC ENG. CO. OF CALIF.—A twenty-eight page booklet describes steps used in preparing input data for computer-aided wiring of DIP sockets and panels. Three optional computer-entry points are described in detail—Logic Diagram, Pin List, and To-To Punched Cards. The Logic Diagram entry is the easiest, requiring only a hand drawn logic diagram. The Pin List entry is ideal for the engineer that wants to do his own IC placements. The

(Continued on page 60)

Punched Card entry is ideal for engineers that do logic analysis or synthesis by means of their own computer. The punched cards provide a good computer-to-computer interface.

108. FAIRCHILD—A new engineering data sheet to help audio engineers create their own consoles by selecting one module from Column A and two from Column B is now available. The console menu is actually a columnar function flow chart of standard Fairchild/Robins units that can be assembled into four console configurations, channel modular, remote control, building block or combined systems. The selected modules can be assembled either by the customer or by Fairchild/Robins. A seven-step specification procedure is suggested, including making an outline, or block diagram, of such required functions as equalization, limiting, monitoring, switching, reverberation, delegation, cue circuits and automatic ducking or cross suppression, and the number and kinds of inputs and outputs.

109. GENERAL ELECTRIC—The PAR system of Personal Areawide Radio communications is described in Bulletin ECR-1685. In the PAR concept, satellite receivers are placed throughout the operating area to pick up radio transmissions from men in cars or on foot. The messages are relayed automatically without human intervention and sent back to headquarters where a voting selector chooses the receiver relaying the best message.

110. HEATH COMPANY—19 catalog is available from this lon line kit manufacturer. The ne catalog features their digital F tuner and a wide line of other state of-the-art audio products. Also ir cluded are their latest additions t the amateur radio line as well as th standard and lab type test equip ment.

111. INTERNAT'L. GOO MUSIC—New IGM Series 70 audio control systems are picture and described in a six-page bro chure. Extended memories are feature of the flexible, "sequen tial" 700 series. Two basic model are the IGM Model 710, with 1,000-event memory and contro over 30 audio sources, and th IGM Model 730, with a standar 3,000-event memory (expandable and control over 39 audio sources Methods of programming the sys tems (through a direct-access key board) to pre-schedule as much a 24 hours with 125 separate event per hour, are fully described in th brochure.

125. SPINDLER & SAUPPE Data sheets are available on tw new Spindler & Sauppe product for multi-image automation, th Media Mix Programmer and th Tri-Cut Control. The Media Mi Programmer is a compact and inex pensive 27-channel audio-visua control device for the complet automation of multi-screen dis solve and mixed-media shows. Th Tri-Cut Control, also compact an low in cost, creates high-spee "cut" dissolves on each of thre pairs of Kodak projectors for multi screen presentations.

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RCA TFE-10A: 2500 Mhz transmitting antennas. Broadband, omnidirectional. New, in original packing Bob Reynolds, 609-877-0881, 32 Mosshill Lane, Willingboro, N.J 08046. 9-72- 3t

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MOTORS FOR SPOTMASTERS
NEW Paps hysteresis synchronous motor HSZ 20.50-4-470D as used in series 400 and 500 machines. Price $39.00 each prepaid, while they last. 90 day warranty. Terms check with order only, no COD's. Not recommended for Tapecaster series 600 or 700
TAPECASTER TCM, INC., Box 662, Rockville, Maryland 20851
1-72-TF

General Electric Camera Equipment—A large stock of boards, hardware, sub-assemblies including encoders, processors, camera heads, and update kits for General Electric PE 240, PE 250 and PE 350 camera chains in new and like new condition. Also will consider trade for microwave equipment. Contact J. Devine 315-797-5220. 9-72-2t

ONE STOP for all your professional audio requirements. Bottom line oriented. F. T. C. Brewer Company, P.O. Box 8057, Pensacola, Florida 32505. 7-71-tf

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SPECIAL—NEW FIDELIPAC NAB CARTRIDGES 10 secs to 6 minutes. Only $1.25 each. Minimum quantity 50 carts. Specify lengths when ordering. Gately Electronics, 57 W. Hillcrest Avenue, Havertown, Pa. 19083. 9-72-3t

New and Used Towers AM, FM, TV, Communications Antennas AM, FM, TV, CATV, Microwave. Complete sales, service, erection and painting. Serving Florida & Georgia. Write DiSCO P.O. Box 1029 Bradenton, Florida 33505 or phone 813- 745-6285. 9-72-3t

One Hour Videotape, Bell & Howell. ½" x 2400'. Current list $39.95. Our price, fresh, unopened. 54% off, only $18.50 per roll. Limited quantities. Sam Davis, AGE Inc. 5362 Cahuenga, No. Hollywood, Ca. 91601 (213) 985-5500. 10-72-1t

IGM 630-15 COMPLETE AUTOMATED BROADCAST SYSTEM. Includes random select control unit complete with card reader, typewriter, remote manual entry, controls and verified logging system. Source equipment as follows: 4 Scully tape playbacks, 4 IGM instacarts, 1 IGM single cartridge playback, 1 time announcer and external studio input. System also includes 3 remote control units with digital clocks, 3 encoding systems, 1 end of message tone generator and 6 IGM matching rack enclosures. System is monophonic, but music sources could be converted to stereophonic for about $1,000. Ted Boyd, WHBC, Canton, Ohio (216) 456-7166. 10-72-1t

For Sale: 5 Collins/ATC cart machines, PC2/190, One Record AMP. All in working condition, some spares. Fred Clinger Chief, Box 789, Bucyrus, Ohio 44820 10-72-1t

RCA TT25 SOUND AMPLIFIER CHANNEL 5 can be modified to picture. RCA TT5A TRANSMITTER CHANNEL 5 can be modified to air cooled. Just removed from standby service, fully operational. Harmonic filter, VSBF, and Diplexer not included. PRICED TO MOVE. Chief Engineer, KSD-TV, 1111 Olive St., St. Louis, Mo. 63101 10-72-2t

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DISTRIBUTOR WANTED Electronic test equipment manufacturer requires distribution network for instruments sold to Broadcasters. Prefer representation but will consider private labeling. Write Dept. 267 Broadcast Engineering, 1014 Wyandotte Street, Kansas City, MO 64105 10-72-

MICROPHONES 1920 to 1940. ALSO LITERATURE. WRITE BOB PAQUETTE 443 N. 7 ST. MIL.W., WIS. 53208 9-72-

HELP WANTED

Director of Engineering for Southwestern group operation which includes AM/FM/TV. Must be familiar with AM directional systems, FCC rules and regulations, filing of all FCC engineering applications, and TV and microwave systems engineering. BS or BA degree preferred. Send resume and salary requirements. Write Dept 268, Broadcast Engineering, 1014 Wyandotte St., Kansas City, Mo. 64105 10-72-

FCC LICENSED TV ENGINEER with 2 years Tech. training and 4 years solid state maintenance experience to work on TK-27s, TK-42s, TR-70s and associated equipment. Contact J. J. Pozzi, Chief Engineer, KBHK TV, San Francisco, CA. EO EMPLOYER M/F 10-72-

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 your complete resume now. The AMPS Agency 11661 San Vicente Blvd., Suite 300, Los Angeles, Calif. 90049. Telephone: 213-820-2678. Broadcasters—For Broadcasters 11-68-

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2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122	130	138	146	154	162	170	178	186	194	202
3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163	171	179	187	195	203
4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124	132	140	148	156	164	172	180	188	196	204
5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125	133	141	149	157	165	173	181	189	197	205
6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126	134	142	150	158	166	174	182	190	198	206
7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127	135	143	151	159	167	175	183	191	199	207
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152	160	168	176	184	192	200	208

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2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122	130	138	146	154	162	170	178	186	194	202
3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139	147	155	163	171	179	187	195	203
4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124	132	140	148	156	164	172	180	188	196	204
5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125	133	141	149	157	165	173	181	189	197	205
6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126	134	142	150	158	166	174	182	190	198	206
7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127	135	143	151	159	167	175	183	191	199	207
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So, you see, we've completely de-bugged our Precision Demodulator. We've taken the time to make sure it's right before marketing it. That's why people are buying it. And trusting it.

If you're considering purchasing a Precision Demodulator, we'd be glad to demonstrate ours for you. Just write or call us today. You'll see how well it behaves with your transmitter.

**A complete list is available upon request.*

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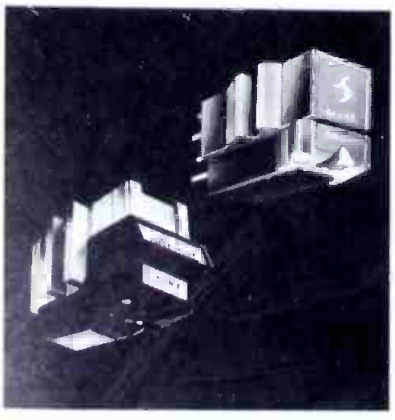

Now it's official! An association equipment survey quoted in BM/E magazine produced some very revealing information on FM broadcast industry preferences — particularly in the category of phono cartridge usage, where a whopping 57% of the respondents expressed their preference for Shure cartridges . . . *more than all other brands combined.* It didn't particularly surprise us because we know our M44 series with its uncommon combination of clear sound, low cost, exceptional ruggedness and excellent back-cuing characteristics, has been the broadcast standard for years. And our peerless V-15 Type II Improved? There simply isn't a better cartridge for "high fidelity" FM operations. Write for the free Shure "Guide to the Conversion of Monophonic Broadcast Facilities for Stereo Records," as well as the complete Shure Phono Cartridge Catalog.

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222 Hartrey Ave., Evanston, Ill. 60204

SHURE

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