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Broadcast Engineering®

the technical journal of the broadcast-communications industry

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Minimize Tape Errors

NAEB goes to Las Vegas
Station-system security
Advancement in IC audio

Canon offers the perfect zoom lens for the camera of your choice

P10 x 20B1



P17 x 30B1



P17 x 30B2



PV10 x 16B



PV17 x 24



PV10 x 15



More and more people are discovering how significantly superior Canon Zoom Lenses are for TV broadcasting purposes. Their outstanding color characteristics, even in dim light, is one of the many reasons why Canon was chosen for telecasting the Munich Olympics.

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Shown on this page are only a few examples of the quality lenses Canon has available to more than meet your particular demands. Specify Canon to stay ahead.

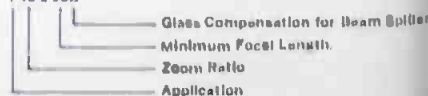
The following are Canon TV Zoom Lenses for the Plumbicon® color cameras currently available on the market:

Size of image tube	Lens	Image format covered
1 1/4" Plumbicon® color camera	P10 x 20B4 P17 x 30B1 P17 x 30B2	17.1 x 12.8mm (21.4mmφ)
1" Plumbicon® color camera	PV10 x 16B1 PV10 x 15B2 PV17 x 24B1 PV 6 x 18B1	12.8 x 9.6mm (16mmφ)

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The Canon TV Lenses Naming System

P10 x 20B



Applications	Image Format	Pickup Tubes
P	21.4mmφ	1 1/4" Plumbicon
PV	16mmφ	1" Plumbicon

Apart from the above, Canon has available TV zoom lenses for 3" or 4-1/2" image orthicon cameras and can also build special lenses to fit your requirements.

Canon

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The technical journal of the broadcast-communications industry

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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.

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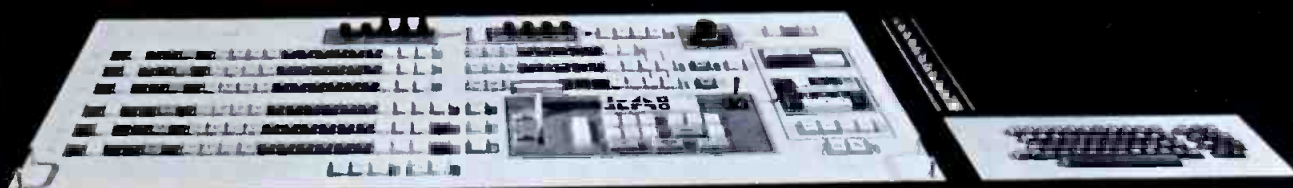
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COUNTING

	TIME	VIDEO SRCE	TR	AUDIO 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 O	
-CLK-		NET			COMEDY HOUR
10:58:30		----	----	-----	AM
	0:10	F2S	I		DISCLAIMER
	0:20	VT1	UDF	AN	CHEVROLET

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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.

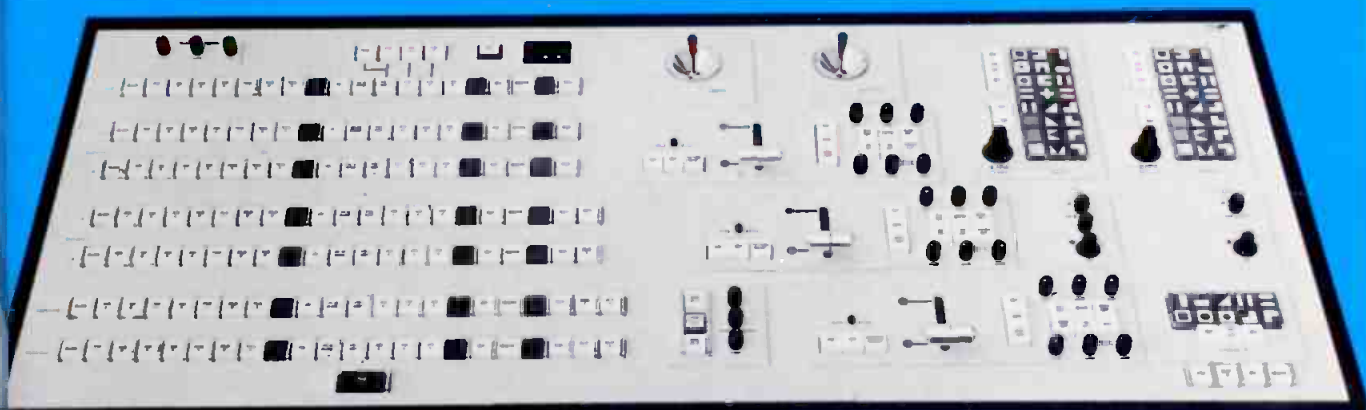
The results of the joint survey should prove interesting. The TASO method is specific with regard to equipment and techniques, but there may be some difficulty in obtaining agreement between two competing engineers as to the actual locations at which the measurements are to be made.

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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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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Application assistance on new or existing designs is available. For data, including complete replacement guide with prices, write: Amperex Electronic Corporation, Professional Tube Division, Hicksville, N.Y. 11802.

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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

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Sarkes Tarzian, Inc.
Bloomington, Indiana



that we are in need of audio broadcast equipment. For example: cart machines, audio control board, turntables, reel to reel tape decks, patch panels, etc. If anyone would donate this equipment we would appreciate it.

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

Alarm Plans Needed

Dear Editor:

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

Although many sources have plans for building a tube-type unit which will provide this function, we are interested in a solid-state alarm.

If any one has such a unit they have built, we would like to "borrow" the plans.

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

Equipment Stolen

Dear Editor:

We have recently had a piece of equipment stolen and would appreciate it if anyone spots the equipment to contact us.

The equipment was a QRK 8-S console, serial 003030. It is an eight pot mixer in a blue metal cabinet. One modification was made to the board; the earphone selector switch was wired into the monitor amp circuit.

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

On Comments

Dear Editor:

I have been reading for many months in BE the comments regarding the term "Engineer", and would like to make the following observations.

Generally, all technical personnel in Radio and TV facilities fall in one 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)

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Letters

(Continued from page 9)

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. Dietz
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 stations 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 District
255 So. Laksy Dr.
Beverly Hills, Calif. 90212

Industrial Television Societies Merge

The Presidents of the Industrial Television Society and the National Industrial Television Association jointly announce agreement has been reached in principle on the following:

1. The two professional industrial-television user groups will merge into a single new organization.
2. The effective date for the merger will be January 1, 1973.
3. A joint merger committee has been established to work on a new constitution, bylaws and organization.
4. A new name has been agreed upon in principle for the emerging organization. A clearance search is being made. The announcement of the new organization's name will be 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)

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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.

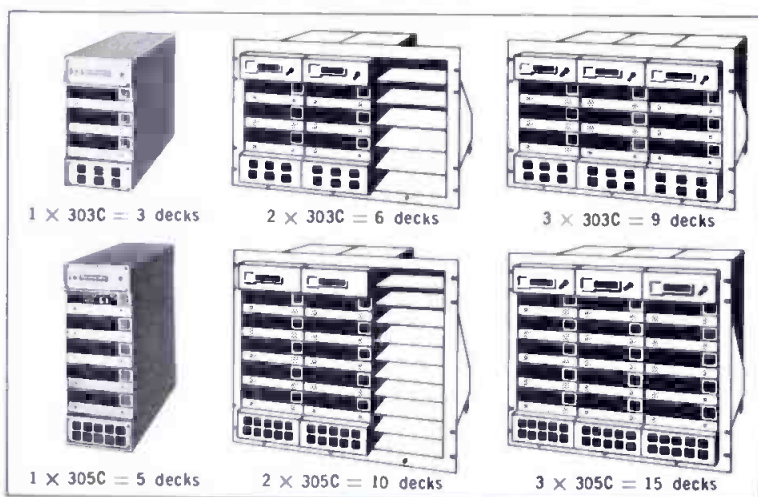
The ITS was founded in 1968 in the San Francisco area and has developed an emphasis on strong local chapters of which the most active include San Francisco, Tulsa, Denver, Chicago, Philadelphia and Western New York state. The ITS has held national and local meetings, published a newsletter and has become 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., PC 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).



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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

the general election period. It said that, if necessary, it would re-examine the report in light of later decisions in the other parts of the inquiry.

Spokesman Selection

In applying the Fairness Doctrine, the Commission pointed out, it has traditionally required licensees to afford reasonable opportunities for the presentation of contrasting views on controversial issues of public importance. The licensee has been given "wide discretion" in selecting the appropriate spokesman, format and time for the presentation of opposing views, with no exceptions, the Commission stated.

Under Section 315 of the Communications Act, licensees are required to afford equal time to legally qualified candidates, and under the political editorializing rules, the licensee must afford a reasonable opportunity for a candidate or his spokesman to respond when the licensee has opposed him or supported his opponent in an editorial.

Under the so-called Zapple ruling, the licensee's discretion was further limited. In that ruling, the Commission held that when a licensee sells time to a candidate's supporters or spokesmen, during a campaign, to urge the candidates to election, discuss the issues, or criticize an opponent, then the licensee must afford comparable time to the spokesmen for an opponent. Free time need not be afforded to respond 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 situa-

tions, 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."

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IT'S ALL IN HOW YOU LOOK AT IT

Circle Number 12 on Reader Reply Card

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

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

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 to make a new recording, and upon completion of the recording and rewind, we observe height and engagement errors on immediate playback? Well, up to three kinds of things may have happened.

First, if the video erase head of the recorder was used to erase the tape during this recording, the tape was heated up. During the record mode, the erase head current begins to heat up the video erase head until an equilibrium temperature is reached in approximately five minutes. While the erase head is on, a portion of this heat is transferred to the tape where, under the influence of the tape tension, the tape begins to stretch a little more than usual. Stretching along the tape length causes a shrinkage across its width compressing the video information recorded on the tape. This action apparently continues until the tape is stored on the takeup reel. Upon playback, the time relationship has been changed, causing engagement and height errors to appear. The female guide must be moved in and up to correct this 50-100 ns of error. To avoid this problem you may disconnect the video erase head

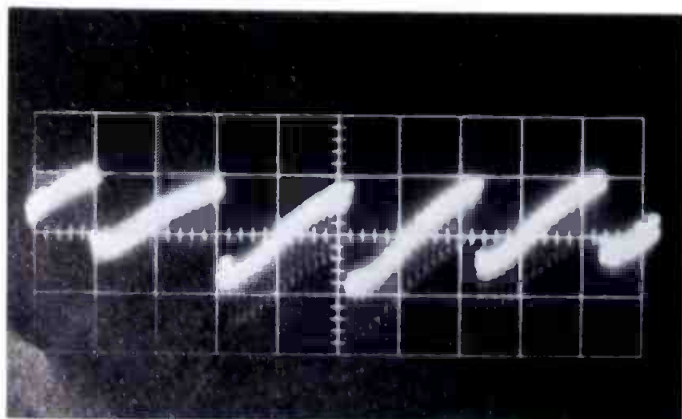


Fig. 1 Engagement error of 60 nanoseconds. The female guide must be moved in to correct this error.

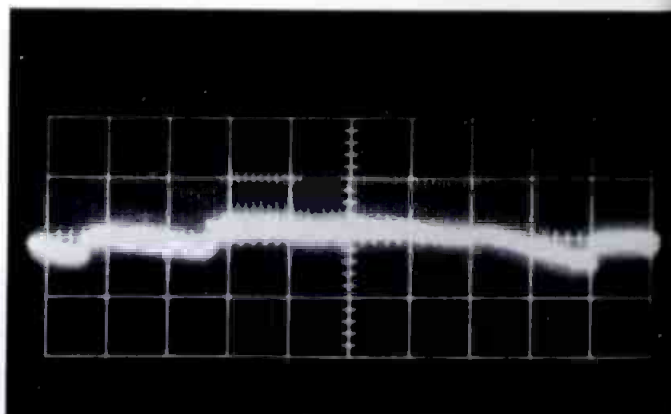
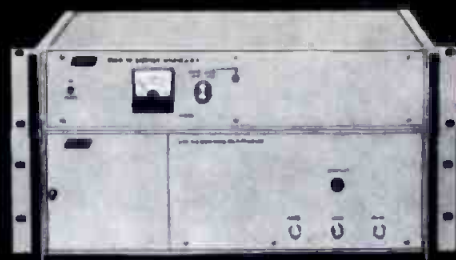


Fig. 2 Negligible geometrical error is observed here on Amtec error signal.

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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

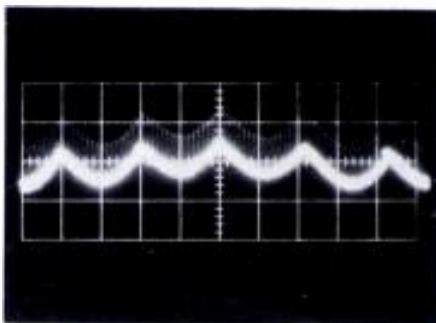


Fig. 3 Guide height error of 30 nanoseconds is produced when guide is too high.

of the 240 generated during playback may be different and a difference will appear as an error.

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 head 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.

†TM Ampex Corporation.



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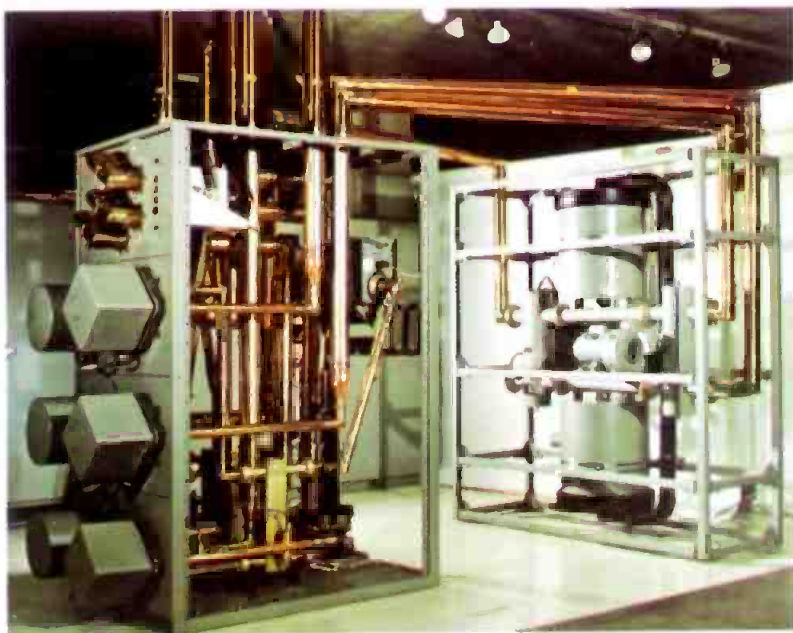
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tape just recorded is often enough to cause an S band error of 10-20 ns. The error appears because of a minute tape oxide buildup on the guide surfaces, collected during tape motion. Dirty tapes, or those that have been heavily used, tend to cause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

rupted 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

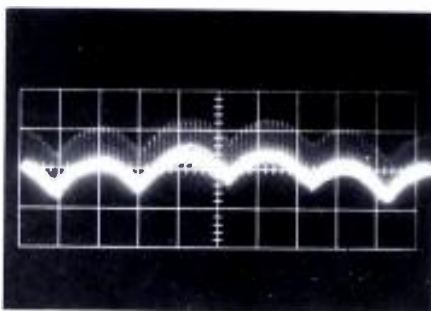


Fig. 4 Guide height is too low, producing 30 nanoseconds of scalloping error.

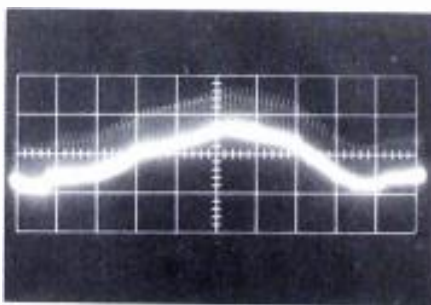


Fig. 5 Once-around error of 60 nanoseconds shown here is caused by mechanical unbalance of the rotary head.

difference becomes greater.

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 other areas, and wear up to 0.3 mil is unusual during the life time of existing head. Since the drum, tip, tape and the female guide are involved in preserving interchangeability, a recording made with new drum and played back with worn drum will exhibit a blue-line color error.

While the hook or one-line error is not usually objectionable in monochrome picture because of relatively low amplitude, it may become a problem of the first magnitude in color. Neither time-base nor velocity compensation can correct this error.

However, there are two things that we can do to minimize the problem. First, we may be able to switch down to the second line (using the Tac Phasing or Switch controls). If the hue-shift is restricted to the first one or two lines we can reduce the effect in the picture substantially.

Second, we can use heads having about the same tip projection (within one mil) for our work. Typically, heads with the same TP will have about the same drum wear. A bad case is observed, we may try interchanging heads. For example, if there is a bad blue-line error, we might try a playback head having higher TP.

So far, the one-line errors described are those that have the disturbance at the beginning or the end of each band shown in the error signal. It is also possible to have a hook error originating at the end of each band. This error is produced by a difference in control-track head penetration between the record and playback heads. Normally, the penetration difference must be unusually large to observe an error and if the penetration is too light, the playback control-track signal is usually too low that playback is difficult. Readjustment of the control-track head penetration will remove or reduce this error, but the longitudinal control-track head position will be changed in the process and will require resetting.

Saturation Banding, Low Tip Projection

Although the Amtec corrector error signal appears flat across each band (see Figure 2), there may be a color error in the picture. If the recording has been made at standard engagement with a head having a tip projection of less than .001 in., saturation banding may be observed, Figure 8. As the head wears down, nearing the end of its life, a point may be reached where the tip-to-tape pressure is inadequate to prevent a spacing loss over part of each band. These show up as dark areas within each band. If saturation banding is recorded into the tape, playback with a higher TP head or the use of Automatic Chroma will restore most of the picture. If saturation banding appears as a result of playback with a low TP head, engagement may be increased slightly and the banding will disappear.

Moving Errors

When periodic vibrations or random disturbances are present, moving errors may be produced in the picture. Two kinds of these errors are discussed below.

Periodic

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

A synchronous vibration frequency produces a stationary distortion. Two-hundred and forty Hertz is an example of this, producing a steady once-around error.

A vibration that differs from the nearest 30 Hz multiple by 2 Hz produces a slow moving error that worms its way up or down through the picture. When the difference is maximum at 15 Hz, the disturbance flutters through the picture rapidly (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

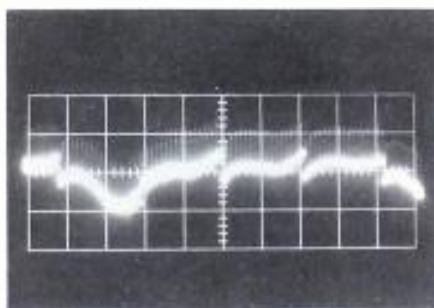


Fig. 6a S band error of 25 nanoseconds shown is within the 40 nanoseconds of error allowed.

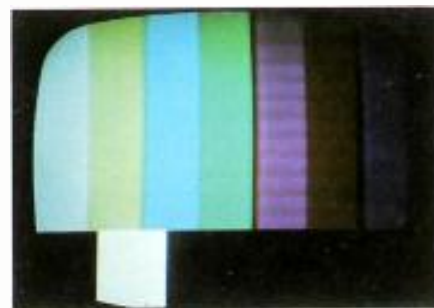


Fig. 6b S band error shows the transition from blue to magenta to red to magenta to blue in the magenta color bar when velocity compensation is not used.

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

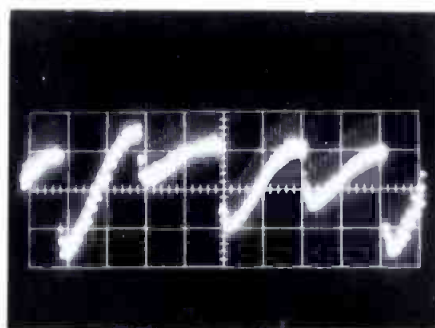


Fig. 7a One-line hue shift error (hook) is more clearly shown by introducing the magenta error. The hook shown here produces a red line error in the picture.

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.

Guide Vacuum

During the discussion of S band error, it was mentioned that a change in the vacuum level sup-

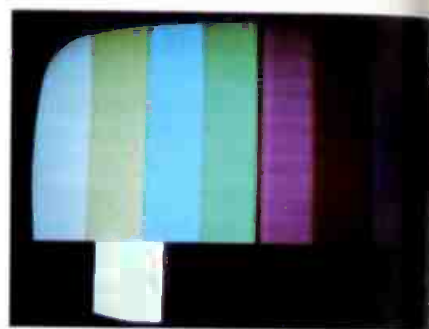


Fig. 7b One-line hue shift error in the picture. A blue-line error appears at the beginning of each head pass.

plied 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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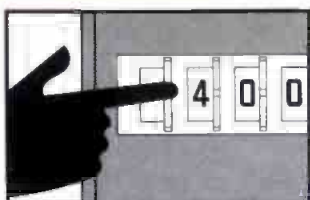
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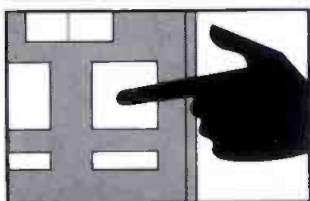


edit HELICAL and QUAD tapes with new, low-cost electronic modules



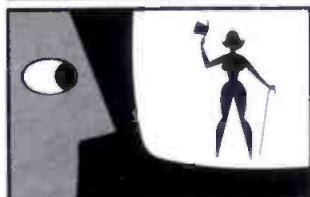
①

ENTER EDIT POINTS
preset the "start" and "stop"
frames for both master and
playback tapes.



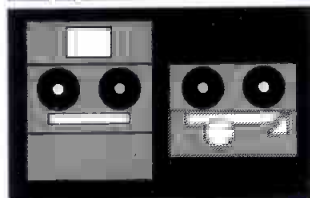
②

PRESS FOR CUE
automatic location of initial edit
points and parking of tapes with
correct preroll allowances.



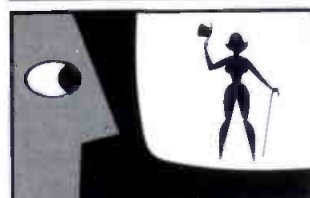
③

PRESS FOR PREVIEW
automatic preview of selected
scene. (Correct the edit points
if desired).



④

PRESS FOR RECUE
simultaneous "single glide"
re-parking of tapes.



⑤

PRESS FOR EDIT
automatic tape synchronization
of tapes and recording of scene
exactly as previewed.



①

ENTER EDIT POINTS
for next scene.



NEW BE 400 SERIES PROGRAMMING MODULES

BE 400 series Edit Programming modules bring preset and automatic Cue, Preview, Sync and Edit to EECO's low cost series of electronic indexing and editing "mini-modules".

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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 permanent 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 prob-

lem, 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

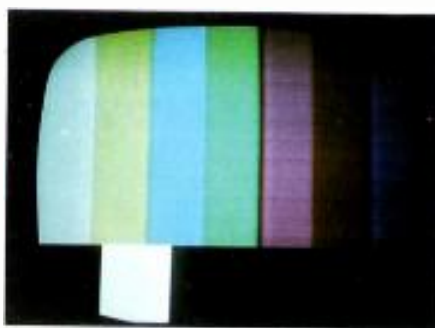


Fig. 8 Saturation banding due to a loss of response appears as a dark area within each band.

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.

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 prob-

lems, or with the use of defective or stressed tape or a low vacuum level, the stage is set for playback instability such as chroma flutter.

If excessive engagement is also introduced, instability is almost certain to appear. Increases of only 0.1 or 0.2 mils are sometimes enough to produce a significant change in stability. Larger increases produce more. Conversely, reducing the engagement used (either in record or playback) will reduce the amount of instability observed.

We commonly use "Standard" tapes to set up the head for operation. Most of us are aware of the changes that take place with the "Standard" tape as it is used. We have only to play it back and observe the changes in engagement error displayed to note that the "Standard" changes with repeated usage. The tape stretches in length each time it is used, compressing the video information across the width of the tape. This means that an ever increasing engagement is required to "Correct the Error".

If you use the "Standard" tape only long enough for the setup and then rewind it, you will observe the changes noted above. If you play your "Standard" tape all the way 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 difficult to stay at standard engagement over a long period of time 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 caused by instability, are removed from monochrome. Moving color errors remain, although in some cases their effect may be reduced. I would like to take this opportunity to thank Mr. Peter Skalon for providing the photographs for this report.

APPENDIX

Definitions and Limits

Stationary 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.

Moving 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 a 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 ($\pm 20\mu^\circ$ /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.

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

Timing

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

Norelco's New PC-72:

The Great

An innovative
new 3-Plumbicon®
color camera
that eliminates

- Camera mismatch
- Cable mismatch
- Color mismatch



Lin Killer

Innovators at Norelco introduce today's most advanced color camera in its price range. Not an updated model. A new generation. It kills many stubborn problems that have tormented video production men for years. And its CLUE feature gives you better performance from other cameras you already have.

With the latest solid state circuit technique and modular design, the PC-72 achieves new standards of stability, reliability, and ease of maintenance. Plus three major new standard features you can't find in other cameras.

CLUE for quick, precise set-up and camera matching. CLUE allows you to set up accurately and more easily without a waveform monitor. Using a black and white monitor, CLUE compares alternate scan lines from the red, green and blue signals. Peak white, black levels and gamma tracking in the color channels are quickly and accurately adjusted

for optimum color balance. CLUE allows the same reference to be used to match between cameras.

Presto, your cameras are set up and matched in a fraction of the usual time!

Precise compensation for standard cable, mini cable or any combination of both. Now ringing and smearing from cable mismatch disappear. It's as easy as dialing a phone. The PC-72 operates with up to 3,000 feet of standard cable or 2,000 feet of mini. Mix 'em up in the line if you like. Just dial the footage of each into the camera. Presto, perfect camera/cable compensation!

Pre-set pushbutton varichrome variable matrixing holds the color the sponsor wants on every shot. Varichrome gives independent remote control of hue and saturation settings for all primary and secondary colors. Without affecting grey scale. Once you've decided the settings you want to compensate for lighting from each camera angle, your final take is routine. Just push a button for each angle. Presto, the color you want in every shot!

Bias light—no lag at low light levels. Bias lighting, adjustable individually in Red, Green and Blue, virtually eliminates lag at low light levels.

And—scene contrast compression. A flick of a switch and scene contrast compression brings out detail lost in shadowed areas...without loss of highlights.

Take your last look at color gremlins... write now for complete information on the new-generation PC-72.

*Reg. TM N. V. Philips of Holland

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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.

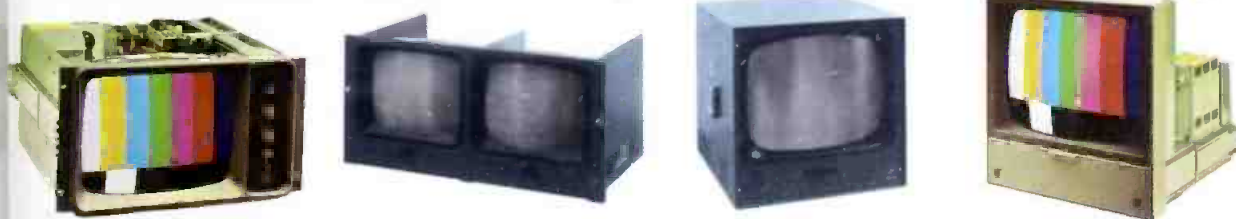
It's known as the TCB-19, from the Miratel Division, Ball Brothers Research Corp. We call it one of the very best because TCB-19 users report a consistently high level of performance.

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.

The TCB-19 performs the way it's built, and it's built well. Check it out!



The rest of the family is also standing by.



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.

We also offer a variety of video accessories from special effects generators to waveform monitors to video signal multiplexers. Depend on the Miratel family for your television equipment needs. Call or write for information.

MIRATEL DIVISION

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Circle Number 13 on Reader Reply Card

Lloyd Kalser 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

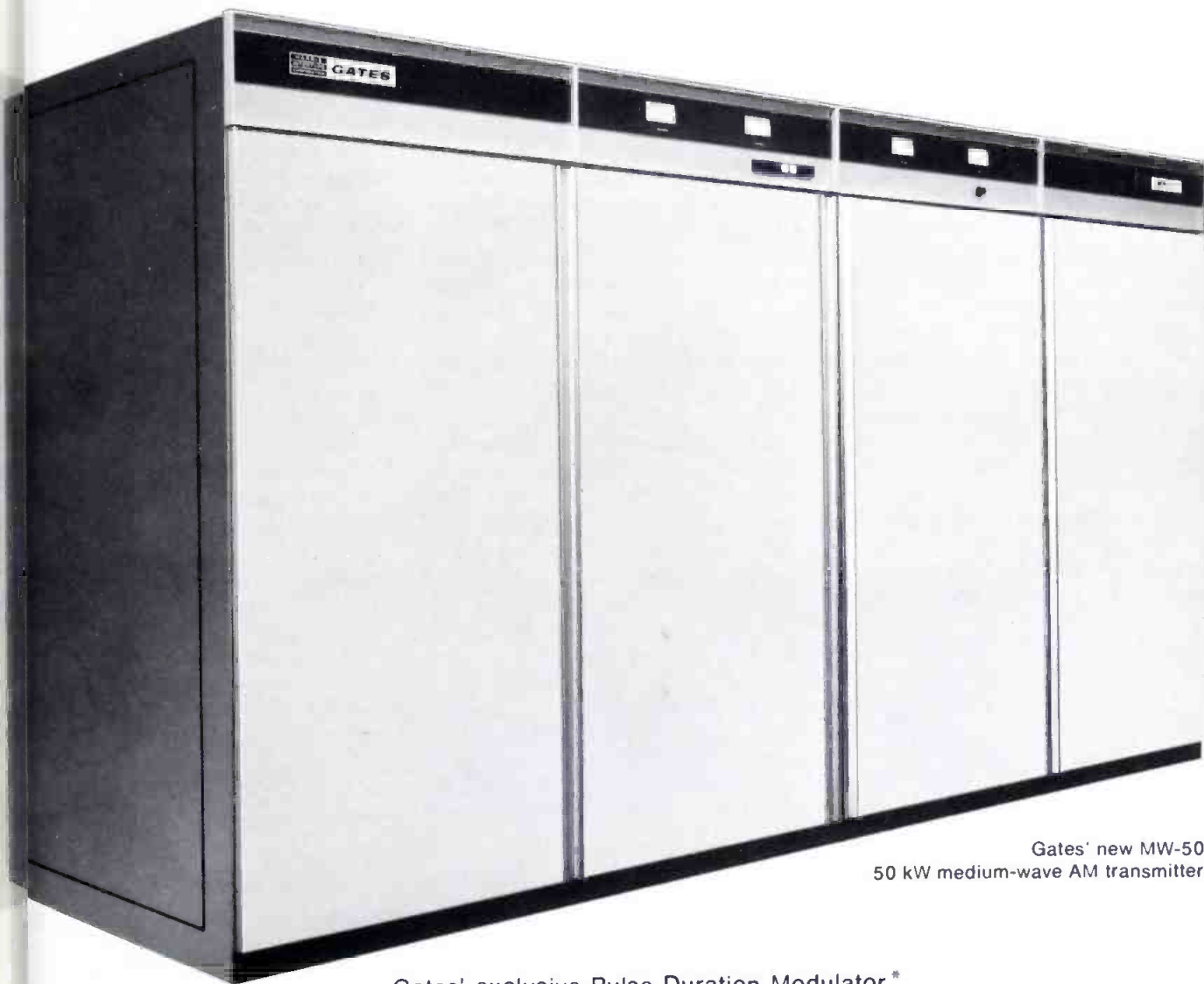
people of consequence than ever before: in the press, in Congress, in Government agencies, industry, civic groups, education, and political parties. Public broadcasting matters! E. Finally, there is a new sense of unity and determination—possibly stimulated by the veto—for everybody concerned to get together and really do something about public broadcasting; to put it altogether in a concerted drive that will once and for all establish public broadcasting as an important, viable, and necessary enterprise in our society.

"The evidence of immense progress can be documented at greater length. Clearly there is much to be encouraged about—though we have a long way to go.

"We continue to work through the stresses and strains of system structure, responsibility, and future goals. We are refining mechanisms to enable thorough participation in decision-making processes, while at the same time vesting confidence and support in national agencies which allow concerted action to be taken once the will of the majority is known. Organizations and procedures have been established and continue to operate and improve. Momentum has been generated and will grow.

"We at the NAEB vow and reaffirm our commitment to a fully developed public broadcasting enterprise dedicated to the service of the American public, and pledge redoubled effort to assist that effort at this especially critical time."

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



Gates' new MW-50
50 kW medium-wave AM transmitter

Gates' exclusive Pulse Duration Modulator* System is 90% efficient. That's why Gates' new MW-50, 50 kW medium-wave transmitter operates at greater than 60% overall efficiency. With greater reliability, greater frequency response, and lower power consumption than any other AM broadcast transmitter in the same power range.

There are other reasons why the MW-50 is superior. Like the use of only 5 tubes (in just 3 tube types) in the entire transmitter. And 130% positive modulation capability.

If you'd like to hear the whole story of the MW-50, write Gates Division, Harris-Intertype Corporation, Quincy, Illinois 62301.



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 possibility of break-in, theft and willful damage was always a specter 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 Fri-

day 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 Com-

pany 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 that 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.



Ampeconomation

COST SAVINGS BY DESIGN WORLDWIDE

AMPECONOMATION means a technique or process of making electrical connections of absolute uniformity and constant reliability for the lowest possible application cost.

Taken from the words "economy" and "automation," the term is only applicable to the AMP manufactured products and automatic stripper-crimper machines.

To attain an AMPECONOMATION production, anywhere in the world, AMP disposes of more than 30,000 different products in the field of wire connections, and also the most extensive series of semi-auto-

matic and automatic stripper-crimper machines.

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.

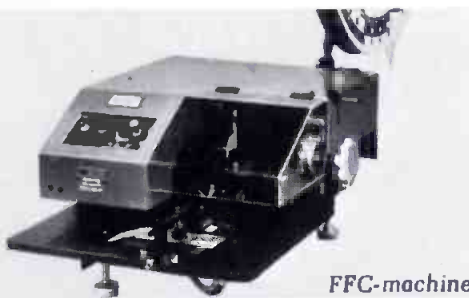
Finally, we also mention the TAPOMATIC, a machine that handles the semi-automatic cable connectors that are applied on a plastic carrier.

In short: The AMPECONOMATION program offers you many possibilities for economical production methods.

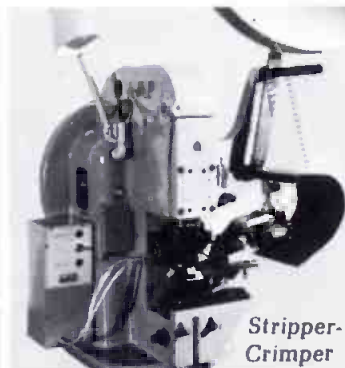
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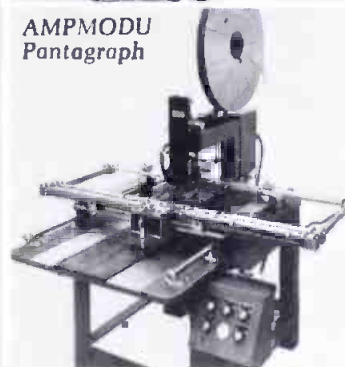
TAPOMATIC



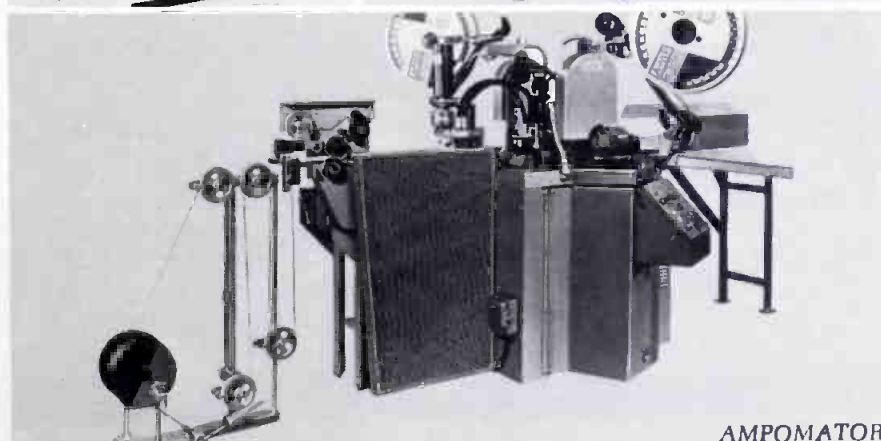
FFC-machine



Stripper-Crimper



AMPMODU
Pantograph

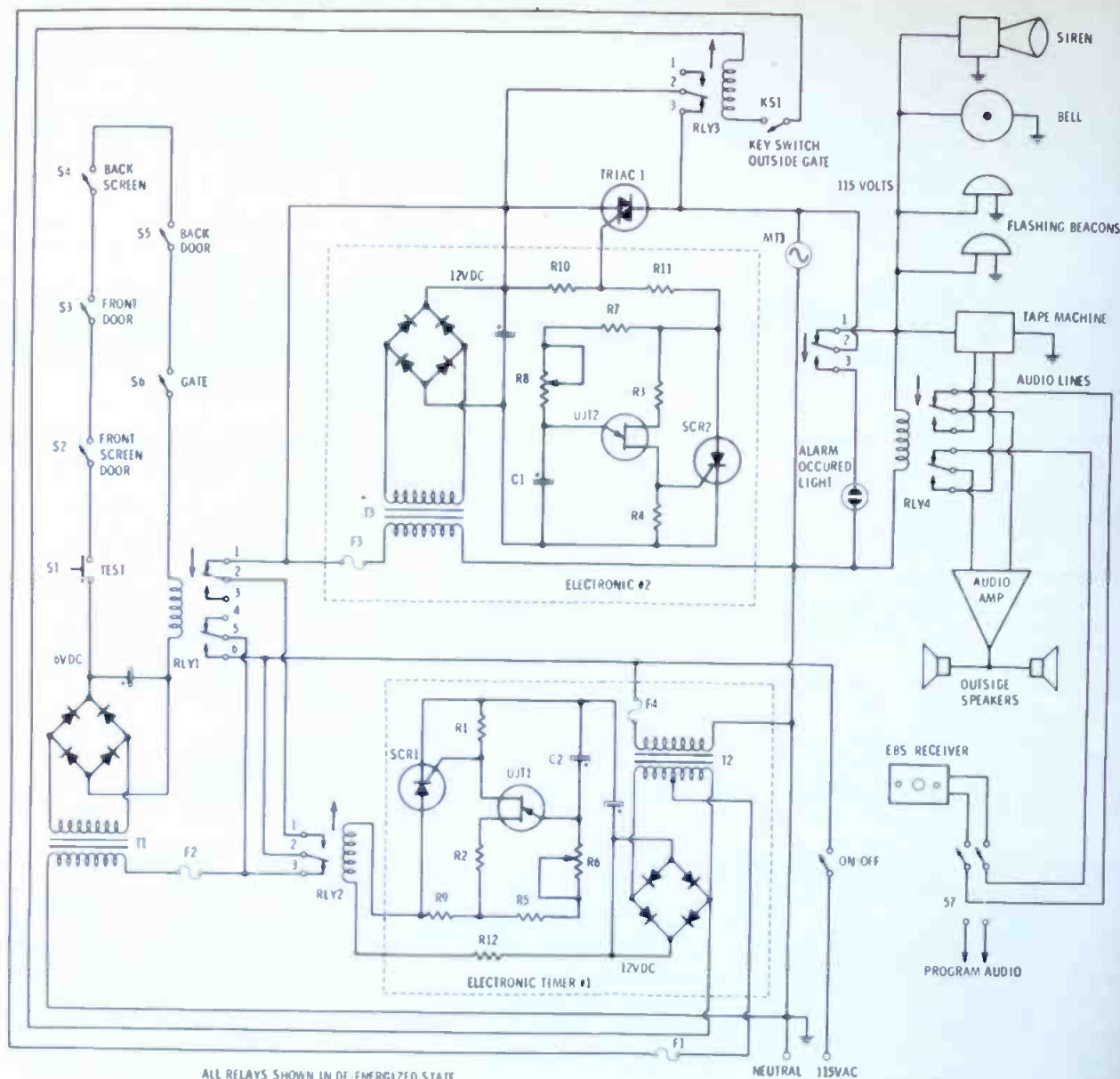


AMPOMATOR

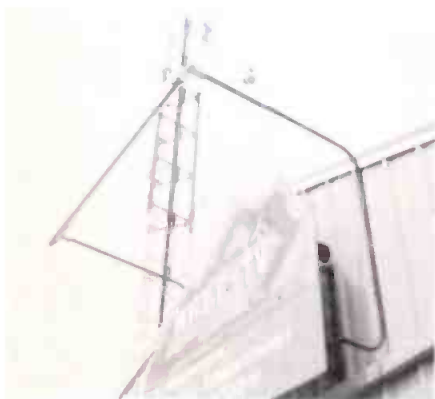
AMP at the FIAREX (Convention)

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.

AMP
AMP-Holland N.V.



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.)

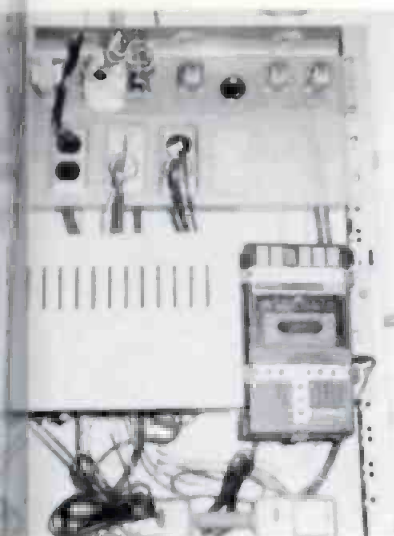
New Security System

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 day-lights 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-



Interior of system enclosure, showing power supply and associated circuitry.

...ing on the RC time constant of the capacitor and C2. The purpose of this circuit is to allow personnel to arm the system, leave the building and exit the gate before an alarm goes into action.

At the conclusion of this predetermined time period, relay 2 will energize 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. KSI 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 FBS receiver to the tape machine for routing to the audio amplifier. The theory of having FBS audio on the outside speakers

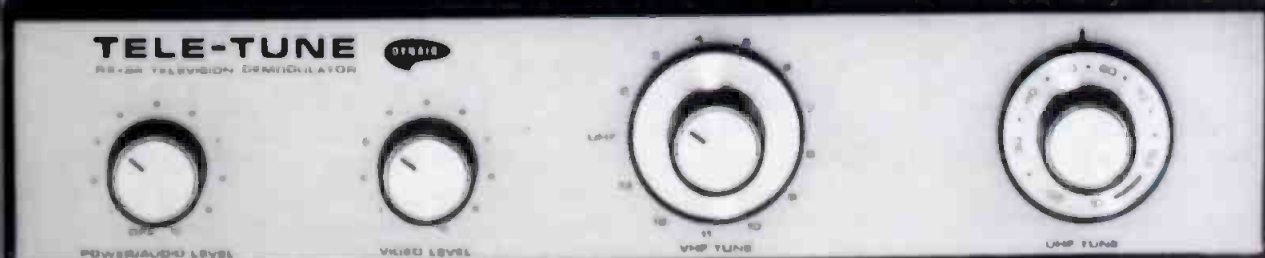
is to discourage prowlers at the outset. Just hearing voices, music, etc., may prevent a break-in. It is also possible to switch program audio outside.

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.

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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

*Maintenance Editor

be a two track stereo unit which also has a four track stereo playback head. Tape speed of $3\frac{3}{4}$ and $7\frac{1}{2}$ 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 pick-up 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 console 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 console 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 equip-

ment, but also be set to standards. Whenever a tape produces poor quality or fails in other equipment it should be checked out on the booth machines. This simple process will quickly isolate many outside machine problems or tape problems.

The booth recorders to be standard setters must be kept optimized both mechanically and electronically. The heads and equalizers should be kept optimized. Use of standard alignment tapes is recommended. While standard alignment for reel type test tapes have been around for some time, up-to-date versions should be used. That is, these should conform to the latest NAB standards.

A standard monaural test and alignment cartridge tape is available from the NAB. Unfortunately a stereo version is not yet available (the NAB has one under development). Many of the cartridge machine 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 console. On some small consoles for stereo, the meters may not track. The AGC levels, and the input to the recorder should be

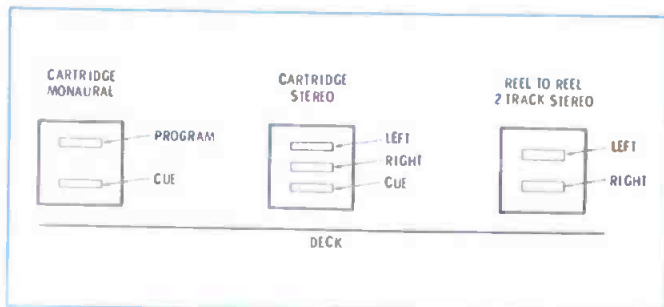


Fig. 1 Track position on broadcast recorder heads for monaural and stereo.

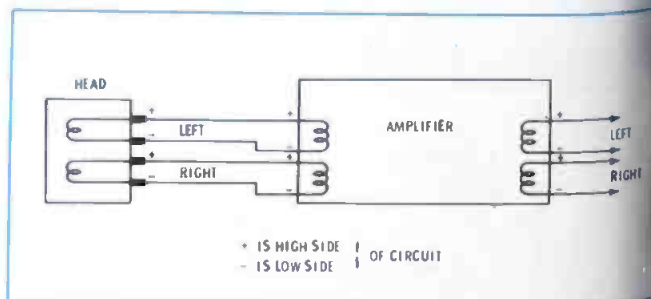


Fig. 2 Correct phasing is important in a stereo recorder. Not only left and right channels in correct positions, but also high and low sides of circuits should be maintained.



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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 console 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 furthest 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 furthest 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 furthest 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 console, 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

Remember the SX-42, the S-40, the Q-129X? Many of these old communications receivers worked their way into radio stations. They were used for a variety of reasons, even occasionally for monitoring the time signals of WWV. By the way, that's more meaningful than ever now. The WWV time is given in voice every minute. What's more, their new format includes storm warning information. But that was only part of it. Community services were monitored as well as foreign news broadcasts. But as frequency allocations changed, these receivers required converters to pull them into the new operating frequencies. In fact, most were simply used as meter station monitors, converted to EBS monitors, or left to collect dust on the floor under the test bench.

In the small market stations it might be just as well to take on the AP or UPI and then rip and read. This is easy and fast. But sooner or later your audience will pay more attention to a station that offers full service information. Of course, you can tie into the network news and let it go from there. But...the tradeoff is local identity.

We can't cover all the methods here that you could use for gathering the kind of news that is meaningful to your audience. Instead, we offer the thought that you can pump immediacy into your news time by checking over what is available on the frequency charts. The history of broadcast news reporting is respectable. And broadcast emergency communications has revealed heroics. But seldom today do we see the station that is totally committed. It takes a fair amount of work to be average. It takes a tremendous amount of work to be excellent. There are alternatives...like feeling your shoes fill up with sweat during a disaster and all you can do is drop the needle on another top 40 record.

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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 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.

the description of DIDS multi-address capability for local disaster warning, it is easy to lose sight of that fact that DIDS is designed to transmit primarily one address - national attack. Disaster warning has been added to make the ten DIDS transmitters more than a single use system. Even though DIDS will not be able to replace what broadcast stations can best perform... decentralized, timely, accurate, local weather warning information from a source the public knows personally and trusts.

Once it is recognized that the principal job of the ten DIDS transmitters is to transmit an attack warning message, it is necessary to consider how a potential enemy will view the DIDS system. Whether the international situation is trending toward peace or war, a warning system must be highly credible from the start and believable. The system must be capable of functioning regard-

less 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-

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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 terminat-

ed. 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 reinforced 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 enter-

tainment 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*

Until recently, IC audio power amplifiers have left much to be desired for high quality performance in broadcast applications. IC op-amps will meet most of the performance requirements, but need booster stages for line driving applications, and certainly when used to drive loudspeakers.

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

The unit to which we refer is the Sanyo NE540L. The 540 has a number of features which (by design) make it highly suitable as a high quality audio power amp. These are:

1. A power bandwidth of 100 kHz 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 $\pm 5V$ to $\pm 25V$).

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.

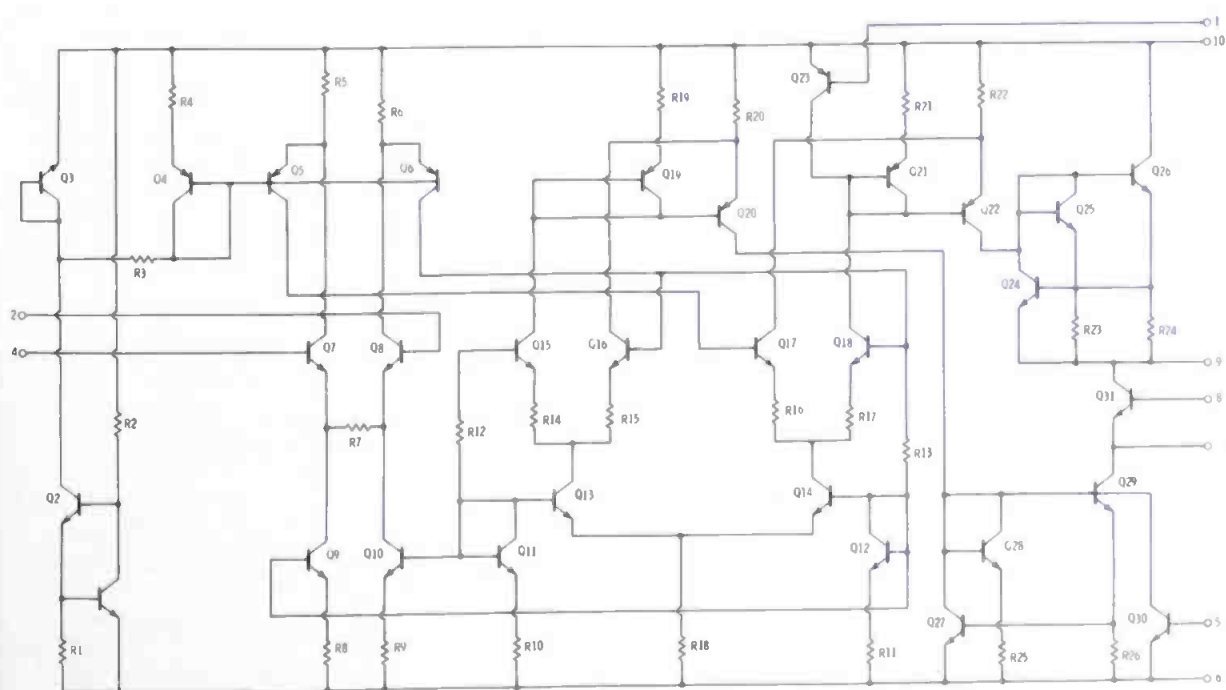


Fig. 1 Schematic of the NE/SE 540L.

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 V_{be} '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 its 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 R_2 and R_1 . Input impedance is set at 10K by R_3 , making it useful for bridging applications.

A number of tests were run on this circuit under various conditions to determine its suitability 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 R_2 and C_c values (see table). Since the 540 is advertised as being able to deliver

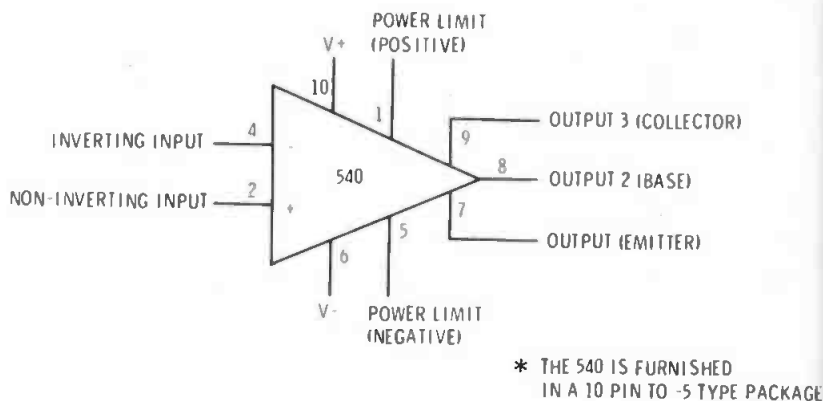


Fig. 2 The 540 pins and operational hookup.

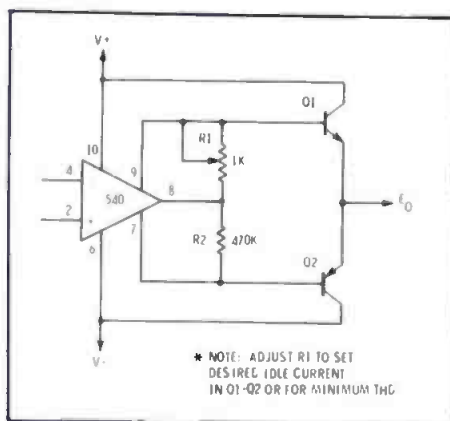


Fig. 3 A method of idle current adjustment with the 540.

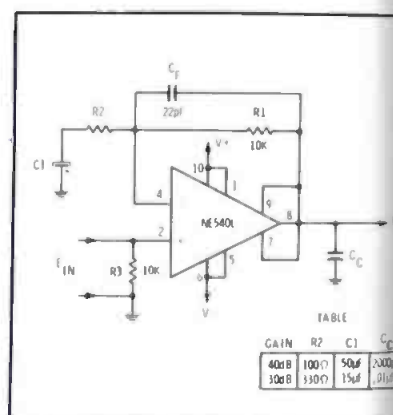


Fig. 4 General purpose 540 amplifier.

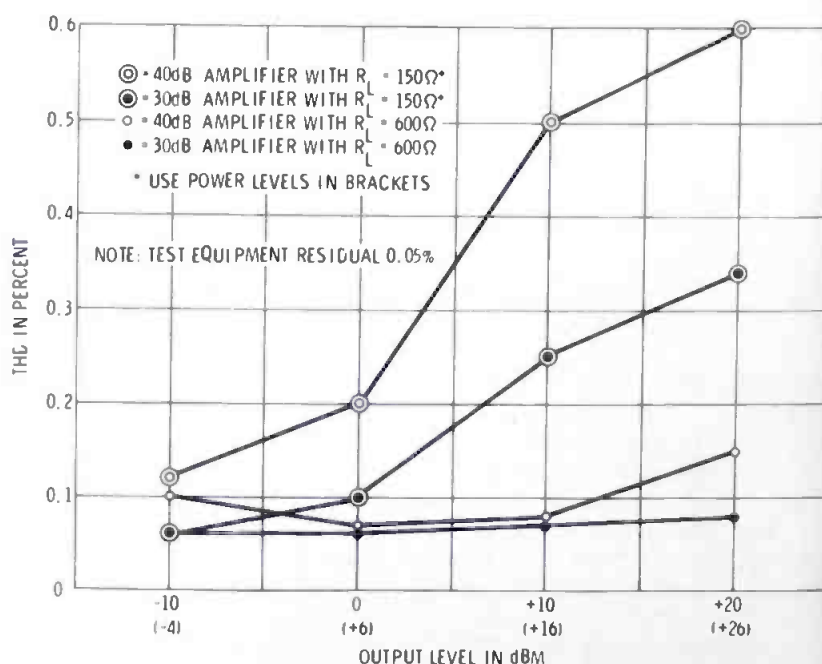


Figure 5

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Watt under these conditions. it is tested with both 600 and 150 Ohm loads. The results of these tests are shown in Figure 5.

The 40dB gain amplifier has a relatively large amount of distortion when loaded with 150 Ohms, which would prevent its use in a program channel. It would be adequate for use as a cue amp, small monitor amp, or some other non-critical amplification. But this same amplifier loaded with 600 Ohms has only 0.15 percent distortion at +20dBm. As a line amp, this could be satisfactory, depending upon your individual standards: i.e., operating levels, headroom, degree of compression and so forth.

The 40dB curves were taken with the manufacturers recommended values and the distortion levels are slightly better than data included on the 540 data sheet (which appears to be conservative).

An additional configuration was tested at a closed loop gain of 30dB (see table with Figure 4), and its results show substantial improvement. This amplifier's performance is also shown in Figure 5 for comparison. Note that at any level up to +20dBm the 600 Ohm circuit has less than 0.1 percent THD. This data was taken with a residual equipment distortion of 0.05 percent. The distortion of 150 Ohm operation is also reduced in proportion.

The power figures shown do not present the maximum output available from the 540 as Figure 5's data was taken with standard supply levels of ± 15 Volts. Raising the supplies to ± 20 Volts would enable the NE540L to deliver very close to the 1 Watt level into 150 Ohms, slightly more with reduced load impedance. However, it appears that the 150 Ohm loading is a reasonable compromise between distortion and power output. Thus the circuit of Figure 4, with a 150 to 8 Ohm matching transformer, could deliver just about a Watt of power using an NE540L and ± 20 Volt supplies.

Frequency Response

These two circuits were also tested for square wave response.

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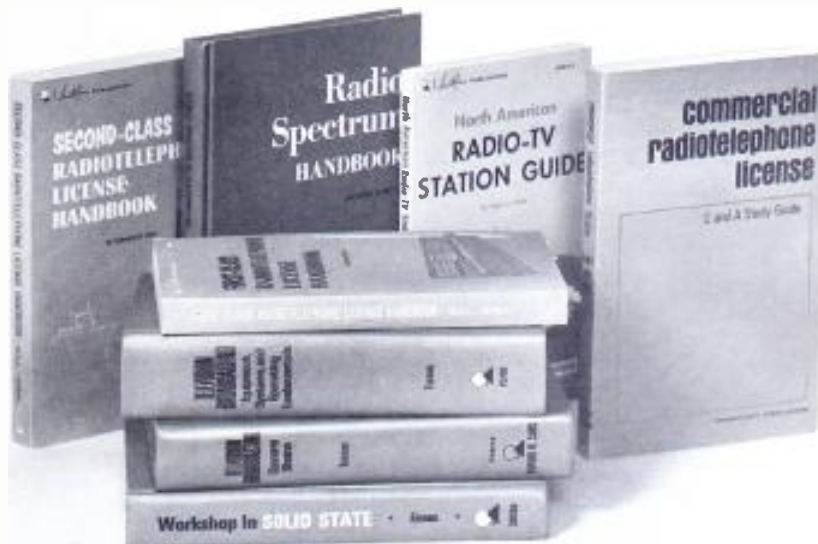
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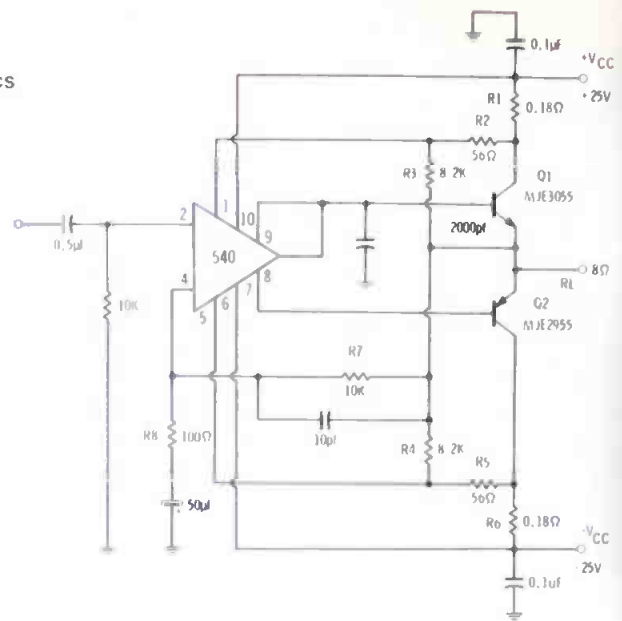
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Fig. 7a Signetics suggestion for a 35 Watt amp.

VOLTAGE GAIN
 $AV = \frac{R7 + R8}{R8}$
 CURRENT LIMITING
 $R1 = R6 = \frac{0.5mV}{I_{peak}}$
 POWER LIMITING
 $R2 = R5 = \frac{V_{CC}}{3mA}$
 $R3 = R4$



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 per cent. At 1 kHz it may have been below measurement residual.

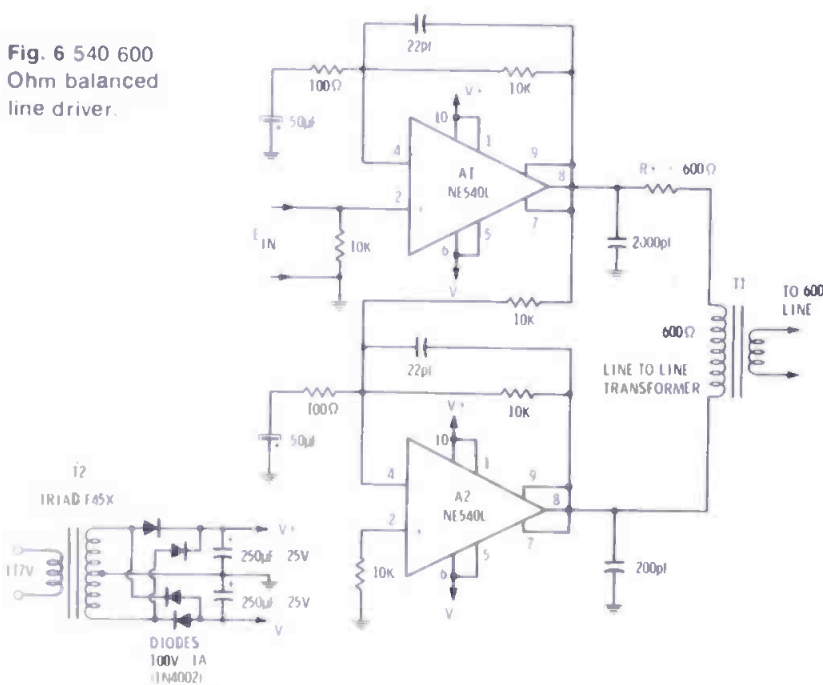
In the 540 the open loop response doesn't start dropping until nearly 50 kHz (the exact frequency depends upon loading), so there is no rise in distortion. As far as the audible spectrum goes, the 540's open loop response is flat! And that makes for a good feedback amplifier.

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.

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. 6 540 600 Ohm balanced line driver.



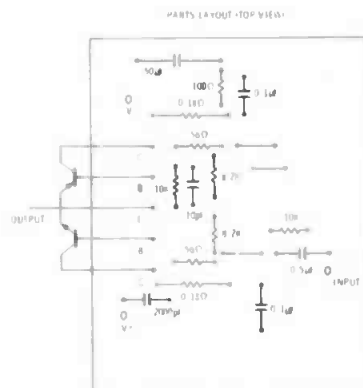
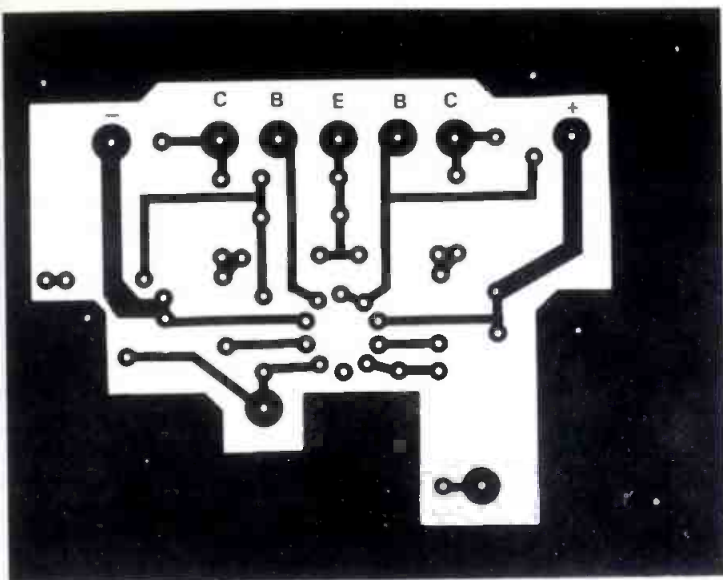


Fig. 7b PC board layout and component hookup.

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

A nifty way to get around this is to use a bridged output stage to supply an extra 6dB of output before the pad. You end up with the same net power after the termination loss. A simple and workable circuit exploiting the 540's virtues in this application is Figure 6.

A1 is a 40dB non-inverting stage as before, driving one end of T1's primary with an in-phase signal. At the same time, A2 inverts this signal and supplies a mirror image of it to the opposite end of T1's primary. Thus 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 if 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 in 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)

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PEOPLE IN THE NEWS

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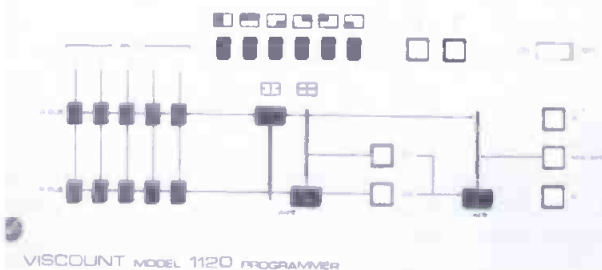
Berkey Colortran, Inc., a division of Berkey Photo, Inc., has announced the appointment of Phillip H. Stidham as Manager, Representative Sales. . . The board of directors of Switchcraft, Inc., Chicago, has elected Clyde J. Schultz as vice president-marketing. . . Leon Berman, President, AEL Service Corp. (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 to the staff of the Electronic Systems Group of GTE as a Public Information Editor. She succeeds Joan P. Shanks recently named to head Project Transition for the group. . . Peter W. Smith has been appointed President of the Western Gold & Platinum (WESGO) Subsidiary of GTE Sylvania. . . The appointment of John J. Davin as Vice President-Materials and Facilities for GTE Sylvania Inc. was announced by Douglas L. Hamilton, Senior Vice President-Finance. . .

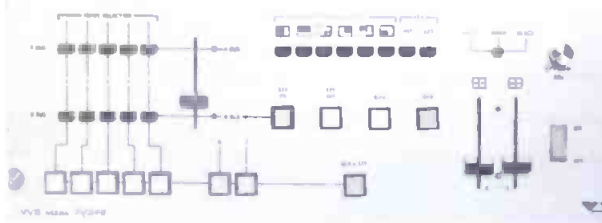
Charles A. Steinberg, Vice President-General Manager of Ampex Corporation announced the appointment of Donald V. Kleffman as marketing manager of the audio-video systems division of Ampex. . . Paul G. Hansil has been named southeastern regional manager for the Ampex audio-video systems division. It was announced by Richard Sirinsky, national sales manager. . . Leon A. Wortman, former manager of corporate marketing services for Ampex Corp., has been appointed to the newly created position of manager of distribution planning and national accounts for the Ampex audio-video systems division. . . 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 Charles Whitcomb vice president of the newly formed Mediatech, Park Ridge, Ill. . . Murray O. Cunningham has joined L-W Photo, Inc., Van Nuys, Calif., in the newly created position of director of marketing. . .

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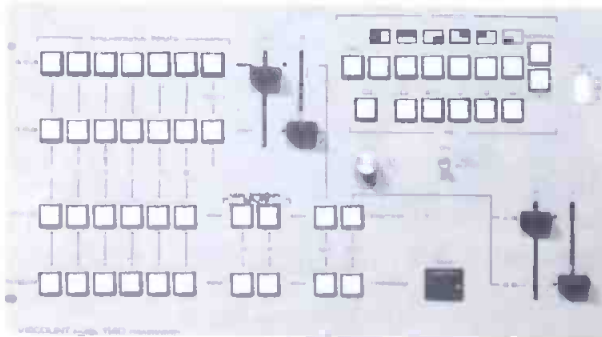


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IC Approach (Continued from page 45)

turning on the IC's internal sense transistors (Q23 or Q30). A slightly forward (IVbe) 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 SE54OL, a more expensive version of the 540. The NE54OL 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 μ f 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 540 to see a higher load impedance and minimizes distortion at high output levels.

The 35 Watt power level is not the maximum power obtainable from a 540 circuit either. Merely halving load impedance to 4 Ohm will double power output, assuming adequate transistor power rating and heat linking. And bridge power configurations are also possible with the 540, one such example is listed on the data sheet.

Summary

What we have described here by no means all that may be done with the 540. All of the popular op amp circuits are possible using the 540 with the bonus of increased power and bandwidth. After you have armed yourself with the back ground data and a hot soldering iron, we refer you to your own imaginative innovations using this new audio IC.

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

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 guidance of selected leaders to ensure focus will provide an opportunity in conclusion for an informal give and take. General Chairman is Irvin Kohlman.

If you would like information on the SPSE or how to obtain a membership write to: Russell P. Cook, Polaroid Corporation, 730 Main Street, Cambridge, Mass., 02139.



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

Most commercially available automation systems do not rely on the reversing ability of a tape deck to perform properly. However, this is not the case for home-brew type systems which often consist of only two decks wired to sequence continuously. For these systems, we often find decks such as the Sully 270 series which is a very rugged series of decks. A tape deck capable of using 14 inch reels and running at 3¾ ips can provide up to 10 hours playing time with 7200 feet of tape.

For ease of changing programming, however, often smaller reels are used. This means that the deck will have to reverse more often, and it must provide the necessary torque for reversing each time. These and other professional decks do use 1800/3600 rpm motors with very small capstan shafts that provide relatively little reversing torque when compared to the inertia on the reels. The net result is often extended periods of dead air right at the end of a tape. This is

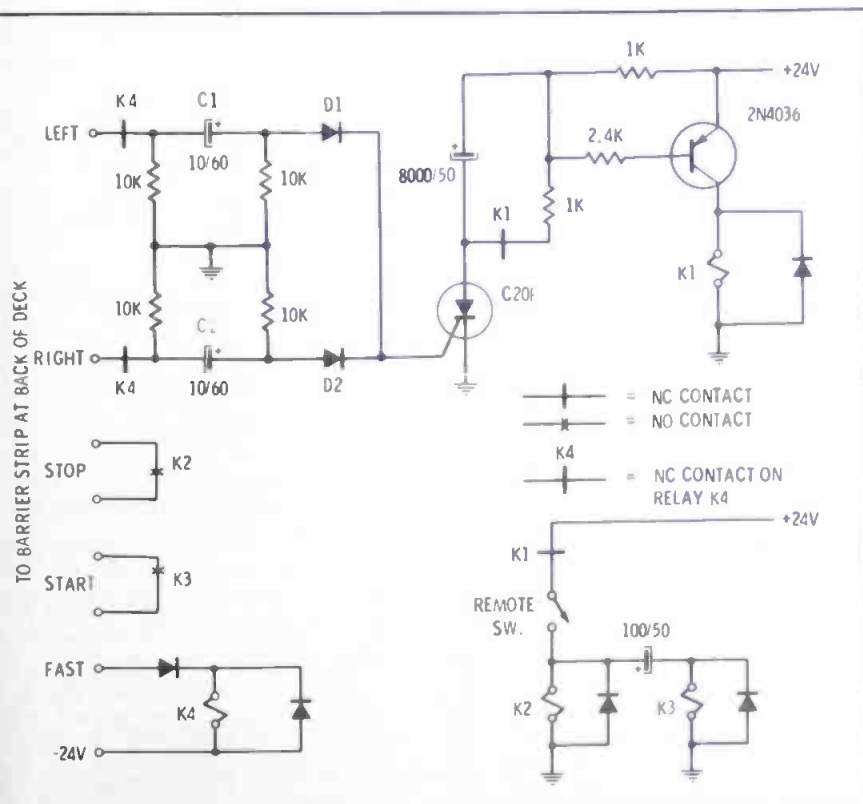
especially noticeable if the deck is not cleaned regularly.

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.



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 $\frac{1}{4}$ the weight of the 642. Even with shock mount and cable it weighs 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

Electro-Voice
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Circle Number 28 on Reader Reply Card

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A77 Mk. III-B Spotmaster/Revox



\$799

- Lifetime guarantee
- Superb specs & performance
- Advanced features
- Accepts 10½" reels & NAB hubs

Check that price again . . . for a broadcast quality stereo tape recorder with all the performance and features of machines costing 50% more. Spotmaster and Revox have joined forces to create the Model A77 Mark III-B (the "B" stands for "broadcast"), a ruggedized version of the recorder that is winning laurels all over the world.

Guaranteed for life. Every basic part of the A77 Mark III-B is protected by a lifetime guarantee except the heads, capstan and pressure roller, which are guaranteed for a full year. This should tell you something about the reliability engineered into the Mark III-B.

18 new features. The original A77 model, so widely praised since its introduction, has been improved in 18 ways. For example, a new oscillator circuit for greater efficiency, lower distortion. A modified and strengthened braking system. A new hardening process to reduce capstan wear. Improved tape handling and spooling.

But we didn't change the already great things: servo control capstan, outstanding speed stability, 10½" reel operation, modular and plug-in electronics, pinpoint editing ease, separate bias adjustment for each channel and speed, remote control of all functions, undetectable wow and flutter, 30 Hz to 20 KHz response, etc.

Designed for rack-mounting, the A77 Mark III-B provides 2- or 4-track stereo operation at 7½ and 3¾ ips. Other speeds, full-track heads, accessories optional. Call or write:

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ENGINEER'S EXCHANGE

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 they are definitely not wanted. The wire should be flexible, and should be terminated with a prod to fit the test point mounted on the printed circuit board just inside the right front of the stereo generator panel.

You will make a connection to the blue test point TP 304. At this point you will get +4.5 Volts DC and you'll also find 8 Volts, peak peak of the 19 kHz pilot frequency. If desired, a small capacitor could be used to connect the BNC connector to the test point, but in the case of the Heathkit counter, it is not needed.

The pilot frequency can be checked quickly here whenever desired without plugging in the test board supplied with the stereo generator. This test point can also be used to synchronize the

(Continued from page 49)

A fourth relay bypasses all auxiliary 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 0 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.

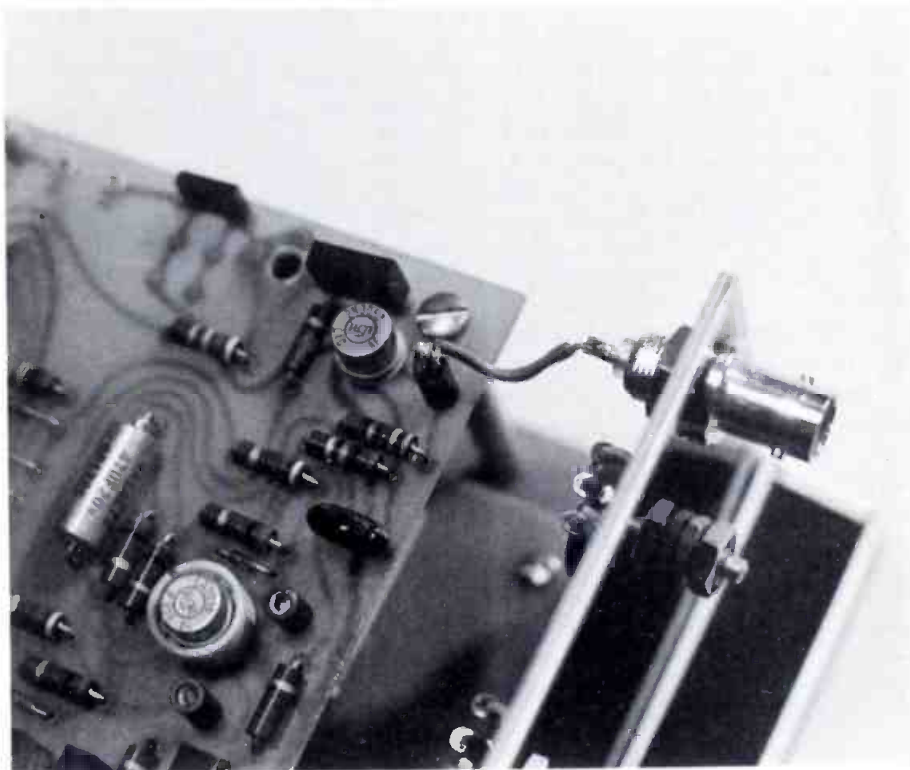
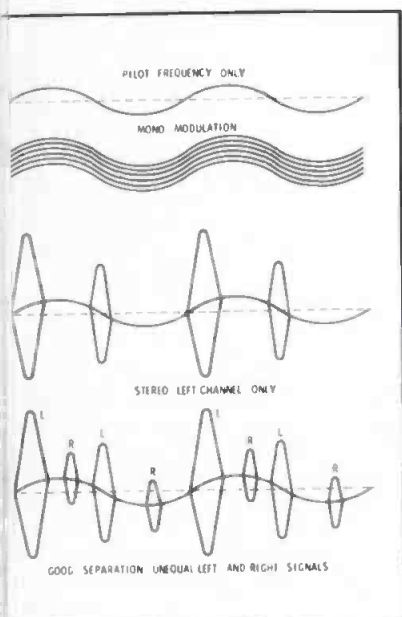
C1, C2, D1, D2 form a differentiating network for the direction

reversing pulse which occurs whenever a direction change button is pushed. The exact shape of the pulse does not matter; the total energy in the pulse is determined by the capacitors. The diodes allow only one edge of the pulse to pass through. The 10K resistors are for discharging the capacitors to insure triggering reliably.

The 8000/50 capacitor is the critical timing element. Its charging current maintains the SCR in conduction until this current drops below 1 ma. This is the figure related to this SCR. A small unit such as the C106 could have been used, but the current for holding is only 0.3 ma which makes the last part of the timing process difficult to control.

As designed, approximately 1 ma of base current will flow into the transistor just at the end of the timing interval. With a moderately high Beta transistor, probably any kind of relay could be used.

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



Keep generator of a typical series type scope in order to give a very useful stereo display.

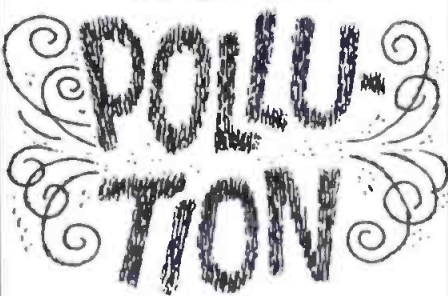
With a wide-band signal fed into the vertical amplifier of the scope, and with the sweep running at 19 kHz, or at 38 kHz, you can immediately see whether or not you are broadcasting in stereo, how good your separation is. Monaural transmission shows up at once with this type of display. If you are using a signal generator to supply tones to the channel at a time, you can identify left and right channels. This display is probably familiar to most of you, but a glance at the sketch will show the advantages.

The audio is superimposed on the base (pilot frequency) in quadrants, and separation, or lack of it, is quickly evident. In fact, a mono signal will show no quadrants; the whole base line will swing up and down with the modulation. To identify channels, remember that the left channel should coincide with the pilot frequency as it crosses the base line in the upward direction.

We feel that this is quite a bit of information to be made available all for the price of a BNC connector, and a few minutes of work.

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

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Circle Number 30 on Reader Reply Card

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.

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Electrolyzed Capstans for longer life	7½-15	440	270-275-280-282	43H-115	150.00
0.00015 Inches Max. Tir.	7½-15	300-350 351-354		54H-56	165.00
High Inertia Rotor	3¾-7½	300-350 351-354		54H-61	165.00

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Inside Out Construction



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Dept. B-5R

console



McMartin

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OMAHA, NEBRASKA, 68102 TELEPHONE (402) 342-2753

Circle Number 32 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 100 feet (½ hour) and 3000 feet (1 hr). Users may also select either a functional plastic shelf box carrier or a durable new plastic shipper at a slight additional charge. Prices of the new tape depend on quantities and package ordered, and are quoted on request through local Memorex distributors.

Circle Number 61 on Reader Reply Card

FM Monitor Receiver

The **Heath Company** has developed a revolutionary FM tuner that has applications in the broadcast, cable, and home entertainment fields.

This new approach to FM tuning involves the digital readout technique for frequency monitoring and tuning. And, all controls are push buttons.

Called the AJ-1510, the tuner eschews the age old knob twisting band scanning technique. Now, band scanning can be accomplished by touching the auto sweep button. The unit will stop at each signal where a broadcast can be received. Touch the by-pass button, and the scan continues to count down from the top of the band.

Circle Number 62 on Reader Reply Card

Broadcast Color TV Camera

A new broadcast color television camera for studio and remote use as well as closed circuit and cable television applications has been introduced by **International Video Corporation**.

The IVC-500A offers significant new features compared to previous IVC broadcast cameras but incorporates the successful tube combination used in the IVC-500—a silicon diode tube in the red channel and Plumbicon tubes in the blue and green channels, he said. The result is the best rendition of reds and the most sensitive color camera available today, Moscarello added.

Major new features in the IVC-500A include:

- new preamplifiers have a greater dynamic range without clipping than 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)

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UP-DOWN DIGITAL TIMER

- Selectable
60 or 100 MINUTE
- Time preset feature
with relay output
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- Solid walnut sides

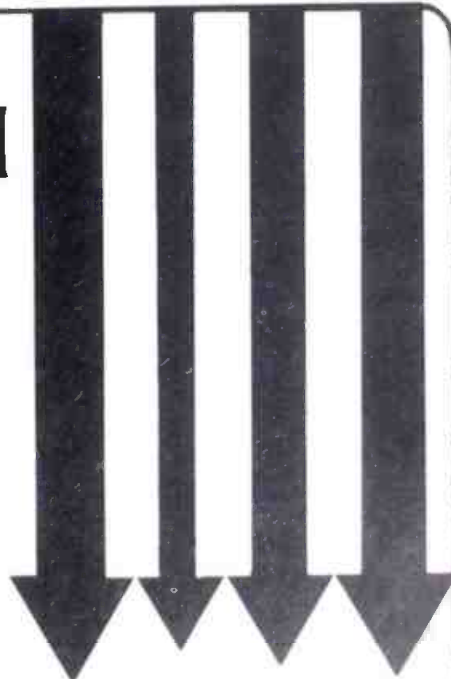
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Circle Number 49 on Reader Reply Card

roduced 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 3 3/4 IPS or 7 1/2 IPS cartridges. Thus no mental calculations are required of the operator.

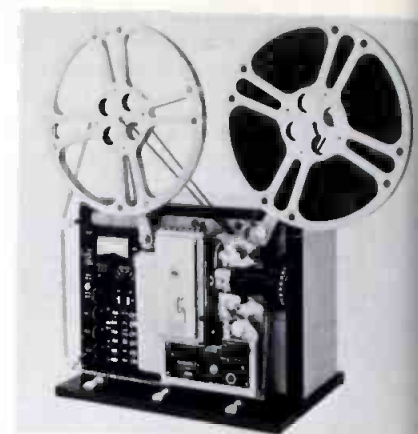
Use of the ACL-25 is quite simple. The user simply dials in the minutes and/or seconds desired, selects the size of cart on the tension control and throws the switch to run. The unit then feeds the exact amount of tape into the hub and stops automatically.

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 television sound projector, the L-W Athena 4000-TSM, offers broad versa-



tility 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

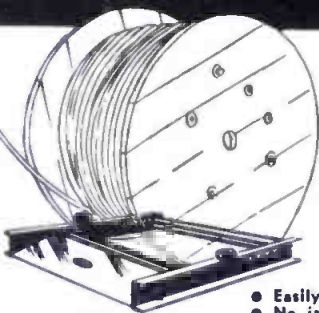
Wideband Scopes

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



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Load cable, wire, rope or anything on reels onto Roll-A-Reel for easy, smooth pay-out or take-up.

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All are drilled for optional auxiliary ball-bearing side rollers, \$8.50 per set extra.



- Handle any reel diameter
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STYLE B

3,000 lbs. cap. for 1 reel up to 48" wide or for 2 reels up to 24" wide each. Weight 110#. PRICE \$117.50 f.o.b. Cincinnati

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Circle Number 35 on Reader Reply Card

time of 10 nanoseconds. Sensitivity is 5 millivolts per division at full bandwidth. Sweep speeds to 20 nanoseconds per division are offered.



The Model 4100 oscilloscope's bandwidth ranges from DC to 75 megahertz. Rise time is 4.7 nanoseconds and sensitivity is 5 millivolts per division at full bandwidth. Sweep speeds range to 5 nanoseconds per division.

The two new Raytheon oscilloscopes have unusually large display tubes. The 8 by 10 centimeter cathode ray tubes feature high brightness (20 kilovolts) for easy and accurate viewing. Plug-in semiconductor and modular printed circuit cards contribute to ease of service and calibration.

A variable hold-off delay for digital applications increases the capability of the scopes for either digital or analog applications in the laboratory or in field service use. Offered for bench and portable use, the scopes can be supplied in rack-mounted configuration where necessary to meet customer requirements.

Circle Number 67 on Reader Reply Card

Multichannel Audio Recorder

Ampex Corporation has begun deliveries of a new compact multi-channel professional audio recorder.

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)

CONTROL AUDIO AT THE MIKE RIGHT HERE



WITH THE NEW SWITCHCRAFT "Q-G" STRAIGHT CORD PLUG

Now, you can give entertainers and broadcasters instant, finger-tip control of sound right at the microphone. The new Switchcraft T*F series "Q-G" cord plug has a built-in switch for "on-off" control of audio. The mike mounts on the plug so the switch knob is easy to operate by thumb—but its low profile alleviates inadvertent operation of the switch.

This new cord plug carries all the other great features of Switchcraft "Q-G" plugs, available in 3, 4 or 5 pin configurations, exclusive "ground connectors" for grounding/shielding through the connector, unique "captive design" insert screw to give a rigid assembly and positive electrical continuity, cable clamp to hold the cable securely, and a flexible strain relief to reduce cable wear.

Add this new Switchcraft "Q-G" cord plug with "on-off" switch to your line of audio connectors. Backed with Switchcraft's merchandising programs and promotions, it's bound to become a top seller for applications requiring control of audio at the mike. For more details, contact your Switchcraft Representative or District Sales Manager at Switchcraft, 5581 N. Elston Ave., Chicago, Ill. 60630.

SWITCHCRAFT

Circle Number 36 on Reader Reply Card

New Products

(Continued from page 50)

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 only moving assembly and eliminate need of belts, clutches, gears, capacitors or mechanical brakes. A fully proportional servo, a self-cleaning read head and phototransistor sensing offer minimum tape strain and wear. Unit is 8.72 inches high, 19 inches wide and 11 inches deep.

Circle Number 70 on Reader Reply Card

Environment-Resistant Oscilloscope

An oscilloscope to use where scopes ordinarily couldn't go is new from Hewlett-Packard. Model 1700E (for Environment-resistant) can be used on shipboard, for example, with no concern for what salt spray may do. Or it can be used in dusty environments, or in a chemical plant, refinery, or any other place where adverse atmospheres abound. It's going to be very difficult for contaminants to get inside this instrument.

The new Model 1700E is able to go beyond the capabilities of earlier ruggedized scopes mainly because of the low power consumption of HP's series 1700 Oscilloscopes. On AC line power, these oscilloscopes consume less than 25 watts when on their optional internal battery pack on DC line, power consumption is only 18 watts. Thus no vent holes are required. The instrument can be sealed up tight as a drum with no concern for heat buildup within. Actually, the majority of components within the oscilloscope operate at only 10-20 percent of their rated power maximum, which assures low heat buildup and favors reliability.

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

Circle Number 71 on Reader Reply Card

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in this issue use free readers
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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 does make a difference. Below is a corrected version.

The problem came when we didn't notice that our artist had tied to section off non-directional (10 kW or less) and Directional Restricted Licenses (when you look across the "Supervisory Operator" line). The correct chart now 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	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		
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 re- quired by license) by a First- Class Operator; Annual Part- ial Proof of Performance by a First-Class Operator; Per- formance 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 Current, (iii) Sample Loop Currents or remote antenna base cur- rents & Phase Monitor Indic., (iv) Antenna Base Current Ratio, 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°

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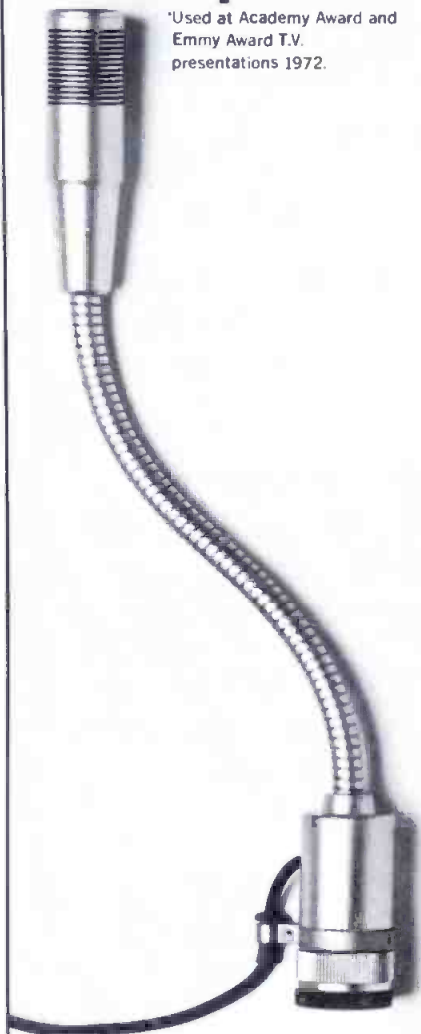
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100. AEL COMM.—"Price and Ordering Information" is a new catalog for AELCC's Mark V Single and Dual Cable Bi-Directional equipment. The eight-page list provides trunk, bridging and extender station module matrixes (including module as well as station 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 horn 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— $\frac{5}{8}$ sq.— $\frac{3}{4}$ sp.— $\frac{3}{4}$ x $\frac{7}{8}$ 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

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cluding one "press-to-test", are
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104. DIALIGHT CORP.—Dialight makes available a 52-page **LED Product Selector Guide**, designated as SG721. The brochure details the company's broad range of light-emitting diodes, indicators, switches and related readout devices. The guide is basically divided into eight product categories—Light Sources; Ultra-Nature Indicators; 0.625" Readouts; 0.125" and 0.205" Readouts; 0.70" Readouts; 0.300" Readouts; Encoder/Drivers; and Switches. All the units described work with or contain light-emitting diodes. For each product category, the company gives complete specifications, curves, applications, and mounting details, where appropriate.

105. DYNASCAN CORP.—Dynascan announces the release of its latest catalog of B & K test instruments. Catalog No. BK-73. The 16-page catalog is in two colors throughout and its listings include 8 new items, 3 of which are oscilloscopes. Two full pages are devoted to probes and other accessories. The 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)

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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—1972 catalog is available from this long line kit manufacturer. The new catalog features their digital FM tuner and a wide line of other state-of-the-art audio products. Also included are their latest additions to the amateur radio line as well as the standard and lab type test equipment.

111. INTERNAT'L. GOOD MUSIC—New IGM Series 70 audio control systems are picture and described in a six-page brochure. Extended memories are feature of the flexible, "sequential" 700 series. Two basic models are the IGM Model 710, with 1,000-event memory and control over 30 audio sources, and the IGM Model 730, with a standard 3,000-event memory (expandable) and control over 39 audio sources. Methods of programming the systems (through a direct-access keyboard) to pre-schedule as much as 24 hours with 125 separate event per hour, are fully described in the brochure.

125. SPINDLER & SAUPPE—Data sheets are available on two new Spindler & Sauppe products for multi-image automation, the Media Mix Programmer and the Tri-Cut Control. The Media Mix Programmer is a compact and inexpensive 27-channel audio-visual control device for the complete automation of multi-screen dissolve and mixed-media shows. The Tri-Cut Control, also compact and low in cost, creates high-speed "cut" dissolves on each of three pairs of Kodak projectors for multi-screen presentations.

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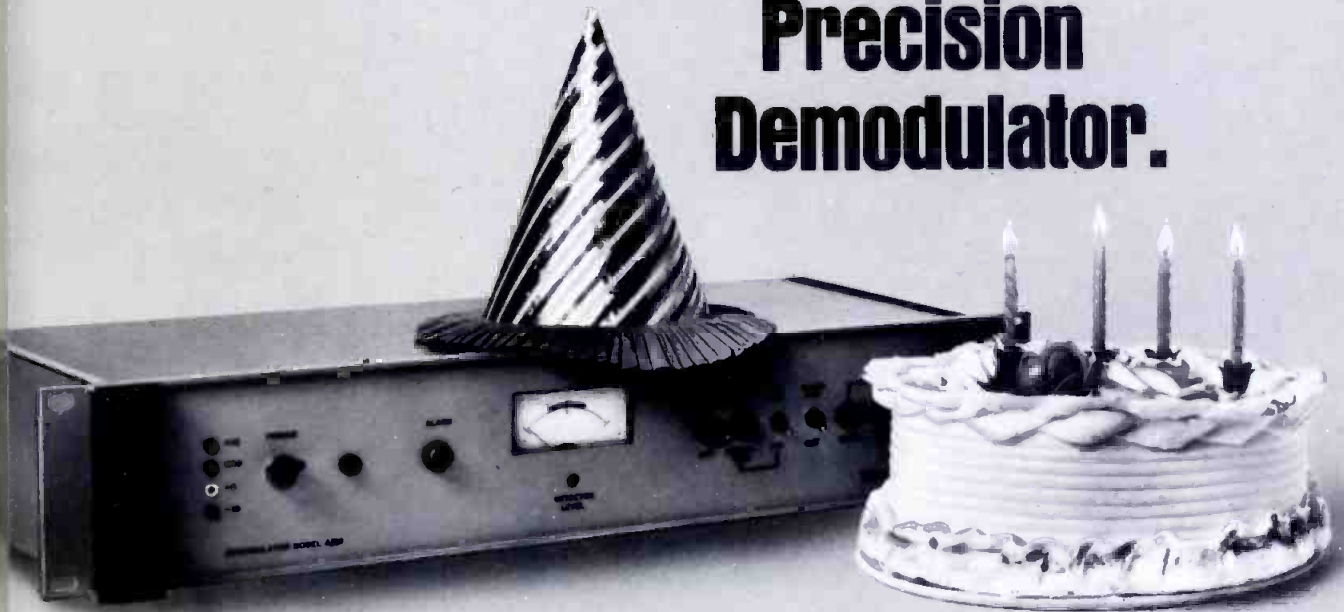
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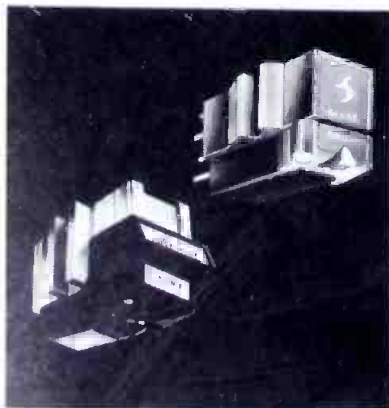
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