

July, 1977/75 cents

Broadcast engineering

**How
do tonal
values
translate?**



Directional antennas

Stereo phasing

The FM proof

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About The Cover

If you want to be sure how your colors will translate, see our opening article on page 18. (The cover picture is supplied courtesy of CBS Television Network.)

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DIRECT CURRENT FROM D.C.



July, 1977/By Howard T. Head and Harold L. Kasse

NAB Proposes Revised Audio Performance Rules

The National Association of Broadcasters (NAB) has asked the Commission to open an inquiry into the Rules governing the audio performance of AM and FM radio facilities and the measurements of audio performance. The new Rules will govern the Proof of Performance now required to be made on an annual basis.

Noting that the present performance requirements were developed many years ago, NAB points to the radical changes in audio processing and control techniques employed by radio broadcasters to enhance the characteristics of the audio signal. A wide range of topics is proposed for consideration, including the behavior of limiting and other processing amplifiers, equalization techniques, pre-emphasis, load characteristics and noise-reduction methods. In addition, the study would include analysis of techniques used in modulation monitors with emphasis on modulation limits and the definition and measurement of "peaks of frequent recurrence."

NAB asks that the Commission inquire into such topics as the type of audio performance data required and method of measurement for all radio stations. All interested parties, including manufacturers, broadcast licensees, and individuals are urged to provide the Commission with information to permit the development of Rules reflecting the current state of the art.

New Class of AM Radio Station Established

The Commission has amended the Rules governing AM radio stations to extend the AM band to include carrier frequencies at 10 kHz intervals from 530 kHz to 1610 kHz. Previously, the lowest AM frequency was 540 kHz and the uppermost 1600 kHz.

The two new established frequencies--530 kHz and 1610 kHz--are to be restricted to a new class of noncommercial radio stations known as a Travelers Information Station (TIS). These stations are to be used to transmit information to motorists and other travelers which would include warnings of road hazards, airport

Continued on page 6

CETEC Jampro's FM Antennas are especially worth listening to.

Hearing a Cetec Broadcast Group antenna specialist explain FM antennas is clearly rewarding. It can result in more listeners and *more revenue* for your station. ☐ Jampro uses the best of modern computer technology. But nothing replaces actual field tests, right? So we do that, too. Another Jampro specialty is optional Pattern Optimization, with field tests for guaranteed $\pm 4\text{dB}$, $\pm 3\text{dB}$, and even $\pm 2\text{dB}$ circularity! ☐ From the new JWCP with 4MHz bandwidth for two or more stations common use, down to the elliptically polarized JLCP, Jampro exclusive knowhow goes into every design, manufacturing and testing step. ☐ The JSCP 'Penetrator' is perhaps the most famous FM antenna in use today. Doesn't that tell the story? If not, our world-wide users' list from every climate and continent surely will. ☐ Think about it. Wouldn't you, as a *professional broadcaster*, prefer to talk to a *broadcast professional*? ... about the very special antennas of CETEC Jampro? ☐ And the entire good group of products from Jampro, Schafer, and Sparta.

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DIRECT CURRENT FROM D. C.

Continued from page 4

directions, and availability of lodging, food and gasoline. Licensees will be restricted to local and federal governmental agencies.

These stations will be restricted to the immediate vicinity of air, train and bus terminals, public parks, historical sites, interstate highway interchanges, bridges and tunnels. The operation will be secondary to services sharing these two frequencies and must accept interference from the primary service.

Some Changes in CATV Technical Standards

The Commission has made minor changes in the CATV technical standards. The revised standards are now based on the physical configuration of a cable system rather than the identities of the various communities served.

Frequency standards for cable carriage are revised for the carriage to UHF translators to require no more accuracy than that of the translator signal. The frequency accuracy requirement for CATV set-top converters is replaced by a frequency stability requirement, and a video signal-to-noise ratio is applied for the first time to direct video feeds.

There was general agreement among both cable and broadcast interests as to the desirability of these changes. Several parties, however, urged the Commission to go further and adopt more comprehensive CATV technical standards to supplement the rather meager standards now established by the Commission's Rules. The Commission agreed that this should be done and stated that it would do so promptly. It's hard to quarrel with that position--it's just as true today as when the Commission said the same thing five years ago.

Short Circuits

The Commission has proposed to prohibit the marketing of external amplifiers capable of operation in the frequency band 24-35 MHz and has instructed its staff to avoid any CB meetings where such amplifiers are displayed. The Commission has authorized an experimental license in the 52-74 MHz band to develop both an industrial and consumer video displayer... The Commission has refused to permit a suburban licensee in the midwest to move its main studio nearer the central city, although the licensee insisted that the only alternative involved miles of travel to the transmitter site over winding two-lane roads and a narrow wooden bridge often covered by high water... The Commission has issued a new volume of CB Rules and an interference book detailing "home remedies" for CB interference to television receivers and home audio equipment... The Commission has adopted Notices of Inquiry into FM quadraphonic broadcasting and AM stereo broadcasting; field testing of various AM stereo systems has begun.

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industry news

SMPTE Conference planned for October

Booth space for SMPTE's 119th Technical Conference Equipment Exhibit is now available, announced SMPTE Conference Vice President Harry Teitelbaum. The Conference and Exhibit, which is scheduled for the Century Plaza Hotel in Los Angeles Oct. 16-21, will feature numerous presentations on different aspects of television and motion picture technology. Among the sub-

jects to be discussed are laboratory practices, film production, television production, television sound and motion picture sound.

SMPTE expects this conference to be the largest in their history, with more than 5,000 professionals expected to attend. Further information on the Conference and Exhibit is available from SMPTE, 862 Scarsdale Ave., Scarsdale, NY 10583.

NAEB expands convention format

Plans to expand exhibitor participation in the 53rd annual convention of the National Association of Educational Broadcasters, held in Washington, D.C. November 13-17, were announced by James A. Fellows, president of NAEB. Fellows said that program modifications, allowing delegates more time to visit the exhibit area, have been approved. These changes will create 8½ hours of exhibit-only time when business sessions or related activity will not be scheduled.

The new NAEB convention, to be held at the Sheraton-Park Hotel, includes a major group of sessions for engineers who are frequently responsible for recommendations to management regarding the purchase of new equipment. These sessions will provide a forum for exhibitors

to make technical presentations on the formal convention agenda and on the exhibit floor. In addition, an Exhibitors Panel is scheduled as a general session to focus on technology and to encourage exhibitor attendance.

Fellows emphasized that the NAEB convention expects to draw over 3,000 public broadcasting and technical executives as well as representatives from the military services, local, state and federal government, foreign embassies, the medical profession, business and industry. He noted that an associate membership requirement in the association, which has been mandatory, has been waived. For further information contact Patricia Kio Moran at (202) 223-6274.

New trade show scheduled for Oct.

INTELCOM '77, the first International Telecommunications Exposition to be held in the United States, will take place at the Georgia World Congress Center in Atlanta from October 9-15. A number of major attractions will be bringing all segments of world telecommunications activity together under one roof, including government telecommunications administrations, users, manufacturers, technical experts, agents, distributors, consultants, educators, and communications officials from around the world.

Primary focus of the exposition will be on the needs of developing nations and will include recent developments in the technology,

economics, financial policy, regulatory and management aspects of telecommunications.

Also on the agenda are approximately 14 intensive two-day short courses covering the most up-to-date treatment of computer networks, fiber optics, satellites, digital trends, management of communications systems, microprocessors, marketing, and finance; and to major manufacturing plants, telephone operating companies and research facilities.

For further information on INTELCOM '77, contact Barbara Coffey, Horizon House International, 60 Washington St., Dedham, Ma. 02026.

Continued on page 9

CETEC Sparta's FM Transmitters are really worth listening to.

3CX3000A7 is an earful.

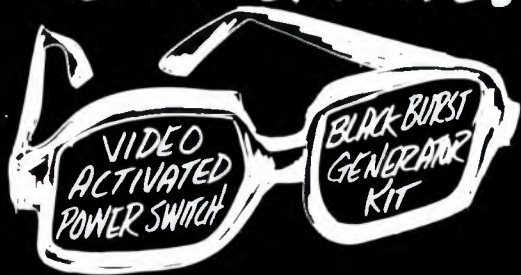
☐ That's the economical ceramic triode specifically designed for our 3 and 5 kW transmitters. Its 'grounded grid' use eliminates neutralization and continuous fine tuning in the 603 and 605B. ☐ Added stability factors: vacuum variable capacitors in the driver stage. Standard APC. ☐ The 603 and 605B, like all CETEC Sparta transmitters, interface with all makes of ATS. ☐ Reliability? Superior high performance from our solid state direct-FM 680 Exciter. It features advanced concepts such as digital, temperature-compensated AFC. The 680 powers all our FM transmitters from 10 W to 25 kW. ☐ Operations? CETEC Sparta transmitters are a breeze. All important parameters are fully metered. All feature Tally Light fault locators with automatic recycle. All provide easy access to components. ☐ *Interesting fact:* only CETEC Sparta makes AM and FM solid state transmitters. ☐ Wouldn't you, as a *professional broadcaster*, prefer to talk to a *broadcast professional*? . . . about the good group of products from Jampro, Schafer, and Sparta? ☐ Contact us. We're ready to listen to you.

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LOOK, at what's
NEW from VACc



TRULY, TWO UNCOMMON VALUES IN VIDEO EQUIPMENT

FROM VIDEO AIDS CORPORATION OF COLORADO

Video Aids Corporation of Colorado's Model VPS-1 Video Power Switch. Reduces color monitor maintenance, electrical energy consumption, and viewer distractions when no video is applied to a color monitor. The Power Switch turns monitors or other devices on and off automatically by sensing the horizontal sync of a composite video signal.

Ideal for race tracks, universities, airports and other locations where monitors are located or mounted in high inaccessible locations, the Video Switch eliminates the need for special ac or dc control lines or the use of tall ladders to turn the monitors on and off. Turn-on time is 0.5 seconds with a 1 volt plus 3db minus 6db video input. Turn-off time is 12 seconds minimum. The video monitor will not turn off when color black is present and the Power Switch is immune from most radiated or superimposed ac noise. Cost of the easy to install Video Power Switch is \$95.00 list.

Video Aids Corporation of Colorado (VACc) Model BBG-1 black burst generator kit provides easy addition of black-burst to any NTSC color sync generator for driving new color cameras and for users of video switchers who desire to fade to color black. Only eight wires connected to the sync generator's outputs and 15 volt power supply makes electrical connection fast and easy to do. The generator kit is self-contained on one small printed circuit board for easy mechanical installation. Typical installation time by a video technician or engineer is less than 30 minutes. Cost is \$89.00 list.

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Toll free Canada (800)-261-4088

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industry news

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FCC provides public access to radio program log data

The Commission has amended its rules requiring radio broadcasters to make their program logs and other data available for public inspection, and to make such material, as well as public inspection file materials, available for machine reproduction. It also continues to require that all radio licensees keep their public files for a period of three years copies of all written comments and suggestions concerning station operation received from the public.

This action, which amends Parts 1 and 73, becomes effective July 5.

The FCC said it would not require commercial television and radio broadcasters to retain and disclose transcripts or tape or disc recordings of new and public affairs programs. The Commission was convinced that the public benefits outweighed the costs the proposal would impose on broadcasters.

The FCC's action is the latest in a series of documents dealing with public access to broadcast station program records.

In January 1974, the FCC amended its rules to provide for public inspection of television station program logs and to establish the procedures which would apply to inspection requests. The revised rules allowed not only access to, but reproduction of station program logs of television licensees. On July 17 of that year, the FCC amended its rules to permit the reproduction of materials maintained locally for public inspection by television station applicants, permittees and licensees, with radio stations to be dealt with later.

FCC responds to court remain on educational station rule

The FCC has issued a response to the U.S. Court of Appeals for the District of Columbia Circuit's reversal of the FCC action amending its rules requiring non-commercial educational stations retain, for 30 days, audio recordings of all public affairs programs that are broadcast. In addition, they must make copies of such recordings available to anyone who requests and payment of a reasonable copying cost.

The FCC's action of December 19, 1975, amended Part 73 to implement Section 399(b) of the Communications Act. (That section requires non-commercial educational stations that receive federal assistance in the form of matching grants or payments to retain audio recordings of programs that have been broadcast in which issues of public importance are discussed. Copies must be made available on request.)

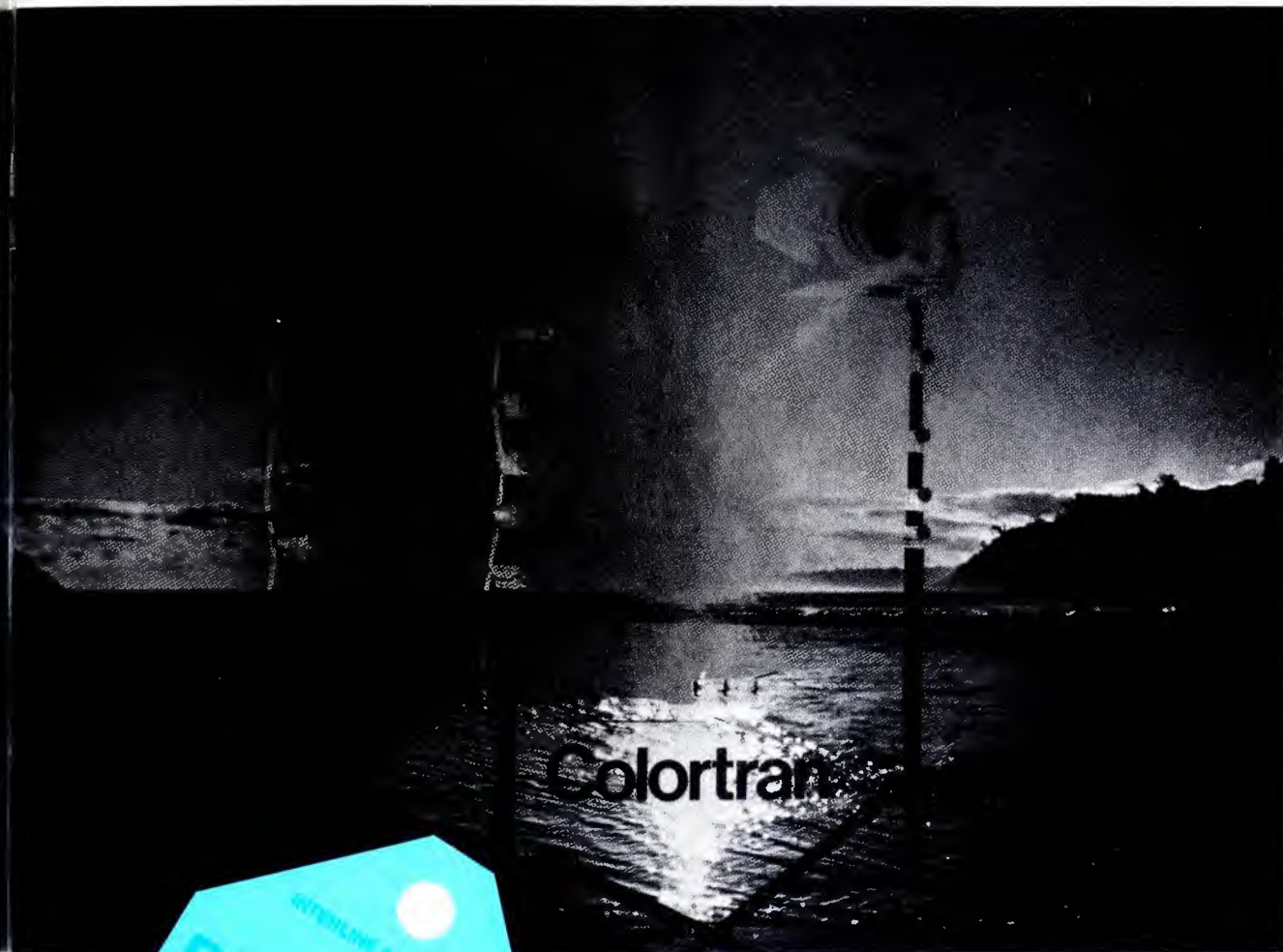
A number of non-commercial educational station licensees sought judicial review of the 1975 action contending that it impinged on their freedom of expression in violation of the First Amendment.

Continued on page 14

aluminum carry case for
Mini-Pro Kit and Pro-Kit IV.



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Lighting Kits must be portable, lightweight, rugged and durable. They are your studio in a suitcase — and must respond to ever-changing location shooting needs, over and over again.

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contrast compression and you have a camera system unsurpassed in stability, picture quality and performance.

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trix for superb colorimetry, H&V con-tours, auto iris, auto white balance, genlock sync generator, switchable gain and gamma, built-in color bars, remote VTR and zoom controls and two audio channels. All this and more make the LDK-11 like no comparable broadcast camera in the world.

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**industry
news**

Continued from page 10

**NRBA convention gears up
for 125 exhibitors**

Exhibit space for the fourth annual National Radio Broadcasters Conference and Exposition, to be held October 9-12 in New Orleans, is 75 percent sold already ahead of the entire amount reserved for the 1976 show. According to Al King, executive vice president for station services of NRBA, "New exhibitors and increased space requested by those who exhibited last year has already assured a sellout for 1977."

The exposition, limited to 125 booths, will be held at the New Hilton Hotel, and will feature the latest in automation, programming services, engineering and radio broadcast equipment.

**Legal Guide available—
helpful to broadcasters**

The Legal Department of the NAB announces the publication of a 600-page guide to provide guidance to radio and television stations on FCC-related problems they encounter in their day-to-day operation.

It is available now at a cost of \$35 for NAB members and \$70 for non-members.

Erwin G. Krasnow, NAB general counsel, said this is the first compilation under one cover of major FCC rules and policies governing programming, commercial practices, employment, engineering and other aspects of station operation. The *Legal Guide* is the result of literally thousands of hours of research and analysis.

He said the *Guide* represents a testament to the constantly increasing burdens broadcasters must take in mind in keeping track of, and complying with the seemingly endless stream of paperwork generated by the FCC's regulatory process.

The *Legal Guide*, clearly written in layman's terms, is intended to be more than a comprehensive explanation of hundreds of FCC rules, reports and court decisions. It gives practical advice to the station manager on complying with Commission regulations, filling out application forms and effectively coping with bureaucracy. For example, one of the appendices provides a listing of telephone numbers and addresses of FCC Field Offices, Government Printing Office Regional Bookstores, and other sources of information.

In 1934, all of the FCC's Rules and Regulations were contained in a relatively simple 180-page booklet. Now it takes 2,750 pages to print only those portions which apply to broadcasters.

In 1934-35, all the Commission's decisions were in the first edition of FCC Reports—388 pages. In contrast, it took five volumes containing 7,140 pages (with smaller type) to cover just a portion of the decisions released by the Commission during the comparable period in 1975-76.



Introducing two new ways to get the lighter side of the news.

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They're by far the lightest, easiest to carry, simplest to use and maintain portable microwave radios to move onto the market.

Because they're so light, the 2 watt MA-2CP and 8 watt MA-2EP open up a new era of flexibility in news gathering at 2GHz. You can go almost anywhere the news is.

Both models have a unique frequency offset capability that gives you a total of 21 microwave channels. Three times the frequency agility of older models.

If you want, we also offer the 2CP and 2EP in 1-channel and 7-channel versions.

In addition, the MA-2EP provides sophisticated diagnostics, switch-selectable tuning and the opportunity of mounting the

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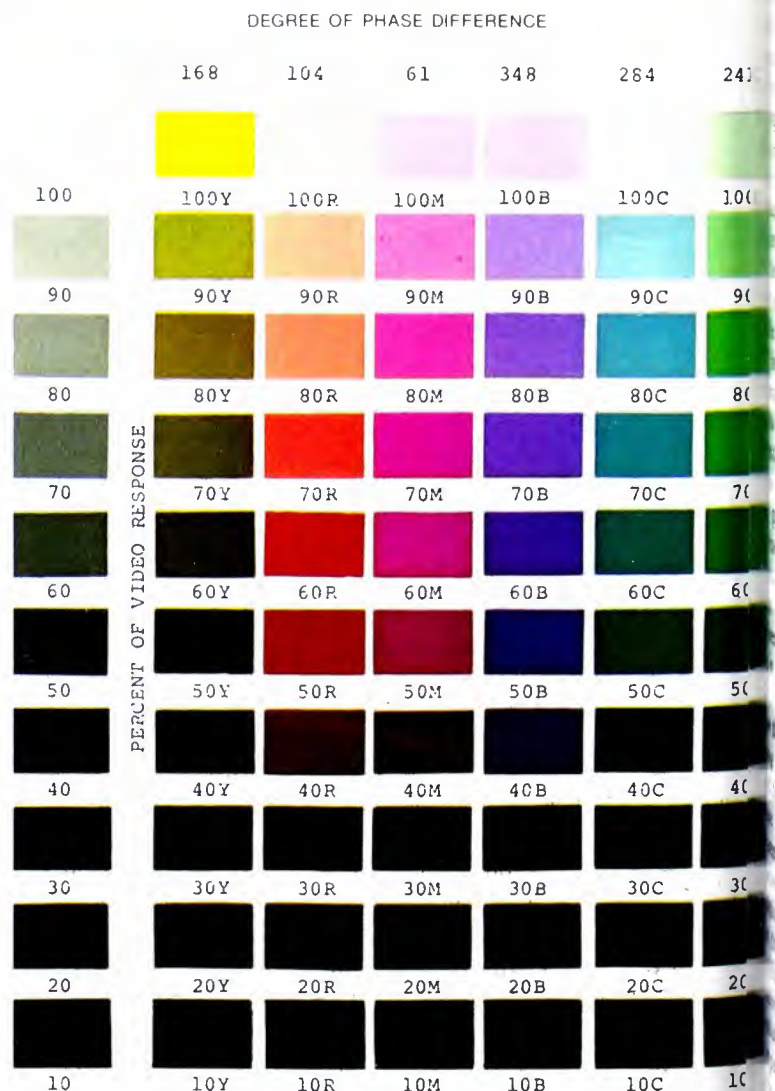
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What you see isn't always what you get

Part 2 of a 2-part series

By Ron Whittaker and Jacqueline Tornberg

Figure 1.
Color classification system and
10-step gray scale.



mentioned in Part One of this article, one of the big problems in television has always been the area of unpredictability associated with the way things appear to the human eye and how they subsequently appear on a TV screen. Colors and tonal values are significantly changed by the television process. As a producer, director, engineer, or art director, you need to know what to expect from the television system, or you will experience some disappointing (and costly) surprises.

This two-part article reports on one of the most extensive studies ever done on the subject. In all, 500 colors were carefully and systematically analyzed. The findings, which ran over 90 pages in their original form, are summarized in this series.

Since there are many thousands of shades of paint available to the television artist and set designer, it would be a hopeless task to try to identify each of them. It is not even possible to analyze one "royal blue," for example, and expect any consistency among manufacturers.

It was the authors' opinion that the best way to approach this dilemma was to select a relatively "true" paint medium which would lend itself to a very accurate analysis. Then, after extensive analysis, certain conclusions and guidelines about color and tonal values in general could be made.

How the study was conducted

Prang tempera pigments were selected for this study, not because they are widely used in television (they aren't) but because they lend themselves to the very precise calculations necessary in a study as this.

Specifically, the color samples were individually mixed from Prang water-soluble, powdered, matte-finish tempera pigments, manufactured by The American Crayon Company. The pigments used were yellow (No. 1550), orange (No.

1551), red (No. 1552), turquoise (No. 1553), violet (No. 1555), blue (No. 1556), green (No. 1557), magenta (No. 1558), black (No. 1559) and white (No. 1560).

The equipment used for electronic analysis of the colors in this study consisted of one E.M.I. 2001/C color camera with three one-inch lead oxide vidicon Plumbicon™ tubes, a Tektronix 520 NTSC vectorscope, and a Tektronix 529 waveform monitor, all of which were from the studios of WUFT, Channel 5, in Gainesville, Fla.

Procedure

The same vectorscope and waveform monitor were used for each analysis, and the same engineer recorded the readings. The equipment used was carefully adjusted to conform to FCC/NTSC guidelines.

The color samples were placed on an easel directly in front of, and at a consistent distance from, the E.M.I. camera. The easel was lit with one 2,000-watt tungsten-halogen scoop, and color temperature was carefully maintained at 3,200 degrees Kelvin.

Although a great amount of data was generated from this study, the authors have selected for discussion only the parts which they feel will be of the most immediate value to television personnel.

Figure 1 summarizes much of the information. It is difficult to accurately mass produce a chart such as this, even with the highest-quality printing equipment. The "television gray" squares (left column) should be totally "colorless"; that is, they should have no magenta, cyan, or yellow cast. The chart should be viewed by daylight. Fluorescent lights should be avoided. Tables 1 and 2 summarize the pigment formulas used.

Shades of gray

First of all, note that the television gray scale shown in Figure 1 appears more compressed between

Continued on page 20

Table 1. Mixing formulas for steps of television gray scale matched in pigment

Percent of paint in sample	Percent of video response
95.5W-4.5B	100
88W-12B	90
78W-22B	80
63W-37B	70
50W-50B	60
35W-65B	50
21W-79B	40
8W-92B	30
100B on blotter paper	20
black velvet material	10

Table 2.
Mixing formulas
for 60 colors
in color
classification
system

Hue	Percent of Paint in Mixture
100 Yellow	84Y-1G-15W
90 Yellow	98.5Y-1.5B
80 Yellow	92.5Y-4/0-3.5B
70 Yellow	86Y-6/0-8B
60 Yellow	76Y-9/0-15B
50 Yellow	64Y-12/0-24B
40 Yellow	45Y-16/0-39B
30 Yellow	16/0-16R-68B
20 Yellow	100B on blotter paper
10 Yellow	black velvet material
100 Red	1R-4/0-95W
90 Red	5R-11/0-84W
80 Red	11R-16/0-73W
70 Red	21R-26/0-53W
60 Red	35R-34/0-31W
50 Red	72R-14/0-14W
40 Red	89R-4M-7B
30 Red	31R-21/0-48B
20 Red	100B on blotter paper
10 Red	black velvet material
100 Magenta	3.5M-96.5W
90 Magenta	18M-82W
80 Magenta	37M-63W
70 Magenta	54.5M-5/0-45W
60 Magenta	74M-1R-25W
50 Magenta	93M-2R-5W
40 Magenta	85M-4R-11B
30 Magenta	35M-15R-50B
20 Magenta	100B on blotter paper
10 Magenta	black velvet material
100 Blue	1.5M-1.5V-97W
90 Blue	8M-5V-87W
80 Blue	14M-11V-75W
70 Blue	18M-17V-65W
60 Blue	31M-23V-46W
50 Blue	43M-32V-25W
40 Blue	56M-38V-6W
30 Blue	33M-22V-45B
20 Blue	100B on blotter paper
10 Blue	black velvet material
100 Cyan	4C-1G-95W
90 Cyan	15C-2G-83W
80 Cyan	34C-3G-63W
70 Cyan	53C-5G-42W
60 Cyan	75.5C-8.5G-16W
50 Cyan	85C-12G-3B
40 Cyan	66C-7G-27B
30 Cyan	31C-4G-65B
20 Cyan	100B on blotter paper
10 Cyan	black velvet material
100 Green	5G-1Y-94W
90 Green	16G-4Y-80W
80 Green	37G-9Y-54W
70 Green	57G-13Y-30W
60 Green	80G-18Y-2W
50 Green	64G-19Y-17B
40 Green	41G-14Y-45B
30 Green	7G-13Y-80B
20 Green	100B on blotter paper
10 Green	black velvet material

video levels 10 through 50 than between video levels 50 through 100. That is, to the eye, the steps from video levels 10 through 50 appear less tonally separated or less visibly distinct than the steps from 50 to 100. Step 100, or "television white," appears not white, but gray. Steps 10 and 20 could not be matched in pigment, since 100 percent Prang black tempera was too reflective. Step 10 is made of a strip of black velvet material, and step 20 is made of 100 percent Prang black tempera, painted on a strip of blotter paper.

An equal mixture of white and black tempera yields a video response reading of 60 percent. Between steps 30 and 80, each step is approximately 15 pigment-mixture percentage units away from its neighbor. At the extremities of the scale, the steps are only 8 to 10 units apart.

A careful examination of the data shows that there is no linear relationship between pigment mixture formulas (percentages of black and white tempera) and video response readings. All that can be concluded is that the addition of more black will yield a lower video response reading, and the addition of more white will yield a higher video response reading. The "shades of gray" aspect of the study constituted "Phase I" of the research.

The dimension of hue

Phase II dealt primarily with the dimension of hue. Fully saturated paints were mixed in an attempt to match the six fully saturated colors of the standard TV color-bar waveform.

The mixing procedures were somewhat similar to those of Phase I. Eight Prang colors were arranged in a circular scale corresponding to their spectral distribution: red, orange, yellow, green, turquoise, blue, violet, and magenta. Between any two adjacent colors, red and orange for example, 10 pigment samples were prepared, ranging from 100 percent red to 100 percent orange. The powdered paints were mixed with water, measured by syringe in cubic centimeters, and then mixed together in varying

percentage proportions, such as 90 percent red and 85 percent orange or 15 cc red and 85 cc orange. There were 10 or more different mixtures for each of the six adjacent pairs of colors on the circular scale, making a total of 97 color samples. These 97 color samples were then placed one by one on the easel in front of the E.M.I. camera, and phase difference and video level readings were recorded.

Also recorded were phase difference and video level readings for the six colors of a specially prepared alignment chart, so that the chart could be used again to serve as equipment at exactly the same levels for the following experiment.

An obvious hue compression was found between degrees 100 and 330 (red) and between degrees 330 and 350 (violet). Much like the compression of the gray scale between steps 10 and 50, these compressed areas indicate an inability of the television system to make as many hue distinctions in these areas.

This particular finding is not surprising when one examines the hue distribution of the visible light spectrum. The range of the red band (80 nanometers) and the range of the violet band (50 nanometers) are two of the widest spectra, the others averaging approximately 30 to 40 nanometers in width.

This information suggests that the compression by the television system in these two areas of the spectrum may be caused by a failure of the system to compensate for the comparatively wide range of these two spectral bands.

This would simply mean that colors between red-orange and magenta and between violet and blue will not reproduce with as many nuances in hue as will other areas of the spectrum. So, if you wish to highlight (shade) a red area—say an apple for instance—with orange, the findings from this study indicate that the red-orange shade would be indistinguishable; red will reproduce as identical hues on a color television set, as well as identical gray values on a black and white television set. There appears to be no need to stock different

Continued on page 20

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What you see

Continued from page 20

paints and papers in various red-orange and red hues, since they all will reproduce alike.

In Figure 2, which deals with hue only, the pigment mixing formulas for each sample are shown. In this figure, it can be seen quite clearly where there are large gaps in the phase difference continuum: between 20 and 60 degrees phase; between 140 and 165 degrees phase; and between 165 and 205 degrees phase. The compression in the red and violet ranges can also be clearly seen.

Perhaps the most startling and significant information shown by this figure is that what appears to be violet to the eye actually registers on a vectorscope as "television blue." A mixture of 60 percent Prang magenta and 40 percent Prang violet yields a phase difference reading of 348 degrees, identical with the blue of the standard color-bar waveform. (The video response of this mixture, however, is 33 percent, 13 percent brighter than the blue of the waveform.) This discrepancy between the eye and television repro-

duction is probably caused by compression in the violet ranges of the television system.

For the television artist this would mean that if a vibrant blue is desired on the screen, a mixture of violet and magenta should be used instead of blue. If blue is used, the result will be a bluish-green, as 100 percent Prang blue registers as 332 degrees phase, or between the ranges of blue and cyan.

It should again be noted that no mathematical relationship was found between the mixing formulas and phase difference of video response in Phase II of the research. As formulas were changed, changes occurred in both phase difference and video response, but these changes were not equal to, nor consistent with, the formula changes. The findings and adjustment factors discovered in Phase II were incorporated into the creation of the color chart (Figure 1).

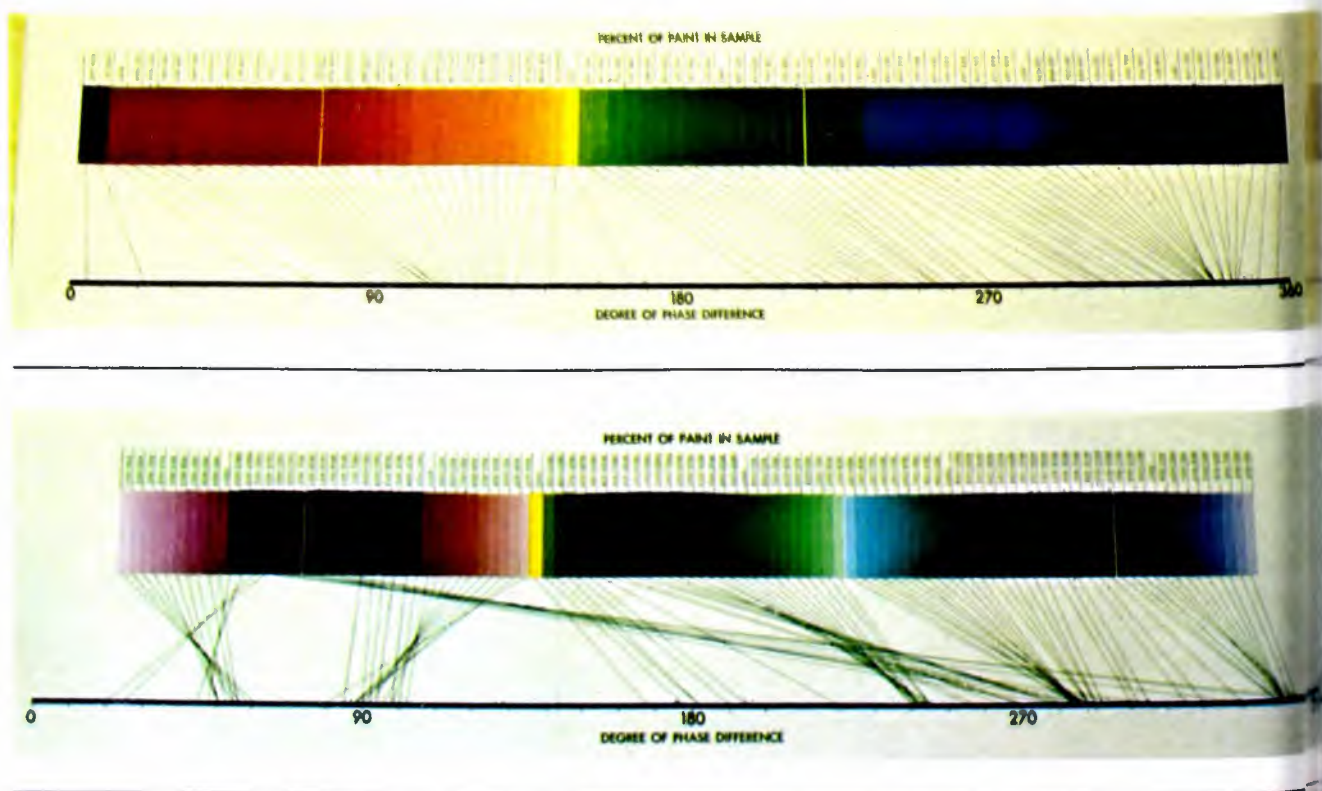
Hue and brightness

Phase III of the research for this study was concerned primarily with the dimension of brightness; but

since brightness and hue are characteristics of color and interrelated to some extent, hue was also of major concern in Phase III.

The object of the third phase of research was to create six saturated hue scales that would match in brightness, step by step, the television gray scale. That it was planned that 54 desaturated hues would be isolated in Phase III, which would match the brightness of the 10 steps of the television gray scale.

For each of the six hues, except yellow (for which only 10 samples were prepared), 19 pigment samples were prepared, making a total of 105 samples. The color samples were placed one by one on an easel in front of the camera, and a double reading, both phase difference and video level, was recorded by the same engineer on each sample. (Because the data obtained were of an unexpected nature, Phase IV was added to the research as a double-check on the findings for the first three phases and as a conclusive means of isolating the 60 colors of the



sm.) Therefore, six fully saturated hues were isolated, and their mixing formulas were kept constant as they were desaturated uniformly with white and black paint. It could be expected that all of the color samples would have identical phase difference readings, and only the video response readings would vary. This premise was proven correct. Both hue and brightness were shown to be dependent variables.

This dependency can be seen in Figure 3. By examining the red hue scale it can be seen that as the paint is added to the fully saturated red, the phase difference shifted from 102 degrees to 5 degrees, and then again to 305 degrees, past magenta and towards yellow.

One of the six isolated colors shifted in one direction or another upon desaturation. When black was added, yellow shifted 116 degrees toward green. (Yellow was not desaturated with white as it had a video response reading of 100 percent when fully saturated.) When white was added, magenta shifted 135 degrees toward cyan.

Figure 2. Phase difference groupings of 80 fully saturated color samples.

Figure 3. Phase difference groupings of six saturated hue scales.

Blue shifted 46 degrees towards cyan when black was added. Cyan shifted 8 degrees toward blue when black was added. And green shifted 37 degrees toward cyan when black was added.

In order to compensate for these shifts in phase, appropriate hues were added to prepare the colors presented in Figure 1 as the final classification system. Orange was added to yellow and red, red was added to magenta, magenta to blue, green to cyan, and yellow to green. Since brightness is conversely dependent upon hue, proportional desaturation changes were made, depending upon the characteristic brightness of the colors added. (See Table 2).

To the television artist these shifts in phase can be a help or a hindrance. In either case, it should be noted that the addition of white will cause red to reproduce more like red. Also, the addition of black greatly alters any hue, especially yellow which becomes green.

Figure 3 shows a consistent "wandering" of hues which have been heavily desaturated with black. That is, hues which register at 40 percent video or below tend to stray significantly from their appropriate hue grouping. For example, some of the heavily desaturated magenta samples register as blue, while others register in the cyan range. This "wandering" was found in all six hue groupings.

The hue samples presented in Figure 1 have also been adjusted for "wandering." Each sample in a particular hue scale registers at its appropriate phase. Those samples registering at 100 percent video and at 40 percent video or below were difficult to read accurately on a vectorscope and appeared colorless on a television screen.

In light of this finding, it appears that if color is desired on the screen at all, television personnel should use only those hues which register between 50 and 90 percent video. All brighter and darker hues appear neutral, so white, grays and blacks may be substituted if desired. The final color classification system for the television artist (Figure 1 and Table 2), then,

consists of 30 actual hues and 30 apparently neutral values.

Use of the system by television personnel

The color classification system presented in Figure 1 can solve many of the problems set forth in Part One of this article. The problem of too many colors can be significantly reduced, for example, since only hues registering between 50 and 90 percent video appear to have an identifiable color on the television screen. By studying the system shown in Figure 1, as well as the body of incidental findings, television personnel will be able to generate their own guidelines on how colors will reproduce electronically.

Theoretically, the findings can be applied accurately only to Prang tempera colors. In reality, however, much of the guesswork can be eliminated from color decisions that must be made with other artists' media having a matte finish, by using Figures 1, 2 and 3 as a guide for color decisions. Remember that each of the 60 color samples in the system corresponds to a specific gray value from 10 to 100.

Since the system contains the six fully saturated colors of the color-bar waveform, the system can also be used by television engineers for aligning color cameras.

In summary...

This rather extensive study produced some unexpected findings on the response characteristics of standard broadcast equipment to specific hue and brightness combinations. It is difficult to summarize 90 pages of data that took almost one year to compile in two short *Broadcast Engineering* installments. Color reproduction is a highly complex and sometimes highly subjective phenomenon. (Part One of this article dealt with some of the very important subjective elements.)

However, by studying the summarized data contained in these two articles, broadcast producers, directors, artists, set designers and engineers should be able to remove much of the "surprise element" from color television production. □

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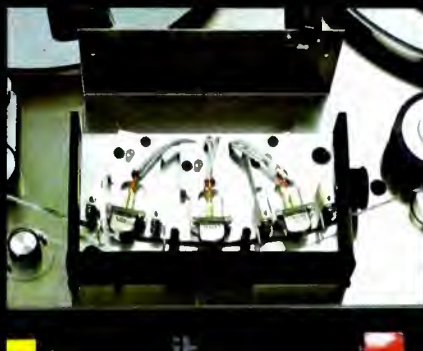
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STEREO PHASING: The untold story

By Dennis Ciapura

The effects of phasing errors on a station's mono FM signal are well-known and certainly much has been written on the subject in recent years. The mono degradation has always been a hot topic because up until just two or three years ago, many radio markets were known to exhibit 80 to 90 percent mono listening statistics. This was true despite stereo market penetration figures of nearly 100 percent on the broadcast end and 80 percent or better on the consumer end of the chain. In other words, we were transmitting stereo signals and most potential listeners had at least one stereo receiver of some sort, but most of the time spent listening was in mono.

The time spent listening is a very important factor, because it gives us an opportunity to either turn the listener on or off, depending upon how we do what we do when he listens most. Obviously then, a muddy, swishing mono air sound was what the listeners heard most of the time they listened, if the station's tape gear had a phasing problem.

As you've probably noticed, we are talking about this mono problem in the past tense, but now there is good news and there is bad news. The good news is that some of the factors that resulted in such a large portion of the time spent listening to mono are changing and we can look forward to a reversal in the trend. Most FM automobile installations are stereo and production cost reductions have made inexpensive stereo table model receivers a reality. This is not to say that mono compatibility is no longer a problem, because most of the time spent

listening in most radio markets is still mono, but the trend is going the other way.

The bad news is that as most of the listening time is converted to stereo, our phasing problems will not be alleviated, because the same phasing errors that resulted in deterioration of the mono signal, also result in similar alteration of the stereo signal. The stereo losses often go unnoticed at the broadcast station, however, because the stereo degradation usually cannot be heard until the signal has been transmitted and received. A strange story? Yes, but unfortunately true. And that is the un-talked-about part of the stereo phasing story.

Can't be heard until transmitted?

When a stereo tape is auditioned in the studio, the left and right audio channels are fed independently through the audio system and out the speaker to the listener, just as the radio listener would hear the tape if he had the tape at home to play on his audio gear. Now let's assume that the station has absolutely perfect fidelity. Should the listener still hear the tape exactly as it would sound on his own equipment? Unfortunately, No. There's just one hitch. The FM broadcast transmission system does not really transmit discrete audio channels. The left and right audio channels are broken down into left plus right and left minus right components when transmitted, and it is the eventual decoding of this sum and difference information that the receiver delivers to the audio system in the home. While there are dozens of stereo generation schemes and

demodulating circuits in use (some of which are switching techniques), the odds are that most stereo listeners hear an audio signal that has undergone at least one conversion where the left and right audio channels have been arithmetically added. And this is the "Catch-22," but first, let's take a look at the mono.

Stuck in the middle

Although we usually think of the left plus right component of a stereo transmission as the mono signal, we must not forget that the L+R is also a component of the stereo information. In fact, with most contemporary music, it's a large part of it.

A solo performer, whether vocal or instrumental, is usually placed in the center channel position on stereo recording. This was always true though. In the early days of stereo, the easiest way to remix a master to make a stereo release was to put each of the audio tracks on either the left or right channel. It wasn't long, however, until the pan pot ruled supreme on recordings with a more natural stereo image began to make its way out of most studios.

Common studio practice for many years now has been to place solo in the center channel, which is the L-R or L+R transmission channel that we customarily think of as the mono signal. Recording engineers usually use one of two methods of maintaining the desired mix when cutting a record featuring a solo vocalist. Either the recording is supplied to radio stations with separate mono side having a solo mix to avoid a phenomenon known as center channel build-up, which

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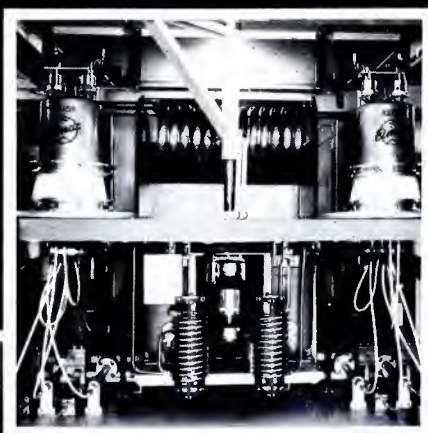
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STEREO PHASING

Continued from page 26

occurs when a stereo recording is played monaurally, or a special phasing device is used to cause about a 3 dB loss in the center channel when the left and right signals are added for mono play.

So, as you can see, our simple and seemingly straightforward stereo recording is not so simple after all. It's stereo, but it's also partly mono...in most cases, primarily mono. At this point you may begin to see how our sloppy-phase tape can sound different off the air than off the tape. When we listened to it in the studio, there was no addition of the left and right channels that would result in a loss of center channel high frequency response as the channel-to-channel phase difference increased with frequency. At the listener's receiver in the home, that solo vocalist would not be reproduced with the same crispness that we heard in the studio, even if the frequency response of the individual transmission and reception channels was perfectly flat. Any addition of the left and right audio channels, anywhere, would cause a loss of highs.

Phase shift losses

Refer to Figure 1, which shows how much loss we can expect from

various degrees of phase shift. As you can see from the data, appreciable losses are suffered as the shift approaches 90 degrees. The loss of rise time in the mid-range is probably more significant than the actual dB loss of response, which accounts for that occasional loss of crispness or bite that poor transient response is notorious for.

Now, let's take a look at what the mono frequency response would be like when a stereo tape is transmitted with phase errors. Figure 2 shows an example of what the frequency response versus stereo position would be for a mono receiver with perfect frequency response. As you can see, components of the stereo program material that appear at far left or far right in the stereo recording suffer far less treble loss than the center channel information. The reason is simple: a left-only or right-only signal will not be subject to any cancellation in the L+R baseband, while the same audio positioned at stage center will appear equally in both left and right and any phase cancellation will result in maximum loss. This results in a rather interesting phenomenon.

The mono frequency response will vary as a function of the stereo

position, even though the signal being reproduced on a mono receiver. Figure 2 is based on a typical tape system with a 90 degree phase shift at 5 kHz due to azimuth error.

How about the stereo?

Figure 3 is a simplified schematic of a typical matrix circuit used in many FM transmitters in operation today. Basically, what the circuit does is to add the left and right channels in phase to generate L+R and add then out of phase (subtract them if you like) to generate the L-R.

Let's assume for a moment that we are feeding the system with a stereo tape input with the same phasing characteristics that Figure 2 is based on; 90 degrees at 5 kHz. The output at the L+R terminals would cancel more and more as the frequency and corresponding phase shift increased until finally at 180 degrees, total cancellation would result in 0 L+R output. On the other side of the matrix, however, the left and right signals, which had been cancelling at low frequencies to produce 0 L-R output, now begin to uncanceled as the frequency and phase shift increase until finally, 180 degrees inverts the signals which are now in phase and the mono signal is shifted from the L+R main channel into the L-R subchannel!

So, now we know where those lost-out-of-phase components have gone to; out of the main channel and into the subchannel. Since this transition is taking place as a function of audio frequency, the stereo frequency response with center channel input with channel-to-channel phasing error depends heavily upon very accurate phase tracking of the main and subchannels in both the transmitter and receiver.

For a stereo generator to be able to achieve 30 dB of channel separation, the phase tracking has to be very close, within 3 degrees, between transmitting end of the chain and usually pass a phase shifted stereo signal without audible loss of center channel highs. This is why modulation monitor audio output can be as fine as long as the head azimuth error and equalization setting combined don't result in loss of individual audio channel high frequency response.

Continued on page 27

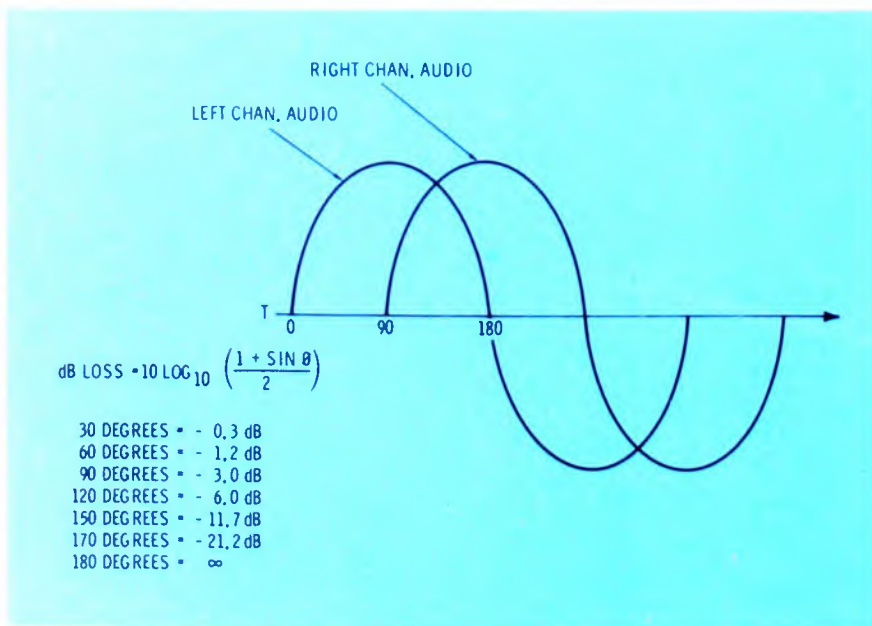


Figure 1. Losses that can be expected at a given frequency at various degrees of phase error between the left and right audio channels. As audio frequency increases, the wavelength decreases and the phase shift increases proportionately. The losses increase rapidly as the shift approaches 180 degrees, however.

WFRV-TV, Green Bay, Wisconsin goes Harris with two TC-80 live color cameras

"We wanted the most advanced live color camera on the market, and that's what we got with our TC-80s. Both cameras are performing beautifully, and the 'futuristic' design guarantees that they will not be outmoded in a couple of years. Also, with these cameras, we have the option of going triax if it's needed later."

Robert O. Southard
General Manager, WFRV-TV



"A lot of things impress me about the TC-80. The excellent picture quality, of course. The stability. The colorimetry. And the way we can set up and control our TC-80s from the CCUs. I like the mechanical construction of the TC-80 head, too--the boards are large, on a vertical plane and run very cool. And the extender boards make maintenance a snap."

Harry Hill
Chief Engineer, WFRV-TV

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Miami Newsfilm Update:

The two largest TV network affiliates in this competitive "Top 20" market choose to upgrade their newsfilm equipment rather than switch to All-ENG, recognizing the indispensable role of 16mm newsfilm in a balanced newsgathering operation.

Despite the continuing "All-ENG" hysteria, the majority of affiliate and independent TV stations across the country have opted for a balanced newsgathering operation — a healthy mix of modern, one-man-band newsfilm cameras and a limited number of ENG units with live transmission capabilities.

What's happening in a "Top 20" market like Miami is typical of current trends in gathering news for television.

Basically a flat narrow strip along the coast, with the Atlantic Ocean on one side and the Everglades on the other, Miami is considered among the fastest growing

markets in the country. Long favored as a major convention town, Miami is also a gateway for South America, Central America, and one-stop service to Europe. Since 1960 Miami has been the third-ranked city in the country in terms of datelines, with more hard news stories in one city than any other market this size.

"Our cost analysis left it very much up in the air as to whether ENG saves you money in the long run."

WCKT-TV, the NBC affiliate in Miami, has won numerous awards in recent years for its outstanding news coverage and investigative reports.

"We have two ENG units with live and tape capabilities," says Gene Strul, News Director, WCKT-TV. "The time had come to decide whether to go All-ENG or to retain film cameras.

"Our cost analysis left it very much up in the air as to whether ENG saves you money in the long run.

"We have also found that, contrary to reports, ENG units still do not serve as replacements for film cameras. We still cannot edit tape with any great speed. And the support equipment for ENG is bulky and difficult to maneuver. We use helicopters frequently to cover stories. (We also use them to rush material to us.) On occasion, we also shoot film from boats. ENG could be a problem when a helicopter or boat is needed. We also do a lot of investigative reporting where ENG would be difficult to use because the amount of equipment required would let everyone know what we're doing.

"As far as the public is concerned, it doesn't make much difference whether we use tape or film. The audience isn't interested in the difference — unless it's live. Of course, the public isn't gaining

anything if a story is put on live just to use the live capability. That's just a promotional gimmick, and the public gets blasé after a while. After all, they have already seen a *moon walk* live, and they see golf games and other events live. After a while they say 'so what.' Why bring in a feature story live when it could have been done better

on film?

"The question was: should we invest in modern newsfilm cameras or more ENG? We felt that our two ENG units were enough to supplement tape and serve our purposes at this point. And so, as our old newsfilm cameras have gone out, we're replacing them with new CP-16 units."



Dave Seeger, Newsfilm Reporter, WCKT-TV, loading his CP-16 into the news car. "VNF 7240 gives us a lot more latitude," says Seeger. "Working on various investigative series and shooting frequently at low light levels, I've probably 'forced' more film than any photographer around here." (Eastman Kodak has recently developed a new, remarkably fast stock, VNF 7250, with an ASA rating of 400, which permits shooting at light levels as low as two footcandles without requiring any forced developing! If needed, the new VNF 7250 can be pushed three stops to an ASA of 3200!)



Gene Strul (right), News Director, WCKT-TV, and Dave Choate, Assistant News Director, in conference about an upcoming investigative series. "We've found that, contrary to reports, ENG units still do not serve as replacements for film cameras," says Gene Strul.



Frank Broughton, Lab and Photographic Equipment Manager, WCKT-TV, accepts delivery of eight CP-16's from Charles Sutyak of Photomart (the regional CP-16 dealer headquartered in Orlando, Florida). WCKT-TV purchased two CP-16's in 1975, and in the winter of 1976-77 — twelve additional CP-16's!



"I don't think our equipment inventory should lie exclusively with ENG or film," says Ralph Renick, Vice President for News, Wometco stations. The WTVJ-TV news department equipment inventory includes two ENG vans, five ENG cameras, and nine of the station's CP-16's.

don't think a station should go All-ENG primarily because, with present ENG technology, your coverage would be limited."

WTVJ-TV, the CBS affiliate, is the oldest station in Miami. And the "Ralph Renick Report" is probably the longest continuing newscast in America. WTVJ-TV has the greatest number of ENG

units in Miami: five.

"I don't think our equipment inventory should lie exclusively with ENG or film," says Ralph Renick, Vice President for News, Wometco stations. "I don't think a station should go All-ENG primarily because, with present ENG technology, your coverage would be limited.

"Plus, some stories, especially features with a great deal of motion involved, lend themselves better to a newsfilm camera. Stories that are better covered with film include some breaking stories where you have to be able to move rapidly, and out-of-town stringer stories. While film in our shop is becoming a back-up or secondary system of coverage, with ENG being our primary and preferred mode of coverage, it is important that the news manager invest sufficiently in film equipment that is reliable.

"As for film versus ENG cost factors, the extra personnel involved in ENG and other extra expenditures have made the two a financial draw, they break down about evenly."



Cameraman Jeff Fort, of WTVJ-TV, takes a light meter reading, getting ready for a federal prisoner to come out of the courthouse building. WTVJ-TV acquired twelve new CP-16's in the fall of 1976, of which nine were assigned to the news department.

Renick (left), Vice President for Wometco, with Jim [unclear], News Department Editor, WTVJ-TV. "We see part of the generation for [unclear] says Renick.



The leading TV stations in Miami may differ in their general approach to news and newsgathering, in the specific tape/film ratios they use in covering the news, and the extent to which they use ENG live capabilities. Though the competition among the stations is keen and lively, on one subject there's a definite consensus: *16mm newsfilm still remains the backbone of a balanced TV newsgathering operation.*

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STEREO PHASING

Continued from page 28

The average stereo receiver is another story though. Many of the less sophisticated sets have very poor main and subchannel phase linearity at the high end which doesn't make the stereo separation sound subjectively bad because the mid-range channel separation is usually quite good. But since the high end tends to go mono, the inevitable high end response losses begin to dull the center channel. The most audible effect is not so much the loss of treble response, which might only be a few dB at 10 kHz on a stereo receiver, but the degradation of midrange transient response that results from lowering the high end cutoff frequency for

center channel information. It's that same dulling effect that blurred the mono signal, except that the stereo losses are more subtle.

Some of the better stereo tuners have a "high blend" circuit that can be switched in to help reduce hiss on weak stations by reducing the separation at high audio frequencies. The audio frequency response of the tuner is not affected by this function and circuit designers like to provide this feature because most listeners would be less annoyed by a loss of stereo at the high end than a constant hiss. If you have access to a tuner with this feature, tune around the band with the switch in and out and you'll be able to tell the

tape-formatted stations by the loss of some high end when the blend is switched in, unless of course the station's tape gear is in top shape or the music doesn't have a heavy center channel at the moment.

This is not to say that tape is necessarily a deficient signal source, for certainly the medium offers programmers an opportunity to fine tune the format ahead of broadcast, but the engineering department must keep the tape tuned up if optimum audio reproduction, both mono and stereo, is to be attained.

Shifting tape load

Realizing what subtle inner workings are acting upon our stereo transmission, it is easier to understand why we hear some odd things on the air that we do. Have you ever noticed that some stations which you know are automatically running a tape format of some kind sound audibly duller on their recordings than stations playing records "live," even though the station is reported to be flat and you know the station isn't overprocessing? How about the carted announcements that don't sound exactly like real live voices even though their recording corders and playback decks are as good as can be.

If you think about it for awhile you'll see there is a very good reason to keep the channel phase within 30 degrees to 15 kHz, a goal that a professional deck can attain and maintain with frequent spot checks. **Tape decks should be checked at the start, center and end of reel because the phasing varies as the shifting tape changes tensions and a compromise setting of the head azimuth may be required for best reproduction the entire length of the tape.**

Many engineering and programming people listen for phasing errors on the air, but limit their attention to the familiar skewed effects common to gross undelayed phase shifts. Less obvious phasing errors can render the station's audio efforts ineffective. If you don't believe it, bridge the left and right channels of your favorite tape deck through a resistive adder and play a mono test tape. You may see an unpleasant view of your center channel.

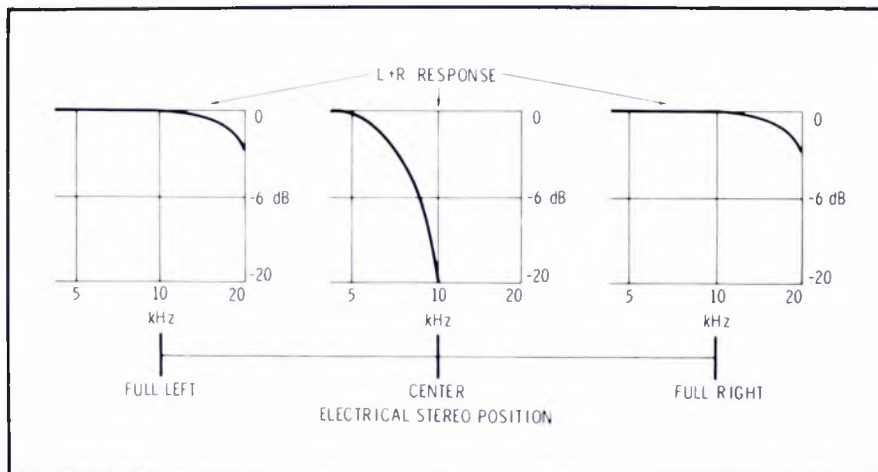


Figure 2. Mono frequency response vs. position for a typical tape deck with a head azimuth error producing a left to right phase shift of 90 degrees at 5 kHz.

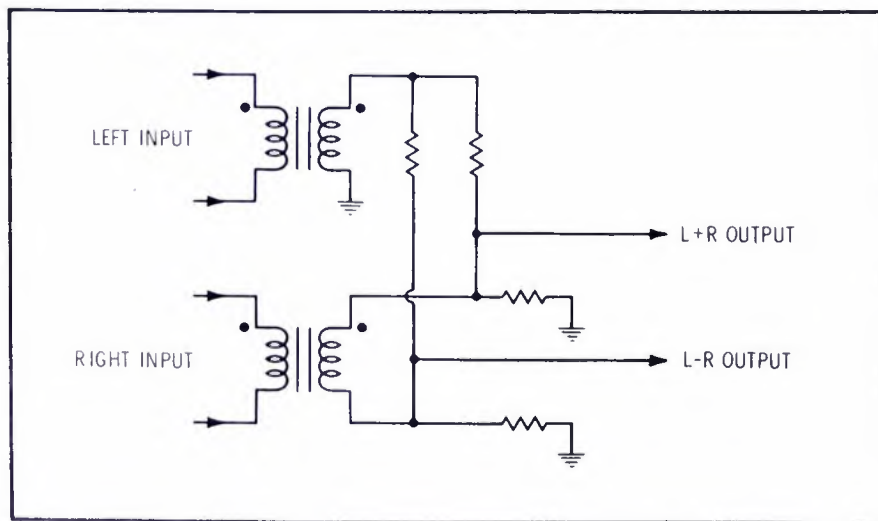
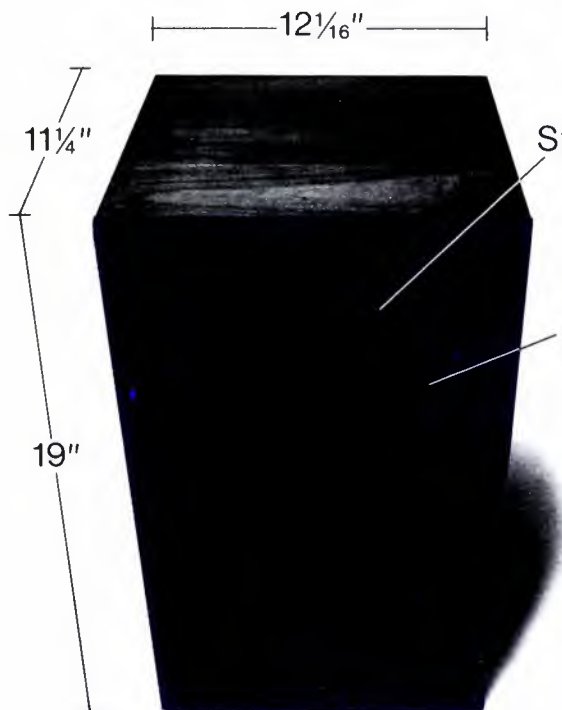


Figure 3. A simplified schematic of a typical stereo generator matrix.

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BE

Directional Antenna Basics

Part 3 of a series

By Robert A. Jones,
Consulting Engineer, La Grange, Ill.,
and Facilities Editor for BE.

This is Part III of our continuing series on the design of directional antenna systems. In Part III, I will expand upon the basic two-tower concept as studied in April.

Two-Tower Addition Formula

There are two basic ways to calculate our two-tower radiation pattern. These are referred to as the addition method and the multiplication method. Equation 1 is that of the addition form:

$$E = Kf(\Theta) \cdot (E_1 + E_2 / \Psi + S \cos \Theta \cos \varnothing)$$

As explained in Part II of this series, these terms represent the tower vectors, (E_1 & E_2), the phase

angle relationship between the two towers (Ψ), and physical spacing in degrees (S). This formula can be rewritten as shown in Equation 2, by separating out the sine and cosine terms:

$$E = Kf(\Theta) \cdot [(E_1 + E_2 \cos (\Psi + S \cos \Theta \cos \varnothing))^2 + (E_2 \sin (\Psi + S \cos \Theta \cos \varnothing))^2]^{1/2}$$

Using this formula the reader can compute the results shown in Table I. In this example I have calculated the horizontal plate pattern, thus $F(\Theta)$ and $\cos \Theta$ can be assumed to be 1.0. The constant "K" was computed, as shown in Formula 4 of Chapter II.

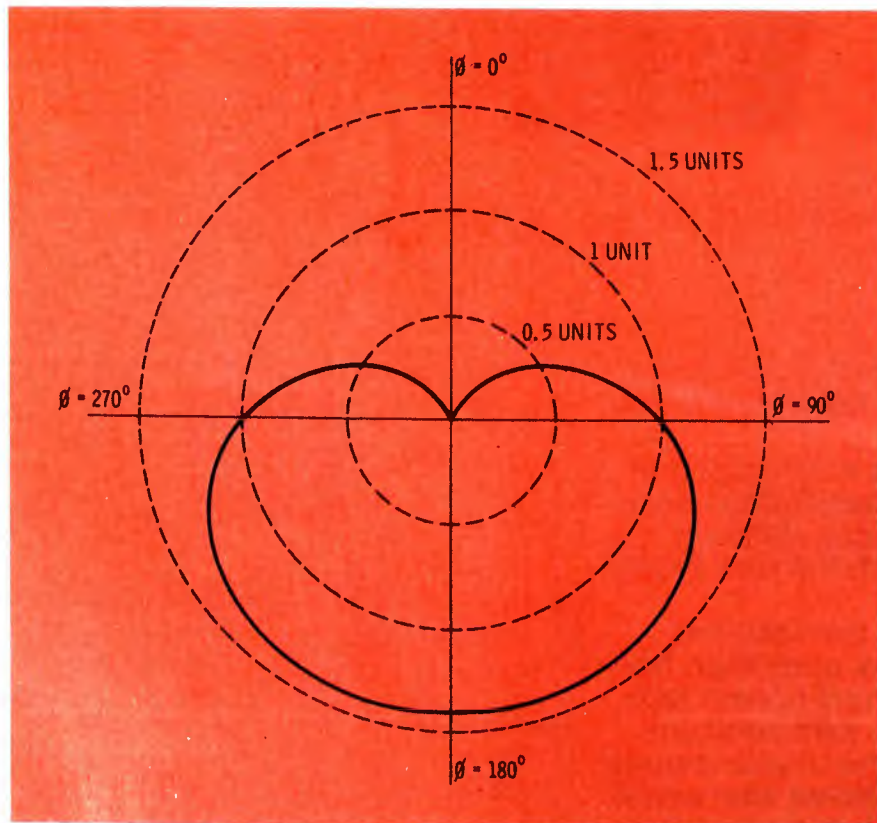


Figure 1

Two-Tower Multiplication Formula

Now let me show you how to develop the same identical pattern with the multiplication method using the formula in Equation 3:

$$E = Kf(\Theta) \cdot \sqrt{\frac{1 + M^2}{2M} + \cos (\Psi + S \cos \varnothing \cos \Theta)}$$

In this formula, all terms are the same as in the addition formula except for term "M". This represents the ratio of tower number two's vector divided by tower one's vector =

$$\frac{E_2 f_2(\Theta)}{E_1 f_1(\Theta)}$$

In Table II, I have tabulated the data used to compute the pattern. Note that the final column in Table I is identical with the last column in Table II except it is 141 percent larger. Figure 1 represents the polar graph of this pattern.

At this point you may say that's all great, but where did Equation 3 come from? Also, why are there sine terms? The reason for this is that in this formula I have written the equation around the mid-point between the two towers. In such a step, the sine terms for each tower will have opposite polarity, hence will cancel each other at each and every bearing calculated. I have outlined the method used to develop Equation 3. Let the expression $(\Psi + S \cos \varnothing \cos \Theta)$ be represented by the term "X". We can then let $E_1 = 1.0$ and write it in Equation 4 as:

$$E = Kf(\Theta) \cdot \sqrt{(1.0 + E_2 \cos "X")^2 + (E_2 \sin "X")^2}$$

Multiplying out we get:

$$E = Kf(\Theta) \sqrt{1.0 + 2E_2 \cos "X" + E_2^2 \cos^2 "X" + E_2^2 \sin^2 "X"}$$

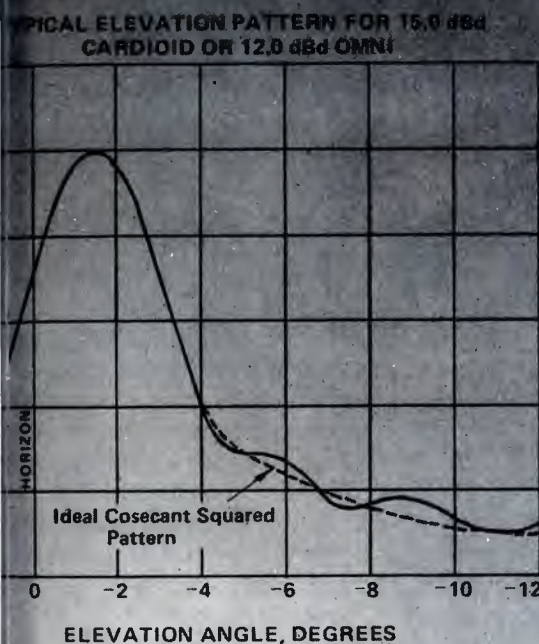
Since $\sin^2 + \cos^2 = 1.0$ (from trig) we can substitute:

$$E = Kf(\Theta) \sqrt{1.0 + 2E_2 \cos "X" + E_2^2}$$

By substituting for X and dividing out the $2E_2$ term we get:

Continued on page 4

UHF-TV TRANSMITTING ANTENNA PROVIDES CUSTOM-OPTIMIZED RADIATION PATTERNS



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$$E = K f(\Theta) \sqrt{2E_2}$$

$$\frac{\sqrt{1.0 + E_2^2 + \cos(\Psi + S \cos \varnothing \cos \Theta)}}{2E_2}$$

The $2E_2^2$ term outside the radical is a constant (for any given design), so it can be included in the K term. Thus we can write Equation 4A as:

$$E = K f(\Theta)$$

$$\frac{\sqrt{1 + E_2^2 + \cos(\Psi + S \cos \varnothing \cos \Theta)}}{2E_2}$$

I want to point out that Equation 3 is the most practical, the least time consuming, and results in the least chance for error. This is no doubt the most widely used method among engineers. Equation 3 is of course identical to Equation 4A, except it is more common to substitute M for E_2 .

Rarely Used Method

There is one other step or method that is rarely used in calculating two-tower patterns. I show it here in Equation 5 mostly for its historic value, and not as a common or generally accepted method of developing patterns. This is referred to as the "half-angle formula." It can only be used when the fields of each tower are equal. For this the reference point is assumed to be $\frac{1}{2}$ way between the two towers.

$$E = K f(\Theta) \left[\cos \left(\frac{\Psi}{2} + \frac{S}{2} \cos \varnothing \cos \Theta \right) \right]$$

This formula is derived from Equation 3 by using the old trig fact that,

$$\cos \frac{A}{2} = \sqrt{\frac{1 + \cos A}{2}}$$

All formulas really represent different trig relationships.

Two-Towers By Computers

Most consultants now resort to the aid of a computer in calculating directional patterns. It will be helpful to understand how the computer calculates a basic two-tower, or multi-tower, pattern.¹ In essence this is done by the addition method, similar to formula 1 above. One tower is written as the reference tower ($E_1 / 0^\circ$). Then each of the other towers is "added" to the reference tower, one at a time, regardless of the number of other towers. The computer program developed by Don Markley and myself was written to accommodate up to 12 towers. In Equation 6, each of the other towers is added in by:

$$\text{Reference tower} + E_n$$

$$\frac{\Psi_n + S_n \cos \Theta \cos (\varnothing - \delta)}{2}$$

The only new term here is the

Greek letter δ . This is to account for the fact that not all the towers may lie in a straight line. For a tower, other than the reference tower, this represents the angle between true north and the reference tower. Figure 2 shows how this angle is determined. For every tower, beyond this reading, there would be a different value. The exception would occur when the towers are on a straight line; in such a case δ would be a constant angle.

Phase Angle Determination

At this point it would be helpful to show how to calculate the constant value of phase angle (Ψ) to produce a null at any desired bearing. In the angle of the tower line in a given two-tower pattern is established, and the spacing between towers is set, the next step is to compute the phase angle. Figure 3 shows the relationship between the tower line, the spacing and the phase angle needed to produce a null at any desired angle. Keep in mind that when a null occurs in a two-tower pattern it means that the vectors from each tower are out of phase and result in the cancelling of the total signal at that angle.

Knowing this one fact, we can write the formula to be used as:

$$\pm 180^\circ = \Psi + S \cos \beta \quad (\text{Equation 6})$$

Continued on page 35

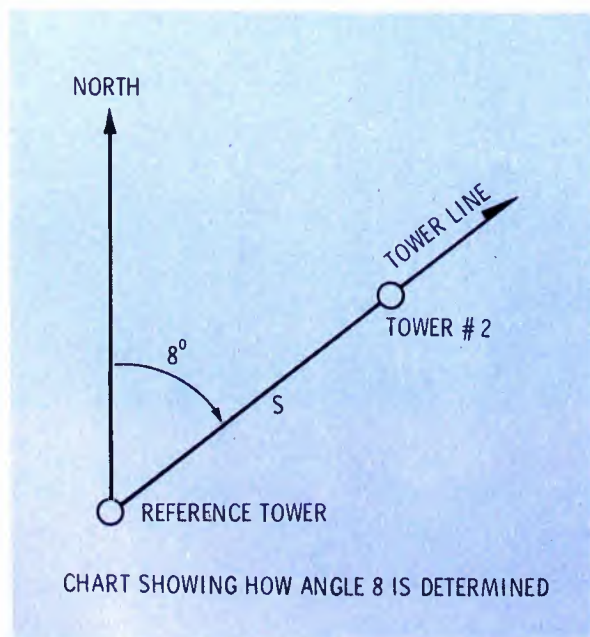


Figure 2

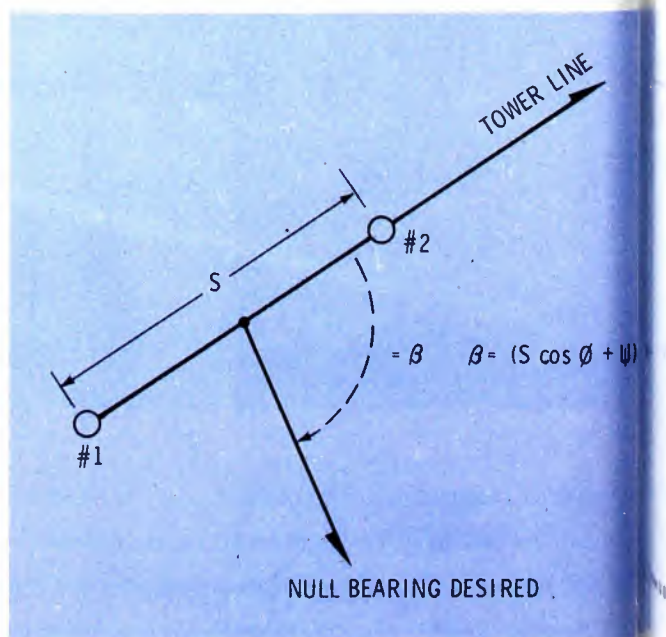


Figure 3

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with 2x range extender	24-432mm	32-576mm
Maximum relative aperture	1:1.6 (f=12-172mm) 1:2.0 (f=216mm)	1:2.1 (f=16-230mm) 1:2.7 (f=288mm)
Zoom ratio	18x	18x
Image format covered	12.8 x 9.6mm, 16.0mm dia	17.1 x 12.8mm, 21.4mm dia
Minimum object distance from front vertex	0.7m (27.6")	0.7m (27.6")
Object dimension at minimum object distance: Wide	103.2 x 77.4cm, 129.0cm diameter	
Tele	5.3 x 4.0cm, 6.7cm diameter	
Back focal distance	62.65mm (in air)	78.08mm (in air)
Glass compensation	69.2mm (BK7)	70.2mm (BK7)
Wavelength range for color correction	400-700nm	400-700nm
Weight	23kg (approx. 50lbs)	23kg (approx. 50lbs)
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Antenna Basics

Continued from page 36

or

$$\Psi = \pm 1.0 = 180^\circ \pm S \cos \beta \text{ (Equation)}$$

It is recognized that the cosine of 180° is always -1.0 . This Ψ can be either a negative or a positive value. The angle β represents the azimuthal angle from the line of the tower to the desired null bearing. With a little experience you will easily learn whether this phase angle (Ψ) is negative or a positive. Generally speaking, if the null angle is between zero and ninety degrees, it is positive. A negative sign is used when the null falls between 90° and 180° .

Null Fill

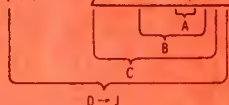
In summary there are two basic ways to compute two-tower patterns. These are called the addition form and the multiplication form. In each case there is one term which is constant for each individual bearing. This is the term $(\Psi + S \cos \emptyset \cos \Theta)$. In fact once you have calculated this term, the other variables are the individual

Continued on page 37

CALCULATING UNIT VECTORS

$$E = F_1 \cos \theta + F_2 \sin \theta \cos \phi$$

$$\text{SUBSTITUTING } = 1.0 (1.0/0 + 1.0 / 90^\circ + 90^\circ \cos \phi \cdot 1.0)$$



A	B	C	D	E	F	G	H	I	J*
θ	$90 \cos A$	$90 \sin A$	$\cos C$	$1 + D$	E^2	$\sin C$	G^2	$F + H$	$\sqrt{J}$
0°	90.0	180.0	-1.000	0	0	0	0	0	0
10°	88.6	178.6	-.999	.001	.000001	.024	.00059	.00059	.024
20°	84.5	174.5	-.995	.005	.000025	.096	.0092	.0092	.096
30°	77.9	167.9	-.978	.022	.00048	.209	.0439	.0444	.211
40°	68.9	158.9	-.933	.067	.0045	.359	.129	.134	.366
50°	57.8	147.8	-.846	.154	.0237	.533	.284	.308	.555
60°	45.0	135.0	-.707	.293	.0858	.707	.500	.585	.765
70°	30.8	120.8	-.512	.488	.238	.858	.737	.976	.988
80°	15.0	105.6	-.269	.731	.534	.963	.928	1.462	1.209
90°	0.0	90.0	0.000	1.000	1.000	1.000	1.000	2.000	1.414
100°	-15.0	74.4	.269	1.269	1.610	.963	.928	2.538	1.593
110°	-30.8	59.2	.512	1.512	2.286	.858	.737	3.023	1.738
120°	-45.0	45.0	.707	1.707	2.914	.707	.500	3.414	1.848
130°	-57.8	32.2	.846	1.846	3.408	.533	.284	3.692	1.921
140°	-68.9	21.1	.933	1.933	3.736	.359	.129	3.865	1.966
150°	-77.9	12.1	.978	1.978	3.912	.209	.0439	3.956	1.989
160°	-84.5	5.5	.995	1.995	3.980	.096	.0092	3.989	1.997
170°	-88.6	1.4	.999	1.999	3.998	.024	.00059	3.998	1.999
180°	-90.0	0	1.000	2.000	4.000	0	0	4.000	2.000

* REPRESENTS LENGTH OF UNIT VECTORS

Table 1

VIDIFONT

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The Thomson-CSF Laboratories Vidifont Mark IV is the complete character-graphic display system. Of course, Vidifont has all the standard operational features, including changeable fonts and flexible disk storage with the patented design for high resolution, proportionally spaced characters in a selection of font styles and sizes.

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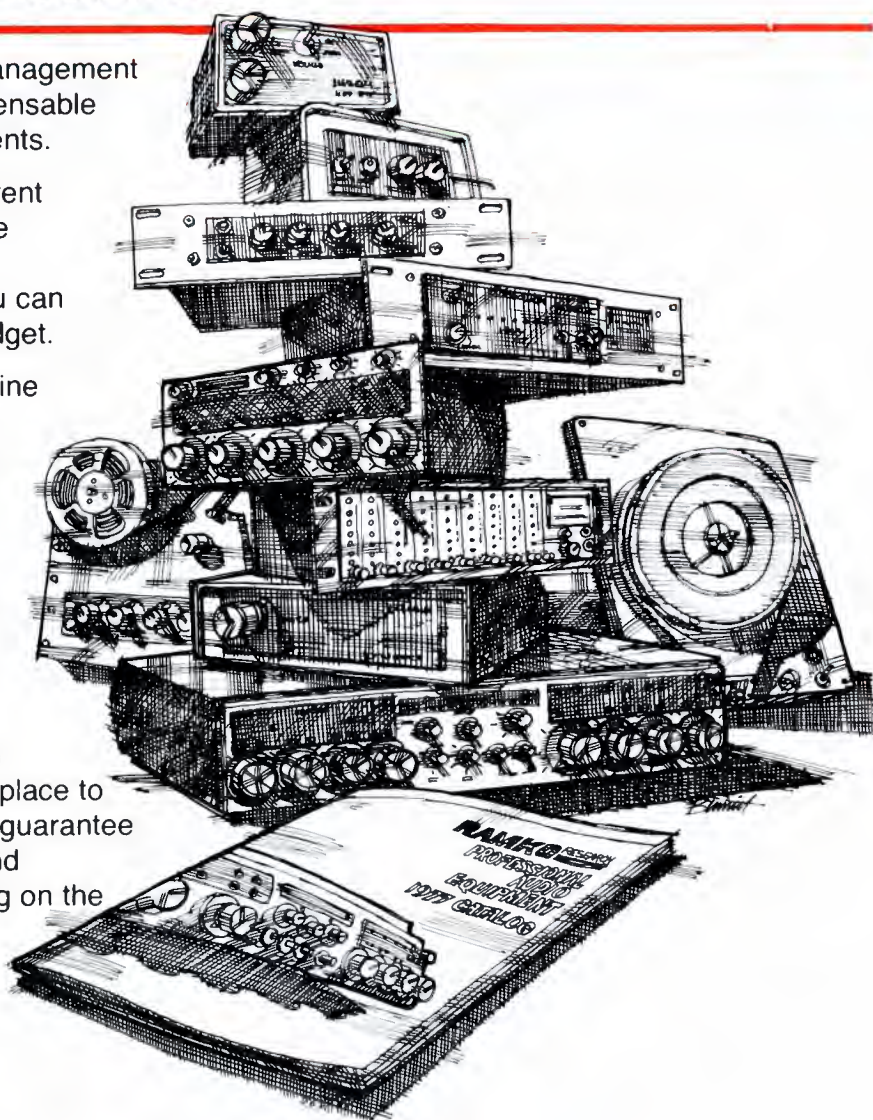
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Antenna Basics

Continued from page 38

fields radiated by each of the two towers. If we then say in our two-tower pattern that our null bearings are set, we then can vary the "depth" of this null by varying the field ratios. As you should recognize, when the individual fields are equal, the nulls will be "pulled-in" to a theoretical zero signal. As the ratio between E_1 and E_2 goes up, this null fills in more and more. By the time this ratio gets down to 100/1 you will have, for all practical purposes, a non-directional antenna.

Well-Formed Nulls

At this point I should point out that the nulls we have been talking about are those that you will find at a great distance over a conductive flat earth. In other words as you walk in closer and closer into a null, it will not hold. This is true for short distances, generally those less than 10 times the greatest element spacing. Near the directional array, predicted nulls cannot be deep, and may not seem like nulls at all. This is due to what I

Continued on page 43

MULTIPLICATION FORMULA

$$E_{UNIT} = \left(\frac{1 + M^2}{2M} + \cos(\psi + S \cos \theta) \right)^{1/2}$$

WHERE $S = 90^\circ$, $\psi = 90^\circ$, and $M = 1.0$

A	B	C	D	E	F
θ	$90 \cos A$	$90 + B$	$\cos C$	$1 + D$	$E/2$
0	90.0	180.0	-1.0000	0	0
10	88.6	178.6	-.9997	.0003	.017
20	84.5	174.5	-.995	.0046	.068
30	77.9	167.9	-.978	.022	.148
40	68.9	158.9	-.933	.067	.259
50	57.8	147.8	-.846	.154	.392
60	45.0	135.0	-.707	.293	.541
70	30.8	120.8	-.512	.488	.698
80	15.6	105.6	-.269	.731	.855
90	0	90.0	0	1.000	1.000
100	-15.6	74.4	.269	1.269	1.126
110	-30.8	59.2	.512	1.512	1.229
120	-45.0	45.0	.707	1.707	1.306
130	-57.8	32.2	.846	1.846	1.359
140	-68.9	21.1	.933	1.933	1.390
150	-77.9	12.1	.978	1.978	1.406
160	-84.5	5.5	.995	1.995	1.412
170	-88.6	1.4	.999	1.999	1.413
180	-90	0	1.000	2.000	1.414

Table

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A true time base corrector that does it all.

The TBC-110A will remove all high frequency jitter, water-fall, skew, and geometry error (S banding) from any type of non-segmented helical scan recorder. H lock VTRs can be corrected to house sync and FCC specifications by locking the TBC-110A to EXT sync. Other types of VTRs, such as line lock models, can be locked to the center of the floating window in the INT sync mode.

Fades, wipes, and inserts possible with non H-lock VTR's.

The internal digital sync generator provides a full complement of pulse outputs that are locked to either the internal oven-controlled crystal, or a VCO that is tracking the video input. The tracking mode (floating window) can be used to lock cameras to the sync outputs of the TBC so that fades, wipes, and inserts can be accomplished with non H-lock VTRs.

Complete video processing.

The TBC-110A provides complete video processing, including such features as separate luminance and chrominance processing in all modes, so that negative black spikes below sync are removed without clipping negative chroma. Chroma Gain and Chroma Phase are also adjustable in all modes (het and direct).

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DM 3/77

the parallax effect. In some
 s the "inductive field" also
 destroy the null in close to the
 s. This generally occurs within
 times the tower height. To use
 mon FCC language, the null is
 dered not to be "well-formed."
 Several factors actually affect the
 signal you would observe on
 field intensity meter as you
 closer and closer to the array.
 e are the angular displacement
 parallel of each of the tower's
 als. As we have noted in
 ous comments, the designer
 s assumed that all signals
 all towers arrive parallel, and
 you are standing at an
 ervation point that is more than
 times the greatest element
 ng, they are. But here, close
 e towers they are not. If you
 to walk directly into the
 le of a two-tower pattern, you
 d find that instead of being
 el, the two signals would be
 ing from exactly opposite di-
 ons (180°).

second factor is the difference
 ath lengths. In the previous
 le, we had talked about the fact
 the difference in path lengths
 calculated by $S \cos \theta$. This can
 nger be true because with non-
 el signals the angle θ to the
 erved is not the same. The third
 r one must apply as a cor-
 on factor is to account for the
 that the loop antenna on the
 ver's field intensity meter will
 iminate.

at this point you might question
 or why the field meter's loop
 nna will not read all signals
 ully, from all towers. This is
 euse the nature of a loop
 nna is to peak in the plane of
 loop and reject along the axis of
 loop. It is normally assumed
 at this discrimination varies as a
 ion of the cosine of the angle
 een the plane of the loop and
 angle of the respective incoming
 als.

my next article, we will look
 the world of three-tower and
 tower arrays. □

Reference

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 ntennas By Computer. Broad-
 st Engineering, March 1967.

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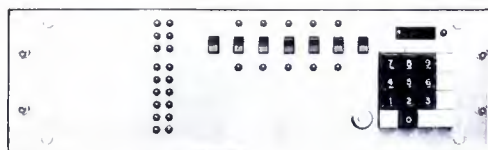
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Montreux '77

A LOOK INTO TELEVISION'S FUTURE

By Joe Roizen

The International Television Symposium and Equipment Exhibition, held in Montreux between June 3rd and 10th, has once again achieved a new high in numbers of delegates, exhibitors and technical papers. In the last category especially, the Symposium Record had to be printed in 10 volumes that must have added at least four kilograms to every participants' already bulging bags full of brochures and baubles.

By all accounts it was a great television show. The big exhibits were lavish with fancy decor and eye-catching shows. ENG cameras relayed color images from hovering helicopters, extended fire ladders, artificial rain forests, or mountain climbing cogged railways. Mobile TV vans, enroute to exotic destinations like Abu Dhabi or Qatar, ringed the exhibit hall like a protective armada with their rooves bristling with extended zoom cameras and brightly-colored parabolas that connected to whirring machinery inside.

Cheek by jowl, the various minis and micros, shoulder-mounted or gyro-stabilized, wandered along the Lac Leman waterfront recording everything in sight. Spring flowers, snow capped mountains, stately swans and strolling lovers were TV fodder for the roving color cameras and voracious VTRs that recorded and repeated these fleeting scenes to prove their quality and versatility.

The one-inch videotape recorder mystery that raised its head at NAB was also in full force, now extending its dilemma to the PAL and SECAM world. For those seeking innovation, there was a back pack omni-directional microwave that relayed pictures from a portable camera without benefit of even triax cable. There was a portable standards converter that did everything

from NTSC, PAL, SECAM, or even PAL-M to any other selected standard, all crammed into a mere 12-inch rack mount unit. U-Matics specially designed for Europe's higher bandwidth and color sub-carriers were also sprouting at a few stands, bringing the introduction of Flaherty-style ENG a bit closer in Europe.

On the social side, there was an endless round of receptions, cocktail parties, banquets, bus trips and boat rides organized by either the committee or individual exhibitors. The 2,600 registered delegates from 55 countries who toured the 135-plus exhibits, sat through the 185 papers and attended the two round tables were in need of the relaxation afforded by the after-hour events. Any participant who left Montreux without having his or her palate satiated by Swiss cheese washed down with a local wine wasn't really trying.

The symposium

The Montreux Symposium is a major part of this international television gathering, and was reflected in the quantity and quality of technical papers that the event seems to attract. Even concurrent sessions were needed on some days to accommodate the topics to be covered, which ranged from satellite broadcasting to CATV, and everything in between.

The Symposium started on Friday with the morning session devoted to welcoming speeches by Fritz Locher, director general of the Swiss PTT, and H. R. Probst, chairman of the executive committee. Howard Steele, director of engineering for the IBA and chairman of the awards committee, announced the two gold medal winners for technical television achievements.

This is a new award specially minted for the 10th Anniversary Symposium.

It was given to John Baldwin of IBA for his work in digital TV and the creation of Digital Intercontinental Conversion Equipment (DICE), and to Claude Mercier, the retiring technical director of French television and an EBU Technical Committee. Symposium citations for noteworthy contributions to television technology were also awarded to Henri Mertens, chief engineer of the EBU, Masahiko Morizono, director of NHK Corp., and Daniel Sauvet-Goichon of Television de France.

The keynote address was delivered by Werner Hess, director of Germany's national television network (ARD), and the 10th International Symposium was officially on its way.

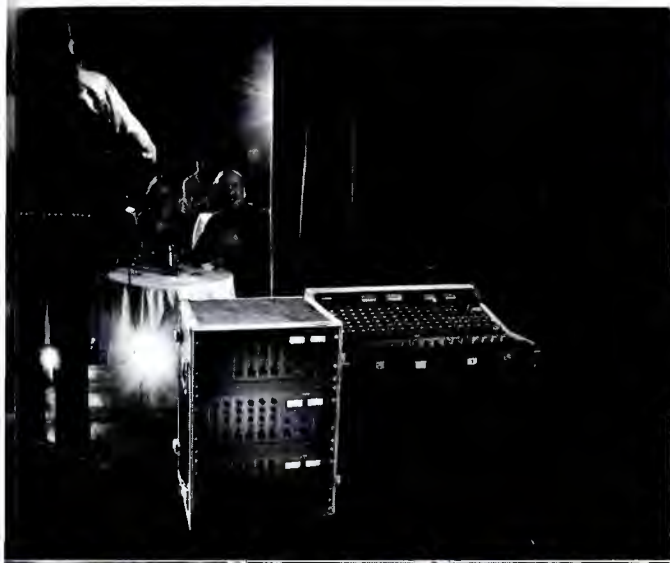
International TV progress reports

After a cocktail reception in the Montreux Casino, the afternoon session on international television progress began. In keeping with tradition, experts from various organizations were invited to review such progress in their areas.

Last year's Winter and Summer Olympic Games were reported on by N. Wassiczek of the ORF in Vienna and Marius Morais of ORTO in Montreal. Wassiczek particularly stressed the help given by neighboring countries in loaning mobile vans and other equipment to permit the ORF to cover such a large television event. Morais used a series of slides specially taken by the CBS Staff and Donna Foster Roizen to illustrate technical installations and methods of signal distribution both local and world wide. Morais stressed that the Montreal Games had the

Continued on page 10

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Montreux '77

Continued from page 44

largest audience ever for a televised event (1.25 billion), and used a record number of intercontinental satellite transmissions to achieve this.

Roland Zavada, engineering vice president of SMPTE, covered North American TV developments. He stated that the latest improvements in NTSC signal handling techniques, including VIRS, had finally removed the stigma of "Never Twice the Same Color" from the system. Victor Rojas of the OTI covered Latin America and the upcoming World Cup Games in Argentina. According to Rojas, these will be covered in PAL with new equipment obtained for this purpose. EBU developments were reviewed by R. Gressman who stressed the potentials of satellite communications for individual countries.

Mr. Balasubramanyam of the Asian Broadcasting Union in Kuala Lumpur gave a very interesting overview of new facilities and TV experiments in that area. The ultra-modern Avalon TV Center in New Zealand and the Indian CTS project, which sent satellite linked educational programs to thousands of Indian villages equipped with wire mesh parabolas, were among the items he covered. Television in the CCIR, the administration of RF spectrum space and operating frequencies was presented by the chairman of Study Group II, J. Krivosheev.

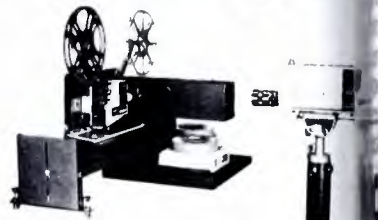
The round table conference

Another tradition at the Montreux Symposium is the round table conference that brings together users and manufacturers in a panel for a discussion about some aspect of television. Following this, the audience joins in to present opinions or ask questions. This year's round table conference was called "Trends in Video Systems Under the Impact of New Technology, Horizon 1985," and was chaired by Joseph Polonsky, who charged the panel members to look into the future with "both eyes open" to avoid any science fiction prognostications.

The round table opened with comments by Bill Connolly of CBS. Connolly pointed out that TV production is moving out of the studio and into the field where conditions are more hostile to the equipment. He would like to see new TV gear that is lighter, smaller and temperature stabilized. In Connolly's opinion, no cable at all is better than

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1977

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Herbert Fix, the technical director of Germany's Institut für Rundfunk Technik, requested that the industry consider four aspects of TV post-production: (1) leasable post-production facilities, (2) simpler on-line editing devices, (3) film transfer to solve standards problems and cinema projection, and (4) improved laser recording for TV-to-film transfer. He wondered if people would still attend movies in 1985 or be satisfied with what comes into the home via TV.

Peter Rainger of the BBC supported Connolly's view of the exodus from studio to field production. He opted for better camera sensitivity and expects the new noise reducers to help. He saw no immediate competitor to magnetic tape, but felt film would still be widely used in 1985. Rainger also predicted that digital techniques will be used for archival recording and that high-quality 625-line TV will have a 34-megabit format.

Peter Hansen from Danish TV asked for sturdier equipment to suit outside broadcast requirements, and would like to see post-production systems in various sizes to suit different purposes.

T. Miuro of NHK concurred with his predecessors and described some developments at NHK (Japan) Research Labs where large screen, high definition experiments are going on.

The last speaker for the users was M. Remy, technical director of Telediffusion de France. He spoke about the new Antiope teletext service in France and the effects of video games, and questioned what to do with some of the new services offered by television.

The manufacturers

On the manufacturers' side, the first presentation was perhaps the most thought-provoking. R. D. Stewart of General Electric (USA) gave the only illustrated presentation. He stated that costs for new solid-state devices in the sensor and memory field are coming down by orders of magnitude. Stewart predicted that by 1985 there will be full broadcast quality CCDs. Both CCD and bubble memories will have roles in signal processing, time base correction, A/D conversion and bandwidth compression. Stewart foresaw a million bits on a chip and the start of an all solid-state recorder with no moving parts (or tape) by 1985.

J. Hillier of RCA followed with the view that 1985 will show what's

Continued on page 48

"The Ikegami HL-77 gives me the best picture I've ever seen on a portable camera."

That's what Jack Everette, Executive Vice President of Midwest Television, Inc., Champaign, Illinois, quotes Midwest news teams as saying about their Ikegami HL-77 ENG cameras. Midwest Television, Inc., has three cameras at Champaign (WCIA), a fourth at the state capitol in Springfield, Illinois, two in Peoria, Illinois (WMBD-TV), and two in San Diego, California (KFMB-TV).

Other comments:

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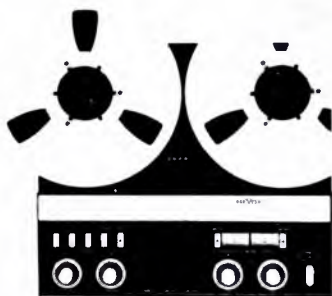
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Continued from page 47

already being worked on in the labs today. He saw two major areas of development: (1) equipment which is self-adjusting, self-aligning and self-testing; and (2) automation of editing and business functions in a TV facility. Hillier felt that technology itself is not the constraint on development, rather that technology's "future shock" limits adaptation and use of new devices.

More for the viewer

Representing Philips, F. de Vrijer had a promising word for home viewers. He said receiver improvements will bring home pictures closer to studio quality. He also saw a large increase in digital TV processing where it's better than analog.

Norman Parker-Smith of Marconi was emphatic about the continuing use of TV pick-up tubes in 1985, and Renville McMann of Thomson-CSF Labs supported him by saying that the cameras used eight years from now will resemble present ones, but will be smaller and more automatic. McMann did not expect camera sensitivities to increase by any great factor, but when solid-state sensors come along, there might be such a considerable improvement. McMann also saw microprocessors in cameras doing a lot of housekeeping, fiber optics from camera to CCU, and remote VTRs controlled by the camera operator.

Mashaiko Morizono had a few reservations about digital VTRs. Morizono from Sony saw better tape formulations with higher density recording solving current analog VTR problems in PAL and SECAM, thus getting to tenth generation utility as is now possible in NTSC. In fact, Morizono said that cheaper, simpler analog VTRs of the future may preclude digital advantages from making a serious entry into the field.

Ampex's Charles Anderson spoke of another aspect of the future, equipment investment return. Anderson queried the broadcasters as to whether they could afford a two-year equipment exchange even if the manufacturers could afford a biennial development cycle. He pointed out that Ampex equipment delivered in 1964/65 was still widely used and the investment of millions of dollars cannot be concisely disposed of just because technical breakthroughs occur at a faster rate.

Hans Groll of Bosch Fernseh followed this theme. He sided with Morizono on the digital VTR question, saying the answer was around the corner. He agreed with Anderson that broadcasters live with current technology, even if the CCDs come along. Initial use will produce some quality loss. Groll also felt that the use of frame stores will lead the way to more digital processing in other areas.

Comments anyone?

With the opening statement made, a lively discussion followed. Howard Steele talked about the recent digital VTR demonstration in Venice at an EBU meeting and challenged the panel members' statements, reiterating that megabits were enough.

R. Zavada of Kodak felt film was still be a major TV medium because it uses little energy and operates in low light. He predicted improvements in sensitivity and the addition of time code to further enhance film's versatility. An EBU commentator suggested flexible and uniform interfaces for computer-assisted TV operations and in Pouzols of Radiotechnique (France) pointed out that receiver buyers spend 90 percent of the money on television hardware while broadcasters only represent 10 percent of the total money spent.

The round table also included a session on receiver development and the consensus among the panel members was that future receivers would include memory circuitry, noise reduction, and teletext facilities at reasonable prices.

R. Gressmann of the EBU asked if it was wise to continue to increase the technological gap between the advanced countries and the developing nations where, he said, the latter were still struggling with basic services.

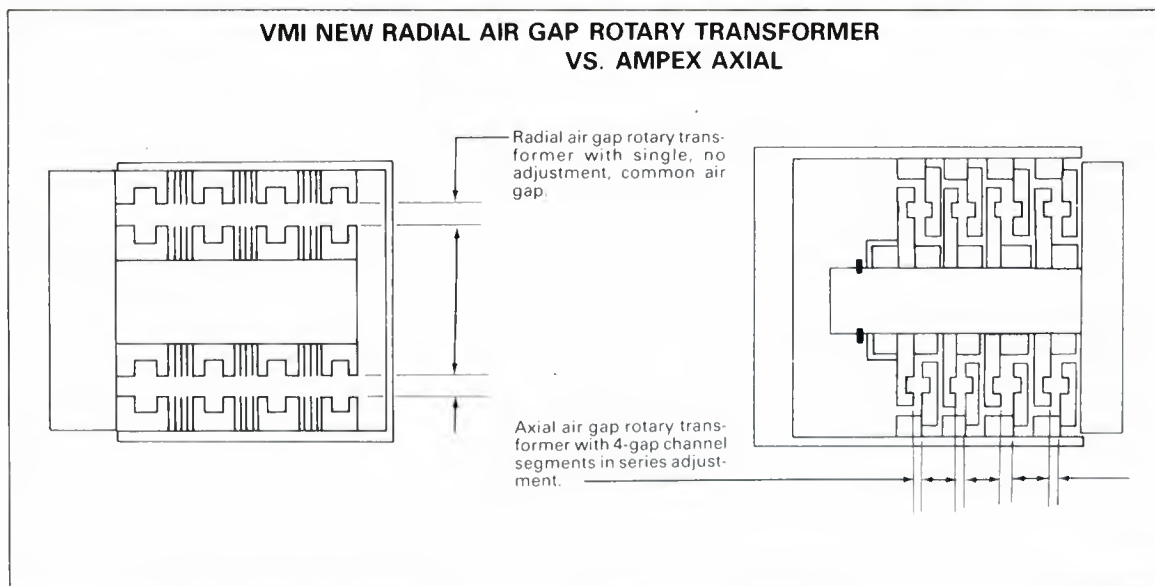
Dee Pourciau of IVC didn't want to see any limits on development and stated that TV gadgetry is not limiting. This last comment may have been in response to a statement by Joe Roizen of Telegen, that some new digital TV studio productions were unnecessarily complex with effect variations far beyond needs. As an example, Roizen pointed to the numbers of switch effects which are unused or have very limited duty cycles.

The summaries presented by the panel members followed most of their opening remarks, with a quotable statements. Hillier's

Continued on page 48

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clusion was that technology, if done right, simplifies an operation and that LSI will make more reliable equipment that is easier to use. Connolly clearly stated that all of the signal processing, digitizing, or manipulation won't make the program better, and many other panelists concurred. Urged by Polonsky to say a few words on behalf of the program producers, Peter Hansen postulated that the average producer wants a nice cozy environ-

ment, with a small group of known people who can work on understandable equipment which does not confront them with electronic wizardry beyond their comprehension. It is to this end that the broadcasters and manufacturers should direct themselves, according to Hansen.

Polonsky thanked the panelists and the audience and expressed the regrets of H. Jushkevitch of the USSR for not having been able to attend. The round table conference closed with Polonsky's hope that progress towards better television

equipment and services will continue in the future.

Increase use of ENG

With 185 papers in parallel sessions lasting five days, it would be impossible to give anything more than a thumb-nail sketch of the symposium. The sessions that attracted large audiences dealt with ENG, one-inch helical VTRs, satellite television, electronic editing and digital techniques.

As he has in the U.S., Flaherty, engineering vice president of CBS, continued to champion ENG as the wave of the future in television operations. His statistics were impressive. According to Flaherty, over 700 U.S. TV stations are now all or partially converted to ENG. Of the 3,000 news crews, 1,200 are electronic with a continuing conversion rate of 300 per year. The use of videotape is still continuing to climb, and CBS is now changing from film to tape on its coms.

Within his own network, Flaherty said that 53 percent of their programming is on tape, and this is increasing because of the impact of smaller cameras, one-inch VTRs, and digital TBCs. CBS has only 10 film crews left and they will be converted this summer. Flaherty, speaking to over 300 delegates, said that the new ENG equipment recently introduced in Europe will undoubtedly lead to a similar conversion of ENG practices on this continent and elsewhere.

A. Todorovic of Yugoslavian VTR gave a concise summary of the history and current status of analog VTRs. John Baldwin of IBA then described a digital VTR developed in their laboratories at Crawley Court (UK). Their test base is the IVC 9000 segmented helical two-inch VTR, but Baldwin indicated that other machines could be adapted.

He suggested that for editing of VTR signals, stay in digital form, thus keeping a first generation quality regardless of the number of dubs made. Then conversion to analog form could be done for final airing of the edited program. The IBA digital prototype VTR still only produces half a TV image, but with smaller, cheaper memories Baldwin said a full-scale VTR was in sight.

M. Favreau of Thomson-CSF (Paris) followed with a well-illustrated paper on their videodisc, a thin plastic film using laser techniques for readout. Picture quality is good enough on this device to warrant serious consideration for some broadcast applications, and

Continued on page

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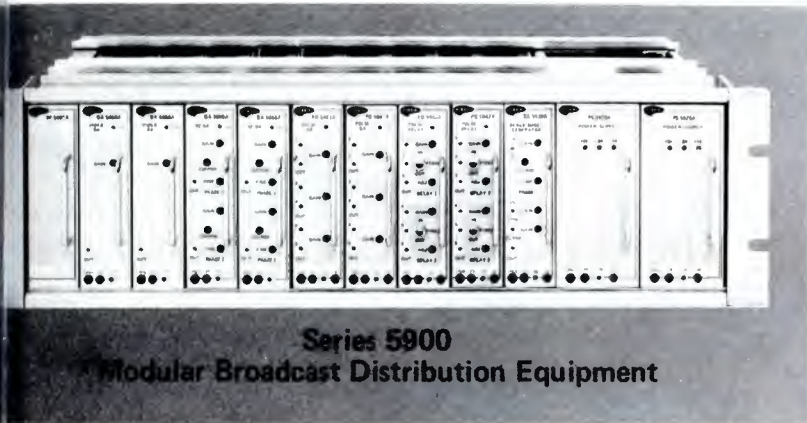
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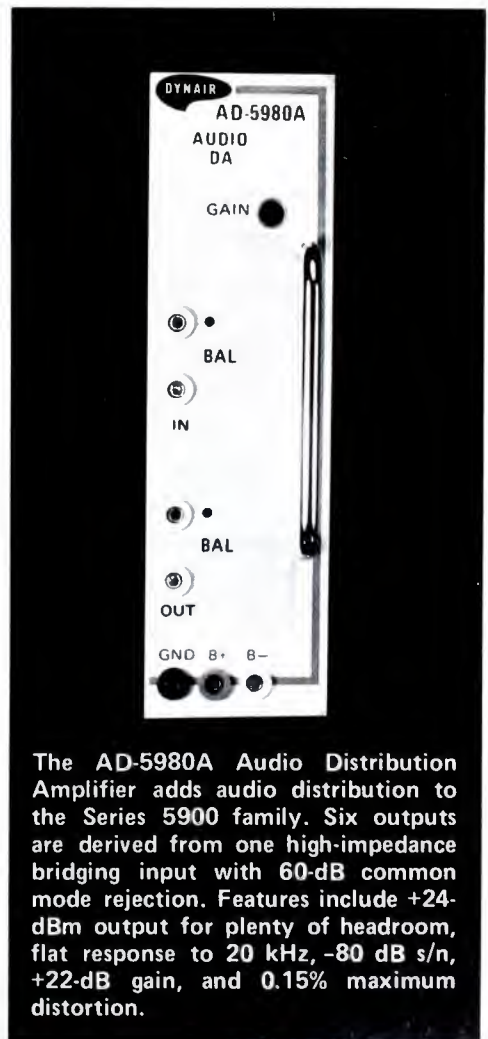


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cording to Favreau.

One-inch helical

The later morning session was the most controversial one. The proponents of three new one-inch helical formats, Ampex, Bosch Fernseh and Sony were pitted directly against each other in a series of three papers describing each system. Fred Remley of the University of Michigan and chairperson of the working group on non-segmented

helical VTRs, preceded the technical reps of the three companies with a survey of the role of one-inch helical recorders in broadcasting. He touched upon the various formats and pointed to their current incompatibility. He also explained what the SMPTE working groups were doing to standardize the segmented and non-segmented formats now being offered.

Bosch Fernseh's representative Henry Zahn described the segmented BCN machine made by his company and also offered by Philips, IVC and RCA. Zahn pointed out

that the problems of slow and motion both for editing or for use were solved by the addition of a frame store and showed tapes that illustrated these features very well. Zahn also showed cassette portable BCN which extends the configurations of the format into every application, studio, field production, ENG or whatever the broadcaster wants.

R. Ravizza of Ampex followed with a detailed explanation of the VPR-1 and VPR-10, the one-inch non-segmented helical recorder offered by Ampex as the latest for studio and ENG use in broadcasting. Ravizza's paper included a detailed description of the automatic scan tracking system (AST) which gives the VPR-1 the ability to broadcastable slow and still frame images. A piezzo-electric wave under the playback video head is mechanically deformed by applied voltages derived from error signals that are generated by RF envelope sampling. The tape playback demonstrations included a tenth generation dub of acceptable quality, and the above mentioned features.

Sony's BVH-1000 was then presented by Y. Suzuki who gave a graphic breakdown of the format features and the VTR design elements. Sony's format eliminated the typical helical dropout period in the vertical interval by having a slow rate head write the vertical interval near the bottom of the tape. They call this the 1.5 head principle. Suzuki claimed this made it possible to retain the original VIRS, VBI, teletext, or any other vertical interval insertions that may be present in the incoming signal. The BVH-1000 also has slow and stop motion for editing purposes and a convenient shuttle or jog mode to search tape or select edit points. In addition, Suzuki described the operational advantages of this "direct" system, as they call it.

The discussion following was spirited, with users or potential users complaining that the proprietary, non-interchangeable formats are causing concern and confusion in the field. However, a member of the audience closed the session by stating that this confusion is what provided all these well-paid, talented delegates with a 10-day vacation in Montreux where they could enjoy the amenities while studying the problem!

Better audio?

The two first papers in the afternoon session dealt with measurement. Continued on page 51

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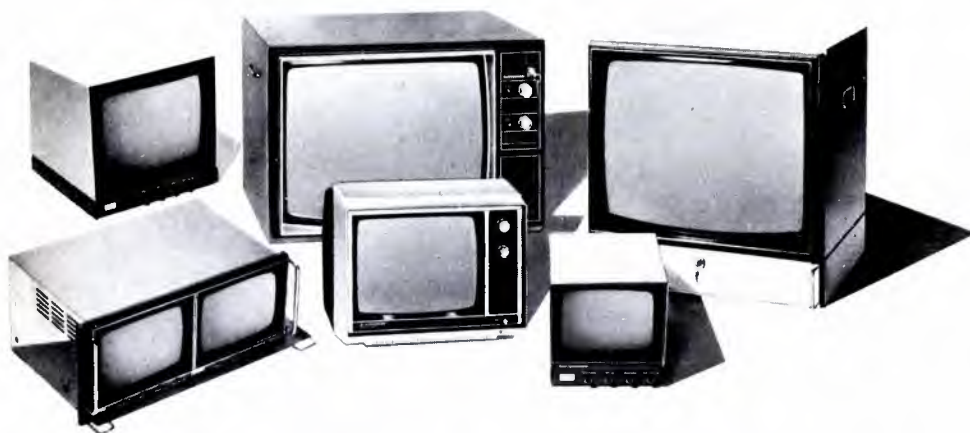
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Continued from page 52

techniques on VTRs and a new quad tape with better audio performance. G. Weltz and G. Eitz of the IRE described methods of precise ratio measurement as well as other parameters. Norman Ritter of IRE showed the audio improvement possible with their recently introduced 8250 quad tape and played a short tape segment which gave audible evidence of this factor.

Dr. Boris Townsend of the IRE and Charles Urban of the IRE teamed up to do a joint paper on the state of ENG within the EBU. Townsend's main theme was that up to now the really portable gear was not quite good enough. What the EBU needed was a magic "black box" which would eliminate noise, moire, chroma/luma delay and other defects of a third generation color-under tape.

Townsend showed a slide of the front panel of such a device with only an "on/off" switch above a label "Magic Image Improver." The next slide showed the inside of the box, which was totally empty except for a short wire lead on the back of the switch. His message was clear. The EBU members want better portable gear suited to their standards.

Charles Urban followed with several examples of ENG operations using various portable or mobile combinations of equipment from different countries. The pictures were good but none of the gear could be described as being low-priced.

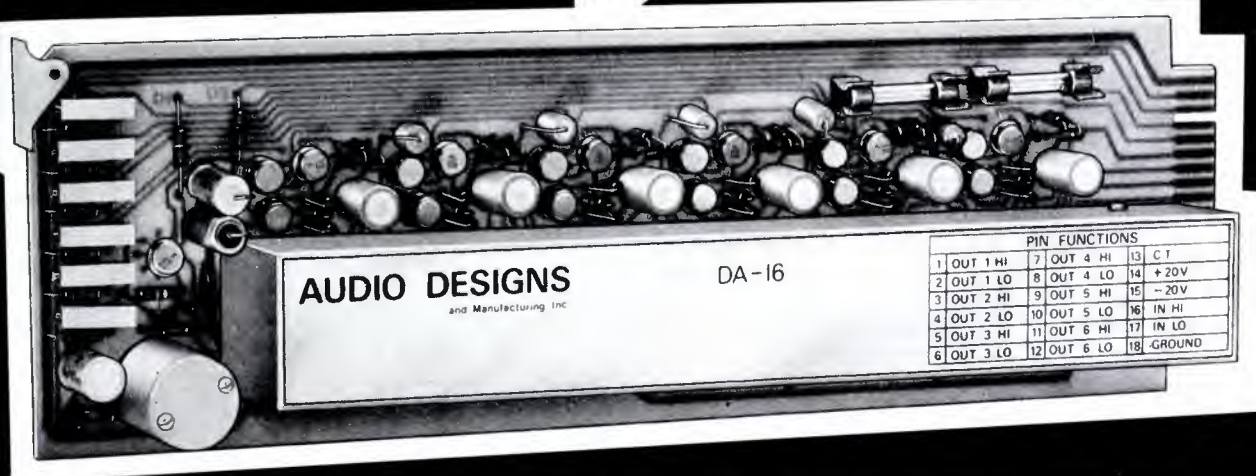
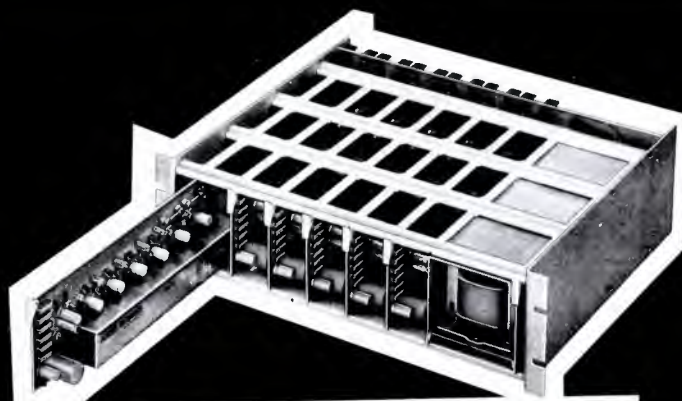
As if cued to respond to the previous speakers, T. Morita of Sony described an upgraded 3/4-inch cassette VTR (U-Matic) that was designed for the PAL and SECAM standards. A variety of mechanical and electrical changes have been made to the standard U-Matic format to accommodate the greater bandwidth and higher subcarrier frequencies of the SECAM/PAL color coding systems. Morita showed a color playback from this improved U-Matic format which, even at a third generation, looked like quite an acceptable broadcast quality picture. Of course, the European networks will have to test the system themselves before any general acceptance of this type of gear for ENG is made. Several representatives of the larger TV services indicated they were about to start such trial periods.

Electronic editing

The following sub-session on electronic editing of videotape had the

Continued on page 53

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Continued from page 54

papers which covered both the technical and hardware descriptions.

W. Habermann of the IRT Munich started off with a review of the field of automation as applied to video recording and editing. Habermann pointed out the reasons for automation in TV studios: (1) saving people-power, (2) efficiency in the use of expensive studio gear, and (3) organization of available equipment for central control. His conclusions were that automation both for normal equipment and for editing systems is rapidly becoming mandatory for television studios. The need to produce more programs in hours on relatively shrinking budgets gets.

Stan Busby of Ampex gave a specific set of recommendations in his paper with regard to television editing systems. Busby defended first the use of distributed intelligence as applied to TV equipment. He claimed that such devices can carry out complex commands on the receipt of a relatively simple signal. The other part of his paper dealt with the standardization problem in computerized editing systems. Busby suggested that all interfaces and signal formats used between the controllers and the machines should be common, thereby allowing for interchange between editing systems that will benefit all.

He also proposed a higher bit rate than is currently used by many electronic editing systems. According to Busby, the alternative to adopting some standards is more copper, more contacts, more computer core and more continued confusion. Adopt some of the methods already developed for data processing, he said, and the television editing world will benefit significantly.

The last paper titled "Distributed Processing Techniques in Post-Production Editing" was jointly presented by Klaus Eichstadt and Roizen of CMX Systems. Roizen made a short review of the present use of computer-assisted editing systems in fast-paced editing of popular variety shows and sitcoms in the U.S. and Canada. The many benefits expressed to Roizen editors he visited was a better schedule and a substantial time saving.

Eichstadt then presented a detailed review of the distributed processing system used on CMX-340-X, and the application

Continued on page



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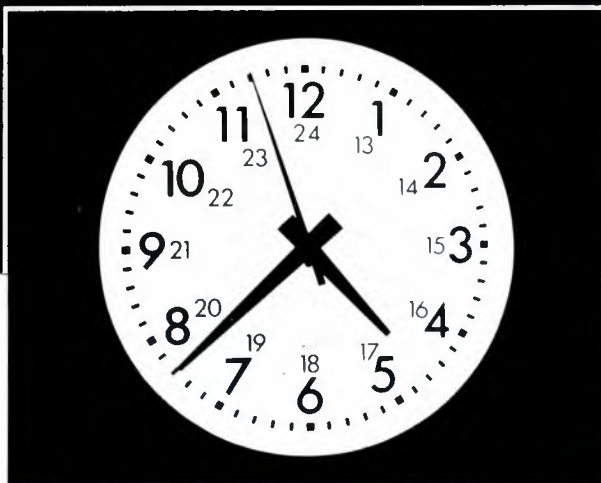
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Continued from page 56

Intelligent Interfaces™ (I²) unit the controlled VTRs or other studio devices. Eichstadt claimed this system could be extended to any studio equipment needing integrated remote control. Eichstadt also pointed out that much in the CMX-347 was similar to the proposals for the AFRABUS system to provide machine control through single cable line pairs looped to all applicable studio devices.

Editing and automation are previously progressing at a pace to cope with modern production demands.

Symposium summary

According to many delegates who were questioned, there were too many papers and often they conflicted in time if they were opposite each other in concurrent sessions. Some delegates claimed the papers were repeats of SMPTE or NAB presentations and could have been eliminated in favor of more open discussion periods.

This may be true for those participants in Montreux who were constantly on the conference circuit. However many delegates in Montreux do not attend the other symposiums in America, the UK or elsewhere and probably did benefit from hearing or seeing first-hand some of the technical presentations offered. Digital techniques not operational in PAL or SECAM, showing the potential path was exposed in papers on noise reduction or digital video effects, and on satellite techniques and services for direct broadcasting using high-powered travelling wave tubes were exposed for scrutiny and discussion.

The exhibition

It was a good news/bad news exhibition. The good news was that many important people came, apparently committed themselves for equipment that suited their needs and pocketbooks. The bad news, according to the exhibitors, was the limited space, high temperatures and matching high prices in the local hostleries.

Nevertheless, Montreux '79 is already an assured happening as the organizing committee is proposing building extensions to the exhibit hall to relieve the pressure and maybe even a few new hotels to handle the overflow crowd expected.

OTARI MX-5050 the original (and still the best) compact professional recorder

Just over two years ago, Otari introduced a unique new product—the first truly professional recorder in a compact package—the MX-5050. Since then, the performance and reliability of this innovative new machine have been tested and proven in over a thousand critical professional applications—by broadcasters, recording studios, A/V departments, musicians, and semipro recordists worldwide. Universal acceptance and repeat orders by these satisfied customers tell this remarkable recorder's success story better than we can.



Bias can be re-optimized in seconds.

As you compare the MX-5050 with other recorders, keep this in mind. The MX-5050 is not a hi-fi machine with a few professional features added later as an afterthought. It was designed from the ground up based on Otari's 10 year experience as Japan's leading manufacturer of professional recorders and high speed duplicators. It is a full professional machine with the performance, features, and field proven reliability that you expect to find only in the larger professional recorders.

Here are some of the key reasons why the MX-5050 is the best compact recorder available today.

Production Features: Creative production is simplified with: Front panel edit to spill tape. Lift-up head cover to mark splices and clean heads. Built-in splicing block on head cover. Adjustable cue to defeat head lifters. Selective reproduce to add new tracks in perfect time synchronization. Two speed operation, 15 and 7½ or 7½ and 3¾ ips (field changeable in dc servo versions).

Performance Features: Headroom is 19 dBm, a full 15 dBm over the switch selectable fixed output of +4 dBm. This standard reference level output can be rear panel switched to -10 dBm to drive a PA system or power amplifier. S/N ratio is NAB weighted 69 dB full track, 68 dB half track, and 65 dB quarter track. Crosstalk is greater than 60 dB half track. Outputs are 600 ohm balanced (standard on half track) or unbalanced. Line input and output connectors are XLR.



Operating Features: Bias is front-panel continuously adjustable (not limited to fixed positions). With built-in test oscillator (not available on other compact professional recorders) bias can be optimized in seconds when changing tape. Record EQ and standard reference level are also front adjustable. Straight-line tape path simplifies threading. Capstan is located on back side of tape for improved tape life. An extra reproduce head is standard on all versions to allow playback of tapes in different formats. For pitch control and freedom from power line variations, an optional dc capstan servo is available with $\pm 10\%$ correction range.



Easy threading; capstan on back side.

Versatility: Available in full-track (with half-track reproduce capability standard), two-track, and quarter-track versions. Walnut case (standard), rugged portable road case, rack mounting adaptor, or floor console. Universal power supply standard. Low impedance input and output transformers and remote control also optional accessories.

See your nearest Otari dealer for the full story or contact Otari. And, if it's multichannel you need, ask about the standard-setting four and eight channel versions of the MX-5050.

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The FM PROOF is no picnic

By Peter Burk, CE, WKBW, Buffalo, NY

Let's face it...FM proofs can be a real pain. The number of measurements required and, in some cases, some pretty tight tolerances to maintain contribute to the discomfort at proof time. But the biggest problem is usually confusion. The rules are a little vague, and the procedure has to be slightly dif-

ferent at every station.

We can't make the FM proof a Sunday school picnic, but perhaps we can make the task easier by removing some of the confusion.

Test equipment

Last month's AM proof coverage included some suggestions on test

equipment, selection and testing. For FM, the requirements are slightly higher since the FCC specs are tighter. The basic rule of thumb is that the test equipment should be 10 times as accurate as the tolerance allowed by the rules. When you connect the audio generator directly

Continued on page 62



-SYMBOL OF PROFESSIONAL TAPE HEADS



MMI Replacement Heads are professional heads — designed for the machines they will be used with — direct retro-fits, both mechanically and electrically — not modified or adapted heads originally intended for "home" or "semi-pro" recorders. But there is more to MMI Heads than their professional performance: An all-metal face that virtually eliminates oxide loading ... More than twice the gap depth-of-metal of some original equipment heads, thus permitting relapping (under normal head wear) for greatly extended head life ... Individual testing and calibrating of each head to insure meeting or exceeding original equipment specifications ... MMI has ¼-inch tape heads for Ampex, ITC, Magnecord, Revox A-77, and Scully. Professional heads for professional recorders — from MMI.

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FM PROOF

Continued from page 60

into the distortion analyzer, audio voltmeter, the residual should be -70 dB or below, and total harmonic distortion should be less than 0.25 percent.

Note that the bandwidth for noise and distortion is different: 50 Hz for noise, and up to 15,000 Hz for noise, and up to 30,000 Hz for distortion. It's generally easier to read both noise and distortion wideband (with no low-pass filter), but if it becomes necessary to use a filter to make noise measurement meet specs, it is entirely acceptable, as long as the bandwidth of the filter is appropriate. Of course, the one kilohertz high-pass filter included on the analyzers must never be left in during the measurements.

When you check the test equipment, include the test leads that you will use for the actual measurements, as well as any transformer pads or low-pass filters that you intend to use.

Set-up

Every station will have slightly different requirements for connection of the test equipment. The Broadcast Engineering Proof of Performance Manual for FM contains a detailed discussion on test equipment interface. If your station is fully automated or for some other reason has an obscure "main microphone input terminal," last month's "Workshop" might help you find a good place to inject the signal.

For stereo stations, a lot of test can be saved by constructing a "proof box." Using either transformers or resistive pads and a rotary switch, build a unit that can be switched to provide left, right, L+R, and L-R signals. Again, the Proof Manual shows one method of accomplishing this.

Pre-test

Before proof night, make a quick check to see that the station is ready for the proof. If the station meets performance requirements at the extremes, it will most likely pass the proof.

Put a priority on noise

Check the noise first. If the noise level is high, it will invalidate all other measurements. The FCC requires that noise be at least 60 dB below 100 percent 400 Hz modulation. Make sure that the stereo subcarrier is on if you're doing a stereo proof.

The noise measurement should be made with de-emphasis switched

FM PRE-EMPHASIS CURVE

(75 usec.)

Frequency (Hz)	Attenuation (dB)
50	0.00
100	0.01
200	0.04
300	0.09
400	0.15
500	0.23
600	0.33
700	0.49
800	0.58
900	0.72
1,000	0.87
2,000	2.76
3,000	4.77
4,000	6.58
5,000	8.16
6,000	9.54
7,000	10.75
8,000	11.82
9,000	12.78
10,000	13.66
11,000	14.45
12,000	15.18
13,000	15.86
14,000	16.49
15,000	17.07

keep the 15,000 Hz tone from over-modulating. Note that this method is not acceptable for the actual proof. It is intended merely to tell you that the system appears to be fairly close to the curve and that when you run the official proof you won't be surprised by a strange bulge or dip in the response.

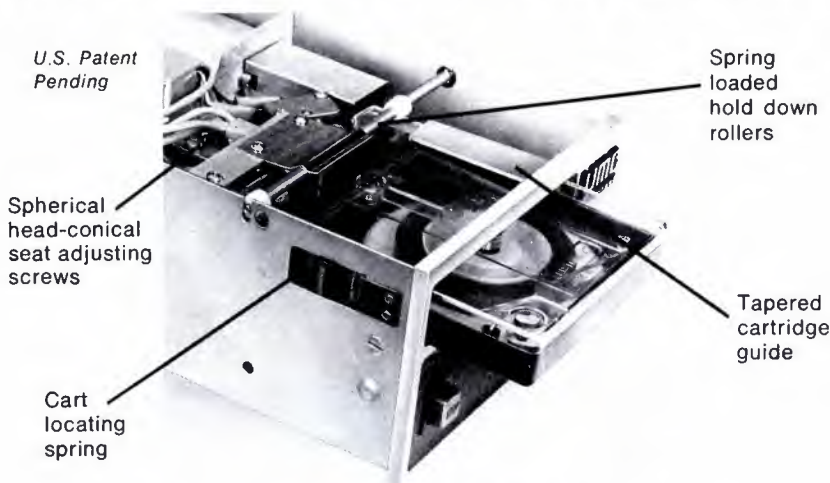
Another method is to set the generator for 100 percent at 400 Hz, then note the amount of attenuation required to hold 100 percent on the modulation monitor at 50 Hz and 15,000 Hz. Fifty Hz should be about the same as 400 Hz, but

15,000 Hz should be close to 17 dB below the 400 Hz level. This method is more precise, but doesn't tell you what's happening between the extremes.

A third method involves construction of a 75-usec de-emphasis filter which is installed on the generator output. This saves a lot of level adjusting and is really handy for spot checks in between proofs, but the filter must be carefully calibrated if the measurements are to be meaningful. The filter can be made a part of your "proof box."

Continued on page 64

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justing screws for which patents have been applied provide uniform, positive contact immune to movement from external forces.

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of the modulation monitor. Note that some monitors don't adequately attenuate the 19 kHz pilot. If necessary, you can use a 15-kHz low-pass filter to decrease the amount of pilot you are reading. If the noise is satisfactory, measure the distortion at 1 kHz and at both extremes (50 Hz and 15,000 Hz), using 100 percent modulation. If the noise measurement is marginal, you should make sure that the distortion is well below the limits, since the noise will be added to the distortion readings and make the distortion appear high when you make the complete proof. Next, make a response check at the frequency extremes. There are several ways to make this quick check. An easy method is to leave the de-emphasis switched in and run a quick sweep with the audio generator. You'll have to reduce the level by at least 17 dB at 400 Hz to



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FM PROOF

Continued from page 63

Stereo pre-test

Spot check separation and cross-talk during the pre-test before proof night, too. Remember that any adjustments made during the actual proof will invalidate all previous measurements. It's like going back to "GO" and not collecting the 200 dollars. Adjust the stereo generator for best performance *before* you run the official proof.

Your separation pre-test should be made at 15,000 Hz, since that's where it's most difficult. To confirm that pilot phase is within the required three degrees, your separation must measure at least 29.7 dB in both directions.

Check for at least 40 dB of cross-talk attenuation, both main to sub and sub to main. It is permissible to adjust the console master gain controls for best cross-talk at one frequency (400 Hz), but they must be left in that position for the remainder of the measurements.

Are stereo proofs necessary?

The rules don't specifically require separation and cross-talk measurements, but they do require that your station be capable of meeting all stereo specifications. You can't prove that you are capable of meeting specs unless you actually do a full stereo proof. In any case, they aren't that difficult or time consuming, and it isn't even necessary to graph the results.

Dolby

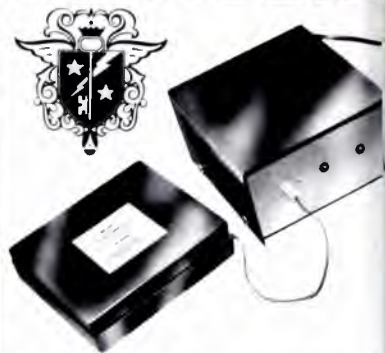
At this time, there is no approved procedure for proofing with Dolby equipment in the line. Patch out your Dolby encoders and run a normal stereo proof with 75 usec pre-emphasis.

Running the proof

Our objective when we run the official proof is to document the fact that the station's *normal* operation complies with the rules. The numbers don't mean much if they don't reflect the way your station is normally run. Sometimes it's necessary to make some changes in the equipment to make the station pass the proof. This is all right as long as the station is left adjusted this way after the proof.

Good engineering practice indicates that we should document the procedure used in sufficient detail that another engineer could duplicate the procedure. Settings of various attenuators and the mode

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audio processors are in should be included in the documentation. Consult the Proof Manual for more details.

Before you begin the actual measurement run, get organized! You should know ahead of time just what sequence you will follow. There are several efficient methods for taking the readings, but perhaps the sequence suggested in Chapter 3 of the Proof Manual saves the most time. The basic idea is to take as many measurements as possible while the frequency and percentage of modulation are held constant.

Don't forget that the response measurement is actually modulation sensitivity. Hold the percentage of modulation constant and adjust the generator output level for each frequency. If you plot the generator output level vs. frequency, you'll get a mirror image of the response.

More on response

The FCC provides a curve that can be used to plot the response. Unlike AM response curves, the FM curve has no reference frequency. That is, it is acceptable

to slide the whole curve up and down, just so that all points lie between the limits.

Since there is no actual requirement that the response be graphed, you don't have to use the FCC graph with the 75-usec. curve. (Of course, the values would have to fit on the curve whether you actually graph them or not.) One of the problems encountered in graphing on the curve is that, especially at the upper end, a straight line between two values doesn't really reflect the actual interpolation of values in between the points.

One solution is to mathematically extract the 75-usec. curve and plot the values on a straight line. The FCC limits can then be added below the line. Part 73.317 (a)(2) spells out the exact limits.

To determine the exact amount of pre-emphasis at any frequency, use the following formula:

$$A = 10 \log [(2\pi fT)^2 + 1]$$

where A = attenuation in decibels, f = modulating frequency in Hz, and T = time constant in seconds (normally 7.5×10^{-5}). The accompanying table provides the calculated attenuation for 75 usec.

Other measurements

In addition to the response, distortion, cross-talk and separation measurements, stereo stations should measure pilot injection level and 38 kHz suppression. All stations must read AM noise and spurious emission. The best way to check for spurious emission is with a spectrum analyzer. Most of us aren't lucky enough to have one, so we have to apply a little ingenuity. If you're affiliated with a TV station, you might be able to borrow theirs. If not, several firms rent them for a modest charge. Besides being necessary for the proof, the results of a spectrum analysis can be helpful if you're involved in interference complaints.

I can't really cover all of the details that go into an FM proof in the "Workshop," but hopefully I've helped to reduce some of the confusion. BE's FM Proof of Performance Manual is, however, a comprehensive guide to conducting a thorough proof.

The author thanks Dennis Ciapura, BE's audio editor, for assistance in preparing this month's "Radio Workshop." □

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people in the news

Four executives have been appointed to management positions in the Cetec Broadcast Group. **Dale Evans**, former audio product manager, has been named acting general manager of the Springfield Division, Sacramento, CA; **Rich Weichbrod** has been appointed to the position of general manager of Broadcast Electronics, Inc., where he was director of engineering, to accept the position with Cetec as product manager; **Jack Lawson**, who was the Springfield sales manager, is now the international marketing manager of the group; and **Grant Campbell**, former corporate manager of internal audits, was appointed group controller.

Systems Resources Corp., the manufacturing subsidiary of CHYRON Corp., announces the appointment of **Joseph L. Scheuer** as president. Scheuer succeeds **Eugene Leonard**, who resigned.

Ronald Briggs joins CCA Electronics Corp. as international manager. Prior to his appointment, Briggs was director of engineering for the Ministry of Information in Qatar, and was in charge of radio and television services...and **Jason S. ...** president of CCA, announces the appointment of **Lynd J. Carter** as sales manager of TV products.

Hugh F. Gillogly steps into the position as national sales manager of the Broadcast Equipment Division of NEC America, Inc...**Richard J. Reilly**, former western regional manager for International Video Corp., announces the formation of his own San Francisco branch of United Media, Inc. Reilly will be marketing video equipment to broadcast and non-broadcast users in Northern California, Oregon, Washington, Nevada and Alaska.

Curtis I. Kring joins Broadcast Electronics, Inc. as vice president of marketing...**Abbott Sydney** moves to the position of international sales representative for Berkeley Colortran, Inc.

Charles S. Craigmile, former chairman of the board and chief executive officer of Belden Corp., died April 30th in Hinsdale, Ill. Craigmile was succeeded by **Richard F. White**, vice president and general manager of Belden Corp.'s Electronic Division, who has been elected president of General Wire & Cable Ltd., a Belden subsidiary in Ontario.

Jerome P. Vondergeest joins Thomson-CSF Laboratories as territorial manager...**Alan Schoenberg** has been appointed northeastern field sales engineer for Telemation.

James M. Hoak, **Robert Dickinson** and **Kenneth McCarthy** have been elected directors of the Kappa State Network, Inc.

Glenn H. Sacra, president of GTE International Systems Corp., announces the appointment of **Herbert C. Edgar, Jr.** as vice president for marketing. Edgar will be responsible for directing the worldwide marketing and sales of satellite communications ground stations, microwave systems and other activities.

Lawrence P. Fraiberg, former vice president and general manager of Metromedia's New York flagship,

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67

vision station WNEW, has been promoted to president of Metromedia Television.

David P. Haney, who is the sales manager of WNA in Iowa City, has been elected executive vice president of Communicators, Inc. Haney formerly held the post of vice president of this corporation...

Robert K. Norton, Jr., program director and chief engineer of KRNA, was elected vice president.

Nicent T. Wasilewski, president of the NAB, announced the appointment of four new members to the Radio Code Board.

Selected to the Radio Board are: **Enzo De Dominicis**, general manager, WRCQ, Farmington, Conn.; **Ron Gomez**, vice president and station manager KPEL, Lafayette, La.; **H. Wayne Hudson**, president, WMPS, Memphis, Tenn.; and **Roy Robinson**, general manager, KFQD, Anchorage, Alaska.

William L. Viands, Jr. succeeds **Joseph F. Abernethy** as general manager of WIOD-AM and WAIA-AM Miami...**Clark W. Davis** moves from corporate vice president to president of the Starr Broadcasting Division, as was announced by **Bruce F. Wilson**, president and chief executive officer of the Starr Broadcasting Group, Inc.

Marlene T. Palmer joins the NAB as assistant to the director of the Broadcast Management Department. Ms. Palmer formerly was a division president of Litt Enterprises, a Washington, D.C. management consultant firm and holding company.

The National AM Stereophonic Radio Committee has named **Chris Payne** as project manager of its upcoming field tests of AM stereo.

NPPA honors photographers for excellence in TV coverage

Winners in the 1977 National Press Photographers Association (NPPA) television news competition were honored at a special awards banquet July 3. Hosted by Eastman Kodak Company, the ceremony was held in Mail, Colo. during the NPPA's annual convention. Denver station KBTB and its assistant chief photographer **Sam Allen** were named earlier this year the "Television News Photography Station of the Year" and the "Television Photographer of the Year" by the NPPA.

Winners in other categories of competition include: news—tie between **Josep Lee**, ABC-TV, New York and **John Elder**, WKRC-TV, Cincinnati; mini-documentary—**Sam Allen**, KBTB, Denver; feature—**Paul Fine**, WMAL-TV, Washington, D.C.; sports—**Her Hakel**, WMAL-TV, Washington, D.C.; documentary—tie between **Jan Morgan**, CBS-TV, New York and **Mykola Kulish**, WCAU-TV, Philadelphia; general news—tie between **Scott Berner**, NBC-TV, New York and **Paul Fine**, WMAL-TV, Washington, D.C.

BE takes a look at Japanese television

By Joe Roizen

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Sophia Loren dons her crash helmet and rides on her Honda, Yul Brynner sells Fuji film, Coca-Cola ads are about as subtle as they get stateside. Japanese television has all of the attributes of our own, with a few differences that are quickly evident, even during a one-week visit.



The TV receiver in the hotel room has no picture adjustment controls on it. On-off/volume and channel selector are all the visitor can manipulate, yet the images on all seven channels are good, having a colorimetric uniformity that is surprising when compared with what is seen in most American hotels. Most channels go on at 6:00 a.m. and run into the early hours of the following day.

Many of the staple programs have a familiar ring, even if the language is inscrutable. There is a Taiko Lalainusan who vigorously directs three young beauties in their morning calisthenics, the morning news report has a lot of Jimmy Carter images chronologically keyed next to the announcer, the educational channel starts in monochrome with a shot of Rodin's "The Thinker" while Nippon Hoso Kyokai's (NHK) entertainment channel begins with rising suns, flapping flags, national anthems and all the hoopla befitting a national network that is supported by license fees and commercials.

However, if you are nostalgic for a little hard sell, the other channels in town (TBS, JOKR, JOEX, etc.) will complement your day with clever visual pitches for everything from sushi to Sonys. In fact, the sin-

.....

gh language cable service piped into hotels for
 s to watch is like an endless commercial inter-
 ed with fleeting programs. It's no wonder that
 average tourist getting on the departing 747 at
 da is usually loaded down with bulging bags that
 in the wares of such suppliers as Nikon, Seiko,
 moto, Panasonic and Suntory. This situation has
 n so bad that Japan Air Lines have large posters
 air ticket offices and at the airport advising
 ngers to travel more comfortably by carrying
 one bag of tax free bargains on board.

Meanwhile, back on the 19-inch Trinitron, the day
 ids with noontime melodramas obviously aimed at
 ousewife tending her electric rice cooker. The
 afternoon promises lots of educational programs
 eas those that tell you how to solder transistors
 C boards and teach you English or German. The
 of such educational material that is on the air
 is astonishing, and switching channels at dif-
 et times of the day yields snatches of history,
 gy, anthropology, various hard sciences and some
 general material that resembles Sesame Street or
 type art and craft documentaries.

le early evening offers audience participation and
 shows with seemingly more participation being
 by children. Light sitcoms from the U.S. such as
 "switched" also appear with Japanese-dubbed
 ad, which doesn't come close to matching the
 h movements. However, the names are not
 eged to protect the guilty and Samantha, Tabatha
 Darren are still recognizable, even with Oriental
 ents.

Those familiar nights

At this pleasantry and low-key programming gives
 into the late night shows that produce a crop of
 age that matches ours, or even exceeds it. In
 ation to imported mayhem of cops and robbers or
 ern shoot-outs, there is a good collection of
 e-grown Samurai swinging, martial arts and
 ve features (Godzilla is a local boy who made
 to satisfy any yen for blood and thunder. I was
 on good authority that there are also X-rated
 e Movies" on after midnight, but I never caught
 with the jet lag enough to stay up that late.

le Japanese adopt American ideas with a zeal that
 es to surpass the originals. Basu Boru (baseball) is
 onal passion, so much so that even Little League
 s get color coverage on local TV, complete with
 ple cameras, professional announcers, player
 e overlays and rooting sections of drum-beating
 ers and costumed cheerleaders. And when the
 re yells "Outu!" no kids in the world ever looked
 crestfallen.

rigued by my TV set's performance and equipped
 a Swiss Army knife that bears a Phillips screw-
 r blade, I removed a side panel that gave access
 e controls. Rolling the vertical I found that at
 four stations were transmitting vertical interval
 signals, and that I could not improve on the
 ance/chrominance settings manually, even when

Continued on page 70

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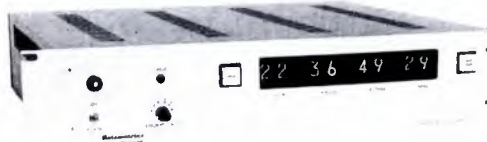
For a listing of all Beau audio heads, please request our new head brochure. Call (203) 288-7731 or write today.

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For More Details Circle (69) on Reply Card

Japanese TV

Continued from page 69

the pre-dawn set of color bars were on each channel. Japan today is the source of much innovation in TV products, as well as in other fields. Some come from the product development done by companies such as Matsushita, NEC, and Sony, others from the research facilities of NHK's laboratories dedicated to theoretical investigations.

A tour of the Sony showroom on the Ginza reveals a few unique products that have not yet been exported to overseas markets. The most interesting is a direct view, 32-inch diagonal Trinitron television receiver housed in a large mahogany cabinet. It includes a Betamax and other accessories like a remote control wand. Going price in Japan for this gargantuan glass eye that makes head and shoulder shots larger than life is a cool \$3,700. Another recently introduced product is a 12-foot (diagonal) large screen projector using individual kinescope lenses (like Advent), but the red and blue channels have been combined through a single lens, thus simplifying the projector optics by 33 1/3 percent. Let's hope the devices make good pictures in their own context. The projector is not intended for home use and carries a \$20,000-plus price tag. Sony also had on display a two-hour version of the Betamax using half the normal tape speed to achieve this time compression on a one-hour cassette.

Technical research

A visit to the NHK Technical Research Laboratories, where basic work on future TV developments is being done, was most informative. Dr. Kenji Hiwatashi, host and a division director of this facility, had sent me a tour that included stops in individual labs that are working on high definition TV, digital conversion, a CCD camera, a teletext system and a small dish for satellite reception.

The high definition TV system uses a 30-inch vidicon shadow mask color CRT with a 5:3 aspect ratio. Line spacing is about 1/3 of the normal and the scanning rate is 1,125 lines at 30 frames, with 2:1 interlacing. The test images come from a special 70 mm line scanner or an RGB camera using larger than normal Saticon's, also developed at NEC. The color images were simply superb. NHK considers this one of the future possibilities for vastly improved public color service.

The 3 CCD color camera is the size of a one-pound box of chocolates and makes color pictures with 90 foot-candles of light. There are 228 x 242 picture elements covered by the NEC pickup unit that measures about 1 cm². The engineer working on the camera was quick to point out that they are still a long way from a practical product and that sensitivity, resolution and picture uniformity don't come near those of current color TV cameras. However, the advantages of having no registration or lag problems added to the potential small size, weight, power consumption and reliability that makes this camera a very plausible goal to pursue.

National teletext

Japan does not yet have a national teletext service such as the Ceefax or Oracle systems in the U.K., but they have developed such a system which is to be tested late this year. The system will provide Japan

ers a great deal of graphic information with al decoders in their home receivers. An index ibing nine different teletext programs is trans- d digitally in the vertical interval of a normal TV mission. A digital IC memory in the TV receiver selection through a keyboard access will allow ising and viewing the programs, which will ide weather forecasts, shopping guides, news ines, etc. Cost of the home adapter should not d \$100.

More than satellites

Perhaps the most exciting work is going on in NHK's r High Frequency (SHF) lab where they have oped a 0.6 meter (2-foot) diameter dish and ver which has reproduced good pictures from missions over the Communications Technology lite originated by NASA. The whole package e, receiver, converter and monitor) goes into a an wagon—the dish itself being packed in a ed, oversized metal suitcase—and can be set up here. The engineer working on this project d have a business card that says, "Have dish, ravel!"

Working at 12 GHz with a down converter that uses itky and Gunn diodes to convert to an IF at 360 H, this miniature earth station makes possible rt home reception from geostationary satellites. n is sponsoring the launch in late '78 of a satellite omestic service, and this antenna and receiver en are intended for that application.

There are other technical wonders such as dual d TV over normal transmission channels that can ceived with an adapter estimated at \$10-\$30 in ity, two-inch return beam, Saticons for higher eution pickup, higher density video recording on g, computer animation devices, and even an g-head transverse VTR on one-inch tape. One item interest not ready for exposure to visitors, is a tial large screen display using gas discharge ils which are fairly thin and can achieve the ure on the wall" display device that has been nt after for so long.

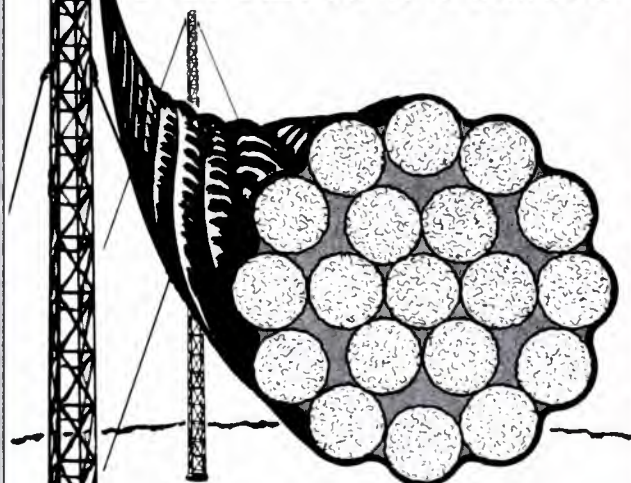
Summary

levision is a dynamic and growing force in both yfect on the viewing public and in its contribution e industrial muscle of Japan. The local citizen has de choice of attractive products to buy and an ally broad spectrum of programs to watch or ed on a "time machine" with a magnetic cassette . The factories use native skills and modern iques to create an ever-increasing torrent of vision products that have penetrated every part of world where home TV service is available.

walk through the Sony U-Matic plant at Atsugi s an efficient operation with the parts coming in ond and the finished units going into styrofoam- cartons at the other. In between, talented men women in company uniforms assemble, adjust and k with traditionally meticulous care, every aspect ill assure an acceptable product going to the mer. The research laboratories contribute the ard thinking that helps maintain the overall nced state of the art that keeps Japanese onic products in the forefront of the outside l.

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MC(FM); 2201 Woodward Heights Blvd.,
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Chapter 2— Southeastern Pennsylvania

The final meeting of the season
held June 13 in the studios of
IA-TV/FM in Pittston. The
program featured a viewing of the
introductory videotape for the
course "Digital Technology for
Broadcast Engineers." This course
has been produced by the Univer-
sity of Wisconsin Extension and at
a future date the course might
be available to SBE Chapters for
drop enrollment for members.

Chapter 5—Atlanta, Georgia

At the April 25 meeting of
Chapter 5, it was reported that

Chapter 5 now has 91 members
with average attendance better than
30 percent. Chairman Artz ap-
pointed a nominating committee
to recommend officers for 1977-
1978.

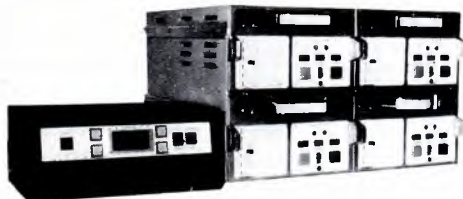
Bob Wehrman, their new nation-
al president, gave a report of the
NAB meeting in Washington, D.C.
and presented certification awards
to nine of the members.

Chapter 26—Chicago, Illinois

Chapter 26 held their May 19
meeting at Telemation Production
Inc., in Glenview. They toured the
Telemation Production facilities.
John Bagby, senior magnetic head
engineer of Spin Physics, Inc., was
the guest speaker and gave an
interesting presentation on "Quad
Video Head" which provided a
great opportunity for all involved in
magnetic recording to get first-hand
information in this highly technical
subject. Chapter 26 also presented
their first Certified Broadcast En-
gineer Certificates along with con-
gratulations to their brother mem-
bers who had been granted cer-
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For More Details Circle (73) on Reply Card

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"No problems at all. Fantastic for their reliability."

That's what Len Eden, Director of Engineering, Broadcast Division, Evening News Association and Chief Engineer at WWJ TV Detroit, and his colleagues have to say about their Ikegami HL-77 ENG cameras. Other comments by the WWJ news crew include:

"We're very pleased with their performance and lack of need for maintenance."

"Temperature conditions are rough in Detroit, but our Ikegami ENG cameras work reliably."

"Super for news."

"Our Ikegami HL-77s are for everyday use. Reliable."

News-gathering teams use more Ikegami ENG/EFM cameras than all other cameras combined. And if they all feel the same way about Ikegami the way they do in Detroit, it's no surprise.

Hear what we have to say about Ikegami ENG cameras. For further information contact Mort Russin, V.P., Sales, Ikegami Electronics (USA), Inc., 29-19 39th Avenue, Long Island City, N.Y. 11101 (212) 932-2577

Ikegami



For More Details Circle (74) on Reply Card

new products

TV graphics system

Recently introduced in a PAL version at Montreux, TeleMation's software-based Compositor I Graphics System features a 999-page memory and one-button call-up of sequence pages. Sequences can be in any order and can be added to or rearranged in seconds. Pages can be rolled or crawled at any of six speeds through "surround" pages containing static copy. These surround pages can be programmed to change as each new page of copy appears on the screen. The roll/crawl speed can also be programmed to change as each new page appears, or can be manually increased or decreased at any time.

As many as eight fonts can be mixed within a single page on a character-by-character basis. Two additional font groups (with eight fonts per group) can be stored on the Compositor I's disk memory, permitting selection of an alternate group for display as required; no disk changing is ever needed.

The three keyboard-selectable character edge styles—"shadow", "border", and "outline"—can be displayed at four luminance levels. An expanded edging option permits six widths of shadow edge and three widths of border/outline.

Twenty-eight colors are available for characters and backgrounds. Characters can be colored individually while backgrounds are colorized in four-scan-line increments. The operator can also select external camera background or an external/internal-color combination. A unique "swap" mode allows characters to be multicolored or shaded with various luminance levels of the same hue.

For More Details Circle (101) on Reply Card

Production Switcher

J & D Electronics has announced the availability of a complete line of professional video switchers. J & D Electronics is a division of J & D International. Their featured new is the 712, a 12-input, 4 switcher buss unit that goes for under \$7,000.

The 712 includes a built-in line burst generator, colorizer and chroma keyer. The unit also features downstream preset and program busses with cut bar, adjustable wipes and edges, color matte, and a built-in pattern mixer with frequency and amplitude controls.

Because of its compact size and NTSC specifications, the 712 is adaptable for studio or van operations.

For More Details Circle (102) on Reply Card

STL, remote control, SCA equipment

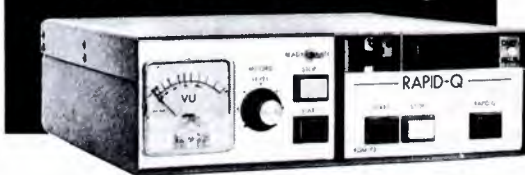
Micro Controls, Inc. announcing new line of radio broadcast STL, remote control - telemetry SCA sub-carrier equipment.

The Studio Transmitter Link systems, available as either a wideband composite employing Phase Lock Loop technology or a narrowband single or dual-channel system, offer state-of-the-art techniques.

It features direct reading forward and reflected power, a 2-8 MHz monitor amplifier built into the receiver, built-in RFI module for both transmitter and receiver, and a full 10 watts of RF output power.

The accessory sub-carrier equipment for the STL also employs the same techniques in the generator. VFO is normally set for either 41 or 67 MHz as it comes from the factory, i.e.,

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and is field-convertible from either
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characterizes design philosophy and
technology from the best of
the digital and analog worlds.

For More Details Circle (103) on Reply Card

Audio operational amplifier

The Holland Electronics model
OA-100 was developed to provide an
alternative to modules currently on
the market. Priced at only \$27 in
quantities up through 24, and \$25 in
larger quantities, the model OA-100
has the following features:

• Has a maximum output voltage of
at least 7.75 vrms (equivalent to
100 mVrms 600 ohms) with bipolar
load power.

• Can supply full output voltage to
10 ohm load.

• Has a high slew rate (10 volts
per microsecond typical).

• Pin-compatible with currently
available audio op amps.

For More Details Circle (104) on Reply Card

RENG transmitter

Comrex Corporation is introducing
the ENG-MIC, a completely self-
contained hand-held transmitter
with one full watt output and built-
in electret microphone for broadcast
quality ENG sound pickup.

The ENG-MIC, model HHT-1KA,
features crystal control, automatic
modulation control and operates on
replaceable alkaline penlight bat-
teries.

The ENG-MIC produces all the
power permitted to broadcasters by
FCC Rules & Regulations, Part 74,
Subpart H.

The frequency range is 450-451
MHz and 455-456 MHz. (Available
on special order at 161.625-161.775
MHz and 947-952 MHz.) The HHT-
1KA is also available with tone
generators for Radio ENG repeater
systems.

For More Details Circle (105) on Reply Card

Chromatic switcher

Shintron has announced the
model 373-DX Chromatic Switcher,
a high-performance unit designed
for all facets of production including
broadcast, ENG, CATV, and CCTV
applications.

The 373-DX is fully plug-

Continued on page 76

NEW FM AND TV FIELD STRENGTH METER FIM-71

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A group of the staff meet in the Broadcast Studio of the Station

It was a College broadcast facility; Now it's a public radio station; KUSC, Los Angeles, still has a Stanton in every table...

It is interesting that the station which provides top quality classical music service to Los Angeles was an outgrowth of a College Radio Station.

It now has been incorporated into the public broadcasting system and serves all of Los Angeles, Ventura and Orange Counties, with a format of 85% classical music and 15% informational programming primarily from the National Public Radio Service. KUSC goes direct from disc to air and uses the Stanton 600E on its turntables.

Since the station has received substantial university support for upgrading their sound, which includes a new transmitting system ... new tower antenna ... new control board ... new turntables ... and new cartridges ... KUSC plans to install Stanton's Calibrated 681SE cartridges in all their turntables.

So, their sure-to-improve sound is certain to have a favorable impact on their growing audience.

Stanton's 681 Calibration Series cartridges offer improved tracking at all frequencies. They achieve perfectly flat frequency response to beyond 20 Kc.

Each 681 Series cartridge is guaranteed to meet its specifications within exacting limits, and each one boasts the most meaningful warranty. An individually calibrated test result is packed with each unit.

Write today for further information to:
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Plainview, N.Y. 11803



For More Details Circle (78) on Reply Card

new products

Continued from page 75

compatible with Sony DXC 1000, 1600, and 1610 series Tricon cameras. It has a built-in color sync generator equipped with a multiple distribution amplifier for sync pulses and front panel controlled subcarrier phase adjustment for each camera input. All switching is done in vertical interval.

For More Details Circle (106) on Reply Card

Radial air gap rotary transformer

Videomagnetics, Inc., (VMI) has a radial air gap rotary transformer available that the company says will eliminate the basic problems of the axial multi-plane types used as original equipment on Ampex MK X rotary head assemblies.

The VMI air gap setting is built into the diameter of the rotor and stator units and are held to tolerance of 100 micro inches, a design aimed at eliminating parasitic modulation of the RF.

Grounding is achieved by using a graphite brush with sufficient eccentric wiper to be self-cleaning and to avoid intermittent contact. According to VMI, there is no condition where microphonics, band noise, or moire are created.

Simple disassembly and re-assembly during refurbishing allows straight forward cleaning. The complete unit mounts on the MK X interchangeably with the axial type. In fact, there is no change in outward appearance.

For More Details Circle (107) on Reply Card

Disc memory system

Knox, Ltd. announced a new versatile disc memory system, the KD128, as an add-on option to new and existing K128 graphic arts character generator. The KD128 offers 280 pages of permanent memory on each diskette. Each page is stored on interchangeable 5-inch flexible discs. The disc itself costs \$5.00. A studio can have a library of over 1,100 pages.

The KD128 is composed of two separate units. The first, rack-mountable, contains the drive unit. The second is the control system which allows the operator, through a 16-key pad, to select pages at random, or sequentially. Continuous roll or crawl is possible through all of the pages. Maximum search time is 1.5 seconds.

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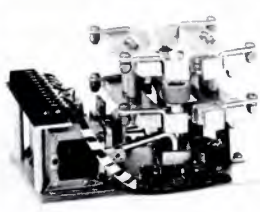
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Broadcast Products Division

HARRIS CORPORATION INTERNATIONAL OPPORTUNITIES

The Broadcast Products Division of Harris Corporation is seeking broadcast engineers interested in expanding their personal growth in the international broadcast market.

Many opportunities are available in our organization which is rapidly growing to meet the existing and future requirements.

Among these opportunities we need.

AREA SALES MANAGERS

You will be fully responsible for managing the marketing of our broad range of radio and television broadcast products in a selected area of the world. Management of the distributor network and customer relations are essential.

Required qualifications include a BSEE or equivalent and 3-5 years practical experience in Radio-TV station engineering, or 3-5 years experience in field sales or service. Some international marketing experience or a Masters degree in marketing is highly desirable.

INTERNATIONAL SALES DEVELOPMENT ADMINISTRATION

Responsibilities include the active support of the Area Sales Managers by responding to customer requirements and coordinating the efforts of the Corporation in the international broadcast systems market. This position provides excellent opportunity for advancement.

Requirements include a BSEE or equivalent, 1-3 years Radio-TV station engineering, 1-3 years marketing/product development/systems engineering with a broadcast equipment manufacturer or 2-5 years international sales experience.

We offer favorable career prospects in a growth environment, competitive salaries, excellent benefits, and relocation assistance. Please direct resume in confidence, giving full pertinent details including salary progression, to Lawrence Carlstone, Professional Employment Supervisor, Harris Corporation, Broadcast Products Division, Quincy, Illinois 62301.



HARRIS
COMMUNICATIONS AND
INFORMATION HANDLING

An Equal Opportunity Employer M/F

HELP WANTED (Cont.)

ENGINEER FOR 2 AM 1 FM small group very important. \$13,000 starting salary. E.O.E. Immediate opening. Reply to Dept. Broadcast Engineering, P.O. Box 12901, Garden Park, KS 66212.

RAPIDLY EXPANDING NORTHEAST M. UHF needs two experienced maintenance men for maintenance of an RCA TTU-110 transmitter. The second, for the upkeep of equipment which includes PC70s, TR 600, TCR 100, Grass Valley switcher. Only enclosed need call 412/931-5747, PA 15214 salary and benefits.

TELEVISION—CCTV Video Maintenance technicians. Full Benefits. Greater New York, New York or New Jersey Area. Send resume to VPC, P.O. Box 268, New Hyde Park, N.Y. 11040.

CCA FM10DS EXCITER tuned to 98.7 MHz associated SG-1D stereo generator, used, \$2,000. Moseley SCG-4T stereo generator at 67 KHz, used, manual, \$1,000. McMartin TBM-3000 Freq. Monitor, used, \$40. Gates GTA-88F Freq. Comp. used, \$50. Miratel AA-1 EBS rcvr., \$25. \$1,000 offer. Contact C.E. or G.M., 218-236-7900.

MAINTENANCE ENGINEERS—KCRG-TV process of expanding its maintenance staff is seeking strong candidates with 1st License, solid backgrounds in general TV broadcast electronics and minimum experience 3 years involving the following: Cameras; Camera Generators; Design and Fabrication; Powered C Band Radar; Microwave; Qu. Helical VTRs; RF; Remote Control; Switching Video. For information, write: Chief Engineer KCRG STATIONS, 2nd Avenue at 5th Street, Cedar Rapids, Iowa 52401, 319-398-8407. KCRG OPPORTUNITY EMPLOYER.

WANT YOUR OWN STATION? Top video broadcaster in competitive market needs aggressive self-starter as chief. Strong maintenance, AM-FM stereo, studio construction. Can you make the best sound better? Reply to Dick McGraw, WCLG FM/AM, Morgantown, WV 26505.

MANAGER, VIDEO MARKETING. East based video equipment manufacturer needs aggressive individual to assume total marketing responsibility. Successful candidate will have experience in both broadcast and CCTV with OEM and direct sales experience, as well as distributor sales management. This is a visibility position reporting directly to President and offering excellent opportunity for growth. Reply to Dept. 381, Broadcast Engineering, P.O. Box 12901, Overland Park, KS 66207.

SITUATION WANTED (Cont.)

CCTV ENGINEER—Experienced in all phase video systems maintenance and operation including helical scan VTR's with FCC 2nd License, desires intermediate position. Will relocate for right job. Contact: Doug G. 8220 Langon Ave., #18, Van Nuys, CA 91411 phone 213/989-1572.

Regional advertising sales offices

Indianapolis, Indiana—Roy Henry, 2469 E. 8th St., Indianapolis, Ind. 46280, (317) 846-7021

New York, New York—Stan Osborn, 60 E. 4th St., Room 1227, New York, N.Y. 10017, 687-7240

Mountain View, California—Dennis Triola, Bayshore Frontage Rd., Room 102, Mountain View, Ca. 94043, (415) 961-0378

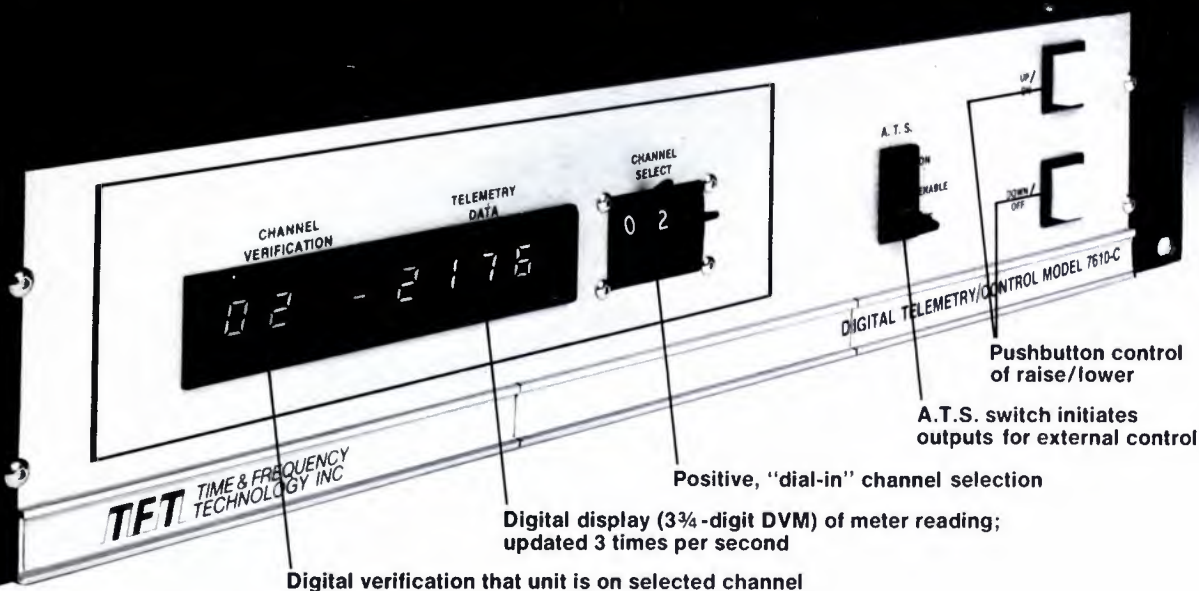
London W.C. 2, England—John Ashcraft 12 Bear St., Leicester Square, 930-0525

Badhoevedorp, Holland—John Ashcraft & John J. Lucassen, Mgr., Sloteweg 303, 6226

Tokyo 1, Japan—International Media Representatives, Ltd., Shiba-Kotohiracho, Minatoku, 0656

BROADCAST ENGINEER

Digital remote control, priced like analog



\$2495



Model 7610 control point (bottom) and remote point modules.

Now you can have ten channels of raise/lower and telemetry in a digital remote control system — the TFT 7610 — that costs only a little more than the most basic analog systems.

With the 7610, you don't have to twiddle calibration knobs or interpolate from meter scales. Instead, you get a positive, unambiguous data display. In addition, you get BCD (digital) outputs that make the 7610 compatible with computer and ATS systems. Most importantly, with TFT digital designs, you get increased data accuracy and fewer errors because of special closed loop data verification.

Along with a low price and digital convenience, the 7610 also gives you convenience features you'd expect to find only in much more expensive systems, if you find them at all.

Calibration, for example, can be done on site by one man. And unique, quick-disconnect barrier strip boards allow you to remove the equipment from the rack without interrupting any of the wiring to the transmitter or sampling points.

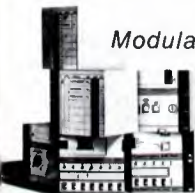
You also have your choice of interconnect setups: telephone lines, STL and SCA or TSL. Data is transmitted via pulse code modulation (PCM) and data modems are built-in.

Modular versatility is another advantage, and a TFT exclusive. For example, when and if you want, you can add up to 60 more channels of telemetry and raise/lower, in 20-channel increments. Or, mate the Model 7610 with our Model 7615 Status Monitoring and Direct Control unit. That will give you direct on/off control and status monitoring — up to 30 channels of each. You can add modules at any time in the field.

So, whether you're upgrading an existing system or starting from scratch, specify TFT for remote control. It could be the start of something big.

For details and a demonstration, contact your TFT representative or call the factory. In Canada: Caldwell A/V Equipment Co., Ltd., Toronto (416) 438-6230.

Modular digitals for remote control.



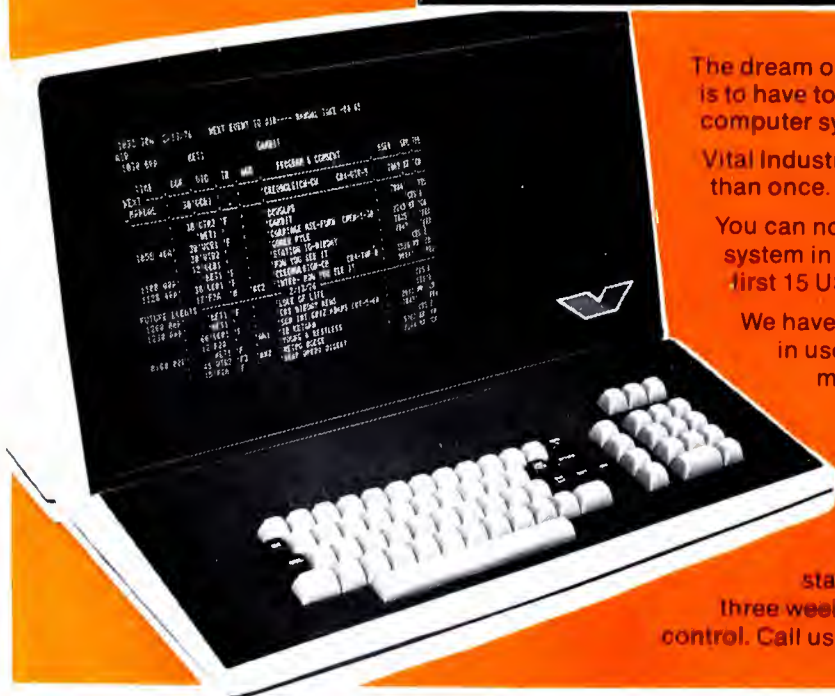
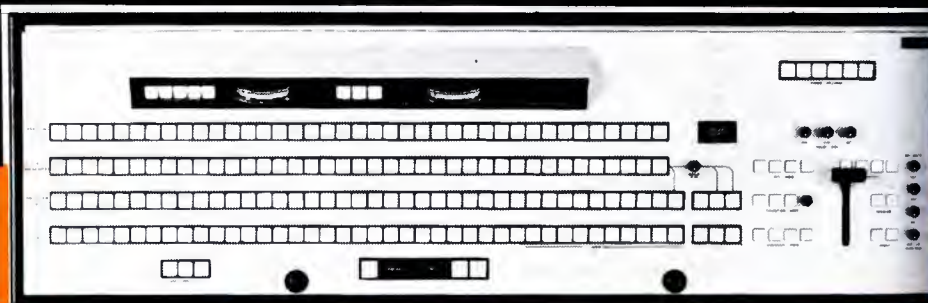
TFT

TIME AND FREQUENCY TECHNOLOGY, INC.

3000 OLCOTT STREET, SANTA CLARA, CA 95051 (408) 246-6365 TWX No 910-338-0584

For More Details Circle (2) on Reply Card

THE VITAL BUSINESS CONNECTION MAKES TV AUTOMATION TOTAL = VIMAX-200



The dream of every TV broadcast station management is to have total automation married with a business computer system with minimum interruptions.

Vital Industries, Inc. has done it, and done it more than once.

You can now see our actual total TV automation system in use in one of several TV stations in the first 15 US TV markets.

We have over 30 technical automation systems in use since 1972. This total experience makes it also possible for us to offer a building block approach of a 32 event preset system to stations as a first step towards total automation.

We have installed a complete automation system, connected it to a business service, and trained station personnel to operate it in less than three weeks. We've got total TV automation under control. Call us toll free, 1-800-874-4608



VITAL INDUSTRIES, INC.
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