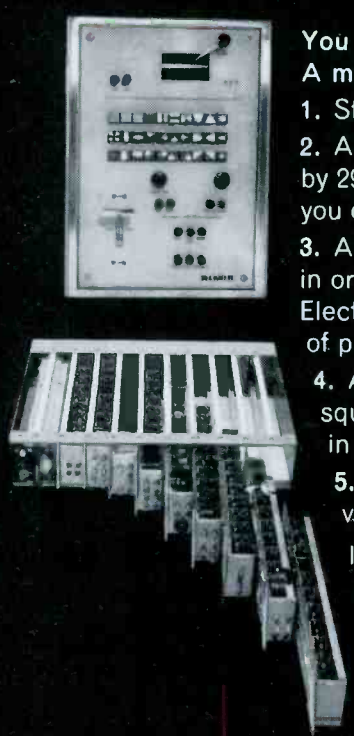
A HOWARD W. SAMS PUBLICATION

SEPTEMBER 1967/75 cents

Broadcast Engineering

the technical journal of the broadcast-communications industry

how to build a versatile special effects system on a not-so-versatile budget.



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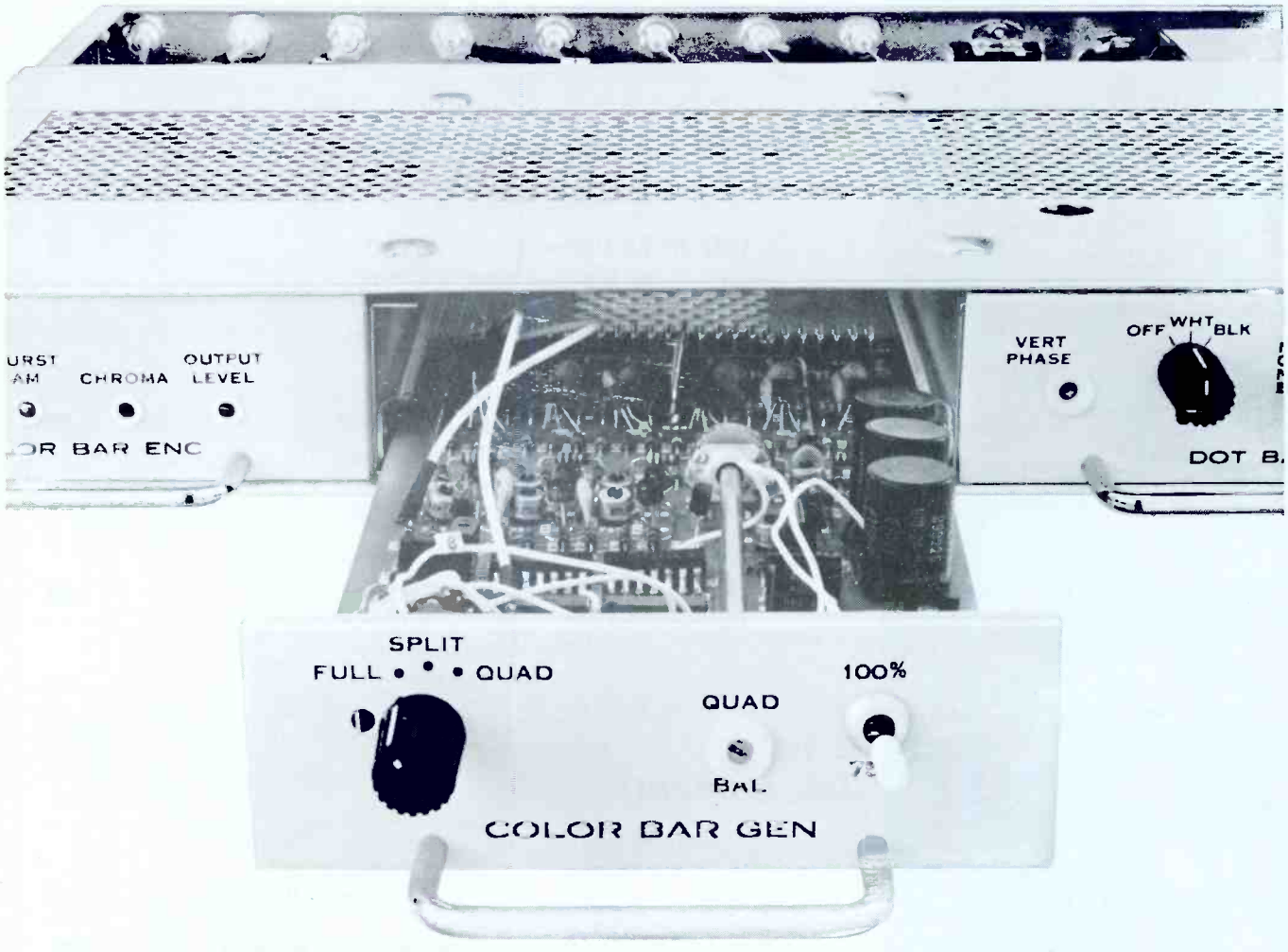

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For specific data on each accessory, contact your local Cohu engineering representative, or call Bob Boutilo direct at 714-277-6700. Box 623 • San Diego, California 92112 • TWX 910-335-1244.

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the technical journal of the broadcast-communications industry

•Broadcast Engineering

Volume 9, No. 9 September, 1967

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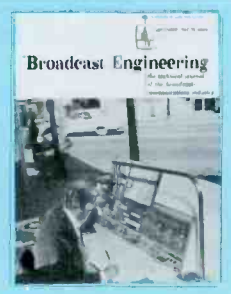
One means to establish public awareness of a station's operations is to have a "show-window" studio complex. Our cover shows an inside view of such a studio at WIFE, Indianapolis.



BOOK REVIEW

Audio Systems: Julian L. Bernstein; John Wiley & Sons, Inc., New York, 1966; 409 pages, 5½" x 8½", paperback, $4.50.

This is a volume in the "Electronic Engineering Technology" series of textbooks designed for use in advanced courses in electronics. The book contains basic theory, mathematical development of theorems, design considerations, and solutions to example problems in specific design applications.

More than half of the volume is concerned with network theory, concentrating on the areas of impedance matching, mixing and dividing networks, attenuating pads, and equalizing systems. One chapter develops the use and application of the terms "decibel," "dbm," and "volume unit," and thoroughly details the use of logarithms in audio-circuit measurements.

Various types and classes of amplifiers are explained and developed, while basic circuits in both vacuum-tube and transistor terms are provided. The advantages and disadvantages of interstage coupling devices and circuits are discussed, and mathematical analysis of these show their effects on system fidelity.

Other, but relatively short, chapters are given to recording systems (disc, magnetic, and film) and audio transducers (microphones and speakers). Each unit or system is discussed, and the principles and theory of their operation are explained in text, diagrams, and photographs.

This volume is intended for, and is within the capabilities of, any broadcast or recording technician able to acquire the knowledge required for a first-class radiotelephone license. Although primarily a textbook, it contains tables and other data which permit its employment as a permanent reference work. ▲

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NEW AKG Condenser Microphone C-61

The System

Low frequency circuit with low noise and low distortion characteristics. Preamplifier with Nuvistor, printed circuit electronics, and audio transformer for balanced output.

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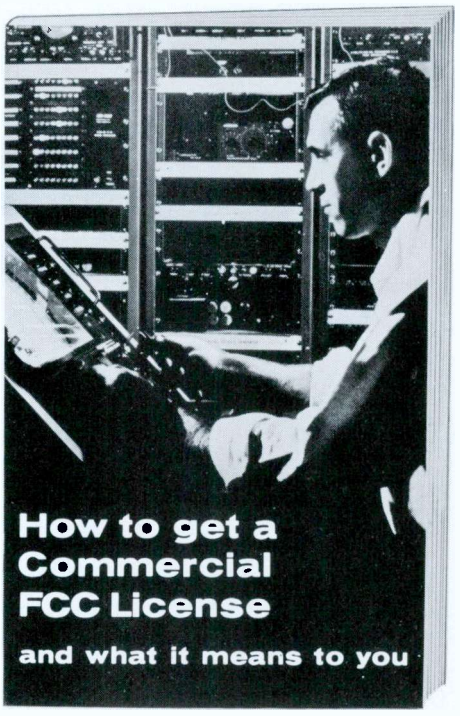
It takes the mystery out of getting the FCC License you need for security and success



NO WONDER you're interested in a career in broadcasting. It puts you right "where the action is"—behind the scenes of show business, news reporting, politics. You meet famous people. You're the first to know the big news about fires, riots, plane crashes. You get to hear wonderful music. You feel in contact with an audience of thousands.

And one of the most secure high-pay jobs in the field is that of the licensed Broadcast Engineer. He's the key man required on the job by the United States Government

New job opportunities are opening up constantly for qualified license-holders. Many more will be needed to operate and maintain the countless new UHF-TV stations expected to begin operation, now that all new TV sets can receive UHF.

So if you dream of making broadcasting your life work, you need that Government FCC License.

But how do you go about getting it? Where do you apply, and when? How do you get ready for it?

To help you, we have published a 24-page booklet, "How to Get a Commercial FCC License." It tells you exactly which types of licenses and permits are issued by the Federal Communications Commission, and what kinds of electronic equipment each type allows you to operate and maintain.

You will learn which subjects must be mastered for each kind of license. Thirty typical exam questions will give you an idea of the level of training required. You'll be told where and how often the exams are held, and how to find out about the exams held nearest your home.

Frankly, the FCC exams are rough if you're unprepared. Two out of three applicants fail to pass. Some fail seven or eight times.

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To receive both books free, just mail coupon below. If coupon is missing, write to Cleveland Institute of Electronics, 1776 East 17th Street, Dept. BE-38, Cleveland, Ohio 44114. Do it right now—if you want a solid career in broadcasting, this could be the turning point in your life.

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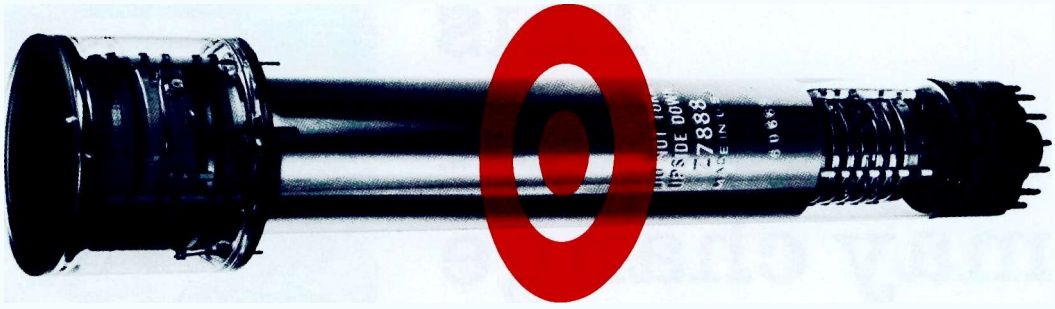

Target innovations in GE Pickup Tubes give you a better picture.

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New innovations in GE Pickup Tube glass target technologies now permit higher signal-to-noise ratios and improved amplitude response in existing color or monochrome TV cameras. The new Z7899 IO, for color remotes and monochrome VTR, and the Z7888 IO, for studio color video taping—give *sharper, quieter,* better pictures. At medium to high illumination levels, they give up to 3 to 5 times longer life than conventional glass targets. Stickiness, loss of sensitivity, and burn-in are virtually eliminated.

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Z7899	New Electronic Glass Target	No	65:1	72:1	65%	Color Remote & Monochrome VTR
Z7888	New Electronic Glass Target	Yes	65:1	72:1	65%	Studio Color Video Taping

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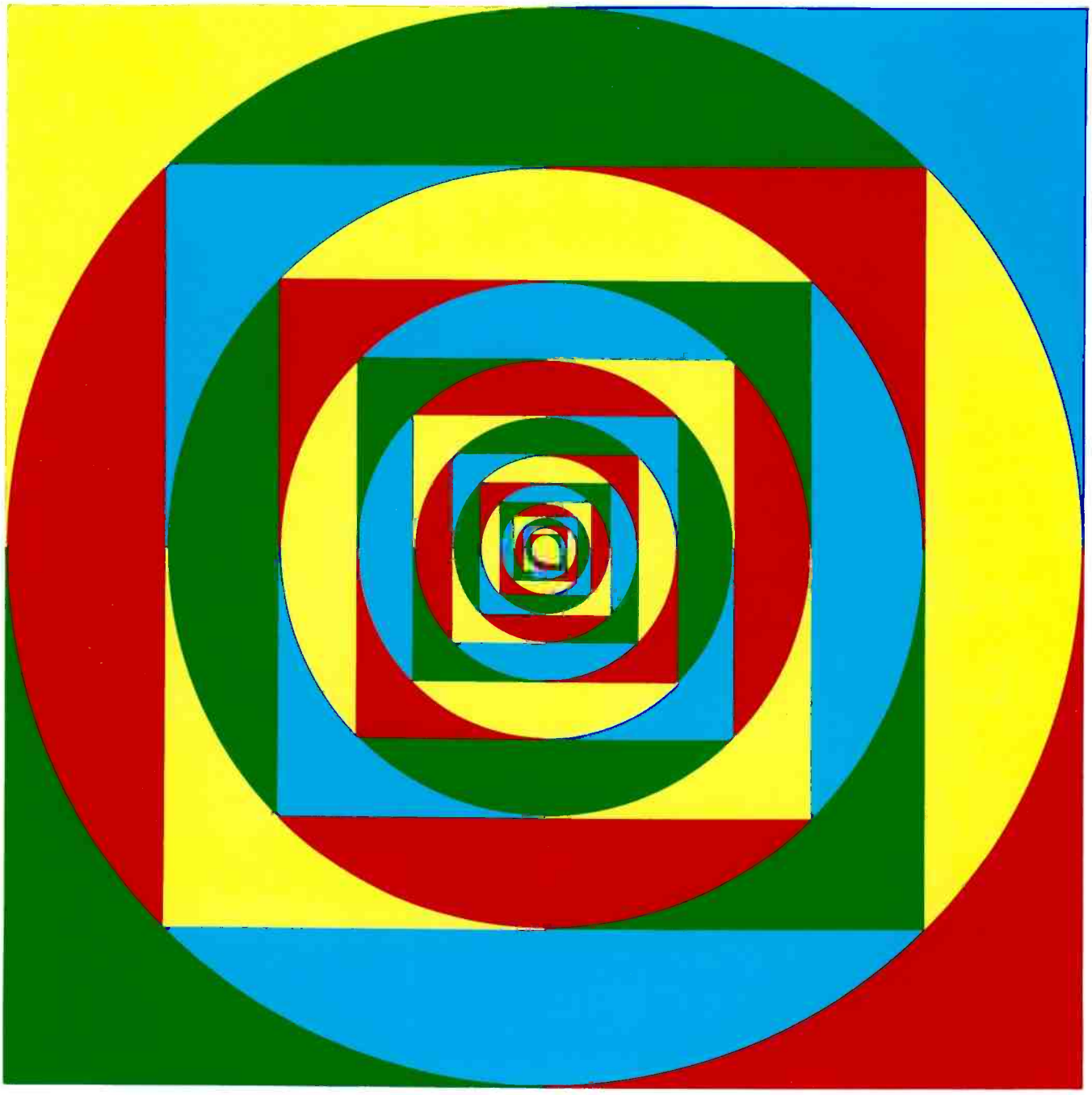
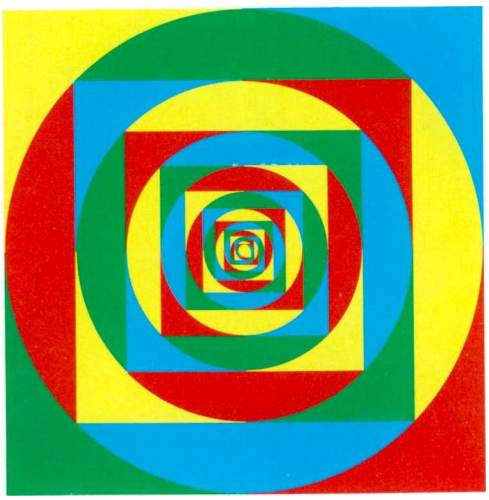


78V was meant to be your master.



78V is the tape to use if you're after excellent masters and great copies.

Here's why:

We designed 78V for the new generation of high-band recorders.

It reproduces colors no other tape can match.

It offers quality video without sacrificing quality sound. (Its signal-to-noise ratio is consistently high. And it has better frequency response, more stable reference signals, and more uniform audio signals than any other video tape.)

It's consistently low in abrasion from reel to reel.

And it's durable. 78V will perform with a minimum of dropouts long after other tapes have failed.

Of course, the best test of a great tape is how well it performs on your recorder.

We'd like you to make that test.

Contact us, and we'll dispatch our man with a reel. We'll also send you more information—including specs—on 78V if you'll write us at 700 Memorex Park, Santa Clara, California 95050.

78V begins where other color video tapes leave off.

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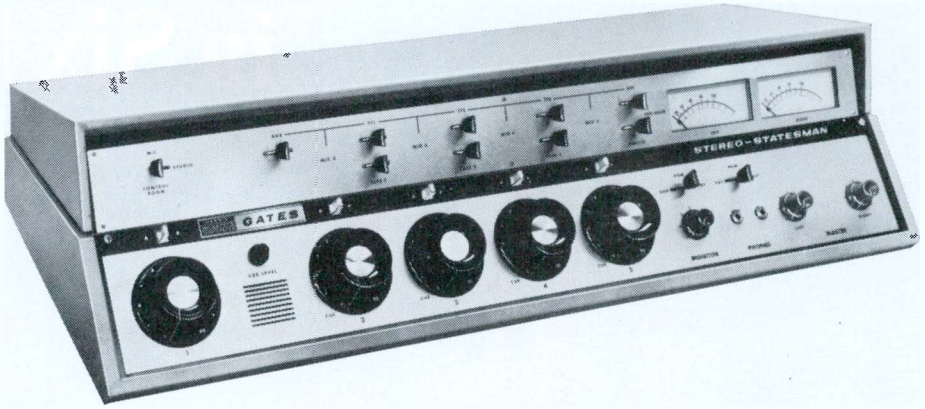
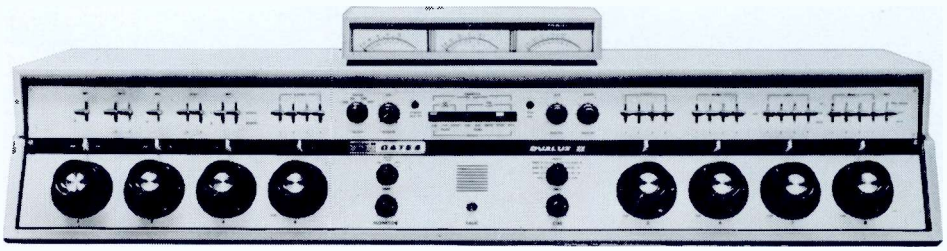
Plug-in silicon amplifiers • 20-20,000 cycle response

Solid state, all new – inside and out. Featuring 100% silicon transistors. All amplifiers and DC power supplies plug in. All three consoles feature 20-20,000 cycle frequency response, with less than 1 db variation. At all frequencies, distortion is less than 0.5% at rated output. Write for complete details. You'll wonder how we could build so much into such compact, handsome packages.



Stereo Statesman

The Gates Stereo Statesman features 5 full stereo mixing channels from 11 inputs. Full logic audio switching. New illuminated program keys . . . exciting new packaging concept.



Dualux II

The Dualux II provides monophonic and stereophonic mixing facilities separately or together. Designed to control AM and FM, FM Stereo and SCA from one control point. Features 8 mixing channels, 13 mono sources and 6 stereo sources . . . a total of 22 audio inputs, plus inputs for automatic programming equipment and an SCA audio signal.

Gatesway II

The Gatesway II with 8 monaural mixing channels from 18 inputs features in-built cue/intercom system; provision for remote announcer operation of studio microphone channels, and a novel variable equalizer for special effects or line correction.

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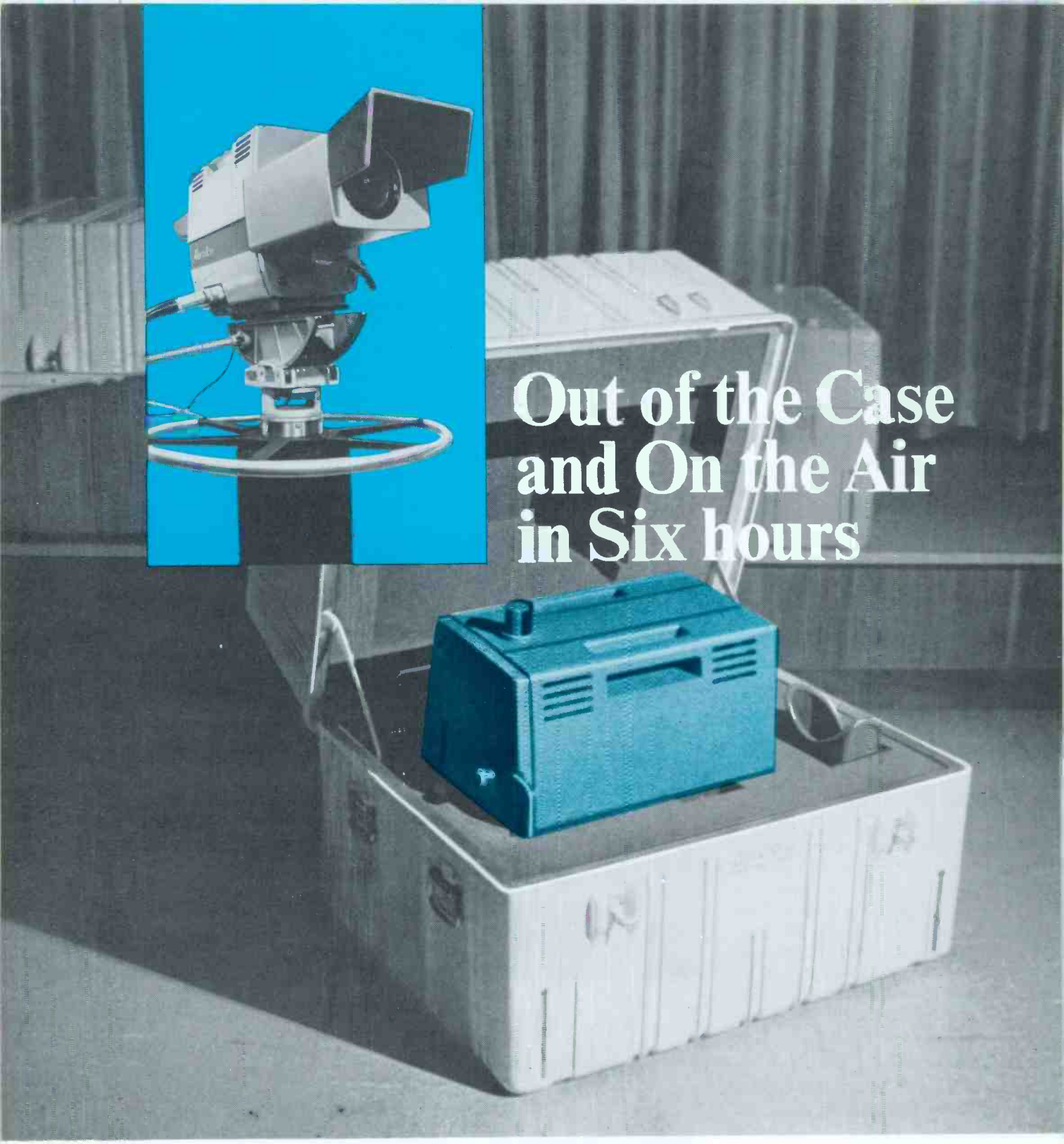


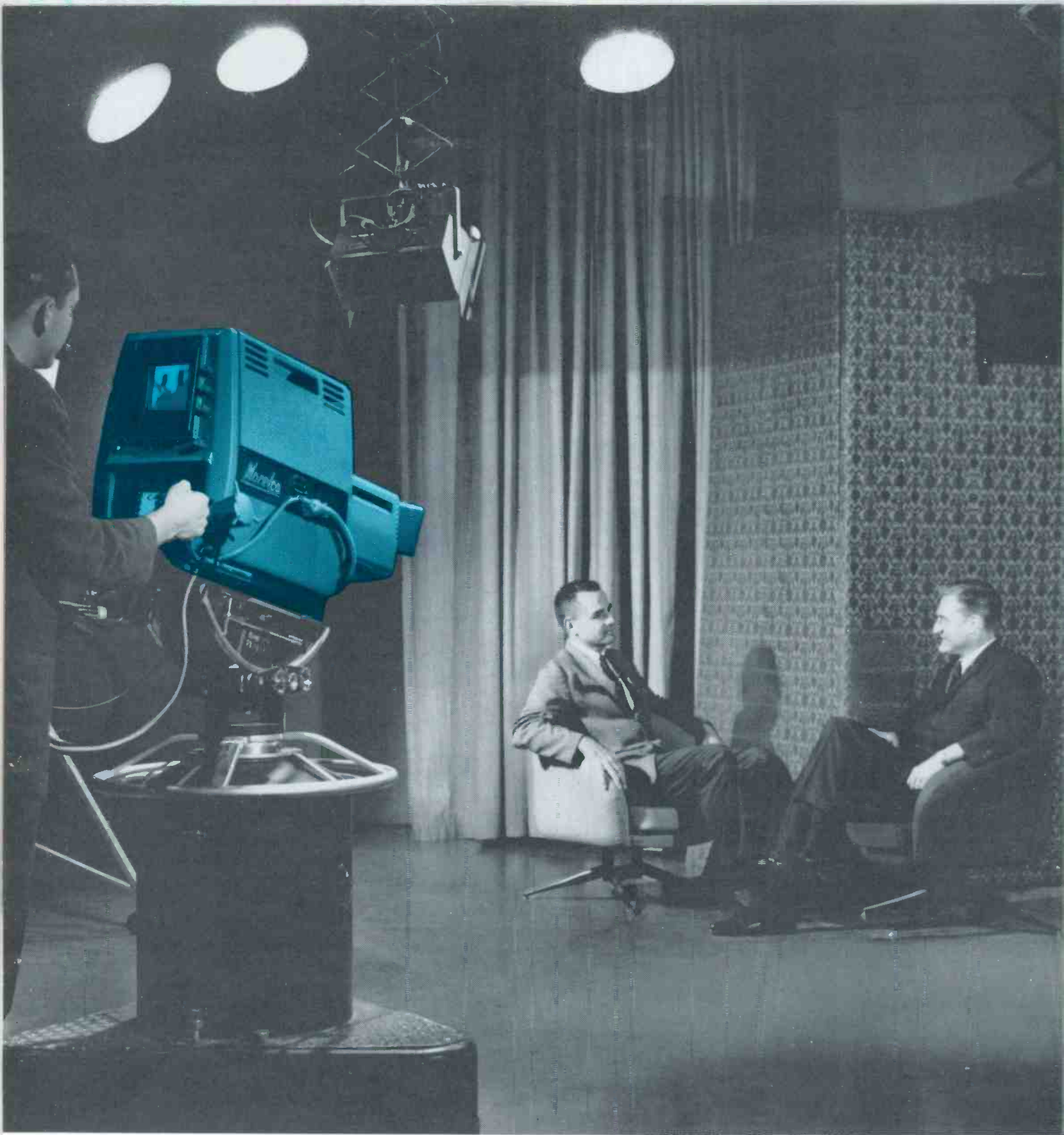
Out of the Case and On the Air in Six hours

To put a TV color camera chain on the air the day you get it is quite a feat, but KLFY, Lafayette, La., did it. Of course, it was a Norelco 3-Plumbicon* PC-70 Camera. That made the original setup and checkout easier because the Norelco is inherently simpler than any 4-tube camera.

KLFY has since discovered that everyday setup is likewise fast and simple. Maintenance is low, reliability is high. And why not? There's one less of everything electronic in the Norelco, and what there is has been designed to give you the sharpest, and the most faithful color picture the state of the art permits.

Check into the PC-70, and very likely you'll soon be checking one out in your studio. Write us or our sales representative, Visual Electronics.

*Registered trademark for television camera tubes.



KLFY-TV News Director Dud Lastrapes interviewing Mr. Herbert Brown, Chairman of the Board of local advertiser Brown's Thrift City Pharmacies

Thomas G. Pears, Gen. Mgr., KLFY, Lafayette, La.:
"Although we had done some prewiring, we were amazed at the speed with which we got our new PC-70 chain in operation. It was delivered right on schedule and a factory representative was on hand to help with the installation. The picture is great!"

1967 NCTA CONVENTION

HIGHLIGHTS OF THE EQUIPMENT EXHIBITS

All the familiar accouterments of CATV operation were in evidence, but the manufacturers also seemed to have heeded NCTA President Ford's call of last year for more local origination. Everywhere one looked, there was equipment for this purpose. The offerings varied in sophistication from simple, low-cost cameras and message-display devices to complete studio setups with live cameras, film chains, and control and switching apparatus. Although much of this equipment, or at least the functions it performs, is not new to television, it has not been widely used in the CATV industry.

For the more familiar forms of CATV equipment, there was emphasis on the concept of 20-channel capability. Although details vary from manufacturer to manufacturer, the general idea is to fit eight or so additional TV channels into the VHF specrum (with the signals all confined to the cable).

From cameras to cable clamps, there was much to interest the NCTA Convention-goer this year. By their variety and scope, the exhibits seemed to reflect confidence in the future of cable television.

Aberdeen Co.

In addition to a line of cable clamps, lashing wire, and buried-cable housings, this company featured the new Model S cable lasher. The machine is designed for lashing cable ranging in size from ¼ inch to 1 inch or more in diameter. It uses .045 or .061 wire, weighs 14 pounds, and spins a 12-inch spiral; it receives its spinning action from the lashing wire as it pays out. The machine is furnished with tow rope and lashing-wire clamp in a fitted metal carrying case.

Advance Industries

There wasn't room in the exhibit booth for samples of the Advance line of towers, buildings, and microwave reflectors; but information and literature were available for interested conventioners.

Ameco

Featured new products were the "Channeleer" head-end unit and the Pacesetter directional tap. The new DT is engineered in accordance with Western Electric specifications. Two or four taps are available, with tap values of 10, 13, 17, 23, 29, and 35 dB. The snap-in housing, sealed against moisture and radiation, is also used for the Ameco line divider, power inserter, blocking capacitor, or splice. The directional tap may be used with various sizes of cable.

The "Channeleer" solid-state heterodyne signal processor includes such design features as modular construction, for convenient change of input or output channel; slide mounting, for maintenance ease; and low power consumption (30 watts at 90-130 volts, 60Hz). The unit amplifies the RF signal and converts it to an IF. The visual IF carrier has AGC applied, and the sound IF carrier is limited; the resulting signals are combined, converted to the output channel, and amplified.

American Electronic Laboratories, Inc.

AEL announced the first use of thin-film hybrid microcircuits in CATV equipment. The Model CT-E trunk extender amplifier and the model CVT-RBM intermediate bridging amplifier feature plug-in microcircuits in equalizer and attenuator applications. Both the extender and the bridging amplifier have bandwidth capabilities of 50 to 27 MHz and frequency response within 0.5 dB.

The standard line of CATV amplifiers was also displayed in the booth.

American Pamcor, Inc.

Especially featured products of this manufacturer, in addition to a general line of terminals and connectors, were thick-wall, heat-shrinkable, self-sealing splice covers and waterproof, crimped-on coaxial connectors which adapt to one fitting.

The self-sealing product line includes tubing, for insulating splices and terminals; end caps; and an aperture (or bulkhead) seal. Designed to provide waterproofing, insulation, and abrasion and corrosion resistance, the material is shrunk to fit over connectors and terminals by application of 250° heat..

The line of solderless coaxial connectors employs a patented crimp with matching tools for uniformity of connection. Included are connectors, splices, wall receptacles, and grounding blocks.

Ampex Corp.

Cameras and video tape recorders

were featured in this exhibit. A CC-326 series viewfinder camera was representative of the line of closed-circuit cameras, which ranges from a random-interlace unit to a "broadcast-compatible" *Plumbicon* model.

The CC-324 vidicon camera (without viewfinder) operates with internal random interlaced sync, or with EIA or 2:1 sync from an external source. The output of this camera is composite video and sync at one terminal, and modulated RF at the other. Both outputs may be used simultaneously.

Video tape machines on exhibit were of the helical-scan type. Included were a Model VR-7000 and two versions of the Model VR-7500, one for black-and-white operation and the other for color. The 7500 machines incorporated high- or low-band operation, fast forward and rewind, and slow motion.

Amphenol Cable Div.
Amphenol-Borg Electronics Corp.

Coaxial cable for CATV application was, of course, the product emphasized in this booth. Featured was a new drop cable, No. 21-1050 (BC59/U). The aluminum outer conductor is bonded to the outer polyethlylene jacket for protection against the weather. The aluminum-sheath construction is designed to offer significantly higher shielding efficiency than does cable with a braided outer conductor.

Anaconda Astrodata Co.

New in the Anaconda equipment line are the *XDR* distribution amplifiers, Model 840 (single output) and Model 841 (dual output). These silicon-solid-state amplifiers are designed with extended dynamic range in keeping with the high-level-distribution design philosophy. Automatic temperature compensation for attenuation and slope variations is provided in these units. Power (AC) is accepted through either input or output, and may be either passed through or blocked.

Also new is Anaconda Wire and Cable's *Sealmetic* cable. This cable has been designed to offer good moisture-protection, physical-flexibility, and electrical characteristics. The cable is available in various sizes and configurations for aerial, duct, or direct-burial installation. *Sealcon* connectors for use with this and other cables are available.

Completing a quartet of new items were the Model 990 75-ohm system analyzer and the Model 912 signal-level meter.

The solid-state, portable system analyzer employs a sweep comparison method to measure insertion loss and gain, return loss, and impedance: measurements and calibrated reference traces are displayed simultaneously on a built-in oscilloscope. Crystal-controlled marker generators are included. The frequency range is 10 to 230 MHz, and the sweep width is variable from 200 kHz to 220 MHz.

The Model 912 portable signal-level meter is a selective RF voltmeter designed for measuring CATV signals from −10 to +63 dBmv with ±0.5 dB accuracy. The unit has a 12-position channel-selector switch, and a phase-lock technique is used to achieve automatic frequency control. The instrument measures peak voltage with a circuit designed to be unaffected by modulation; the taut-band meter is calibrated in rms units.

Asteroid Corp.

This company displayed its new Weather Data Model 106 for one-glance weather information; the Model 4100 RF modulator; and the Model 4150-S Voice-Alert System for pre-empting the CATV audio channel during police, fire, weather, or other emergencies.

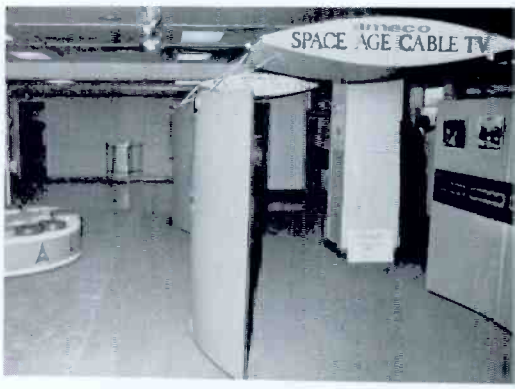
Also shown in the booth were the Afco CCTV camera and the Model 707 Emerg-Alert system for pre-empting audio and video channels.

AT&T

Information regarding services this telephone company provides for CATV systems was available at the AT&T booth in the Red Lacquer Room.

Benco Television Corp.

Benco has "launched" a Clipper line of clip-in line-extender and multiple directional-tap units. Two-tap or four-tap plates may be clipped into the housing to make the Clipper 2 or Clipper 4, respectively. Zero-dB and 1dB thru plates, and the Benex Clip-



per line extender fit the same housing. The units are designed to pass 10 amps AC and to have full bandwidth, including midband. A variety of mounting bracket and clamp configurations is available, and housings are made for one-connector (terminated) and two-connector requirements. The seized-center-conductor method of connection is available.

Blonder-Tongue Laboratories, Inc.

A line of test equipment and equipment for multiset drops was shown. A new product was the Powerdrive high-output single-channel VHF amplifier with AGC. The output stage of this amplifier is operated at less than 75% of rated plate dissipation. The amplifier has input and output test jacks and two mixing outputs, which provide for a loop-through configuration.

Also featured was a line of modular directional tapoffs, Models 3424 through 3429. Each complete unit consists of a basic photo-printed microstrip directional coupler and a splitter plate with one to four outputs. Attenuations from 8 dB to 40 dB are available in 4-dB steps. Other features include messenger-strand mounting, 412 or ½" entry fittings, seized-center-conductor entry fittings, and a housing designed to be weather and air tight.

Burnup & Sims, Inc.

This contracting, manufacturing, and engineering firm presented its services in the field of CATV system construction.

Cal-Tel Construction Co., Inc.

Cal-Tel's construction services for CATV systems were the subject of this company's exhibit.

Cascade Electronics Ltd.

This is one of the companies planning for 20-channel system capability. The Cascade method is based on the use of 20-channel circuit boards designed to plug into existing amplifier housings. Operation would be in the 40-250 MHz region, either by adding 8 channels to the present 12 or by carrying 20 channels in the 120-240 MHz range.

Other featured items in the Cascade booth included these: A bridger amplifier is provided with a thermistor for compensation of the cable temperature characteristics; an extension cord is available for placing the thermistor into a cable duct. There was an underground- or pedestal-mounted splice with AC and RF test points. A 15-dB line extender had provision for tilt, gain, and response adjustment by using a tool from outside the case. A seized-center-conductor connector was demonstrated on sample pieces of cable. A cast-aluminum power-supply housing with silicone seal was shown; this was for underground or aerial mounting. The company stressed its line of equipment for underground systems. Also featured was the Model CEDA 2-40, an apartment-house amplifier with 40-dB gain.

CAS Mfg. Co.

Featured item was a new solid-state Channel Control head-end system utilizing plug-in modular circuit-board construction. The equipment performs conversion of any input VHF channel (UHF on special order) to any desired VHF output channel. Separate aural and visual IF amplifiers with temperature-compensated AGC are employed, and limiting is applied to the aural signal. Standby video and audio modulators (at the IF's) permit local origination or emergency-alert capabilities on any or all channels. (The latter function can be performed remotely by dialing into the system by telephone.) Duplication protection is possible by using an auxiliary tuner and switching the protected signal in place of the distant signal.

Other featured products included the "Milk-Cow" backmatched transformers for providing one, two, or four outlets from a single existing pressure-tap block.

C-Cor Electronics, Inc.

The exhibit was centered on the Novacor line of CATV amplifiers, designed to provide very high output level with low noise. The amplifiers make use of integrated circuits with all solid-state devices. All *C-COR* trunk amplifiers are built with automatic level control, which operates from the channel-13 visual carrier or a separate pilot signal.

Collins Radio Co.

Microwave relay systems were

available for examination. The Collins MW-808D is a new short-haul system for the CARS band (12.7-13.25 GHz). This is a remodulating system employing modular construction; it is entirely solid-state except for the transmitter klystron. The equipment is designed to meet the requirements of NTSC color video transmission. Also in the display was a long-haul system, MW-109E, which operates in the 5.925-6.425 GHz range.

Craftsman Electronics, Inc.

There were three featured products in this manufacturer's display. First was the Vista tap. This modular device is built to Bell System specifications and is available with or without seized-center-conductor connections. It is designed to supply one to four subscribers. Interlocking grooves between the plate and housing provide RF shielding, and the unit is made for quick clamping to the messenger. The connector is of waterproof design.

Second in the group was the Model 800A directional tap for burial applications. An epoxy sealing compound is used inside the case. Rounding out the trio of products was the Model 900A/2200 modular directional tap with 24-channel capability.

Dynair Electronics, Inc.

Solid-state, etched-circuit modular construction has been used in the Series 4000 head-end equipment. Combinations of these modules in a universal mounting frame provide three units of head-end equipment, as follows: The RX-4000A TV demodulator includes a 12-channel VHF converter; as an option, an oscillator may be added for crystal control of one channel. The RF and IF passbands are shaped to handle color transmissions. A 75-ohm video and a 600-ohm audio output are provided, along with a 75-ohm video/4.5 MHz audio output. The HX-4000A heterodyne converter is used to convert any off-the-air signal to an IF and then reconvert to a desired VHF output channel. This is done to permit removal, through filtering, of out-of-channel interference and to maintain signal levels within the channel. The Model TX-4000A audio-video modulator is intended for use in systems having either local origination facilities or a microwave feed. A composite television signal is generated at an intermediate frequency and then heterodyned to the desired output channel.

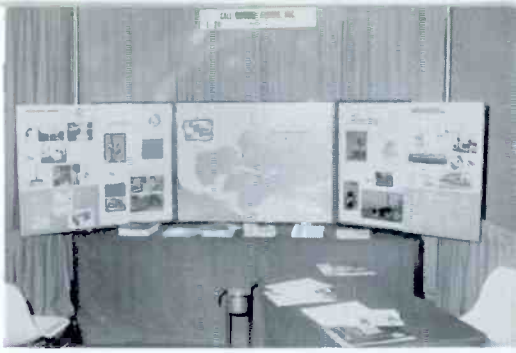
In the realm of test equipment, Dynair showed its Model TS-100B sideband analyzer. This solid-state instrument is used primarily in testing and aligning television transmitters or CATV modulators operating on VHF channels. Its internally generated RF sweep output is applied to the circuit under test, and the RF output of the circuit is applied to the RF input of the analyzer. Vertical and horizontal signals for an oscilloscope are delivered by the analyzer. The TS-100B uses silicon transistors throughout, and all operating indicators, controls, and connectors are on the front panel.

Entron, Inc.

Entron celebrated its 15th year in CATV, and a large sign reading "20 channels" served as a backdrop for the exhibit.

Highlighted was equipment for use from the antenna mast to the customer tap-off. Model C-200 is a solid-state, mast-mounted unit for converting a UHF channel to a VHF channel. Crystal control and temperature compensation of frequency are incorporated in the design. Also mast-mounted is the solid-state Model P-1 single-channel VHF preamplifier. A three-section preselector filter, two-stage amplifier, and DC power supply are built in.

For amplification beyond the head-end, a number of amplifiers were shown. The Model B-3 bridging amplifier is designed for trunk-line use. This silicon-solid-state unit is powered through the cable from a remote transformer, and remote power may be directed down any of the distribution lines. Model E-22 is a "DeLuxe Suitcase" extender amplifier for distribution-line use. This unit is also cable powered, and power may be passed through it to other units. The Model E-3C extender amplifier is another solid-state, strand-mounted and cable-powered unit. A printed circuit and "in-a-line" construction are used in this unit. The Model R-6T is a fully transistorized "Suitcase" repeater amplifier featuring tilt-corrected automatic level control and spectrum coverage through the VHF-TV, FM,



and intermediate bands. This strand-mounted unit is also cable powered.

Model RB-6T is a transistorized unit incorporating a repeater amplifier and bridging amplifier in the same housing. The repeater section has tilt-corrected ALC and covers the VHF television, FM, and intermediate bands. The unit is cable powered, and power can be sent down any or all distribution lines of the bridger section; the bridger may be removed without disturbing the repeater.

To supply power to remotely powered amplifiers, etc., the Model RPT-3120C remote power-supply transformer is available. This unit can supply up to 12 amps at 30 volts into the cable.

The MTU-8 series of multiple tap-offs is designed for pedestal mounting in buried-plant CATV systems. These units are provided with bottom-mounted input and output fittings and eight front-panel house-drop connections.

Finally, Entron exhibited its Model M-225 frequency converter for field-strength meters. It converts 225 MHz to 73.5 MHz for checking the level of the 225-MHz pilot carrier.

Ft. Worth Tower Co., Inc.

This company presented products from its line of towers, microwave reflectors, communications buildings, and tropo-scatter antenna systems.

Gilbert Engineering Co., Inc.

Gilbert's line of Diamond G connectors was the feature of this display. Recent additions to the line include several units for .412, .500, and .750 cable. There are also seized-center-conductor connectors for these cable sizes and for 4920 and 4930 cable.

Hewlett Packard

A number of items of test and monitoring equipment were shown. Among them was the Model 6946A 17-inch monochrome picture monitor. Features of this monitor include all silicon solid-state circuitry; a constant-delay wideband video amplifier; use of feedback for stability in video, horizontal, and vertical circuits; and a circularly polarized safety glass. Another unit was the Model 191A television waveform oscilloscope including such features as a 20-kv CRT, RGB operation for color-camera set-up, and a high-impedance probe input for troubleshooting.

Test equipment included the Model 3410A AC microvoltmeter. This is a solid-state, tunable, phase-lock voltmeter with 13 ranges from 3 microvolts to 3 volts full scale. Its frequency range is 5 Hz to 600 kHz. Also shown was the Model 1415A time-domain reflectometer for use in conjunction with an oscilloscope (Model 141A) to locate cable faults by means of a "closed-loop radar method."

International Telemeter Corp.

The 1967 and soon-to-be-introduced 1968 models of three equipment types were shown. Focus 12 is a 12-channel VHF-to-VHF converter, used where strong local signals received directly cause ghosting when the cable signal is viewed. The unit is fully solid-state and incorporates heavy shielding and detent channel selection with no fine tuning.

The Plus 13 is connected between the drop and the receiver to add 13 channels to a CATV system. Nine channels between 120 and 174 MHz and four channels between 216 and 240 MHz are translated to channel 2 or 3. The 12 standard channels are bypassed to the set and selected with the normal tuner. The unit is fully transistorized.

The solid-state Gamut 25, also placed between the drop and the receiver, converts up to 25 channels (in the ranges of 54-88 MHz and 120-240 MHz) to channel 2 or 3. Extensive shielding is used to minimize interference problems in strong-signal areas.

ITT Wire and Cable Div.

Amid their many types of cable suitable for CATV use, this company featured a new irradiated polyvinyl-chloride insulation on their XV 125 hook-up wire. The 110° C continuous operation rating makes it resistant to temperatures encountered in equipment and to contact with soldering irons.

Jerrold Electronics Corp.

Jerrold used a "Roaring Twenties" theme to emphasize the introduction of its Starline Twenty system for 12- or 20-channel CATV distribution. The use of Starline Twenty equipment per-

mits the operator to install a 20-channel system, or to install a 12-channel system and convert it later to 20-channel operation. Only a change in head-end equipment and the addition of top-of-the-set converters are necessary in performing the conversion. The display in the Jerrold exhibit included an operating 20-channel system feeding 20 receivers.

In the Starline Twenty series are these trunk-line stations: Model ST-1 includes main-line amplification, AGC, and bridging amplification; Model ST-2 is similar but has a manual-gain trunk-line amplifier. Model ST-3 is used where only trunk-line amplification and AGC are needed; Model ST-4 is used where only trunk-line amplification is needed.

The Model ST-5 distribution station is a high-gain unit used either as a trunk-line terminating unit or, with an auxiliary directional coupler, as a bridging amplifier. Model ST-6 is a low-gain distribution station used on a feeder line where it may be necessary to cascade up to four of these amplifiers. Models SLE-20A and 20B are line-extender amplifiers. Model SLE-20A has a variable tilt control to compensate for tilt of 12 to 20 dB of cable; Model SLE-20B compensates for 4 to 12 dB of cable.

The new solid-state Channel Commander II head-end signal-processing unit is the successor to the tube-type Channel Commander. The unit receives a single VHF channel, processes the signal, and delivers it on any standard VHF channel (including the input channel) or a special VHF channel for use on a 20-channel system. Features include completely modular construction, crystal control of all oscillators, and separate IF and VHF AGC circuitry.

Another attraction in the exhibit was the demonstration of Jerrold's computerized signal surveys. Information about some 850 VHF and UHF TV stations is programmed into a large digital computer. When information about a proposed site is fed to the computer (by teletype connection), a list of all stations within 120 miles of the site is printed out, together with pertinent data to determine whether or not the community has access to enough useable signals to warrant further investigation.

Complementing the line of CATV equipment were several items of solid-state test equipment for use by CATV system technicians.

Kaiser CATV Corp.

Twenty-channel transmission based on existing plant systems of Kaiser manufacture was the principal new feature here. The system utilizes additional channels between navigation frequencies and channel 7 and a set-top converter at the subscriber's set.

Other new products were mainly existing equipment repackaged in a new, die-cast housing.

In the booth was an illustrated description of other Kaiser Industries activities and a demonstration of a Flite-Path system for aerial navigation.

Lenkurt Electric

Featured were two microwave systems, the model 75A microwave radio system and the Model 76 microwave radio system for television.

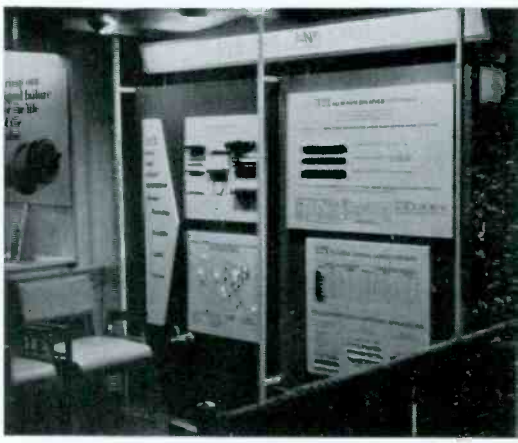
Lindsay Specialty Products, Ltd.

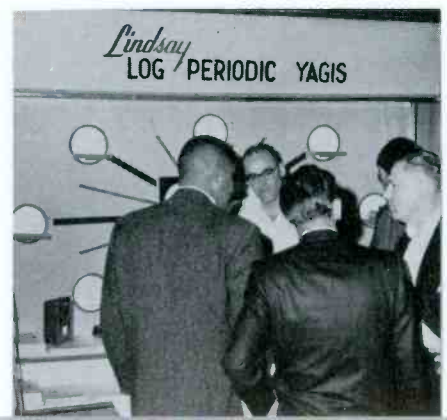
Featured in the booth was a new log-periodic Yagi with an added director train to produce a gain figure equal to that of a quad antenna. Other products included 24-volt AC power supplies with 2-amp and 6-amp capacities, and a TV/FM signal splitter with 0.5 dB loss on TV frequencies and 3 dB loss on FM frequencies. A consultation service to engineer antenna installations for CATV operators also was featured.

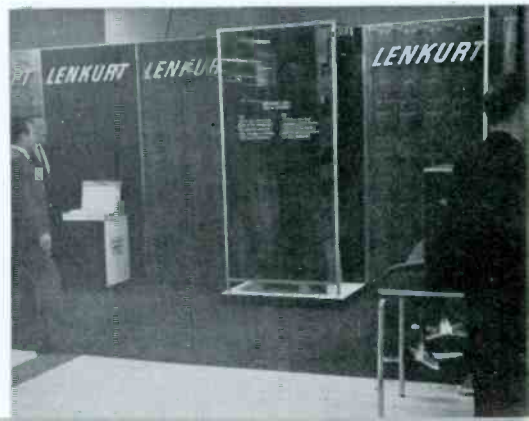
Packard Bell

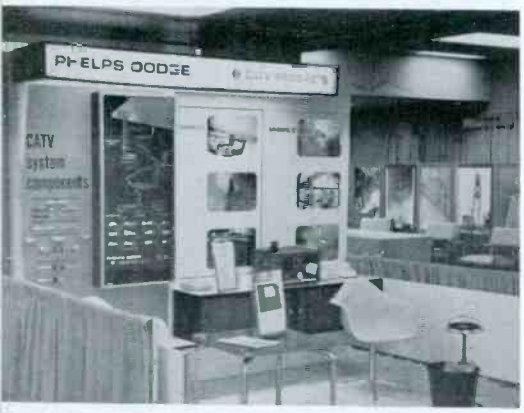
Equipment for local origination was exhibited. Featured were the Model 920 and Model 9200 cameras. Model 9200 is a self-contained viewfinder camera with motor-controlled zoom lens. A "floating" vidicon housing permits 60° tilting without movement of the camera and viewfinder; the camera can be panned through 360°. The viewfinder has an 8" CRT. Two Model 9200 cameras are used in the Model POS-2 TV-studio equipment for CATV and other origination.

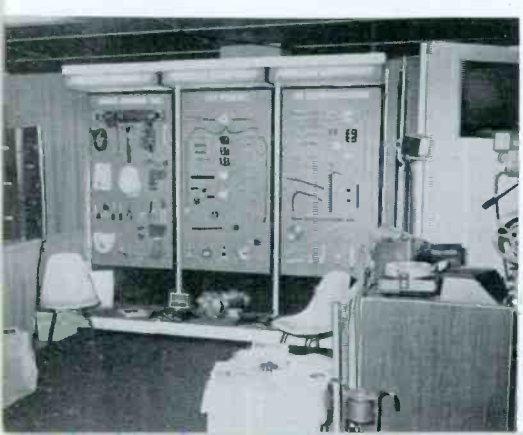
Model 920 is a transistorized cam-











era with a built-in automatic light compensator and a white peak clipper. It is designed for use with an external EIA sync generator, if desired.

Phelps Dodge Copper Products Corp.

Coaxial cable was the central theme of the exhibit. Foamflex cable was presented along with *Spirafil II* cable, in which the solid polyethylene helix completely covers the solid copper inner conductor.

Also featured was a new type of cable designed for direct burial. This cable is made with an outer tin-plated steel jacket for protection from physical injury.

Plastoid Corp.

Representative items from this company's line of cable products were shown.

Preformed Line Products Co.

Items from the company's line of products were highlighted by the Safety Guy-Wire Dispenser. This device, made of wire, assembles into a "cage" which restrains a coil of guy wire while it is payed out by one man. The dispenser is disposable after use.

The one-piece Guy Guard is a plastic tube with a portion of the side wall separated into a strip and molded into a helix. The Guard fits around the guy, with the helix wrapped around the wire to hold the unit in place.

Various other wrap-around cable-attachment devices were exhibited, including the Teletap for attaching the drop wire to the cable messenger.

Pruzan Co.

Electronic and line-construction equipment, and lineman's equipment and tools were presented by this supplier. Items from the Smith and Craftsman equipment lines have been added to the Pruzan catalog.

Raytheon Co.

This company brought to the convention its KTR-3A solid-state microwave equipment. This is a 5-10 watt, 6-13 GHz heterodyne system. For stability, the system uses a drift-cancellation technique developed by the Bell Laboratories. The equipment provides an 1800-message-channel capability (or NTSC color TV with four 15-kHz audio channels). Quick access for maintenance is a design feature.

Rohn Systems, Inc.

Information was available about the company's line of towers and related products.

Scientific-Atlanta, Inc.

Three new items of head-end equipment were highlighted. The Series 6000 single-channel preamplifiers employ field-effect transistors; these preamplifiers are designed for situations in which a weak signal must be amplified in the presence of a strong adjacent-channel signal. Two of the units may be used with a coaxial-cable harness to amplify nonadjacent-channel signals received on one antenna, without the 3 dB loss in effective antenna gain encountered when a hybrid splitter is used.

The Model 6045 preamplifier is designed for reception of signals received on channels 4 and 5 with a broadband antenna, without the 3-dB loss in effective antenna gain that results from using a hybrid splitter or mixer. The unit has an aluminum housing designed for tower mounting.

The Model 6100 solid-state receiver is of completely enclosed, modular construction and is designed to receive any VHF channel. It has a field-effect transistor RF amplifier and crystal-controlled input and output converters. The visual and aural IF modules have separate AGC systems, and the receiver has a built-in output-level meter.

Shibaden Corp. of America

The theme of this display was origination equipment. The FP-108 camera is a portable unit with optional choice of lenses and internal or external sync. The SV-700 VTR uses ½" tape and weighs 53 pounds. A console for CATV included two monitors, four camera inputs, a switcher/fader, and a special effects generator. Also shown was a film-chain camera.

Sony Corp. of America

In this manufacturer's booth were the EV-200 and PV-120U *Videocorders* for CATV origination and other uses. A special feature of the

EV-200 is the availability of two audio tracks. Both machines offer slow-motion and stop-motion capability. The Model EV-200 uses 1″ tape, and the Model PV-120U uses 2″ tape.

Spencer-Kennedy Laboratories, Inc.

One highlight of the exhibit was SKL's demonstration of system analysis by computer. A teletype link was established between the booth and a Chicago computer facility. When information concerning a system was fed into the computer, a number of system performance characteristics were calculated by the computer and printed out by the teletype.

Additions to the Colorburst 7000 line of equipment include amplifiers that provide closed-loop automatic level control and automatic slope control. In the SKL/7027K trunk amplifier, a pilot at 205.25 MHz controls the "flat gain," and a second pilot at 73.5 MHz controls the slope. This amplifier (and the trunk-bridging amplifier combination, SKL/7037K) employs solid-state circuitry and includes integrated-circuit differential operational amplifiers to process the detected pilot signals. Plug-in pads and equalizers are available.

A new piece of test equipment was the SKL/7224 twelve-channel test oscillator. It provides one to twelve VHF picture carriers in any combination. The solid-state equipment provides crystal-controlled carriers, which may be CW or modulated.

Other featured products included the SKL/262 high-level distribution amplifier and a radio alarm system. The latter consists of remote alarm (for police, fire, ambulance, etc.) boxes containing transmitters which relay the alarms to a central point. A tape printer maintains a record of messages, and the equipment is self-checking from the base station with every transmission.

Superior Cable Corp.

The featured item for this exhibitor was Alumagard (jacketed or unjacketed) and Alumagard Type IM (figure-8) coaxial cable with stated spectrum capability to 300 MHz without discontinuities.

Other products and services of this company are Coppergard copper-shielded cable, connectors for Alumagard and Coppergard cables, and Comm/Scope services in the areas of CATV system planning, engineering, and construction.

Sylvania Electric Products, Inc.

Equipment for local origination was arrayed in Sylvania's studio exhibit. The SC-16A viewfinder vidicon camera was demonstrated with a zoom lens. Also in the exhibit were the 15A vidicon camera, a film-pickup chain, and a 3-bay control console. A new color scheme for Sylvania equipment —black case with a blue stripe—was in evidence in the display.

Tape-Athon Corp.

Presented by this firm was the "New" programmer, a tape-playing system which employs a four-position switch and a clock for control of four reel-to-reel decks to provide non-repetitive, automatic audio programming. Features of the system include 32 hours of continuous service without repetition, automatic standby in the event of failure of one or more decks, automatic interspersing of 2 decks, AGC, VU meter, 15-watt amplifier, and a 7-day clock for daily on-off operation.

Shown as part of the programming system were the model 900 tape deck and the Tape-Athon background-music service.

Telemation, Inc.

Local origination was the keynote of this exhibit also, and a complete origination package integrated into a *Weather Channel* 97 was in operation. Two positions of the *Weather Channel* were occupied by a slide projector and a 16-mm sound-on-film projector. Other, separate program sources were a live camera (GE) with viewfinder and an Ampex helical-scan VTR. Solid-state monitors and quartz-iodine lighting were included in the system.

The heart of the studio equipment was Telemation's new Model TMV-600 *Cablecaster* video control center. This equipment combines in a desk-top unit the functions of a two-bus, six-input switcher; pulse-distribution amplifiers; video-level meter; video processing and control for up to four cameras (modified GE TE 14/15 and TE 20 units); video output amplifiers; and power supply. All cameras are

syncronized from one source, which may be an industrial sync generator in one of the cameras, an external EIA generator, or an optional built-in EIA generator in the control center. The unit can be operated from a remote switching location or by an automatic programmer.

Several other Telemation products were on display. The Model TSG-2000 is a broadcast-type synchronizing generator making use of computer techniques. The Model TMM-203A optical multiplexer accommodates two 16-mm film projectors and one 35-mm slide projector. The unit, available with a remote-control panel, achieves image selection by means of motor-driven first-surface mirrors. The *Weather Channel* 75 is a table-top version of the *Weather Channel* 97; it also is compatible with the *Cablecaster* system. The Model TMP-205 nonduplication switcher provides switching on any selected minute and at odd-second intervals. *News Channel* provides a continuous printed display of news from the AP wire service. The origination of audio programming was demonstrated using *Spotmaster* cartridge equipment. And the *Telectern*, overhead camera system for educational and other uses, was in operation in the Convention's "channel 4" production area.

Telesis Corp.

New and featured was the Telemark I automatic nonduplication program switcher, Model 1619. Program-change requirements are set up on a program board (one for each channel) by means of a bank of small switches. Stepper switches, actuated by the discharge of a capacitor and timed by a battery-powered clock, select the days and hours. The actual routing of the TV signals is done by separate coaxial relays; either deletion or substitution can be accomplished.

Also in this exhibit was a new line of CATV amplifiers with plug-in modules. These units employ solid-state circuitry and have input and output impedances of 75 ohms. Model 1400 is a trunk amplifier for the 50-225 MHz range. Model 1614 is a trunk amplifier for the 5-90 MHz frequency range. Model 1403 is designed as a high- or low-gain bridging amplifier for use on the main trunk in the 50-225 MHz range. Model 1117 is a line-extender amplifier (50-225 MHz).

Television Presentations, Inc.

A method for the presentation of news and information was shown in this booth. Called Alphamatic News, the system consists of a character generator (developed by RCA Victor Company, Ltd) which converts news (supplied by United Press International) and stock quotations (supplied by the New York Stock Exchange) to twelve lines of characters for reading from a television screen. Ten of the lines are for news, and the bottom two are for stock information. Local insertions can be made via punched tape from an optional teletypewriter.

Television Utilities Corp.

This exhibitor showed two cameras, the VF-1500 with remote control, viewfinder, and EIA sync; and the VF-1000.

The Telesync horizontal-vertical crawl was also presented in this booth. This device consists of a drum on which material for airing is attached. The material is presented white on black or black on white by means of transparent plastic film prepared on a typewriter. The drum can be positioned to provide either vertical or horizontal crawl.

Theta-Com Corp.

Short-haul employment of microwave signals in the 18-GHz band was demonstrated by this exhibitor. Called AML (Amplitude Modulated Link), the system translates the normal VHF television band to the 18-GHz region for transmission. Upon reception, the signals are translated to the original band for distribution. The demonstration equipment consisted of a transmitter, two transmitting horns and receiving dishes, and two sets of twelve monitors. Multichannel program material for the exhibit was supplied, via cable, from another exhibit.

The equipment is not available for sale pending FCC approval of this type of operation on a regular basis.

Times Wire & Cable
Div. of Int'l. Silver Co.

Cables and connectors for CATV were shown by this exhibitor. The

company placed emphasis on the performance of the JT-1000 series of aluminum-sheathed cable; specifications of this cable include a minimum of 30 dB return loss (unweighted for channels 2-13.) The manufacturer also states that upon request (at an additional cost) it will sweep test the cable to 300 MHz.

Transitube, Inc.

Vidicon cameras for CATV or CCTV use were presented. The COM/ANT 650 camera is a solid-state unit with automatic light compensation, video and RF output, and a built-in microphone for sound pickup. Also shown was the COM/ANT M800 8″ video monitor with built-in transistorized two-way audio system.

Trans-Lux Distributing Corp.

The subject of this display was equipment for origination of informational material. Included was a system for automatically displaying stock information; stock quotations received by wire are printed out on a moving paper tape which is then scanned by a camera.

Receiving considerable emphasis in this exhibit was a drum device (Automated CATV Products PSD Mark III) for displaying information over a CATV channel. Visual matter—news items, community-service announcements, locally prepared news photos, etc.—is pasted (or taped) to the periphery of the 20-inch drum. As the drum rotates, a camera scans the visual material; the speed may be varied, or the unit may be stopped if desired.

R. H. Tyler Co.

Introduced was an all-electronic *Weather-Scan* system with no moving parts; the unit employs electronic switching. Other items in the booth were Roto-Scan, a weather-presentation concept in which the camera scans with a circular motion and stops at each position; Weather-Scan, with conventional horizontal scan; and the VU-Finder 2-13 viewfinder camera.

Vikoa, Inc.

A variety of new models has been added to the Vikoa (formerly Viking) line.

The Model ST 1000 is a self-contained solid-state vidicon camera for CATV, MATV, or CCTV origination. It includes an automatic light compensator and has both video and RF outputs.

A new time-weather-channel originator is called the Weathercaster. It comprises a fixed vidicon camera focused on a rotating mirror which scans eight viewing positions, including a clock and a six-sided rotating sign holder.

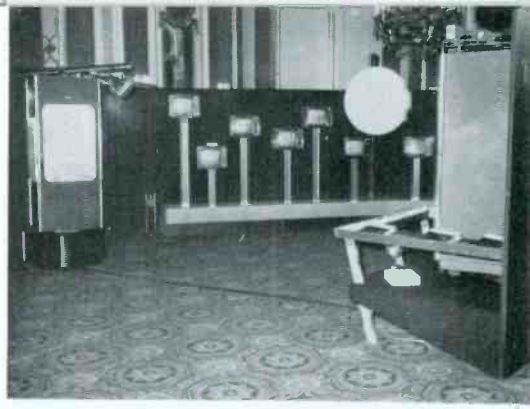
The Duplomat nonduplication switcher accepts 12 inputs and provides six outputs. The unit is set once a week by inserting metal plugs into the appropriate holes; switching takes place at 15-minute intervals. A "catch-up" mechanism restores the unit to the correct schedule after power failures.

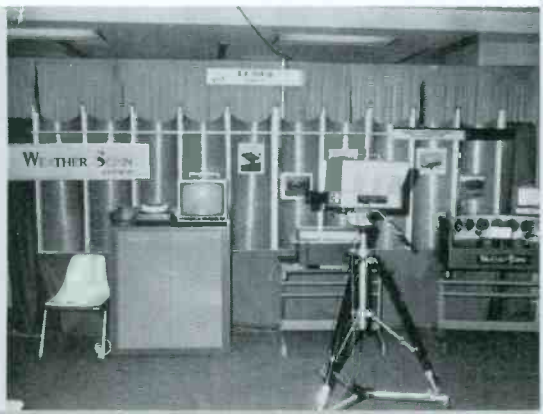
Two solid-state field-strength meters for CATV use were introduced. Model 481 is a portable AC/battery unit with an illuminated meter and individual channel calibration. Model 482 is designed to be mounted in a 19″ rack. It is similar to the Model 481 except that it has a built-in audio monitor with speaker. Frequency coverage is continuous channel 2 through FM, channel 7 through channel 13.

A third-generation Mustang solid-state line extender is the Mustang III, Model 568M. This modular amplifier for the 50-220 MHz range has separate tilt and gain controls to compensate for 12 to 20 dB of cable. For convenience in bench servicing, all RF transistors are mounted in individual sockets.

Model 451 is a new line extender in the Futura line of solid-state modular CATV amplifiers. Separate tilt and gain controls compensate for equivalent cable lengths of 10 to 20 dB. Frequency range is 50 to 220 MHz.

Additions also have been made to the hardware line. The Model 443 spacer is used with a Model 444 strap to separate cable from equipment. The Model 415 E-type cable-lashing clamp is used to secure cable-lashing wire at the end of a span. The Model 449 feed-throughs (black for outdoors, beige for indoors) cover drill damage to the subscriber's home and protect dropline cables from abrasion. ▲





Supplement to

REVIEW OF PROFESSIONAL MICROPHONES

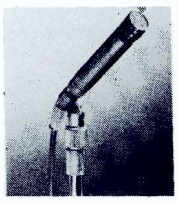
New models, discontinued models, and changes to last year's listings are included in this comprehensive supplement.

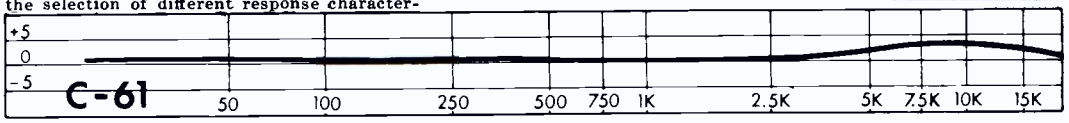
AKG (Norelco)

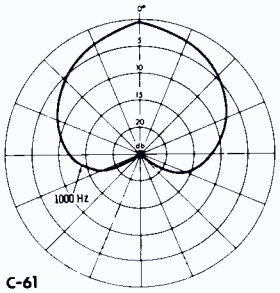
North American Philips Co., Inc., 100 E. 42nd St., New York, N. Y. 10017

C-61

Changeable-pattern condenser—Output level: −42 dB (re 1 mw/10 dynes/cm²)—**Impedance:** 200/50 ohms—**Dimensions:** 5″ × ¾″ dia—**Weight:** 6 oz—**Accessories furnished:** power supply, 33-ft cable, stand adapter—**Accessories available:** W-17 Windscreen, H-60 Suspension—**Price:** $280.
Comments: Interchangeable capsules allow the selection of different response characteristics for adapting the system to various types of environment and recording applications.



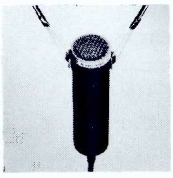


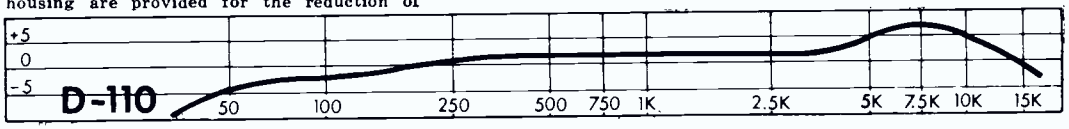


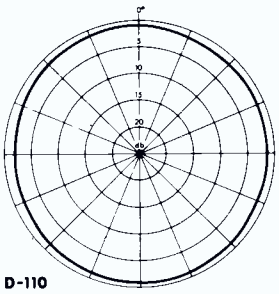
C-61

D-110

Dynamic lavalier—Output level: −56 dB—**Impedance:** 200 ohms—**Dimensions:** 3″ × ¾″ dia—**Weight:** 3 oz—**Finish:** Dark gray—**Accessories furnished:** Neck cord, clip, 30-ft cable—**Price:** $80.
Comments: A suspended capsule and double housing are provided for the reduction of handling and cable noises. High output serves to improve signal-to-noise ratio.

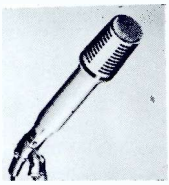


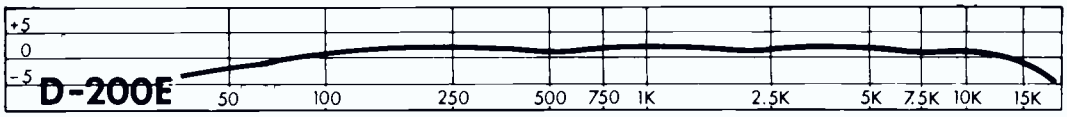


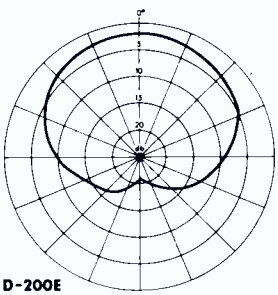

D-110

D-200E

Cardioid dynamic—Stand-mounted or hand-held—Output level: −55 dB—**Impedance:** 200 ohms—**Dimensions:** 7¼″ × 1½″ dia—**Weight:** 8 oz—**Finish:** Matte gray—**Accessories furnished:** Stand adapter, 15-ft cable, case—**Accessories available:** W-4 Windscreen, ST-305 table stand—**Price:** $75.
Comments: The microphone features separate capsules for the high and low frequencies, with a crossover network at 500 Hz. The systems are internally shock mounted to reduce handling and cable noise. The microphone is designed for uniform front-to-back discrimination.





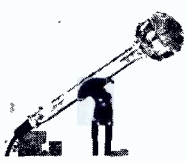

D-200E

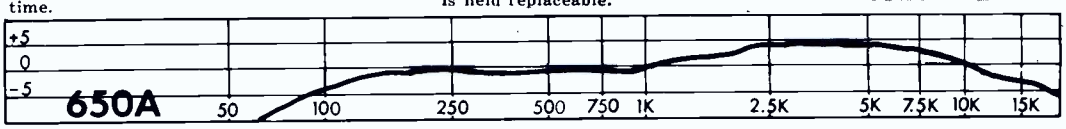
Altec Lansing

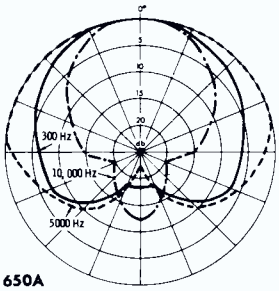
Altec Lansing, 1515 S. Manchester Ave., Anaheim, Calif. 92803

650A and 651A

Dynamic, Cardioid—Hand-held or Stand-mounted—Output level: 650A, −56dBm; 651A, −57dBm—**Impedance:** 650A, 150/250 ohms or 20,000 ohms, changeable; 651A, 20,000 ohms only—**Dimensions:** 650A, 6-13/16″ × 1¾″ dia; 651A, 7½″ × 1¾″ dia—**Finish:** Satin Chrome—**Price:** Not available at this time.
Comments: These microphones feature built-in breath and "pop" screens for the suppression of unwanted noises. The diaphragm is resistant to the effects of shock, blasts, and corrosive fumes, and has been designed to withstand extreme humidity and temperature variations. The dynamic pressure unit is field replaceable.





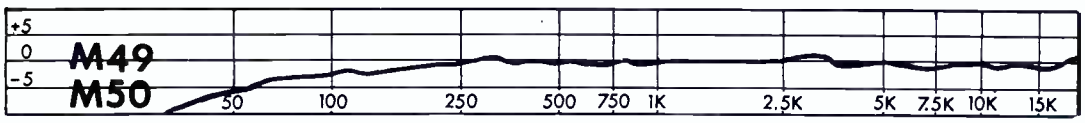


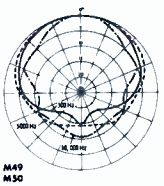
650A

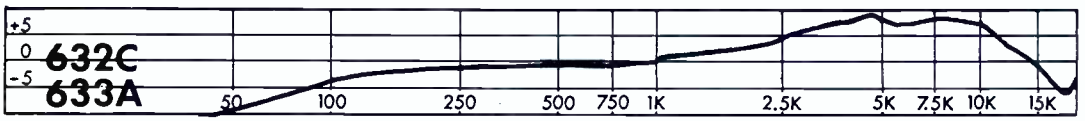
Availability of the following microphones has been discontinued: M-30 Condenser System and Models 674A, 675A, 678A, 679A. Information appearing in last year's microphone survey for the following microphones should be modified as follows:

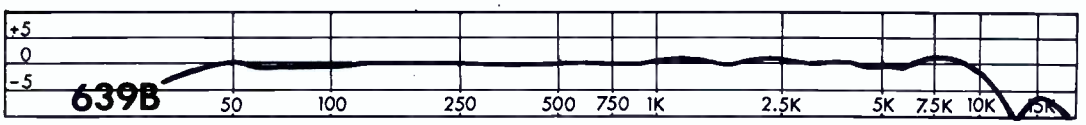
M-49—Price: $199.50
M-50—Price: $199.50
M-51—Price: $199.50
M-52—Price: $199.50
632C—Price: $52.00
633A—Price: $54.00
633C—Price: $66.00
639B—Price: $337.50
677B (replaces 677A)—Price: $25.50.
684B—Price: $66.00
685B—Price: $84.00
686A—Price: $48.00
687B—Price: $42.00
688B—Price: $75.00
689B—Price: $87.00
689BX—Price: $105.00
697A—Price: $59.70

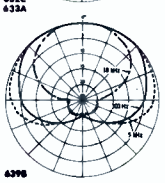
The response curves and polar graphs which follow apply to microphones which were listed in last year's article. Each graph or curve is marked to indicate its applicability.

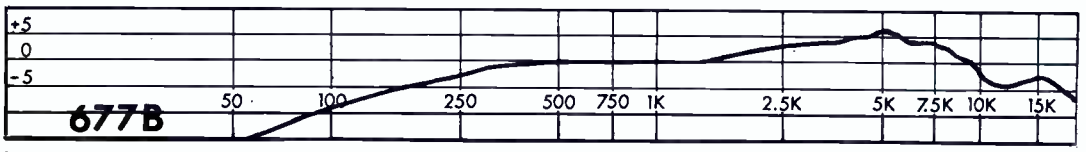


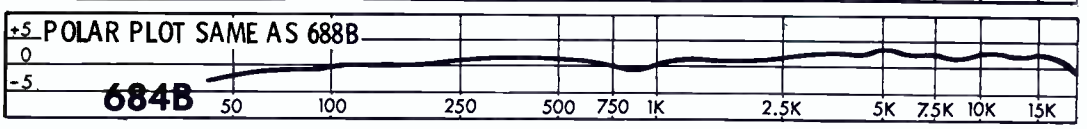


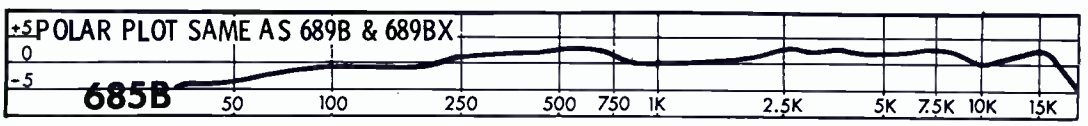


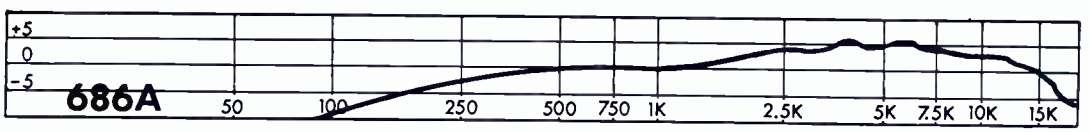


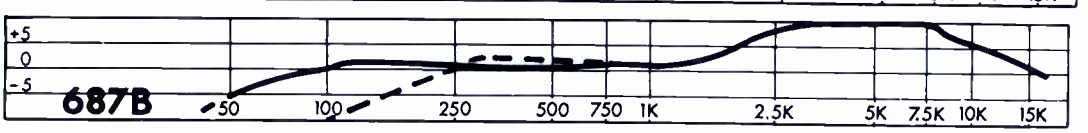


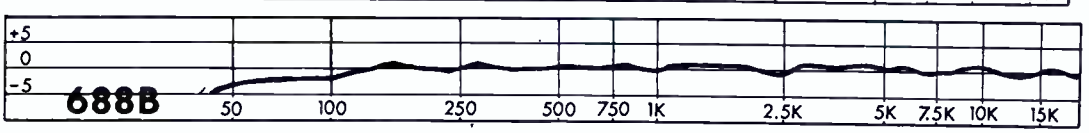


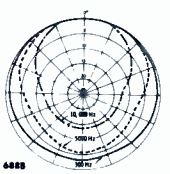


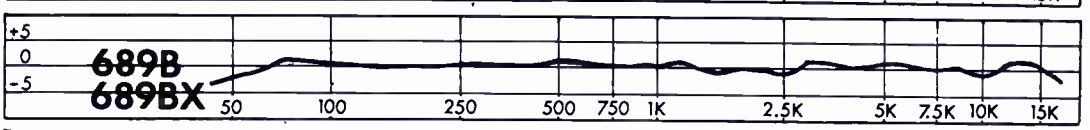


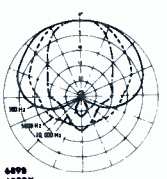


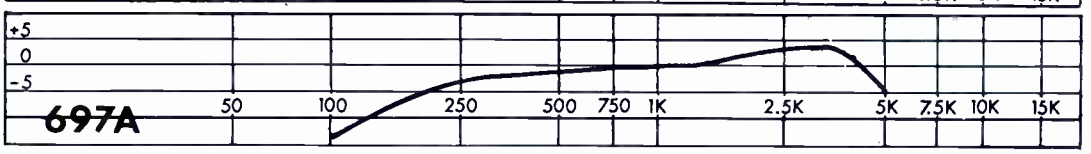










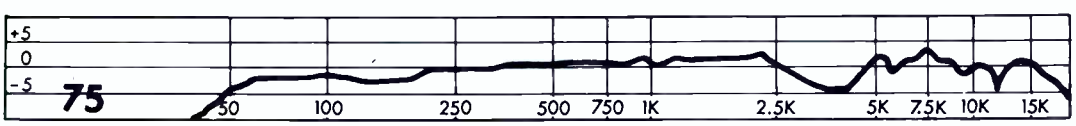


Bang and Olufsen

Dynaco, Inc., 3912 Powelton Ave., Philadelphia, Pa. 19104

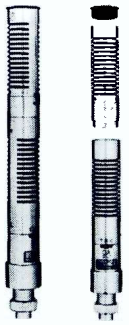
75

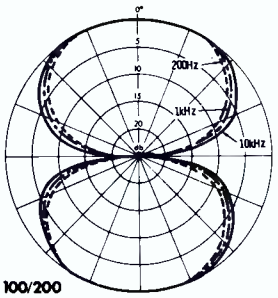
Omnidirectional dynamic—Lavalier or stand-mounted—Sensitivity: 80 dB below 1 v/μbar **—Hum sensitivity:** −139 dB**—Impedance:** 200 ohms**—Dimensions:** 4½″ × 1-1/16″ dia **—Accessories furnished:** 6-ft cable and DIN plug, neck band, and built-in desk stand. **Comments:** This microphone has a spherical directional characteristic.



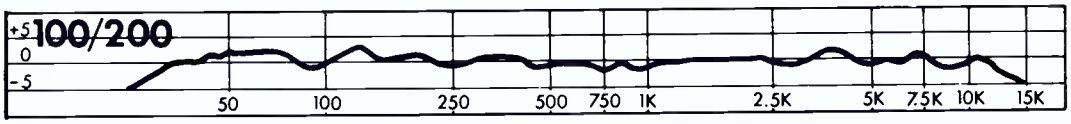
100/200

Figure-eight ribbon — Stand-mounted or suspended—RETMA Gm Sensitivity: −156 dB—**Impedance:** 150/200 ohms—**Accessories furnished:** foam-lined case, bayonet clip for stand use, 20-ft cable, ball-swivel mount—**Accessories available:** Stereo spacer for dual mount, matching transformers—**Price:** 100, $89.95; 200, $149.95.
Comments: This unusual microphone is designed to provide stereo pickup at one point by stacking two directional microphone units. The stereo version is the Model 200, and a single element unit for monophonic use is the Model 100. A switch in the base unit is for selection of normal, close, and off.





100/200

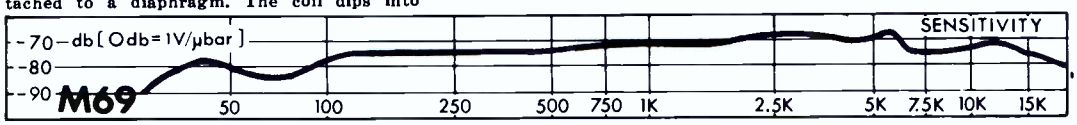


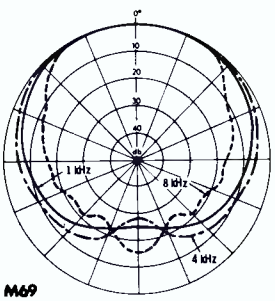
Beyer

Elpa Marketing Industries, Inc., New Hyde Park, N. Y. 11040

M 69

Cardioid moving-coil dynamic—Hand-held or mounted—Output level: 0.24 mv/μb—**Impedance:** 200 ohms—**Dimensions:** 170 mm × 48 mm dia—**Weight:** 240 grams.
Comments: In this and other moving-coil dynamic microphones, a copper coil is attached to a diaphragm. The coil dips into the field of a permanent magnet in response to the movement of the diaphragm, inducing a voltage which corresponds to the vibrations from the sound source.

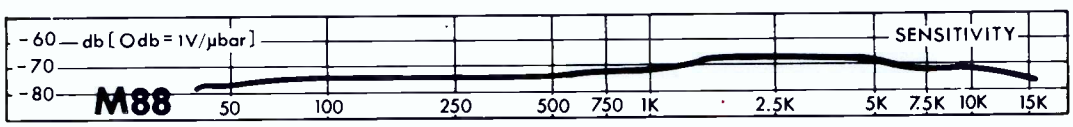


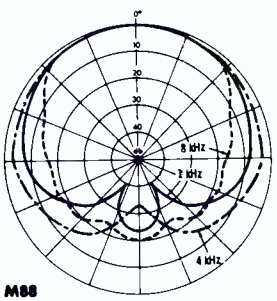


M69

M 88

Cardioid moving-coil dynamic—Hand-held or mounted—Output level: 0.28 mv/μb—**Impedance:** 200 ohms—**Dimensions:** 170 mm × 48 mm dia—**Weight:** 225 grams.
Comments: This microphone employs the same operating principles as the M-69.

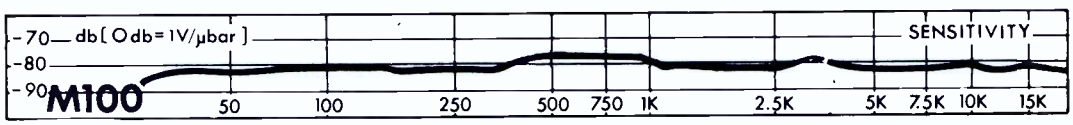


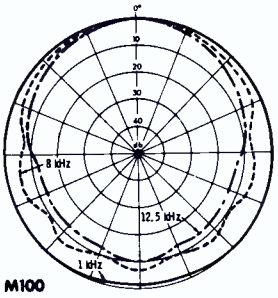


M88

M 100

Omnidirectional, moving-coil dynamic—Stand-mounted—Output level: 0.1 mv/μb—**Impedance:** 200 ohms—**Dimensions:** 140 mm × 26 mm dia—**Weight:** 115 grams.
Comments: Another moving-coil microphone by this manufacturer, this model has been especially designed for studio application.

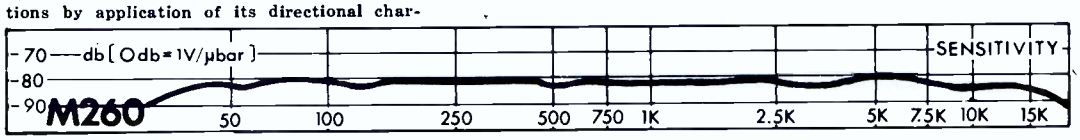


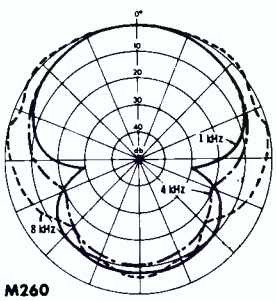


M100

M 260, M 260 SM

Supercardioid dynamic ribbon—Hand-held or stand-mounted—Output level: 0.09 mv/μb—**Impedance:** 200 ohms—**Dimensions:** 165 mm × 43 mm dia—**Weight:** 250 grams.
Comments: This microphone was designed to reduce feedback in adverse acoustic situations by application of its directional characteristic. Model M 260 SM has a built-in "Voice-Off-Music" switch.





M260

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Solid State Color STABilizing AMPlifier

with A.G.C. model VI-500

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through complete and accurate temperature compensation

AUTOMATIC VIDEO LEVEL CONTROL
Maintains video peaks constant to a preset level, with reference to blanking.

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Sync tip clamps remove hum, tilt and other low frequency disturbances. Where excessive negative spikes or transient-noise are present, additional noise immunity is available with an external pulse regenerator at $300.00

SYNC LEVEL
Sync level is maintained at a constant amplitude despite large variations in input.

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Accurately compensates for losses in up to 1000 feet of coaxial cable.

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Sync Level
White Clip
Chroma Control
By-pass switch

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Chroma response continuously adjustable ±4db. from unity.
For Automatic chroma feature to assure constant burst level, add $200.00.

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Stretch adjustments provide a high degree of flexibility to compensate linearity characteristics of transmitters of all ages.

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Mono or **Color** non composite output board in lieu of white stretch for additional $100.00.

APPLICATION
At the input to all transmitters (VHF, UHF. 2500 MHz) and remote inputs to your station. You may use the non composite output (color or mono) and bring it into your switcher for mixing with local signals. You may use it at the input and output of VTR's including helical scan recorders. At the line output of your switcher, at the input and output of microwave equipment and for air pick-ups.

Price for the VI-500 still $1,750.00 **Remote controls $150.00 . . . One out of 3 stations in the country already enjoys the benefits of this stabilizing amp.**

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Write for complete information and specifications.

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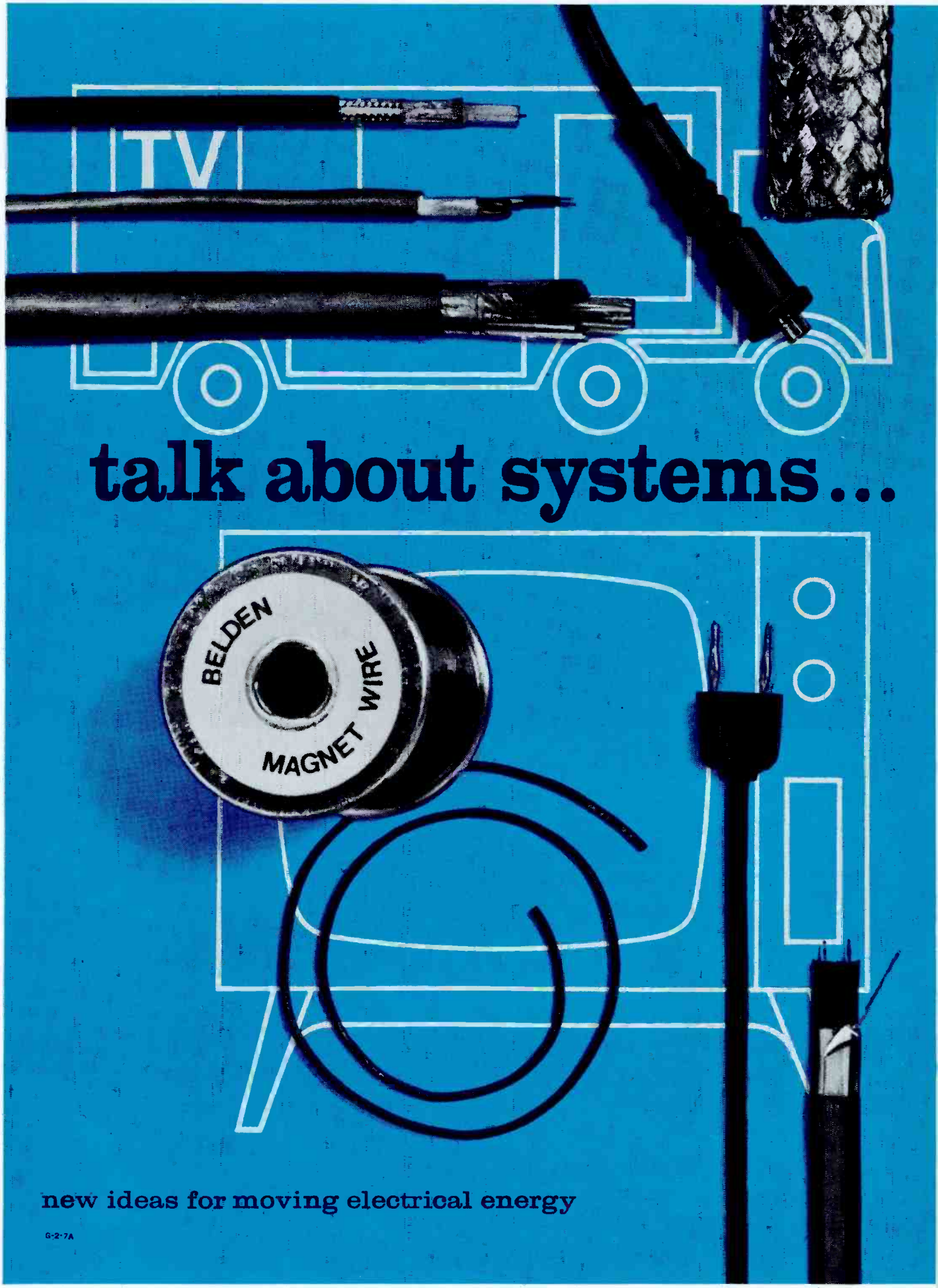
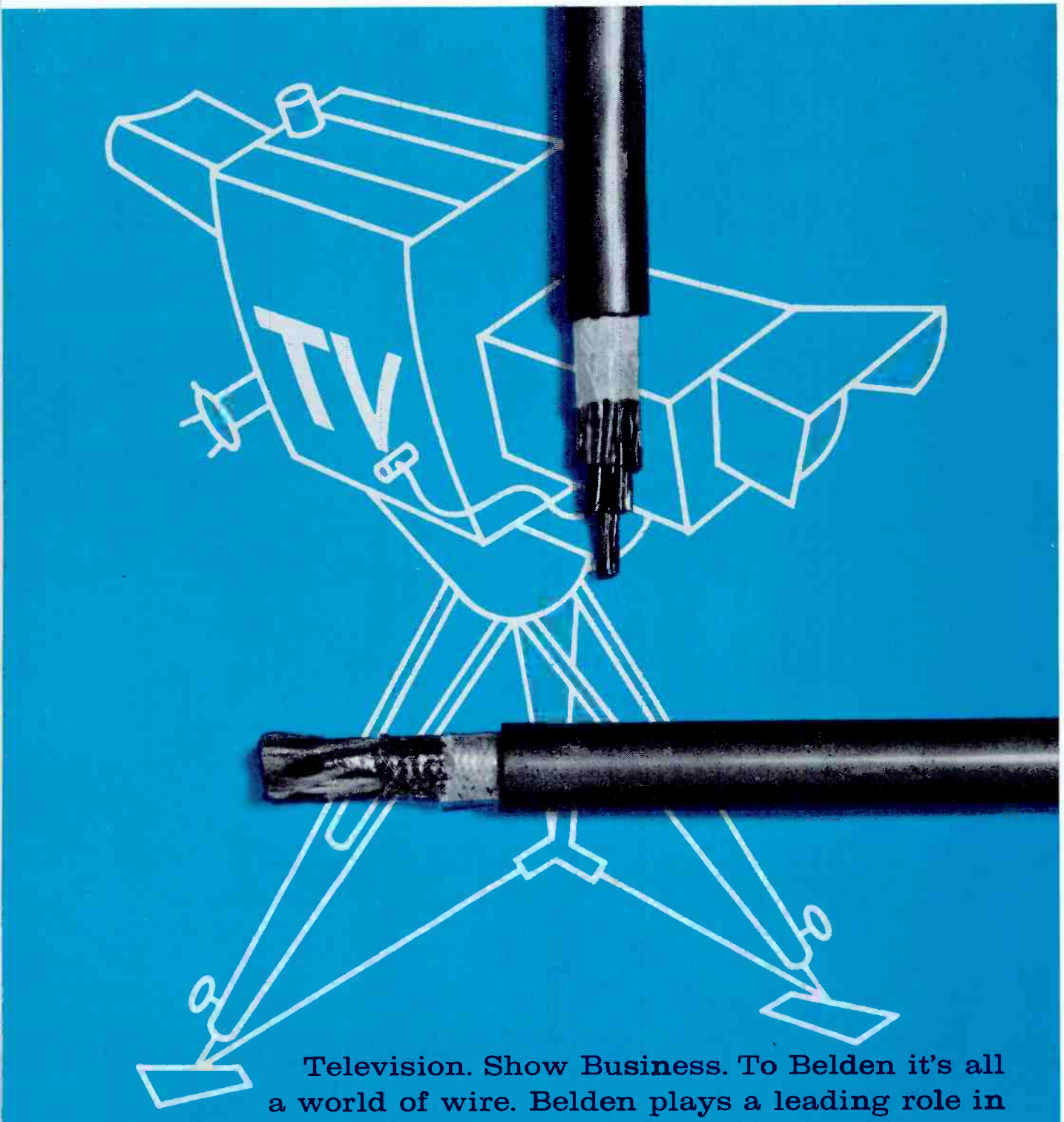
As Advertised in BROADCAST ENGINEERING



talk about systems...

new ideas for moving electrical energy

G-2-7A



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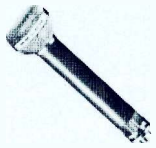
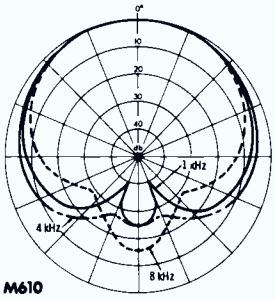
BELDEN

Circle Item 13 on Tech Data Card

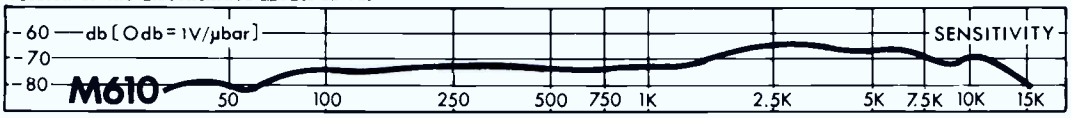
M 610, M 610 SM





M610

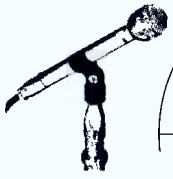
Cardioid moving-coil dynamic—Hand-held or stand-mounted—Output level: 0.2 mv/μb—**Impedance:** 200 ohms—**Dimensions:** 165 mm × 45 mm dia—**Weight:** 240 grams.
Comments: Featured in this microphone is a voice-music switch (in Model M 610 SM) and a clip-on windscreen. It is an improved version of the discontinued Model M 61.

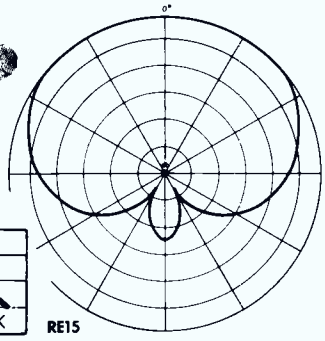


Electro-Voice

Electro-Voice Inc., Buchanan, Mich.

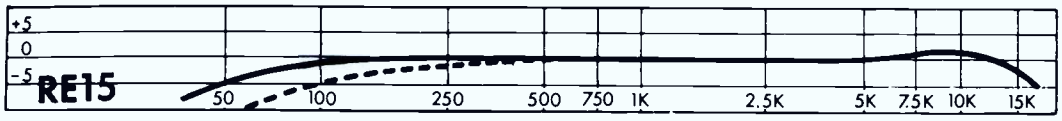
RE 15





RE15

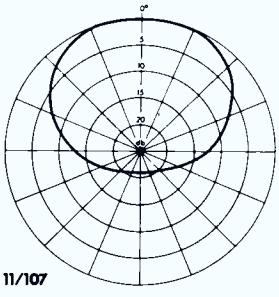
Supercardioid dynamic—Hand-held or stand-mounted—Output level: −56 dB—**EIA sensitivity:** −150 dB—**Impedance:** 150 ohms—**Dimensions:** 6-7/16″ × 1⅜″—**Weight:** 6 oz—**Accessories furnished:** 18-ft, 2-conductor shielded cable with Cannon XLR-3-11 connector; metal carrying case; Model 310 clamp—**Optional accessories:** Model 311 "Snap Out" clamp.
Comments: This microphone appeared in last year's review as Model KE15. Except for slight changes in the response curve, features discussed in the earlier report are identical.



Geloso

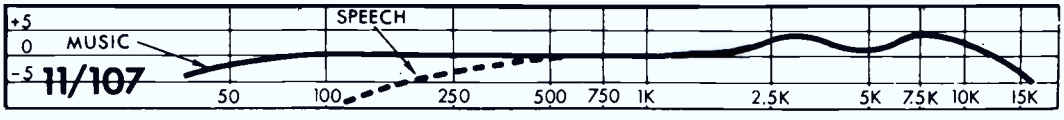
American Geloso Electronics, Inc., 251 Park Ave. South, New York, N. Y. 10010

11/107



11/107

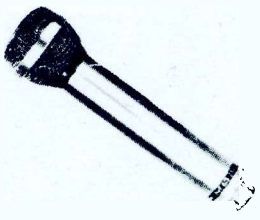
Cardioid dynamic—Hand-held, stand-, or boom-mounted—Output level: −55 dB—**Impedance:** 250 ohms—**Dimensions:** 6½″ × 1″ dia—**Weight:** 7½ oz—**Accessories furnished:** Stand adapter, 25-ft, 3-conductor detachable shielded cable with phone plug.
Comments: A self-contained "music-speech" switch for altering frequency response is provided. A matching transformer (No. 11/1) must be employed with high-impedance inputs.



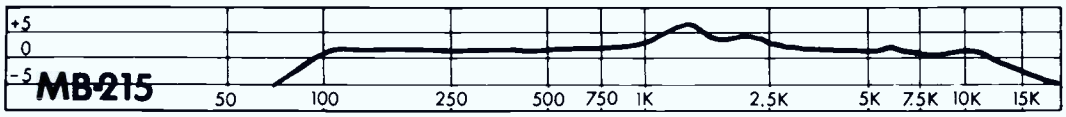
MB

Dobbs/Stanford, 569 Laurel St., San Carlos, Calif. 94070

215

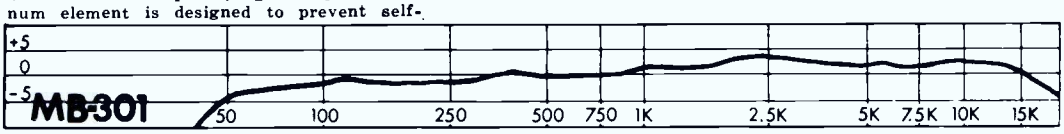


Cardioid dynamic—Hand-held or stand-mounted—Impedance: 200 ohms—**Dimensions:** 150 mm × 38 mm dia—**Weight:** 130 grams.
Comments: The characteristics of this microphone are the result of a special tempering process used in the construction of the diaphragm. The metal screen helps to reduce unwanted noises when the microphone is used for close talking.



301

Cardioid dynamic-ribbon—Hand-held or stand-mounted—Impedance: 200 ohms—**Dimensions:** 180 mm × 50 mm dia—**Weight:** 300 grams.
Comments: The special, light-weight aluminum element is designed to prevent self-oscillation. The meshed-wire grille provides screening against wind and breath noises.



Neumann

Gotham Audio Corp., 2 W. 46 St., New York, N. Y. 10036

This manufacturer will soon introduce a new series of condenser microphones which employ field-effect transistors. The microphones will be available in two power-system options; the 70 series will employ modulation-lead powering, and the 80 series is to employ a phantom-power system. The suffix numbers of each series correspond; that is, KM73 and KM83 are identical microphones except for the power supply. The same is true for Models KM74/KM84, KM76/KM86, and U77/U87. (In the case of KM73/KM83 and KM74/KM84, the housing also differs for the two series.)

KM73/KM83

Omnidirectional condenser of the pressure type—Output level: KM73, 3 mv/μb; KM83, 0.5 mv/μb—**Impedance:** KM73, 200 ohms; KM83, 200/50 ohms—**Dimensions:** KM73, 145 mm × 24 mm dia; KM83, 101 mm × 21 mm dia—**Weight:** KM73, 95 grams; KM83, 80 grams—**Price:** Not available.
Comments: These microphones are designed to capture the overall effect of complex sound sources. To achieve this effect, the frequency response is essentially uniform in all directions.

KM74/KM84

Cardioid condenser of the pressure-gradient type—Output level: KM74, 3 mv/μb; KM84, 0.5 mv/μb.—**Impedance:** KM74, 200 ohms; KM84, 200/50 ohms—**Dimensions:** KM74, 145 mm × 24 mm dia; KM84, 101 mm × 21 mm dia—**Weight:** KM74, 95 grams; KM84, 80 grams—**Price:** Not available.
Comments: The directional characteristic of these microphones is almost independent of frequency. For a polar graph and frequency-response curve for these microphones, refer to the Neumann Model U-64, shown in last year's review.

KM76/KM86

Switchable-pattern condenser of the pressure-gradient type—Output level: KM76, 2.6 mv/μb; KM86, 0.7 mv/μb—**Impedance:** KM76, 200 ohms; KM86, 200/50 ohms—**Dimensions:** 175 mm × 46 mm dia—**Weight:** 200 grams—**Price:** Not available.
Comments: Microphones of this series are provided with a plug-in head assembly which contains two single capsules. This permits setting the directional pattern to an omnidirectional, figure-eight, or cardioid characteristic. A special feature at the omnidirectional and figure-eight patterns is uniform response to the low frequencies.

U77/U87

Switchable pattern condenser of the pressure-gradient type—Output level: U77, 5 mv/μb; U87, 0.8 mv/μb—**Impedance:** U77, 200 ohms; U87, 200/50 ohms—**Dimensions:** 200 mm × 56 mm dia—**Weight:** U77, 500 grams; U87, 550 grams—**Price:** Not available.
Comments: These microphones utilize the same capsule as the model U-67 (presented in last year's article) and consequently exhibit the same polar pattern and frequency response. By means of a switch at the microphone, an omnidirectional, figure-eight, or cardioid pattern can be set. For close talking in the cardioid position, the resulting rise at the low-frequency end can be switched to "linear." Extremely high sound pressures can be prevented from overloading the amplifier by reducing the sensitivity of the capsule. By inserting batteries into the microphone case, it is possible to operate the microphone without external power feed.

KML

Cardioid condenser for lavalier use—Price: Not available.
Comments: This microphone was designed for those situations (interviews, etc.) where the wearer also wishes to pick up another person's voice. The person interviewed speaks directly into the microphone, and the interviewer addresses the unit at a 90-degree angle. This results in a 6-dB sensitivity reduction for the interviewer's voice; at the usual distance between speakers, both voices therefore arrive at the capsule at about the same level. The unit has been designed for consistent frequency response at appropriate incident angles. The microphone also can be used in any instance where a lightweight, unobtrusive unit is required.

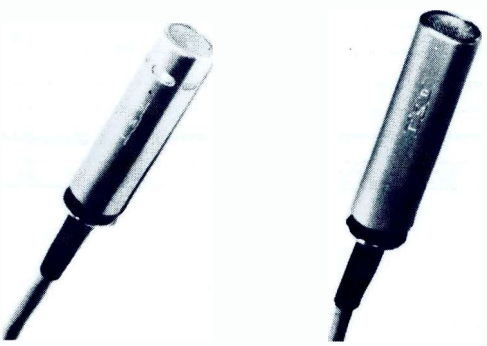
Norelco (See AKG)

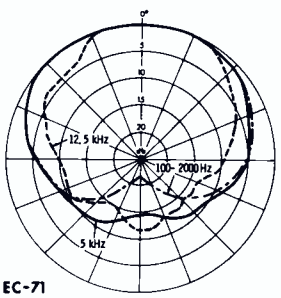
PML

Ercona Corp., 432 Park Ave. South, New York, N. Y. 10016

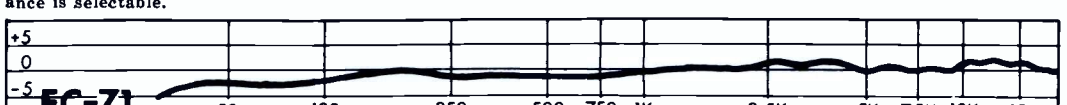
EC71, EK71

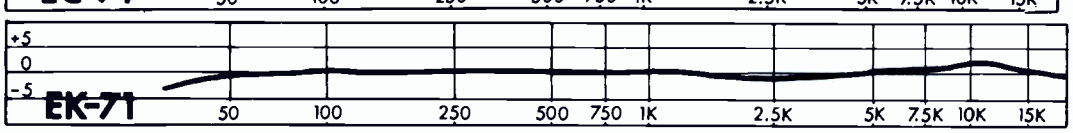
Omnidirectional (EK71) and cardioid (EC71) miniature condenser—Output level: −48 dB—**EIA sensitivity:** −134 dB—**Impedances:** 30/50, 200, and 600 ohms balanced, Hi-Z unbalanced—**Dimensions:** 2-11/16″ × 11/16″—**Weight:** 1¼ oz—**Finish:** anodized satin—**Accessories furnished:** ⅝″ × 27 tpi stand adapter and 12-ft cable to power supply—**Accessories available:** Optional power supplies (battery and AC, mono and stereo), windscreen, lavalier mount, transistorized three-way mixer, signal- and microphone-extension cables—**Price:** EC71, $109.50; EK71, $99.50.
Comments: Field-effect transistors are used in the circuitry of this microphone. Impedance is selectable.

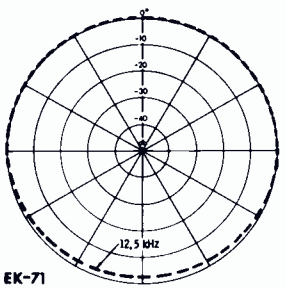




EC-71



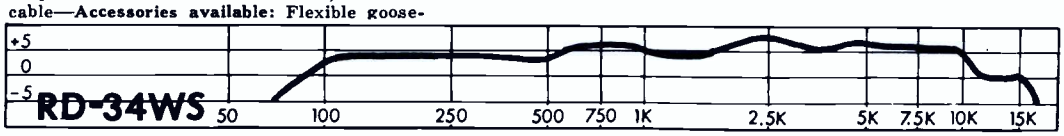


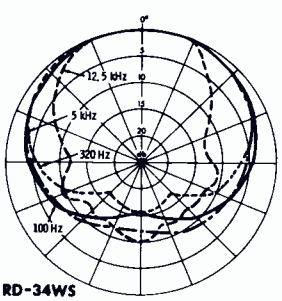


EK-71

RD34WS

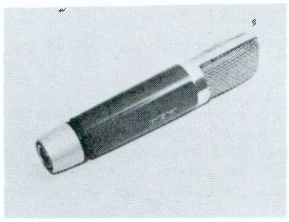
Cardioid dynamic—Output level: −54 dB—**EIA sensitivity:** −150 dB—**Impedance:** 200 ohms—**Dimensions:** 4⅛″ × 1¼″—**Weight:** 5 oz—**Finish:** Black anodized and satin gray—**Accessories Furnished:** ⅝″ × 27 tpi stand adapter and 18-ft unterminated, shielded cable—**Accessories available:** Flexible gooseneck—**Price:** $75.
Comments: The built-in windscreen may be employed to reduce undesirable feedback, background noises, etc.



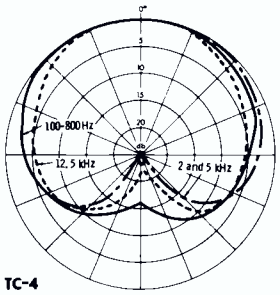


RD-34WS

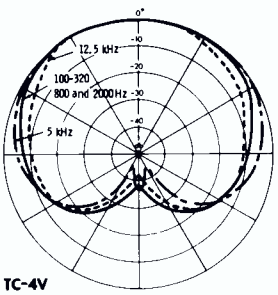
TC4 and TC4V



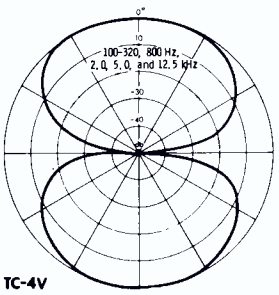
Cardioid (TC-4) or variable (TC-4V) pattern (omnidirectional, figure-eight, and cardioid) condenser—Boom or stand mounted—Output level: −45 dB—**EIA sensitivity:** −124 dB—**Impedance:** 200 ohms—**Dimensions:** 1-1/16″ × 5⅝″—**Weight:** 5 oz—**Finish:** Black matte—**Accessories furnished:** ⅝″ × 27 tpi stand adapter and 20-ft cable to power supply—**Accessories available:** Optional power supplies (battery and AC, mono and stereo), boom shock mount, transistorized three-way mixer, signal and microphone extension cables—**Price:** TC-4, $275; TC-4V, $295.
Comments: The antireflection finish is especially suitable for film and TV usage. The microphone amplifier is solid-state; two field-effect transistors are employed.



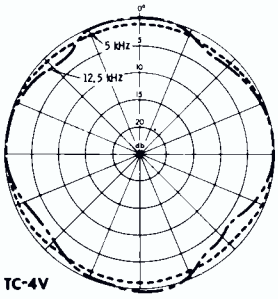
TC-4



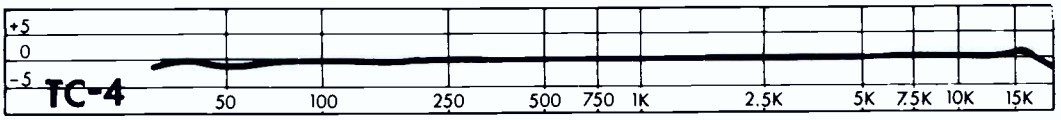
TC-4V

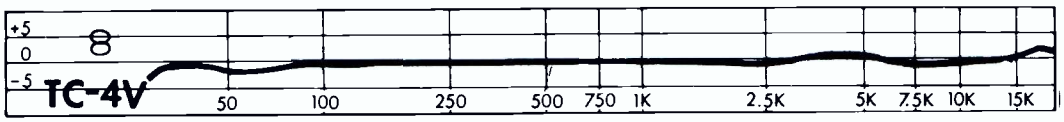


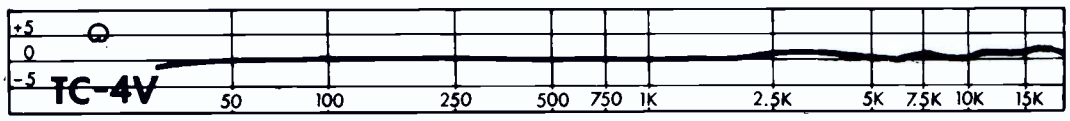
TC-4V

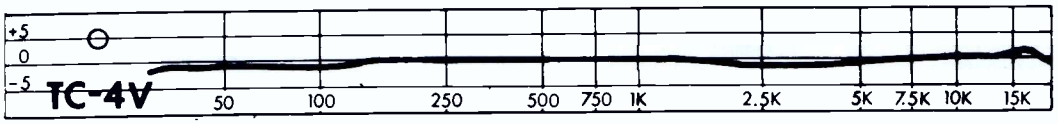


TC-4V





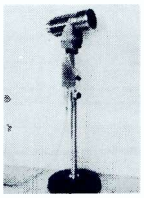




Primo

Primo Co. Ltd., 2043 Mure, Mitakashi, Tokyo, Japan

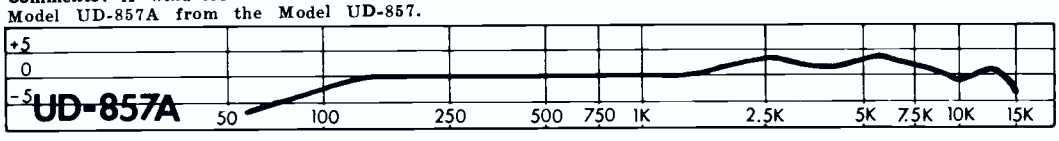
UD-842

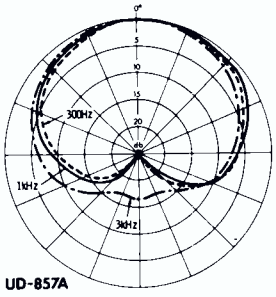


Dynamic—Stand-mounted—Sensitivity: −51 dB (50,000 ohms), −71 dB (600 ohms)—**Impedances:** 50,000 ohms, 600 ohms—**Dimensions:** 120 mm × 177 mm × 48 mm dia.
Comments: Integral to the microphone are: a three-step tone-control switch, an impedance selector, a built-in windscreen, and a shock absorber.

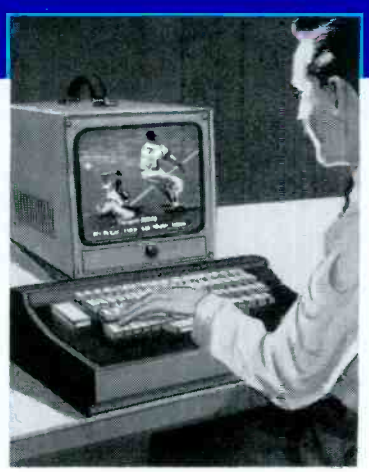
UD-857, UD-857A

Cardioid dynamic—Stand-mounted or hand-held—Sensitivity: −53 dB (50,000 ohms), −72 dB (600 ohms)—**Impedance:** 50,000 ohms, 600 ohms—**Dimensions:** 235 mm × 44 mm dia.
Comments: A windscreen differentiates the Model UD-857A from the Model UD-857. Thus the basic microphone is suitable for music applications in the studio, and the windscreen version is for outdoor use.





UD-857A



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RCA

Broadcast and Communications Products Div., Radio Corporation of America, Camden, N. J. 08102

Changes to specifications listed in last year's review of RCA microphones are as follows:

BK-1A—should read: **Omnidirectional dynamic**
BK-5B—should read: **Uniaxial ribbon**
BK-6B—should read: **Omnidirectional dynamic**
BK-11A—should read: **Bidirectional ribbon**—**Weight:** 2 lbs—**Price:** $107
BK-12A—should read: **Subminiature omnidirectional dynamic—Price:** $95.
KU-3A—should read: **Cardioid ribbon**
MI-10006-A—Discontinued
SK-30/31—Price: SK-30, $30.00; SK-31, $31.00
SK-39A—should read: **Omnidirectional dynamic—Price:** $31.75
SK-45B—should read: **Omnidirectional dynamic—Price:** $37
SK-46—should read: **Bidirectional ribbon**
77-DX—should read: **Variable-pattern ribbon cardioid—Price:** $290.

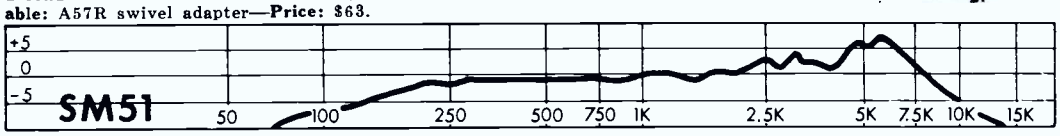
Shure Bros.

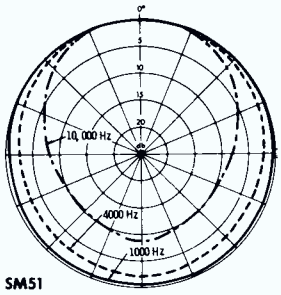
Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill. 60204

SM51

Omnidirectional dynamic—Lavalier—Output level: −60.5 dB—**EIA Sensitivity:** −153 dB—**Impedance:** 50 to 250 ohms—**Dimensions:** 2½″ × ¾″ dia—**Weight:** 2 oz—**Finish:** Nonreflecting gray with stainless steel grille—**Accessories furnished:** "Positive-Lock" lavalier holder and belt-clip assembly; 30-ft, 2-conductor shielded cable—**Accessory available:** A57R swivel adapter—**Price:** $63.

Comments: The "Positive-Lock" lavalier holder is designed to provide simple, noiseless adjustment of microphone position, and to hold the microphone firmly in the selected position. The belt clip permits attaching the cable at the waistband to relieve cable weight and pull, and to absorb sudden tugs on the cable.



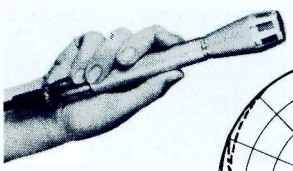


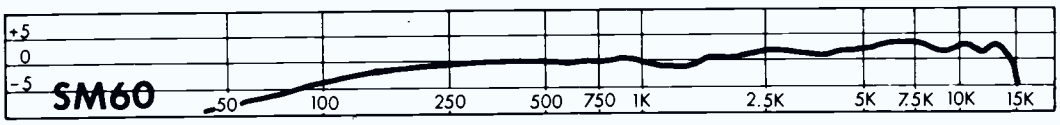
SM51

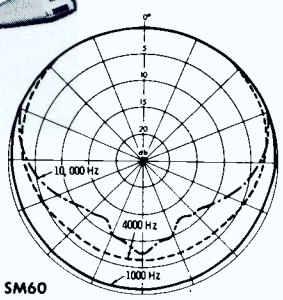
SM60

Omnidirectional dynamic—Hand-held or stand-mounted—Output level: −59 dB—**EIA sensitivity:** −153 dB—**Impedance:** 150 ohms (to match 50- and 250-ohm inputs)—**Dimensions:** 6-7/32″ × 1¼″ dia—**Weight:** 6 oz—**Finish:** Nonglare matte metallic—**Accessories furnished:** Swivel adapter for ⅝″-27 tpi; 20-ft, 2-conductor shielded cable with XLR-3-11C connector attached—**Accessory available:** S33P desk stand—**Price:** $49.20.

Comments: A built-in wind and pop filter is to provide control of breath noise and popping when the microphone is used for close speaking. The need for outdoor windscreens is removed.







SM60

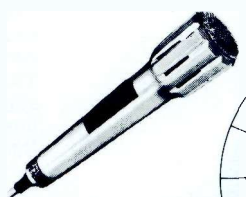
Sonotone

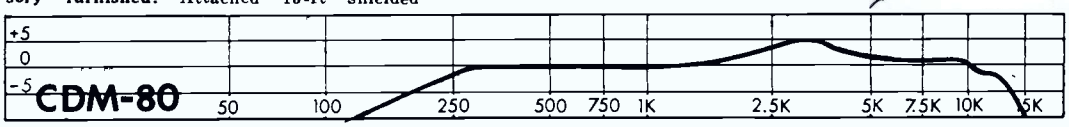
Sonotone Corp., Elmsford, N. Y. 10523

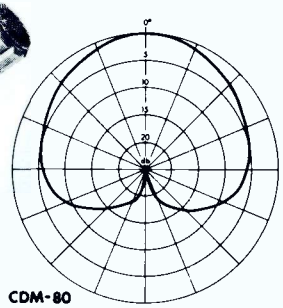
CDM-80

Cardioid dynamic—Hand-held or stand-mounted—Output level: −59 dB, 50,000 ohms; −61 dB, 200 ohms—**EIA sensitivity:** −155 dB—**Impedance:** 50,000 and 200 ohms, cable-connector selectable—**Dimensions:** 5¼″ × 1¼″ dia—**Weight:** 5 oz—**Finish:** Brushed chrome plate on diecast housing—**Accessory furnished:** Attached 15-ft shielded cable (no plug)—**Accessories available:** desk stand and ⅝″-27 tpi adapter.

Comments: This microphone has approximately 20-dB front-to-back ratio from 100 Hz to 10 kHz. An on-off switch is incorporated into the case. A wind-blast filter is built in. The cartridge is rubber isolated.



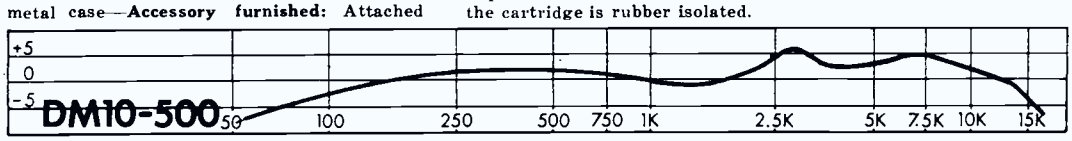


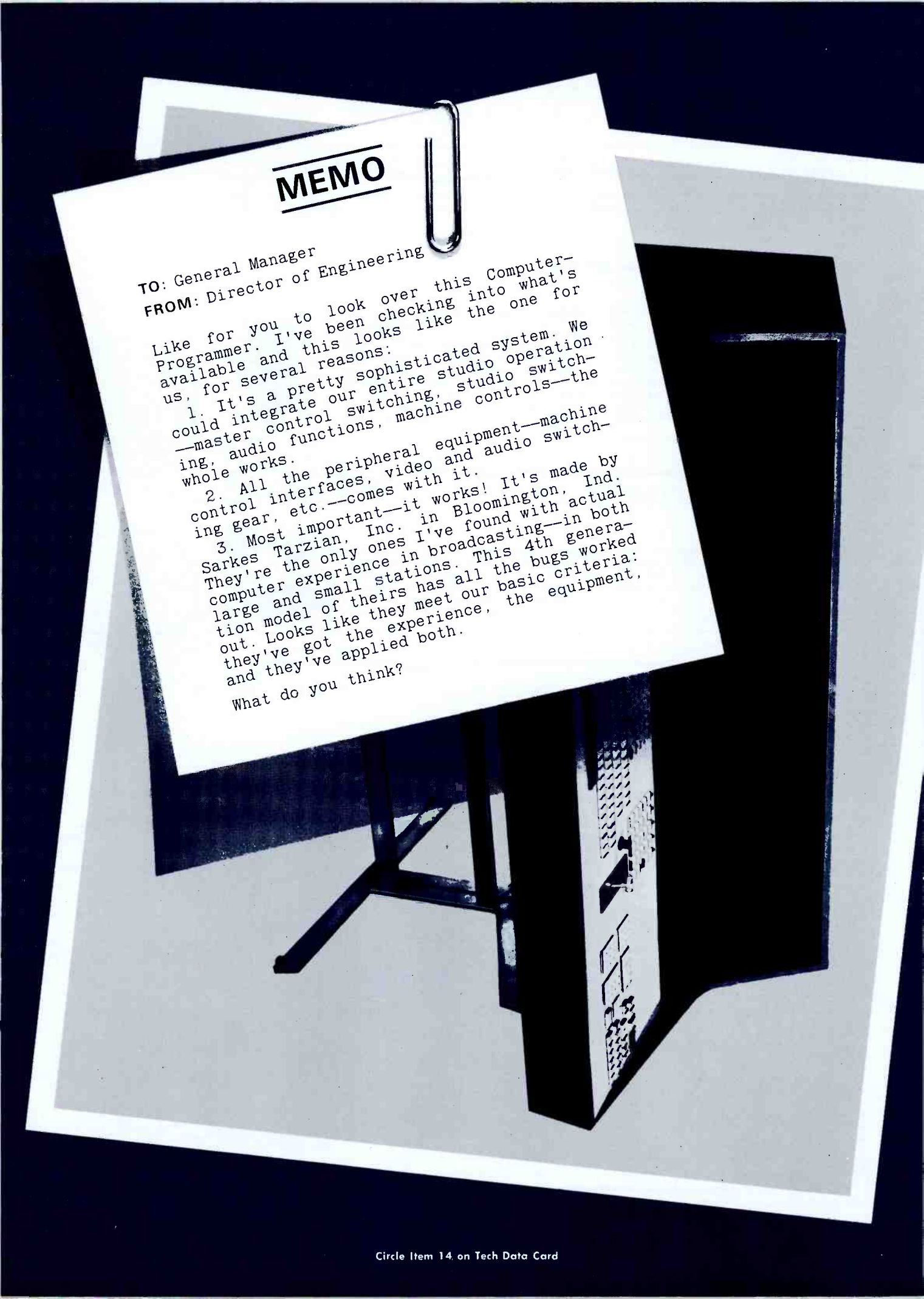

CDM-80

DM 10-500

Omnidirectional dynamic — Hand-held or stand-mounted—Sensitivity: −58 dB—**EIA sensitivity:** −152 dB—**Impedance:** 200 ohms—**Dimensions:** 5″ × 1½″ dia—**Weight:** 8 oz—**Finish:** Brushed chrome on diecast metal case—**Accessory furnished:** Attached 15-ft, 2-conductor shielded cable (no plug)—**Accessories available:** Stand and adapter.

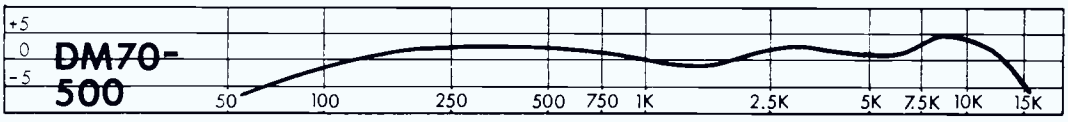
Comments: This microphone is available with an on/off switch and/or 50,000-ohm output impedance. It has a built-in windscreen, and the cartridge is rubber isolated.





DM 70-500

Omnidirectional dynamic—Lavalier, hand-held, or stand-mounted—Output level: −62 dB—**EIA sensitivity:** −156 dB—**Impedance:** 200 ohms—**Dimensions:** 4-¼″ × 15/16″ dia—**Weight:** 2¾ oz—**Finish:** Brushed chrome on diecast metal—**Accessory furnished:** Attached 15-ft, two-conductor shielded cable (no plug)—**Accessories available:** stand and adapter.
Comments: Light enough to be used as a lavalier, this microphone can be mounted on a stand. Models are available with 50,000-ohm output impedance and/or with an on/off switch. The windscreen is built in.

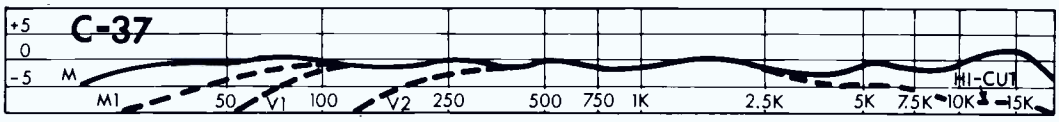


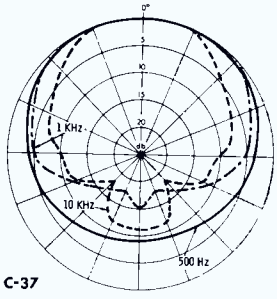
Sony

Sony Superscope, 8150 Vineland Ave., Sun Valley, Calif. 91352

C-37

Uni- and omnidirectional condenser—Output level: −50.6 dB—**EIA sensitivity:** −142.6 dB—**Impedance:** 50, 250, 600 ohms (connection change)—**Dimensions:** 2⅜″ × 8½″ × 1-13/16″—**Weight:** 1.3 lbs—**Finish:** Non-reflecting gray and dark anodized—**Accessories furnished:** Carrying case, microphone cover, battery, screwdriver, ⅝″-27 tpi stand coupler, technical/operating manual—**Accessories available:** AC adapter, extension cable—**Price** $325.
Comments: A specially designed FET is used to provide a 4- to 6-dB improvement in S/N ratio. A three-step, low-frequency roll-off switch and a directivity switch are provided on the unit. The self-contained battery is rated for operation of the all-solid-state circuitry for 300 hours. The metal grille is coated with plastic foam for close-lip or outdoor use. A double-diaphragm, rubber vibration absorber is built into the microphone holder.

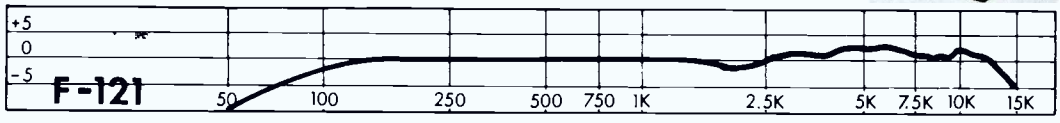


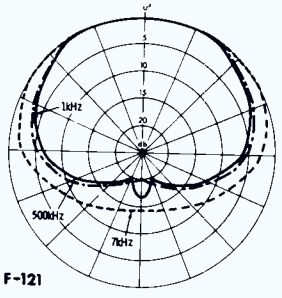


C-37

F-121

Dynamic cardioid—Stand-mounted or hand-held—Output level: −58 dB—**EIA sensitivity:** −149.8 dB—**Impedance:** 50, 250, 600, 10,000 ohms (connection change, shipped 600 ohms)—**Dimensions:** 7″ × 1½″ dia—**Weight:** 8 oz—**Finish:** satin anodized aluminum—**Accessories furnished:** 20-ft, 3-conductor, shielded cable with Cannon XLR-3-11C connector, Type A-6N desk stand with ⅝″-27 thread, support arm—**Price:** $99.50.
Comments: This microphone has a built-in, plastic-foam wind and breath filter for close-lip or outdoor use. An on/off switch with safety lock is provided.





F-121

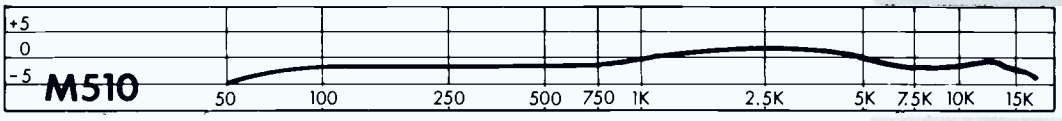
Syncron (See Vega)

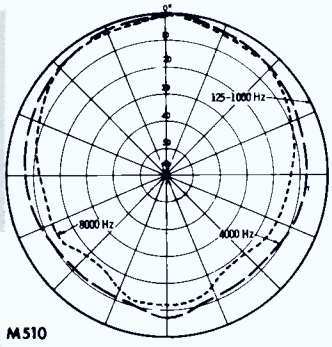
Telefunken

Telefunken Sales Corp., South St., Roosevelt Field, Garden City, L. I., N. Y. 11530

ELA M510

Omnidirectional dynamic—Hand-held or stand-mounted—Output level: −52 dB—**Impedance:** 200 ohms—**Dimensions:** 125 mm × 55 mm dia—**Weight:** 195 grams.
Comments: A slight rise in the mid-frequency range has been incorporated to help create "presence." A built-in, wire-mesh windscreen permits outdoor usage, and a compensation winding in the system has been designed to attenuate interference from magnetic sources.

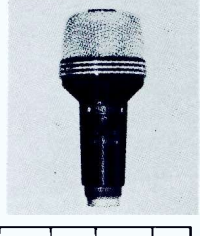


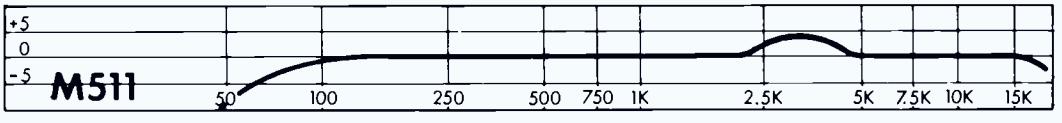


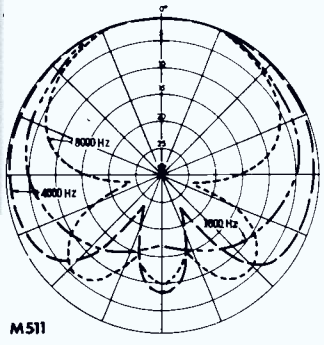
M510

ELA M511

Cardioid dynamic—Hand-held or stand-mounted—Output level: −51 dB—**Impedance:** 200 ohms—**Dimensions:** 122 mm × 55 mm dia—**Weight:** 190 grams.
Comments: This microphone is intended for use in unfavorable acoustic situations when reverberation or noise from a particular source can be reduced with the cardioid characteristic. A switch in the shaft allows bass damping from 0 to 14 dB at 100 Hz.







M511

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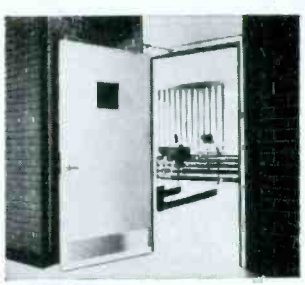


Overly

Circle Item 48 on Tech Data Card

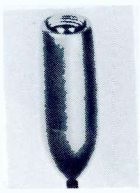
Trusonic

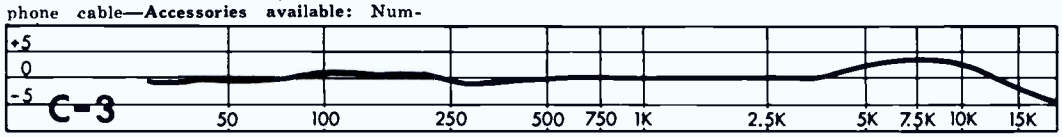
Trusonic, 389 N. Fair Oaks Ave., Pasadena, Calif. 91103

C-3

Omnidirectional condenser—Hand-held, stand-mounted, or lavalier—Output level: −40 dBm—**Impedance:** Cathode follower from OD-6 oscillator-demodulator — **Dimensions:** Hand-held or stand-mounted, 7½" long; lavalier or clip, 1¾" × ⅝" dia—**Accessories furnished:** Hand-held insert, 50-ft microphone cable—**Accessories available:** Numerous, including lavalier, lavalier clip, extension cables, plug-in low-impedance matching transformer (50, 200, and 600 ohms), etc.

Comments: Tuned RF circuit, no polarizing voltage. Cable may extend several hundred feet from microphone to oscillator-demodulator without appreciable loss.

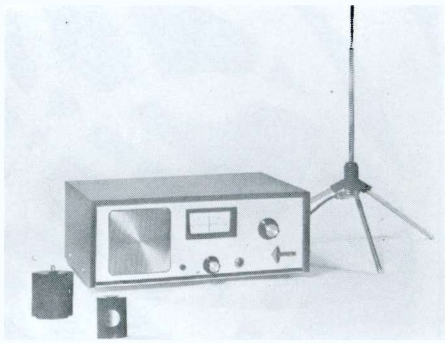




500

Omnidirectional condenser microphone with integral miniature FM transmitter (Model 500T) and separate receiver (Model 500R)—Dimensions: 500T, 1⅞" × 1⅜" × ¾"; 500R, 4½" × 13" × 8½"; battery pack, Model 500BP (for 26 hours continuous operation), 2¼" × 2" × ⅞"—**Weight:** 500T, 1⅜ oz; 500R, 11 lb—**Accessories furnished:** Lavalier attachment, battery pack, receiving antenna, receiver, external antenna with BNC type connector, cable—**Accessories available:** for 500T, clip and power-cable on-off switch; for 500R, plug-in line-matching transformer and antenna cables of various lengths; for battery pack, checker.

Comments: The Model 500 wireless microphone system consists of a condenser microphone; transistor transmitter; battery case; and FM receiver with variable tuning, automatic squelch, AFC, zero-center tuning meter, and adjustable line output. Both monitor and line outputs are independently adjustable. Line impedance can be matched by plug-in line transformer. Transmitter can be worn as a lavalier, or clipped to pocket or tie. Transmitter and receiver may be used at distances of up to 300 feet. The subminiature transmitter has a separate battery pack which can be concealed on the person. Operating frequency of transmitter is 42.98 MHz, or special selected frequency established at time of purchase. The receiver may be monitored with or without headphones.



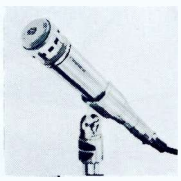
Turner

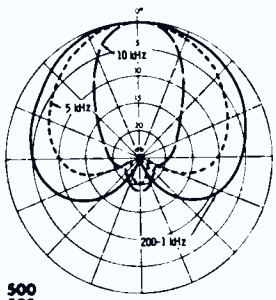
The Turner Co., 909 17th St., N. E., Cedar Rapids, Iowa 52402

500/505

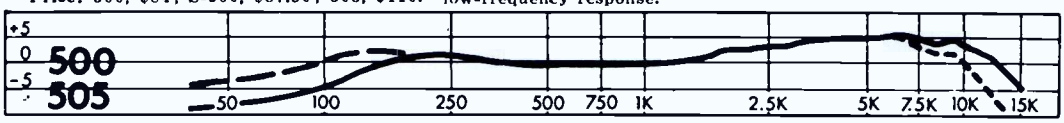
Cardioid dynamic—Hand-held or stand-mounted—Output level: −55 dB—**Impedance:** 150 ohms and Hi-Z (40,000 ohms)—**Dimensions:** 500, 6-13/16" × 1-17/32" dia; 505, 7½" × 1-17/32" dia—**Weight:** 12 oz—**Finish:** Satin chrome (also available in gold)—**Price:** 500, $84; S-500, $87.50; 505, $110. Gold-finish models: 500G, $94; S-500G, $97.50.

Comments: The Model 500 is available with an on-off switch as Model S-500. The Model 505 has a two-position switch which introduces a ferrite-core inductor to modify the low-frequency response.





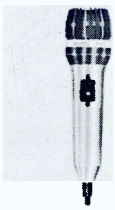
500
505

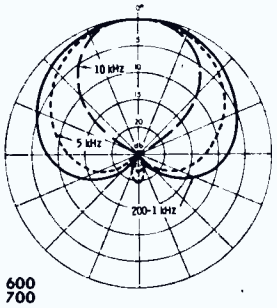


600 Series

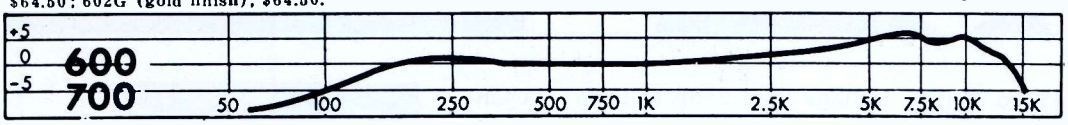
Cardioid dynamic—Hand-held or stand-mounted—Output level: −55 dB at high impedance—**Impedance:** Models 600, 601 (stereo pair), and 600G, 40,000 ohms; Models 602 and 602G, 150 ohms—**Dimensions:** 6" × 1⅝" dia—**Weight:** 14 oz—**Finish:** Satin chrome or gold—**Price:** 600, $59.50; 601, $133; 602, $59.50; 600G (gold finish), $64.50; 602G (gold finish), $64.50.

Comments: This microphone series features a four-stage blast filter for the control of pop, wind noise, and feedback.





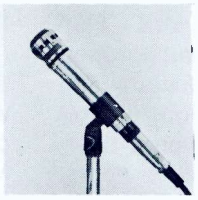
600
700

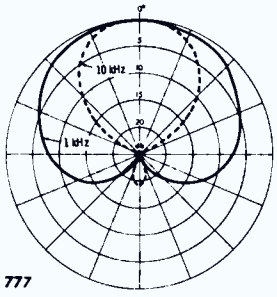


777

Cardioid dynamic—Hand-held or stand-mounted—Output level: −79 dB—**Impedance:** 150 ohms—**Dimensions:** 7½" × 1-17/32" dia—**Weight:** 12 oz—**Finish:** Satin chrome—**Price:** $110.

Comments: This microphone has been designed especially for use in broadcasting and other applications where unwanted background noise presents a problem. It features rolled-off bass response and a rotary on-off switch.





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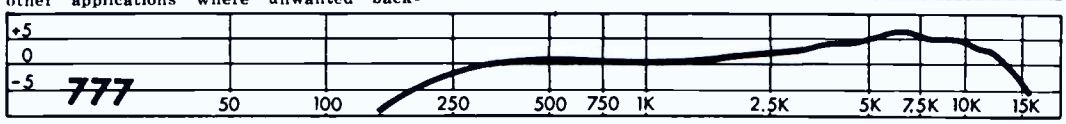

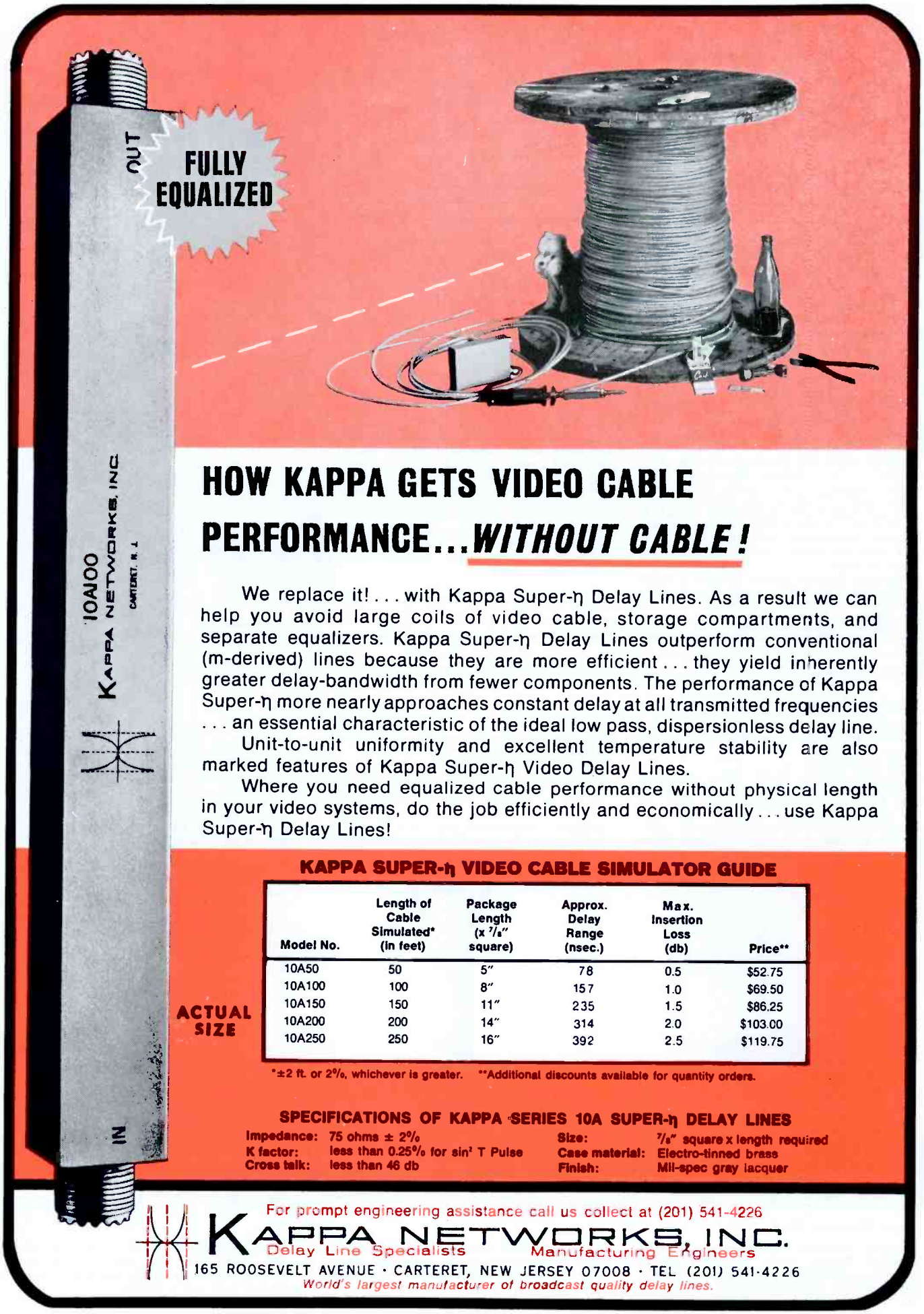

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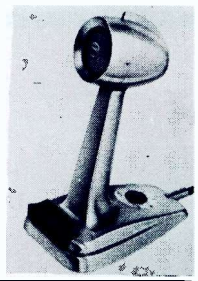
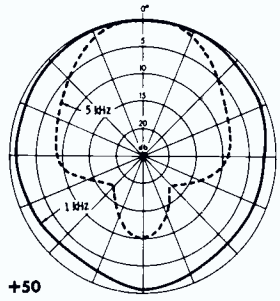
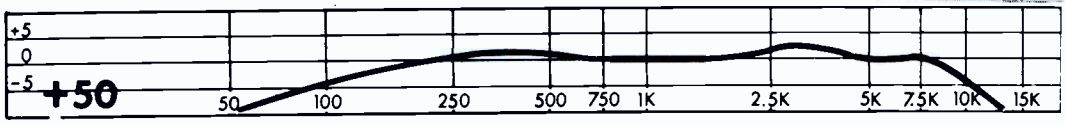
+50

Cardioid dynamic—Built-in stand—Output level: −20 dB—**Impedance:** 150/600 ohms—**Weight:** 1 lb, 11 oz—**Finish:** Satin chrome.
Comments: This microphone has a self-contained 50-dB preamplifier operated from its own internal battery. The amplifier is driven by a special 600-ohm dynamic interior and utilizes an interstage volume control for improved signal-to-noise ratio. The output of the amplifier is coupled to the line through a matching transformer which provides 600-ohm and 150-ohm output impedance. The choice of output impedance is made with a slide switch on the baseplate of the microphone. The impedance slide switch is equipped with a locking device to prevent an accidental impedance change.







+50

University

University Sound, 9500 West Reno, P. O. Box 1056, Oklahoma City, Oklahoma 73101

The following microphones are no longer being manufactured:

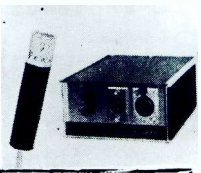
Models 1000, 1040, 1050, 4000, 4040, 4050, and 4080.

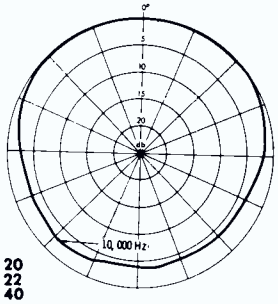
Vega

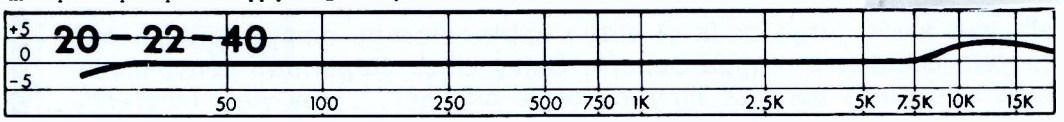
Vega Electronics Corp., 1161 Richard Ave., Santa Clara, Calif. 95050

20, 22, and 40

Omnidirectional condenser—Stand-mounted—Output level: −55 dBm—**Impedance:** 50, 200, 500 ohms and Hi-Z—**Dimensions:** Microphone, 4″ × ⅞″ dia; Power supply, 4¾″ × 2½″ × 6½″—**Weight:** Microphone, 7 oz; Power supply, 4 lb—**Finish:** Microphone, matte beige; Power supply, brushed aluminum and black vinyl—**Accessories furnished:** 20-ft, 3-wire shielded cable, clamp-on swivel adapter—**Accessories available:** Windscreen and extension cables—**Price:** 20, $185; 22, $315; 40, $240.
Comments: Vega 20 system includes a single microphone plus power supply. Vega 22 system includes 2 microphones plus dual power supply. Vega 40 system includes a single microphone with detachable cable, windscreen, and power supply. A 6CW4 *Nuvistor* is used in the microphone as a buffer amplifier. The power supply has switchable low- or high-impedance output and switchable low-frequency roll-off. Cannon XL connectors are used throughout. The 40 system is designed to require no overload protection, and not to be susceptible to "popping" with the windscreen in place.



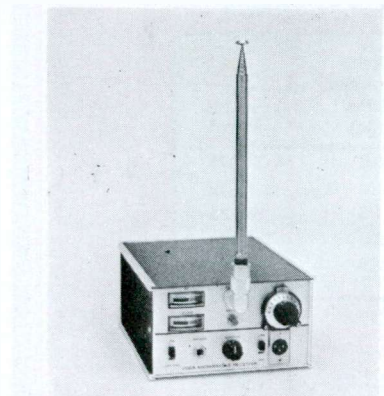


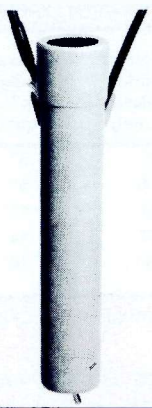


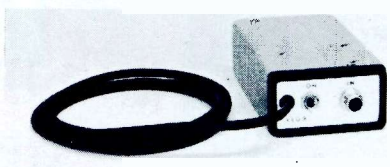
20
22
40

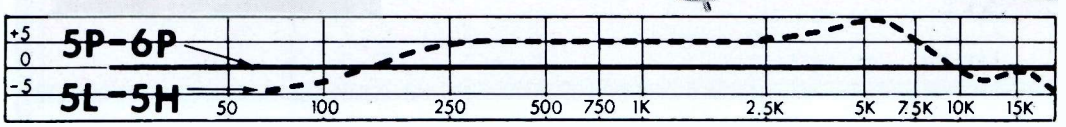
Wireless Systems

Wireless system consists of receiver and lavalier, hand-held, or pocket-model microphone.
Model 10 Receiver:
Frequency Range: 25-28 MHz, Auxiliary Radio Broadcast Service; 30-37 MHz, Business Radio Service—Output: −50 dBm at 200 ohms balanced; 0 dBm at 600 ohms balanced; 1 mw at 600 ohms unbalanced—Frequency Response: 10-20,000 Hz ±1 dB—Sensitivity: 1 μv for 20-dB quieting—Dimensions: 6½″ × 4¾″ × 7¾″—Price: $350.
Operates on mercury batteries, rechargeable battery (extra), AC, or 12 volts DC.
Model 6P Wireless Microphone:
Pocket model transmitter for use with any external microphone—Power input: 1 watt for use in Auxiliary Radio Broadcast Service—Input impedance: 200 ohms unbalanced bridging—Dimensions: 2½″ × 4″ × 1¼″—Battery life: 12 hrs—Weight: 14 oz—Price: $375; System, $675.
Model 5 Wireless Microphone:
Available in lavalier (5L), hand-held (5H), and pocket-transmitter (5P) models. Power input 200 milliwatts for use in Auxiliary Radio Broadcast Service or Business Radio Service. Response shown is for lavalier and hand-held models with built-in microphone. Input impedance and transmitter response same as Model 6P. Battery life: 15 hours—Dimensions: Lavalier and hand-held, 5¾″ × 1″ dia; Pocket transmitter: 2″ × 3¾″ × 1″—Weight: 7 oz—Prices: Lavalier and Hand-held, $300; Pocket transmitter, $275; Systems, $570-$595.
Pocket Model 5P is available as Model 5PD with additional audio input at .5 volt, 250,000 ohms unbalanced for use with electric guitar, tape recorder, etc. Price: $325; System, $625.
Accessories:
Carrying cases, carrier-operated relay, rechargeable battery, remote signaling relay modifications.







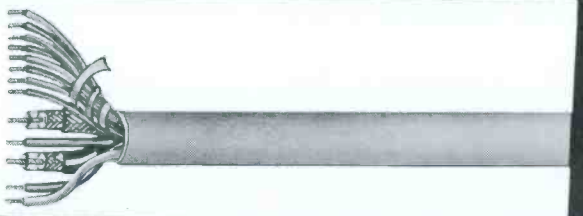


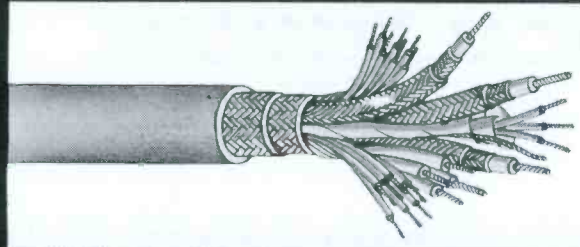
Vega/Syncron S-10

Cardioid condenser—Hand-held or stand-mounted—Output level: −53 dBm at 10 dynes/cm²—**Impedance:** 200 ohms—**Dimensions:** 7⅜″ × ⅞″ dia—**Weight:** 9 oz including battery—**Finish:** satin nickel—**Accessories furnished:** mercury battery, carrying case, swivel mount, 20-ft 2-conductor shielded cable—**Accessories available:** windscreen, desk stand, and suspension—**Price:** $260.
Comments: AC power supply available. Omnidirectional Model S-10B available at $240. For photo, curves, and additional comments, see the Syncron listing in last year's review.

Cat. No. 113—13/Conductor TV Eye Camera Cable

Construction:
9—#22 AWG (7x30) T/C Vinyl Insulation
2—#18 AWG (16x30) T/C Vinyl Insulation
1—RG-58A/U 50 Ohm Co-Axial Cable
1—72 Ohm Co-Axial Cable with outer Mylar Shield
Gray Vinyl Jacket—Nom. O.D. .470
Maximum Length—2000 ft.





Cat. No. 124—24/Conductor TV Color Camera Cable

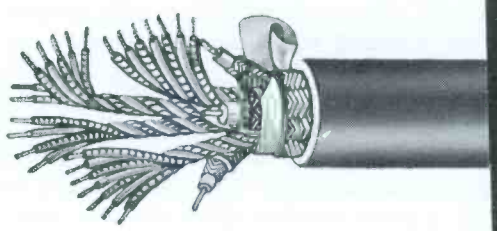
Construction:
14—#22 AWG (7x30) T/C Vinyl insulation, color coded
3—#22 AWG (7x30) T/C with Mylar Shield and Drain ground wire.
4—#16 AWG (16x30) T/C Vinyl insulation
3—#53.5* Ohm Co-Axial cables
Tinned Copper Braid Overall Cotton Braid
Gray Plastic Jacket—Nom. O.D. .795
Maximum Length—2000 ft.

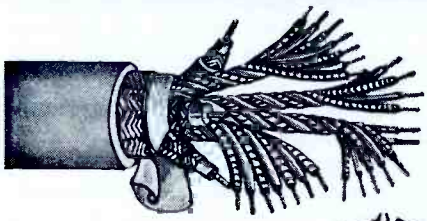
Cat. No. 128—28/Conductor TV Camera Cable

Construction:
4—#18'2-(16x30) T/C Vinyl Plastic insulated, color coded
21—#22 AWG (7x30) T/C Vinyl Plastic insulated, cabled in three groups of seven
3—Co-Axial Cables Nom. Imp. 51 Ohms
T/Copper Braid Shield—Gray Vinyl Jacket—Nom. O.D. .750
Maximum Length—2000 ft.

Cat. No. 129—29/Conductor TV Camera Cable

Construction:
5—#18 AWG (16x30) T/C Vinyl insulated and Mylar Shield with #22 Stranded drain ground wire
1—#75* Ohm Co-Axial cable with Pvc Jacket
7—#22 AWG (7x30) T/C Vinyl insulated color coded
2—#18 (16x30) 2—#16 (26x30) T/C Vinyl insulation and Mylar Shield with #22 Stranded drain ground wire
1—#93* Ohm Co-Axial cable with Pvc Jacket color coded
7—#22 AWG (7x30) T/C Vinyl insulated color coded
4—#22 AWG (7x30) T/C Vinyl nisulated color coded
Tinned Copper Braid Shield Overall
Soft Dark Blue PVC Jacket—Nom. O.D. .795
Maximum Length—1500 ft.





Cat. No. 138
NEW 28/Conductor 75 Ohm Camera Cable

Construction:
4—#18 AWG (16x30) tinned copper, Vinyl insulated, color coded Aluminum Nylar wrapped shield around 4 conductors with stranded drain wire, Mylar tape over this shielded group.
21—#22 AWG (7x30) tinned copper vinyl insulated cable in 3 groups of 7 color coded, one group of 7 has an aluminum-Mylar wrapped shield overall with a stranded drain wire, Mylar tape over this shielded group.
3—Coaxial cables. Nom. Impedance 75 Ohms
Tinned Copper Braid Shield
Heavy Black Jacket to resist extreme heat and cold
Maximum Length—1500 ft.

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1967 NCTA TECHNICAL SESSIONS

The technical sessions saw papers delivered on such diverse subjects as wave propagation, equipment and systems, measurements, and properties and applications of cable. In all, some two dozen talks and panels were presented in four sessions for the information of the technically minded in attendace at the Convention.

Monday Session

Noise Figure—Its Meaning and Measurement

The first paper of the convention was delivered by Carmine D'Elio of Vikoa, Inc. In it he showed the meaning of signal-to-noise (S/N) ratio and noise figure, and illustrated their application in CATV systems. Noise figure for a system was defined as the ratio of input S/N ratio to output S/N ratio.

The noise figure of a "black box" can be determined by measuring the input and output S/N ratios. This is not the case in designing an actual system, however, and an engineer must calculate what the operating levels should be for a given amplifier and cascade in order to achieve a given S/N ratio at the end of the cascade.

In calculating the noise figure for an entire system, the contribution of each system component must be known. An equation for computing the overall system noise figure was shown. A simpler equation for use when component contributions are equal and system gain is unity (which is the usual case in a CATV system) also was presented.

Once the system noise figure is known, it is possible to calculate the required input S/N ratio for any desired output S/N ratio. A sample calculation was used to show how this is done.

Next, the input S/N ratio was discussed. If either the signal or noise voltage is known, the other can be calculated. The design problem is to determine what minimum input signal is necessary to achieve a desired output S/N ratio. To do this, the noise voltage present at the system input is computed. A sample calculation was made for the standard 4-MHz bandwidth, 75-ohm cable impedance, and room temperature. With the S/N ratio in dB and the noise level in dBmv known, it then becomes possible to express the signal level in dBmv.

From a general discussion of S/N ratios, the speaker proceeded to the special problem of tilt, or compensation for the effect of high-frequency losses. It would appear that amplifier tilt control would cause a high noise figure on the lower frequencies, but lower cable losses at these frequencies are compensatory. The end result is a comparable S/N ratio across the spectrum. Computations were used to clarify these statements.

At this point, an analysis of the antenna to head-end feed was made. Loss in this area is a direct reduction of the S/N ratio. The head-end noise figure has very little influence on the overall system figure, provided it is not excessive. A calculation was used to demonstrate this statement. Also shown was the use of output-S/N calculations to determine whether or not it would be worthwhile to employ a preamplifier when an antenna signal is marginal.

The conclusion drawn from the examples was that an output S/N ratio can be improved only by reducing the noise figure of individual system components, or by increasing input signal levels.

Distortion in CATV Amplifiers

In his presentation, Ken Simons, vice-president—R&D, Jerrold Corp., gave an elementary introduction to the nature and effects of the nonlinear distortion in CATV amplifiers. Two forms of distortion are important: Second-order distortion results, in extreme cases, in the compression of one peak of a sine wave and the expansion of the other; third-order distortion results, in the extreme case, in compression (or expansion) of both peaks. It was shown that the effects of second-order distortion may be analyzed with an equation involving a linear term and a term proportional to the input voltage squared, while the effects of third-order distortion can be analyzed with an equation including a linear term and a term involving the input voltage cubed.

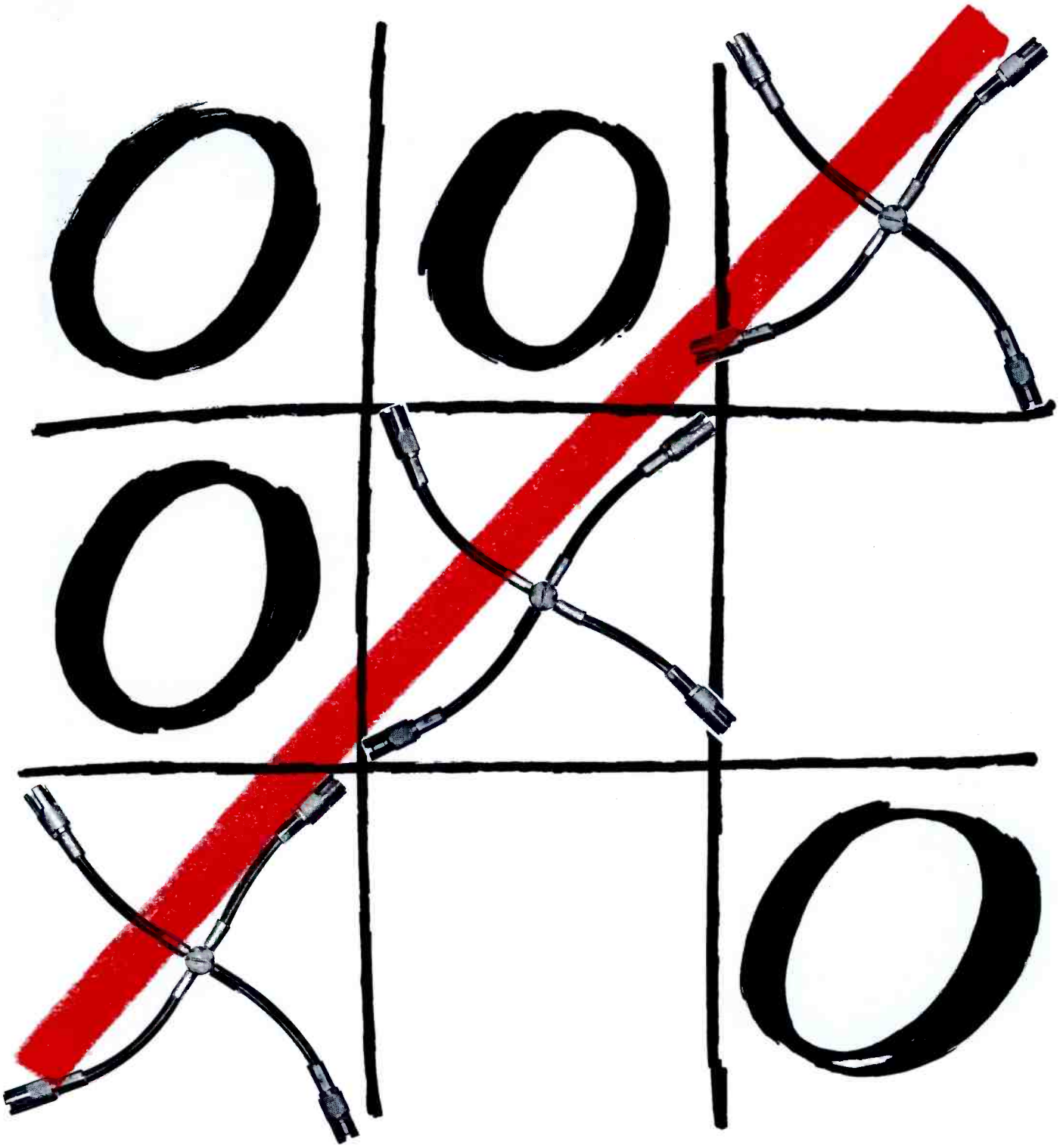
In present CATV systems, the speaker said, second-order distortion is generally unimportant because it results in distortion products at frequencies which are either sums, differences, or second harmonics of the carriers present. With the standard frequency assignments, these products fall outside the channels used.

He added that third-order distortion is the limiting factor in determining permissible output levels in most CATV amplifiers, since it results in cross-modulation between channels. The resulting beats between carriers fall inside the channels being used.

The Spectrum Analyzer

In the second presentation of the first technical session, Mr. Alan Ross, of Nelson-Ross Electronics, Inc., discussed the use of field-strength meters as spectrum analyzers, and then described a commercially available instrument designed specifically for use as a CATV spectrum analyzer.

The field-strength meter is basically a heterodyne receiver with a meter for reading input voltage. It can be converted to a spectrum analyzer (SA) by displaying its



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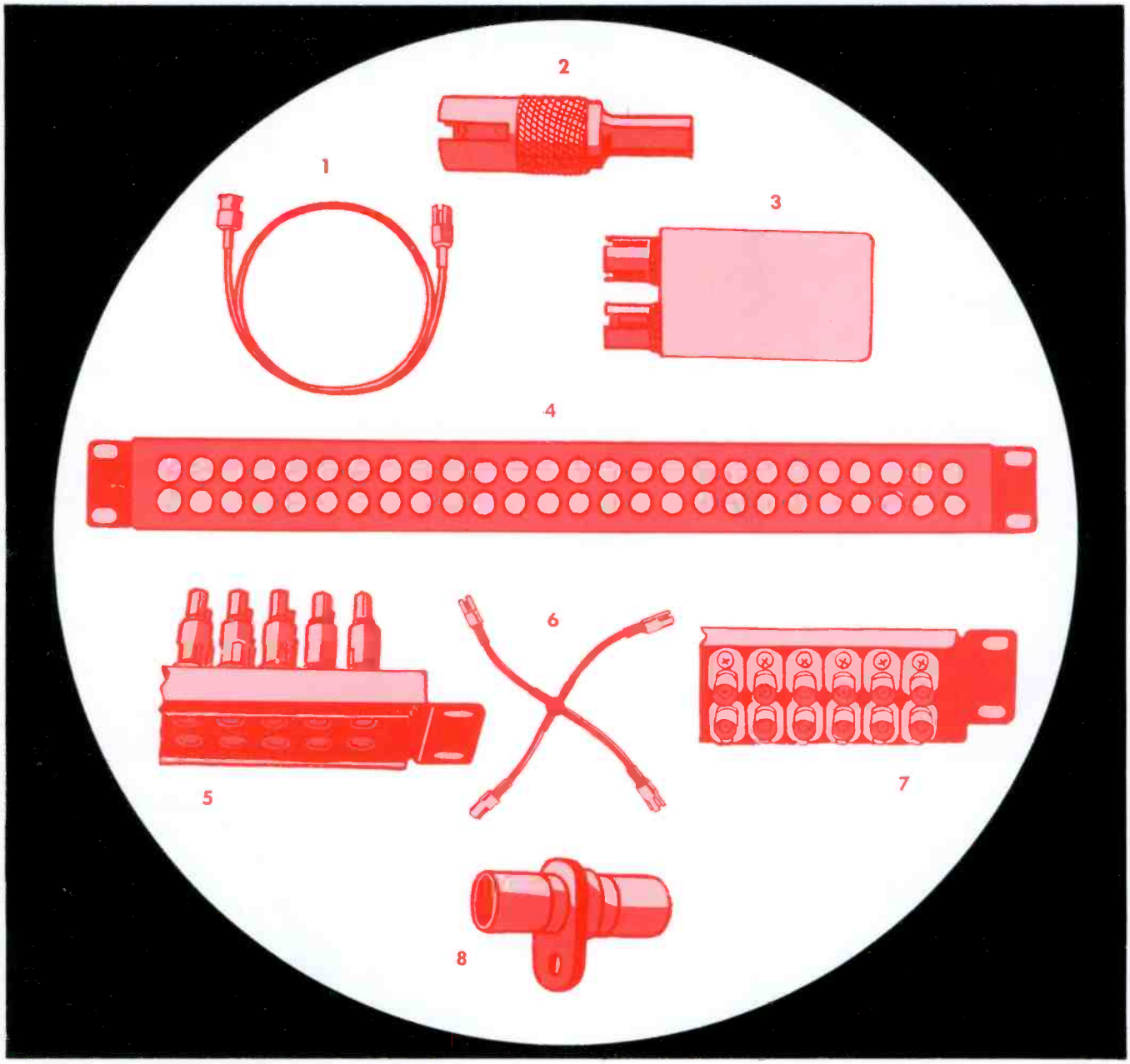

SHOWN ON COVER: COOKE MODEL 105-8 FOUR-WAY BRIDGING NETWORK, used with Model 105-24 coaxial jack in front or rear of panel to parallel 4 RF circuits or feed 3 RF circuits from a common source. **1**. COOKE MODEL 105-6 TEST CORD. To be used with Model 105-24 coaxial patching jack. One end has Model 105-3C quick disconnect connector; the other, std. BNC or UHF male connector. **2**. COOKE MODEL 105-3C QUICK-DISCONNECT SNAP-LOCK CONNECTOR for RG-58/U coaxial cable. Push-on/pull-off, snap lock, quick-disconnect action for use in high density situations. Crimp sleeve included. Mates with all jacks of Cooke's Model 105 series and may be used with Model 105-24 patching jack. **3**. COOKE MODEL 105-9 QUICK-DISCONNECT NORMALING PLUG for use with Model 105-24 coaxial jacks mounted on ⅝" centers. Also used when patching adjacent circuits. **4**. COOKE MODEL 105-52A JACK PANEL accepts 48 Model 105-24 coaxial patching jacks mounted in two rows of 24 on ⅝" vertical centers. Black phenolic; top and bottom designation strips; metal mounting brackets each end. **5**. COOKE MODEL 105-52A PANEL (see 4), shown with permanent cabling using 105-3 connectors. **6**. COOKE MODEL 105-7 FIVE WAY BRIDGING NETWORK permits paralleling 5 RF circuits or feeding 4 RF circuits from a single source, as it has 4 Model 105-3C connectors as coaxial cable terminations plus a junction receptacle for connector or patch cord. **7**. COOKE MODEL 105-52A PANEL (see 4) showing mounting of Model 105-24 jacks. **8**. COOKE MODEL 105-24 COAXIAL PATCHING JACK, a shielded miniature jack used in high density RF patch fields. Will accept Cooke quick-disconnect connectors at either end. • Other jacks and hardware available. Write or call for specifics.

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detector output on an oscilloscope or other device, and by providing an automatic mechanical drive for the tuning mechanism. The mechanical sweep is not practical for high-speed sweeping, however, and an electronic sweep would be preferred. Varactor diodes can be used for this purpose, but RF-stage tracking is difficult to achieve. Eliminating the RF stage reduces sensitivity and results in poor image rejection.

In spectrum analyzers, image rejection is achieved by using very high IF frequencies and conversion to lower IF's for narrow bandwidths. The instrument thus developed is electronically swept.

The Nelson-Ross Mark I CATV Analyzer was described by the speaker. This instrument is designed to provide complete sweep in one scan, 60-dB display dynamic range, 75-ohm input impedance, 600-kHz display capability, and log, linear, and square-law vertical scales. Other features include a crystal filter for restricting bandwidth to 5 kHz.

Advantages of the SA were then listed. Among those specified were sweep-frequency display from 0 to 300 MHz in maximum dispersion setting, resolving power comparable to an FSM in the "wide" mode, increased resolving power in the narrow (5-kHz) position, and optional log, linear, and square law response.

The principle limitations were said to be high noise figure and low sensitivity. The speaker indicated that the instrument is subject to overloading at levels much lower than an FSM. Additionally, the unit is difficult to calibrate for absolute readings; however, it can be used as a transfer standard.

The paper next went into the area of instrument applications. First was use of the SA for visual inspection of all the carriers at one time. This permits analysis of the settings of the gain and tilt controls. Next mentioned was the use of the instrument as a field-strength meter. The SA is used as a transfer standard, and a reference signal is compared to the signal being measured. Level is then read off the signal generator.

The speaker also stated that interfering carriers can be located and identified with the instrument. He told how the SA was used to identify a police transmitter so strong that it caused color dropout by interfering with the tuner IF. With the source of difficulty known, it was possible to effect correction through the use of a high-pass filter.

Other applications enumerated were observation of overload and distortion, observation of spurious outputs, and signal-reconnaissance work.

A Low Cost TDR

With a high-quality oscilloscope, line reflections can be observed. This permits use of the unit as a time-domain reflectometer (TDR). This explanation and techniques for using the method were the subject of a talk by Robert Scherpenseel of Kalispell, Montana's Northwest Video.

The TDR signal, the speaker explained, is a positive pulse which starts at DC and rises to approximately 20 volts. Fed through an RC network, it becomes a spike. When this is applied to a CATV cable, any reflections returned from discontinuities are observed on the oscilloscope trace.

Knowing the distance signals travel in a given amount of time in a specified medium (dielectric) permits calculation of the distance to a reflection point. An aid in these calculations is a calibrated graticule, each division representing different values in terms of distance, depending on the range to be considered.

The speaker presented a series of slides in which TDR displays resulting from various cable conditions were illustrated. The reflections were shown to be caused by tapoffs, splitters, splices, and bad cable. The latter were particularly apparent with high gain settings.

In the question period following the talk, Mr. Scherpenseel explained that the phrase "low-cost" is relative; the oscilloscope he used lists at $875, whereas a regular TDR instrument costs about $3000.

Summation Sweeping CATV Systems

A method for setting system operating levels and frequency response in an accurate and reasonably simple manner was discussed by I. Switzer of MacLean-Hunter Cable TV, Ltd. (Toronto, Ontario). The method involves the combining of sweep-frequency and level-measurement techniques. This approach presents certain problems that must be overcome, however. These were: (1) adjustment of amplifier gain and level, (2) oscilloscope synchronization to the sweep generator at the headend, (3) the effect of sweep signals on amplifier AGC.

One of the problems, that of oscilloscope synchronization, was said to be a matter of locking the remote scope display to the power line. Many scopes have built-in provision for this; however, in the case of cable-powered transistor amplifiers, a separate power source must be used for the remote scope. In this case, it is necessary to sample the AC from the amplifier to synchronize the scope without loading the system cable. The result is to provide good synchronization of the sweep generator at the head end with the test instruments at the amplifier under adjustment.

Discussed next was the matter of frequency-response adjustment. Describing a comparison technique in which operating-level and amplifier-gain adjustments are made while system response is being observed, the speaker explained how a reference signal and sweep signal can be overlaid on the scope display so that amplifier sweep output can be adjusted to achieve desired levels and tilt. The degree of accuracy is dependent on the reference-level source, but can be improved with a flat detector and (if necessary) an accurate moving-coil meter. Each amplifier is adjusted to compensate for the losses and tilt of the immediately preceding cable section.

Under normal operating conditions, AGC is employed. Adjustments must therefore be made with it activated. A trap, designed to prevent activation of the amplifier AGC by the sweep signal, is used to notch the sweep at AGC pilot frequency. Response of the amplifier AGC to the sweep signal should be carefully studied. A case history was presented to show why the trap should be carefully designed.

Another special problem covered was the accessibility of the amplifiers to the service technician. The use of jumpers was discussed and led to the conclusion that a lightweight instrument package should be developed so that technicians may carry it up the pole. This would also entail development of a flat-response high-impedance probe to permit monitoring through amplifier test points.

Further discussion was about analysis of the low output levels in fairly large systems. Approaches such as the use of calibrated booster amplifiers and good, sensitive indicating instruments were mentioned.

Low sweep speeds, Mr. Switzer continued, are necessary in the study of a system's "fine" (detailed) response characteristic. This response is related to mismatches, and an oscilloscope must be able to respond to the slow sweep speeds in order to locate them.

In concluding remarks, the speaker discussed the use of photographic records and his intention to use sweep-

summation methods to assess the feasibility of an 80-amplifier string.

System Design Based on Complete Equipment Evaluation

The next paper was the joint effort of Robert J. Brown, of Tele-Vue Systems, Everett, Wash., and Jerry A. Laufer of Total Telecable, Inc., Seattle, Wash. In the paper the pre-installation equipment evaluation tests of a ten-cascade system, including cable, were described.

Disappointed with the performance of a 600-mile solid-state system, and faced with the planning of 1000 more miles of construction, Tele-Vue Systems put together a testing facility in which all operating parameters of CATV equipment could be tested. Mr. Brown described the facility.

For testing temperature effects, an 8-foot by 10-foot walk-in freezer was acquired. Heat is developed with a 2000-watt, thermostat-controlled defrosting coil. A temperature range of −40° F. to + 140°F is thus made available (tests are made between −20 and +120°F). A cascade of 10 amplifiers can be accommodated. The amplifiers are joined by 22-dB lengths of .412 cable (to be changed to ¼-inch cable to make more room in the chamber). During a cycling period of thirty hours, tests for cross-modulation, noise, and response are made at various temperatures.

Tests for noise are made with a broadband amplifier, functioning as a 50-dB noise generator (10-dB noise figure and 40-dB gain) feeding the system under test through an input attenuator; a field-strength meter is connected to the system through an output attenuator. The attenuators are set for maximum at the input and zero at the output, and the FSM is adjusted for a +8-dB reading. Output attenuation of 3 dB is then introduced, and input attenuation is reduced until the +8-dB reading is again achieved. The remaining attenuation on the input attenuator subtracted from the output of the noise generator gives the noise figure of the system being tested.

For cross-modulation tests, a 12-channel signal source is comprised as follows. A 15.75-kHz square-wave signal is applied to a channel-6 remodulator, and the channel-6 signal is converted to an IF by a head-end signal processor. The IF signal is applied through a splitter network to 12 up-converters; their outputs are combined in a network to provide a 12-channel test signal.

For readout, output from the system under test goes to a hybrid splitter, one branch of which feeds signal to a field-strength meter (for measuring levels and effecting demodulation), through a 15.75-kHz preselector filter to a wave analyzer. The use of the preselector permits cross-modulation measurements down to −100 dB. The other branch of the splitter is used for beat checks. The signal goes to a demodulator which in turn provides video signal to a video monitor (for picture analysis) and IF signal to a spectrum analyzer (for scanning).

At this point, Mr. Laufer began a description of test results, supporting the discussion with slides of charts and graphs. He stated that with "perfect" amplifiers, changes in cross-modulation and S/N ratio occur because of cable variations alone. Variations were shown for three types of ten-amplifier cascade, with no AGC, AGC at every third position, and AGC at every position. With no AGC, temperature variations accounted for cross-modulation variations up to 46.7 dB, and S/N variations changed 16.38 dB. With AGC at every third position, the figures were 7.7 dB and 6.57 dB, respectively. With AGC in all amplifiers, cross-modulation did not vary, but S/N variations were 3.9 dB.

Two sets of curves were then presented for a system with 22-dB spacings and AGC at every third position. These demonstrated that most cross-modulation temperature variations occured in the first few amplifiers in the system.

All cable tests assumed stable amplifier performance, but errors of 6 dB in amplifier cable equalization were observed in a ten-amplifier cascade in the test chamber. In actual system operation, low-band operation appeared stable, but temperature-variation error occured in the high band for two reasons: improper system cable equalization with temperature, and amplifier-response changes. Both contributed to cross-modulation increases with temperature decreases.

The speakers felt the ideal solution to these problems would be amplifiers which compensate for cable-slope temperature variations. Until they are available, however, it is necessary to cope with existing systems. In their system, three steps were taken to stabilize the overall signal. (1) Additional thermal equalizers were installed where the insertion loss could be tolerated. (2) The head-end pilot carrier level is varied to change all AGC gains with temperature variations. (3) Output of those distribution amplifiers and line extenders past the fifteenth trunk amplifier is lowered by 2 dB to provide more tolerance for changing levels.

Conclusions from the tests were that the high band is the major area subject to cross-modulation, which was the most serious problem. By holding the high-band level constant with AGC, and allowing the low band to vary, visible picture-quality changes are less prone to occur.

The tests, effected on most of the equipment available, revealed as much as 15-dB variation between manufacturer-rated output capability and capability measured in the tests. The paper concluded that it is impossible to design a system using published specifications, unless an NCTA standard is developed which will reveal the basis of specification measurements.

Developments in CATV Amplifier Measurements

A detailed analysis of windshield-wiper effect—its causes, and methods to measure its presence properly—was the concluding presentation of the first technical session. In the paper, William A. Rheinfelder, director of research and development for Anaconda Astrodata Co., revealed the techniques and theoretical approach used in a number of measurements which led to his observations. These were that windshield-wiper effect is produced by countermodulation, which is the result of undesired demodulation and subsequent remodulation.

In the analysis, which included use of mathematics, Mr. Rheinfelder showed that, at low levels and in the presence of third-order distortion, standard cross-modulation exists. However, as the signal level increases, rectification (demodulation) occurs ahead of amplification. This results in an input direct current and new nonlinearities. The sum of the baseband frequencies and second-order distortion results in countermodulation which cancels the cross-modulation and produces windshield-wiper effect.

Undesired detection was shown to be the result of either inter-element rectification (such as grid-cathode or base-emitter) and/or any second-order nonlinearity (square-law detection). Modulation is then produced by other second-order nonlinearities. The significance of showing that countermodulation is the cause of windshield-wiper effect is that measurements for cross- or inter-modulation have little meaning where this effect is concerned.

The making of windshield-wiper tests was discussed. In

the absence of repeatable and accurate test techniques (which involve subjective quality criteria), the speaker recommended the direct method. This requires application of twelve input signals at levels increasing to the point where the effect is observed. The signals may be standard TV test signals with or without back porch. Error sources frequently encountered in the use of this method were discussed also. These included conversion and sync correlation, live signals, spurious responses, levels, and television-set screen readouts.

The speaker enumerated some precautions which should be observed when tests are made on CATV amplifiers. These included stressing that the amplifier and cable should be precision-aligned; jumpers should be avoided; the system should be adjusted and temperature operated for normal usage; AGC loops should be open; and (for multichannel operation) twelve test signals should be used. Especially emphasized was that identical test conditions must be used when comparison tests are made.

In concluding observations, Mr. Rheinfelder said that the distortion may stem from a nonlinear amplifier in which the normally linear input impedance becomes nonlinear at high input levels.

Tuesday Session

Short Haul Microwave

Much interest was generated by a paper prepared by Harold Osaki and deliverd by Lyle Stokes, both of Hughes Aircraft Co. In the paper a new concept for the transmission of CATV signals over a range of two to ten miles was discussed. Using microwaves in the 18-gHz band, the system is oriented toward those situations where cable laying is prohibitively expensive, for example when streets must be torn up or where water and other natural barriers must be crossed.

The design philosophy was explained as one in which system complexity was applied to the transmitter. This approach was used in order that a variety of receiver types could receive signals from a single source. Other considerations were: 2000 MHz of spectrum space is available in the 18-gHz band; a range of from two to six miles would serve the purpose; and −57 dB intermodulation levels could be maintained. The use of amplitude-modulated signals was the result of consideration of the extreme bandwidth and detection problems that frequency modulation would entail. With the selection of a single-sideband, suppressed-carrier system, work on the system, called Amplitude Modulated Link (AML), began.

As the speaker traced the history of development of the system, he also explained how it works. Essentially, low- and high-band VHF signals (consisting of channels 2 through 6 and the FM band, and channels 7 through 13, respectively) are fed to up-converters where they are mixed with the output of klystrons. The composite signal for each band is filtered to remove undesired signals and then fed into an appropriate power amplifier (traveling-wave tube) before being delivered via waveguide to the transmitting antenna. A dish antenna at the receiver intercepts the signal from the fan-beam transmitting antenna and feeds it to the receiver electronics for processing. The receiver local oscillator is phase-locked to a pilot signal, and the modulated microwave signal is down converted to the exact original input VHF frequencies.

When the experimental version had been constructed and laboratory tests indicated satisfactory performance, rain tests were conducted in New York City. It was explained that the amount of rainfall which will adversely affect picture quality falls in relatively short periods of time (daily averages are meaningless). System performance proved to be satisfactory until the short-term rainfall began to exceed one-half inch per hour. The rainfall factor is also a product of hop mileage. At a range of six miles, performance will be below 40 dB for six hours in a year. With allowances for the time of day when such heavy rain falls, it can be anticipated (for New York City) that pictures of less than optimum quality will be important about two and one-half hours in a year.

In concluding remarks, the speaker pointed out that the system is not yet for sale because the FCC has not authorized its use for other than experimental purposes. Applications have been made, however, and the developer of the system, Theta-Com (jointly owned by Hughes Aircraft Co. and Teleprompter Corp.), is optimistic that the Commission will allocate channels for its use.

TV Signal Propagation

Mr. Thomas D. Smith, of Scientific-Atlanta, spoke next. Mentioning the need for better knowledge by CATV technicians of television propagation, he expressed his feeling that this knowledge could be put to use in the performance of signal surveys, selection of head-end sites, identification of interfering signals, and design or specification of antennas and antenna arrays.

The paper was divided into two parts, the first of which dealt with the regions of propagation reception. The regions were discussed individually, and characteristics of each were dealt with in some detail.

The "line-of-site" region was considered first. This area, the speaker stressed, is characterized by the direct radiation of a signal from the transmitting antenna to the receiving antenna. Formulas for calculating the distance to the radio horizon were presented. The effects, through phase difference, of reflecting objects and a reflecting earth on signal strength also were discussed.

The area where most CATV towers are constructed is the "beyond-the-horizon" region. Mr. Smith continued by saying that diffraction is one phenomenon encountered in this region, and its effect is creation of ill-defined "shadow" areas where reception is possible for a short distance. The mean field strength decreases exponentially with distance, but increases exponentially with antenna height.

A fairly recent discovery was the existence of random irregularities of atmospheric dielectric constant. These "blobs" are always present, and result in what is known as "tropospheric scatter." The weak reflected signals fall to earth well beyond the horizon and can be used for long distance reception.

Two types of fading in scatter propagation were treated. These, he said, are of short and long duration. The first is caused by random reflections and sometimes results in limiting bandwidth to 5 MHz. Cyclic changes can occur in a matter of seconds. The second type of fading is of relatively long duration (hours or days) and is slow in its rate of change. It is caused by atmospheric variations.

Briefly mentioned was the sporadic "E" layer which causes skips of from 500 to 1400 miles because of reflection from ionized clouds in the region of the "E" layer.

The second part of the presentation was given to the means by which propagation is effected. This required explanation of the layers (or regions) above the earth through which signals pass or are reflected: The troposphere (0 - 6 miles) is characterized by winds, storms, and rain; it causes many variations in received signal levels.

The stratosphere, or constant-temperature area (6 - 40 miles), causes little noticeable VHF signal effect. The E layer of the ionosphere (50 to 70 miles) produces some reflections.

The refraction index was developed as the ratio of free-space velocity to velocity in a dielectric medium. In a windless atmosphere, a reduction in the temperature/water vapor content with increase in altitude results in higher transmission velocity. The net result is that the wave is bent back toward earth. The effect of a refractive index which decreases linearly with height is the same as if the wave traveled in a straight line on an earth whose radius is 4/3 (1.33) times the true radius.

Changes in the refraction index during early morning and late evening hours are caused by atmospheric changes occuring at different rates for different altitudes. The consequence is greater signal strength at these times because the effective radius is greater than 4/3 of the earth radius.

Ducting was explained as the result of refractive-index changes which are more rapid than normal. This causes wave reflections similar to a bouncing ball, and the wave appears to be "trapped" or "ducted." Methods for indicating standard and ducting conditions by meteorological observations were presented by Mr. Smith at this point, although he mentioned that precise determinations are difficult to make.

Concluding the presentation, methods for predicting propagation of TV signals were shown. These included use of government publications. The speaker stressed that measurements should be made over a period of time. Also discussed was the cochannel interference from distances greater than 500 miles caused on the lower band (channels 2 - 6) by the sporadic E layer. Although severe at times, this is not so great as the interference caused by the troposphere at all frequencies.

Space Diversity Reception

The paper on TV propagation was followed by one in which tropo-scatter-propagation theory was considerably expanded. In it, Ken J. Easton, of Toronto's Famous Players organization, also described a two-antenna system which employs the space-diversity technique.

He began with a short history of TV-frequency allocation in the United States. The discovery of troposcatter phenomona led to an allocations plan which made allowance for over-the-horizon propagation. These same phenomena gave birth to CATV, which was designed to bring television signals to people who otherwise would not have enjoyed them. From then until now, CATV has been concerned primarily with long-distance reception.

For some time, CATV head-end planning was based on the concept of smooth-earth diffraction, and antenna height was increased to maximum. Ultimately, for mechanical reasons a practical limitation was reached in the distance a station could be received usefully with multiple arrays.

In 1955, a number of papers were published which described a practicable system for receiving signals from up to 300 miles via "tropospheric forward scatter." It was believed that the propagation resulted from atmospheric turbulence which produced signal-scattering blobs. A number of systems have been built which exploit the forward aspects of this propagation mechanism. These are used for point-to-point communications, however, and CATV has pioneered in the application of the principle to television signals.

Canadian experiments culminated in the 1963 construction of a troposcatter CATV system at North Bay, Ontario, which provides signals from a distance of 260 miles. Subsequently, other systems have been built in Canada and the United States.

Much has been learned from these systems. First is that a very high-gain antenna is necessary. Usually this is a parabolic antenna with a large capture area. Next is that attenuation can be calculated as a function of the angular distance between transmitter and receiver. Antenna height is not critical; antennas are virtually at ground level, at an effective height of 30 or 40 feet.

Also, it has been learned that signal amplitude varies with time, for both short-term and long-term duration. Long-term variation depends on the season and the geographical location, and usually is worst during February or March. It can be anticipated in design, but short-term amplitude variations, because of atmospheric turbulence, are subject to selective fades of very short duration. If such fades are observed on two antennas a short distance apart, they do not appear at both antennas. This fact led to development of the diversity technique.

Fades in two antennas spaced 50 to 100 wavelengths apart show an almost complete lack of correlation. Frequency diversity, employing two frequencies, shows the same phenomenon. With two antennas and two frequencies, quadruple diversity is achieved. This, of course, is not possible in CATV because the transmitting frequency cannot be controlled.

Mr. Easton discussed the factors which must be considered in the design of a troposcatter system. The primary consideration is an S/N ratio of not less than 29 dB. With entertainment television not in service 24 hours per day, it is possible to achieve this standard 99 percent of the time. This means less-than-acceptable service of 15 minutes per day, or about 3 minutes during prime time. A troposcatter antenna must be designed to achieve the stipulated standard.

The parameter most easily controlled is antenna gain. A typical parabolic antenna 50 feet high and 270 feet wide has gain from about 28 dB on the low band to 38 dB on the high. If an S/N ratio of 29 dB cannot be achieved, then the proposed transmitter should not be used, or less-than-acceptable service will be experienced.

The design for short-duration fades can be accomplished best by employing the principle of space diversity. The cost of constructing two 270-foot parabolics is about $34,000, but by splitting the 270-foot design into two 120-foot units, properly designed, a signal only 3.5 dB down can be achieved at a cost of about $18,000. An analysis was made showing that long-term hourly median signal was improved by 2.5 dB so that the net loss incurred with the two smaller antennas was only 1 dB.

Next considered was the effect of selective fading. Observations were noted that in television reception, bandwidth is of considerable significance. By controlled switching between the two antennas, however, it is possible to provide a stable signal. The switching apparatus consists of two TV receivers, the demodulated output of which is fed to a DC comparator which determines selection of the desired antenna. Switching may be during the blanking interval or by a solid-state device with one microsecond switching time. Use of a space-diversity antenna system for more than one channel requires frequency separation of at least three percent, and separate diversity switches for each channel must be used.

Mr. Easton then described two dual space-diversity systems near Ottawa with which he is associated. Two of the 120-foot antennas receive channels 10 and 12 from Montreal with spacings of 79 and 84 wavelengths, respectively. The other two will be used to receive channel 7 from

Watertown, N. Y., and channel 11 from Kingston, Ontario. The latter system presented a special problem because the two stations are oriented 38° apart. One of the antennas is directed to Watertown and the other to Kingston. Slewing the antennas, he said, will probably result in loss of space-diversity effect on channel 7 because of the 38.5 wavelength separation, but this may not be too important. Calculations indicate the off-axis orientation will result in reduced signal strength as well, when space diversity is in use.

Also described were two Yagis used to receive channel 5 from Plattsburg, N. Y. If tests indicate the necessity, space diversity will be applied to them. It will be more convenient to move them if present spacing of 48 wavelengths is not adequate.

Mr. Easton indicated that the antennas are constructed but the diversity-switching equipment is not yet ready for installation. In the meantime, tests using monitors indicate the beneficial effect diversity techniques should have. They should, he said, result in great improvement in service reliability.

The tests also demonstrated the frequency-sensitivity of the fades. The author thought it possible to demodulate a signal into its various components in order to apply diversity switching to each element. Experience will determine whether the complexity is necessary.

The presentation was concluded with a number of slides showing the antenna site.

CATV and the National Electrical Code and National Electrical Safety Code

The theme of the second technical session shifted at this point to electrical codes. Mr. James Stilwell, of Telesystems Corp., traced the history and organization of the National Electrical Code (NEC). He said that its basic application was to private property with respect to fire claims which have to be paid by insurance companies. The code, it was explained, is developed by 18 correlating committees from specified industries, and is issued every three years. The next volume will appear in 1968. At present the NCTA is not represented in developing the code, and the portions of it which apply to CATV are inappropriate for present use, he said.

The speaker then told of code recommendations which have been made by the NCTA. Based on an already enacted Canadian code, the new section would require the grounding of an outer conductor as close to the point of entry as possible. The new section also would permit the use of cable-powered equipment with a 60-volt limit. It was pointed out that the proposed section has not yet been adopted as part of the NEC.

Mr. William F. Karnes, also of Telesystems Corp., then took the floor to explain the National Electrical Safety Code (NESC), sponsored by the Bureau of Standards. The NESC provisions applicable to CATV are primarily concerned with pole lines, especially with respect to spacing, guying, etc. The speaker commented that the NCTA is concerned because copies of the code are hard to obtain, and many systems do not have it for consultation.

Pointing out that CATV is a growing industry under close scrutiny, Mr. Karnes said that proper construction is important, but is not too difficult because the code is not strict.

Concluding remarks were used to deplore a telco practice of citing the NESC's requirement to reserve communications space on the pole. It was stated that this is not specified by the code, and the effects such a provision would have on guy strength, etc., may be ignored.

The NCTA Standard on CATV Amplifier Distortion

Next was a panel discussion of the proposed NCTA standard for specifications to be used in the measurement of amplifier distortion. The panel was chaired by Archer S. Taylor, and was comprised of Jacob Shekel, Mike Rodriquez, Ken Simons, Heinz Blum, and Earl Hickman.

In what amounted to a question and answer session, various aspects of the issue were covered. This included such items as test waveshape, carrier levels, spurious frequencies, instruments to be employed, and subjective quality evaluations.

Of particular interest was the matter of instruments to be used. The cost to CATV systems was given careful consideration, and comments were made to the effect that any standard should be easy to apply. This inferred that values should be realistic and simple to measure. A square wave, for example, is simpler to generate than a pulse.

The special area of third-order harmonics in three adjacent channels led to considerable discussion; one panelist pointed out that these low-level, spurious signals hide under a carrier and look like an adjacent carrier. Another panelist revealed that computer calculations showed 63,000 beat possibilities from this problem. Some manufacturers, it was said, now have instruments available to analyze this problem, and others indicated a willingness to do so when standards have been established and sufficient interest is expressed. The latter statement applied equally to other instruments, as required.

Questions relating to how manufacturers will quote specifications were also raised. This led to the issue of correlating standards to practical cases. There is, it appears, a need for other than a subjective definition, because any point can be specified with such a standard.

Just before adjournment, one panelist reminded the group that the standard did not set a level of distortion as a desirable goal; rather, its objective was to apply standards to measurement techniques.

Comparison of Demodulator-Modulator Versus Heterodyne Signal Processing For CATV Head Ends

A comparison of heterodyne and modulator-demodulator signal processing for CATV head-ends was presented by Gaylord G. Rogeness, director of engineering, Ameco Engineering Corp. This entailed an explanation of how each system works, with a listing of advantages and disadvantages.

First discussed was the heterodyne system (or VHF converter with IF amplifier). A requirement to avoid signal degradation during conversion is a flat passband from 750 kHz below the picture carrier to 4.18 MHz above. A block diagram illustrated how the signal first passes through an RF amplifier before conversion to an IF frequency. Separation of audio and video and recombination at the IF amplifier output permits independent adjustment of the individual carriers.

Delayed AGC provides for better utilization of the S/N-ratio characteristics of the RF amplifier. Conversion to the desired VHF channel is accomplished by the output oscillator and the output mixer. On-channel conversion is achieved using the input local oscillator with the output mixer and disabling the output local oscillator.

Excellent low-frequency phase linearity was illustrated by presentation of a curve showing a flat amplitude response over the entire video modulation bandwidth. A similar curve for the demodulator/modulator revealed a loss of 6 dB at the carrier frequency. Also mentioned was the complete absence of quadrature distortion in the

heterodyne method because this system merely translates the video-modulated RF signal.

Shown next was a block diagram of the demodulator. Similarities to the heterodyne system up to conversion to IF frequencies were pointed out. From there, gain is introduced in the IF amplifier after which video and audio are detected, the latter being available at both audio and 4.5-MHz-subcarrier frequencies.

A discussion of modulator-demodulator performance followed. In summary, the circuit design becomes critical with respect to the IF amplifier and the detector because of cross-modulation and high-frequency phase distortion. Further, employment of an envelope detector leads to introduction of differential gain and phase which can only be minimized. Also, application of vestigial-sideband signal results in an effect similar to low-frequency phase distortion at low modulation, and quadrature distortion at high modulation; the latter introduces overshoots and streaking.

Two demodulator applications were shown. One was the modulation of a microwave transmitter, and the other was direct application to a VHF modulator which drives a cable system.

Problems characteristic to the modulator were shown to occur in the modulator and the VSB filter. At high modulation percentages, differential gain and phase occur on the color subcarrier. The VSB filter, necessary for adjacent-carrier operation, generates phase distortion and must be optimized.

Sources of distortion in the two systems were presented in tabular form. Phase nonlinearity in both systems can be minimized, but the distortion characteristics of the demodulator-modulator system, such as low-frequency phase distortion, differential gain and phase, and quadrature distortion require complicated video processing equipment for correction.

Further analysis revealed that, because of its fewer components, the heterodyne system has the probability of higher reliability. The modulator system, however, automatically provides a CW carrier signal to the cable system in the event of program failure. This provision must be added to the heterodyne system. A further, but subtle, modulator advantage is the possibility of a better-than-received signal. This is not possible with the heterodyne system because the signal is never below IF frequencies.

In concluding remarks, the speaker mentioned that although the heterodyne method offers more advantages than the demodulator system, the use of microwave links requires the presence of demodulator-modulator systems, and special effort must be made to minimize their problems.

Wednesday Session 1

MATV Techniques For CATV Operators

A paper describing MATV techniques, equipment, and practices opened this technical session. In it, Fred Schulz, of Blonder-Tongue Laboratories, Inc., explained that "risers," or "branches," are the lines from which tapoffs are taken. Usually coming from splitters without reamplification, and usually limited to 15 tapoffs per branch, the risers can be horizontal or vertical, depending on the character of the building. Methods of running cable and locating equipment were then treated briefly, with illustrations used to show how these appear with respect to the building.

System design was the next subject, and the first item was the calculation of system losses. This included employment of many CATV principles, such as the use of graded tapoffs and analysis of channel 13 and the longest riser losses as the determinant for amplification requirements. A sample calculation was presented which showed how this can be done.

The speaker then explained that an MATV system must also be carefully installed. A list of good installation practices followed: cable should be run separately from other wiring and plumbing; the MATV installer should drill his own holes; cable should be run away from cracks or separations and preferably through conduit; 2-inch GEM boxes should be used at tapoffs with 6 to 8 inches of cable left in the box; all risers must be terminated; and all electrical codes must be followed.

Observing that an MATV system is usually part of the electrical contract in a new structure, Mr. Schulz gave a list of things of which an MATV installer should be aware. They included a detailing of what items each supplier is to provide in terms of equipment and labor, channels of communication, guarantees, and system checkout. Also discussed were those instances in which the MATV installer is the prime contractor. This discussion covered items such as material and labor, the use of written verifications, guarantees, and the installation itself.

MATV costs, he said, are subject to considerable variation, and cannot usually be quoted on a per-tapoff basis. He suggested that the use of a cost sheet is the best method for making estimates.

Another question treated was whether a CATV operator should enter the MATV business. The speaker said that in the absence of a qualified MATV installer, the CATV operator should do the job. Good relations with MATV installers is important, however, because MATV systems are frequently good CATV customers.

The next remarks were of special interest; they dealt with CATV charges to MATV customers. He suggested a lump sum as most convenient, with motels being charged one-half the regular home-subscription rate. He also suggested that good-will donations of service to hospitals could be useful as a public-relations tool.

Expanded Band CATV Capabilities

Explaining that CATV is a mixture of art and science, Dr. Leon Riebman, president of American Electronic Laboratories, Inc., said the art aspect occurs with the visualization of future possibilities to which its scientific aspect can be directed. This has already led to the development and application of broadband amplifiers for carrying twelve channels, and more recently to amplifiers with 270-MHz capability.

Observing that it is already possible for some viewers to receive more than twelve off-air channels, the speaker outlined the five methods which are currently being explored as avenues by which CATV can expand its present 12-channel capability. These are: (1) the sub-channel method (5-95 MHz), (2) the mid-band method (108-174 MHz), (3) the dual-coaxial cable method, (4) the octave-band method (20 channels between 120 and 240 MHz), and (5) the spectrum above 220 MHz (220-270 MHz). Each method was then analyzed.

The sub-channel method is limited to twelve channels and is subject to multioctave problems. These can be overcome, but at considerable expense.

The mid-band approach also presents multioctave problems and becomes involved with other frequency allocations, notably those in aircraft communications and guidance.

Using dual cables not only is expensive, but also requires very tight shielding to keep crosstalk at reasonable levels.

Problems similar to midband usage are present in the

octave-band approach—which is really a hybrid of the midband method.

Utilizing the higher spectrum permits the use of conventional twelve-channel techniques if the proper equipment is selected. This includes specification of 300-MHz cable and the application of modular concepts in equipment design to allow channel expansion at any future time.

AEL, Dr. Riebman pointed out, is adopting the high-spectrum approach. In addition to the 270-MHz trunk-extender and intermediate bridging amplifiers introduced at the show, AEL is modifying and developing head-end and test equipment so that a complete 270-MHz line will be available.

The speaker then discussed the problem of a set-top converter. These are being produced now by several manufacturers, and set manufacturers have exhibited an interest in providing conversion capability in the set itself.

The last problem mentioned was the effects of temperature variations on system performance. The AEL approach, called Auto-Tilt, will utilize sensing of pilot carriers at both ends of the spectrum and require a frequency-flat AGC system. It should, it was indicated, be available in about six months.

Concluding remarks urged system owners to bring their ideas and needs to the manufacturers.

Automatic Equalization as a Factor in System Level Control

The next speaker was Argyle W. Bridgett, manager, design engineering, Spencer-Kennedy Laboratories, Inc. By resolving CATV problems to the reception and transmission by cable of high-quality television signals, he explained that cable attenuation becomes the primary obstacle which must be overcome. This is accomplished by introducing amplification at appropriate intervals along the cable. The amplifiers, however, introduce signal degradation in the form of noise and intermodulation distortion which, in turn, limit picture quality and system length.

"V" curves relating noise and intermodulation to the number of amplifiers in a system were then presented. These showed how signal levels and amplifier gain are used to develop a system margin in the maintenance of S/N ratios and the management of intermodulation distortion during the design period. Pointed out, however, was that practical gain settings are not always uniform, and variations will reduce system margins with respect to noise at low levels and intermodulation at high levels.

The next topics were the effects of frequency and temperature attenuation. Mentioned was the loss with increasing frequency, and both slope and overall loss changes with temperature variations. Automatic level-control amplifiers can compensate for half the variations, but slope correction also must be provided.

Temperature-operated equalizers serve this purpose. This requires the use of a thermistor in the equalizer network. A curve was displayed to show the temperature response of a typical unit. For various reasons, the units do not always work perfectly, but careful location of the devices can reduce their imperfection to limits within the system margin. The speaker explained that some ALC amplifiers have slope variation designed into the circuit, but these must be custom built and are not easily corrected.

The last method discussed was the automatic pilot-operated equalizer. Pilot signals at extremes of the frequency range are compared, and slope correction, if necessary, is applied. This method is limited to the control range of the amplifier and must, therefore, be carefully designed.

In conclusion, Mr. Bridgett expressed his belief that, because none of the systems can match the cable response exactly, cascading one type of unit will result in a fault buildup. This is best accommodated by employment of all three systems.

Temperature,Temperature Design, and Automatic Level Control for CATV

Before delivering his prepared paper, James R. Palmer, president of C-Cor Electronics, Inc., expressed his opinion that CATV manufacturers should not, for the present, engage in the production of more-than-12-channel systems. This delay, he felt, would give the industry an opportunity to examine the prospects carefully, and then to come up with a system that would serve the industry for years ahead.

His talk was concerned with the design of CATV systems to operate in the environment by which they are surrounded, particularly with respect to temperature. A chart was exhibited showing temperature extremes for nine locations in the United States. The effect was to indicate how systems designed for one area would overperform for another, and that seasonal adjustments can be used to lower temperature-compensation requirements.

The selection of amplifiers was next explained as a function of system length, and an example was used to show how use of 40-dB amplifiers, substituted for those of 22 dB, resulted in reduction of the number of amplifiers required. This concept, the speaker indicated, could be used in half of the existing CATV systems, particularly those in metropolitan areas.

With properly selected amplifiers, stabilized head-end feeds, and well-regulated power supplies, the only factor which can effect signal level is the temperature. Since this factor—the effect of temperature—is completely predictable, the speaker said, an automatic level-control system can be designed which will take care of these variations.

The explanation was then given that a temperature-variation allowance of 120° will take care of about half of the United States. With winter and summer adjustments, the same allowance will take care of the other half. Automatic level control of ± 3 dB at 40 dB will allow for a 120° temperature range. The $\pm$ 3-dB ALC allowance give ranges of $\pm$ 70° F for a 34-dB amplifier, and $\pm$ 80° for a 28-dB unit. This analysis showed that the lower-output amplifiers provided temperature-control range considerably in excess of any real requirement.

Commenting further, Mr. Palmer expressed his belief that every trunk amplifier should have temperature control. It must, however, be set correctly, and technicians should have ALC-temperature charts.

Slides were then presented to show how the use of 40-dB amplifiers extended maximum feeder lengths. The design comparison showed sixteen amplifiers in a 22-dB system and only five for a 40-dB system.

The speaker, in his concluding remarks, pointed out that bridging amplifiers must not have a gain-temperature characteristic that aggravates the situation.

Mid-Band Use in CATV Systems

The next agenda item was a report by Gay C. Kleykamp, director of engineering, Kaiser CATV Corp., of simulated and live operational tests of a 19-channel CATV system. The seven additional channels were inserted into the midband frequencies from 121.25 to 157.25 MHz at 6-MHz intervals, and were delivered to the system out-

lets through unmodified Phoenician Series trunk amplifiers.

Signals for the laboratory tests were supplied by a "white screen" tester. Modified Benavac head-end units were used to convert signals generated on channels 2 through 8 to the midband channel frequencies (labeled A through G). These were then mixed by nonadjacent channel looping and combined with the standard VHF channels for feed into the first amplifier of the system under test.

The simulated test system was described first. This consisted of 18 stock amplifiers with AGC at every second location. The amplifiers were spaced by 22-dB sections of 75-ohm cable. The system was adjusted for normal operation.

A tabulation of cross-modulation results for various combinations of levels was made. This led to a determination that it would be possible to operate 32 amplifiers in cascade, if the proper operating levels were used.

The next part of the report was concerned with the signal after the midband channels were converted to channel 2 for television-set display. For this purpose, a converter was supplied by International Telemeter Co. The speaker indicated that no perceptible picture degradation was in evidence.

The test equipment was then moved to an operating system at. Merced, California (operated by the General Electric Cablevision Corp.). This system employs the same Kaiser equipment as the simulated tests, but is 34 amplifiers "deep." White-screen measurements, made using a General Radio wave analyzer, indicated midband cross modulation better than expected, but the high and low bands were barely within predicated levels.

With the system in normal operation (12-channel input) at slightly higher than normal levels, channels A through G were added one at a time. A slight "beat" appeared on channel 5, but no other aberrations were observed. The system was then extended to 42 amplifiers, and again no indication of any kind of degradation was apparent.

In his analysis of test results, Mr. Kleykamp stipulated that not all 42-amplifier cascades could carry 19 channels without derating. This capability is a function of the amplifiers in use. Several factors to consider before application of midband channels were given: amplifiers must have high output and good output linearity with respect to cross-modulation; conversion and mixing must result in clean head-end output; pilot-carrier signals must be protected from adjacent-channel interference; amplifier noise figures must be low; the channel converter must be well constructed; and second-order harmonic distortion must be watched for.

PERT/CPM—Uses in CATV

Mr. Donald Stewart of Superior Cable Corp. concluded this Wednesday meeting by discussing the application of planned management to CATV projects through the use of Program Evaluation Review Technique (PERT) and Critical Path Method (CPM) techniques. Their value was demonstrated by employment in major defense projects which resulted in the saving of money and years in time.

Demonstration of the method required the use of a chart in which development of an entire CATV system, from conception through franchise, financing, subscriber sales, construction, and system checkout, was displayed. In the technique, each step is placed in its time perspective, and careful estimates show the critical path at which each step should be accomplished.

The advantages listed were that a job gets done, time and money are saved, and responsibility is fixed. Limitations were also specified; it is only a tool, it must be updated, and its application can be complex.

In the talk, Mr. Stewart cited many successful applications and explained in detail how use of either PERT or CPM can reveal unrealistic goals or the need for alternate approaches to the completion of a project.

The speaker concluded by saying the best way to learn the technique is to apply it. Available at the meeting was a bibliography on the subject.

Wednesday Session 2

How to Evaluate Coaxial Cable for Maximum Utilization and Longevity

Lead-off speaker for this session was Mr. Allen M. Kushner, manager, engineering services of the Times Wire and Cable Div. of the International Silver Co. Mr. Kushner presented several guide lines for use in evaluating cable for use in CATV systems.

The speaker stated two primary limiting factors: stability of electrical characteristics, and functional obsolescence. The first becomes important when system performance becomes degraded beyond acceptable limits, and the second comes into play when the electrical characteristics do not permit the system to be used economically for a function different from the one for which it was chosen. Important electrical characteristics include attenuation, shielding, and return loss. Of these, attenuation was considered first.

The speaker stated that most present-day cable for CATV applications employs a foam-polyethylene dielectric. Moisture forms in this material during extrusion, but it is subsequently removed in another stage of manufacture. The problem is then to keep moisture from re-entering the foam; a metallic barrier is the most practical approach. Experience shows that moisture can enter the cable either through improperly installed connectors or through the pinholes that inevitably form in the sheath.

Because moisture is almost certain to enter the cable at some point, it is mandatory that moisture propagation along the cable be minimized. Possible propagation paths are between the center conductor and the dielectric, between the dielectric and the metallic barrier, and through the foam dielectric itself. The first two modes can be effectively controlled by making the foam adhere tightly to the center conductor and by tightly compressing the surface of the dielectric to the outer barrier. Movement of moisture through the remaining path, the foam itself, is slow, and over a considerable period of time an insignificant portion of a long run of cable would be affected by one leak.

A test for moisture-tightness of cable was described at this point. The test consists of introducing *Freon* into one end of the cable sample at 10-15 psi, and testing along the length of the cable with a halogen detector. There should be no vapor transmitted through a ten-foot sample.

The speaker mentioned that other dielectric materials would give lower losses and better return-loss figures than are obtainable with polyethylene. However, it is not now possible to bond these materials to the center conductor.

In concluding his remarks on attenuation, Mr. Kushner said, "It is our conclusion that a cable from which longitudinal travel of moisture can be prevented will be able to maintain a constant attenuation for an extended time."

Shielding efficiency, it was stated, is an important cable characteristic that is often overlooked because aluminum-sheathed cable inherently provides an excellent degree of shielding. It was pointed out, however, that any break in the shield, either in the sheath itself or at a connector, allows unwanted signals to pass into or out of the cable.

The importance of low resistance of the outer conductor, as lightning protection, also was stressed at this point. It was added that in those applications where a jacket is required, the jacket is as important as the outer conductor. Only certain jacket materials are suitable, and when extruded these have pinholes that must be detected (with high-voltage techniques) and removed.

The speaker next directed his remarks to underground burial of cables, a technique that may be required more and more to reduce "visual pollution." Cables for this purpose must be protected from corrosion, rodents, installation damage, and damage caused by digging subsequent to installation. In some severe cases, a steel jacket with a polyethylene outer covering may be needed. Perhaps copper can be used as an outer conductor to inhibit corrosion.

The speaker said that return loss is not affected by moisture, but it could be affected by physical damage or severe corrosion of the outer conductor. A more serious problem is a multiplicity of splices with impedance differing from that of the cable. Nonuniform spacing of splices is helpful, but a tightly controlled nominal impedance was suggested as being more desirable.

Returning to the second primary limiting factor (functional obsolescence), Mr. Kushner observed that the most obvious change in function will be the offering of more services (*i.e.* 20-channel systems, etc.) System expansion to as high as 300 MHz seems economically feasible in the foreseeable future. When broad bandwidths are considered, return loss is the parameter of concern. The speaker stated that the present state of the art is such that good return loss can be maintained to 300 MHz. He added that it appears that a cable good to 300 MHz will also be good to 500 MHz.

In conclusion, these criteria for evaluating the life expectancy of cable were offered: (1) Moisture tightness. (2) Susceptibility of outer conductor to splitting. (Determine by flexing.) (3) Lightning protection. (Check DC resistance of outer conductor.) (4) Corrosion resistance. (Apply pressure under cable jacket and test for leaks.) (5) Return loss.

Underground Construction Panel

Construction of underground cable systems was discussed by a panel of four speakers. The first was Ted Hughett, of Alarm Corp., Carmel, Cal. When a system was built in Carmel, the city required an underground installation. No sidewalks or utility easements were available at the time of construction, so for accessibility the cable was put six to eight inches below the blacktop streets —a practice the speaker did not recommend to others. The system now uses polyethylene ducting buried 24-30 inches deep; 2-inch duct is used for trunk lines, and 1½-inch duct is used for distribution lines. Pull points are spaced 250 feet apart.

The advantage of this method of installation is that a permanent raceway is provided, and it is not necessary to dig up the cable for repairs or modifications. Direct burial was not recommended because the cable is easy to damage and hard to repair. In new areas, the system makes use of joint trenching with other installers of underground lines. The raceways are installed for addition of the cable later when needed.

Mr. Hughett observed that underground construction costs more than aerial construction, but this is offset by the absence of make-ready or pole rental. Also, a buried system is less susceptible to storm damage.

Sam Booth, of Sarasota (Fla.) Cablevision, next related his system's experience with direct burial of cable. He expressed a preference for double-shielded cable with a flooding compound between the shield layers. At first, trenching was used, but this was described as "the hard way" because of problems with lawns, etc. It was concluded that plowing in of the cable is better; a vibratory plow is used, and the cable is pulled from a stationary reel. A depth of 30 inches was tried by the Florida system, but it was decided this was too deep; 18-24 inches is used now.

House drops have proved to be a troublesome problem. Pole drops, etc., defeat the purpose of underground installation. One satisfactory approach was the use of a machine made for putting in sprinkler lines. The machine cuts a trench about one inch wide and six inches deep.

Another serious problem is the requirement of crossing highways without ditching. In some cases, Mr. Booth related, permission was obtained to use a concrete saw to cut a slot ½-inch wide and 12-inches deep in the pavement. Several other approaches have been tried and abandoned; his company is now trying to dig under the pavement with an auger.

Mr. Mark Wolfe, of Anaconda Wire and Cable Co., spoke next. He emphasized that each system must be engineered individually; general rules cannot be applied to everyone's problems. There are many available options, and each one has its price; practical engineering determines which is best for a given case. This speaker pointed out that underground construction is not new; in fact, it has been used for 40 years or more. Over this period, he said, the cost of such construction has gone down while its reliability has gone up.

A factor contributing to the advancement of underground techniques has been a new technology in selection and use of nonmetallic coverings. Investigation has shown that the molecular structure of polyethylene is important; a high molecular weight must be used in this application. The covering must be properly applied; if it is not to act as an osmotic membrane, it must be in complete and intimate contact with the shield—an adhesive bond is one method used for this purpose.

Mr. Wolfe observed that cable installation techniques have improved, too. In general, he said, special equipment has solved most problems. The capability of putting the cable three feet below grade has helped alleviate problems with rodents, insects, etc. The use of vibratory plows, which surround the cable with rock-free dirt, was also mentioned.

Mr. Wolfe concluded his remarks by observing that ". . . we need not run scared when faced with installing an underground system."

The final panelist to speak was Walt Roberts, director of research for Superior Cable Corp. He discussed some of the factors responsible for deterioration of performance in buried cable. Attenuation stability is the desired objective. Attenuation changes result from changes of dielectric loss and changes in loss contributed by the shield. (Loss change because of a change in the center conductor indicates a disaster as far as the cable is concerned.) Water vapor in the dielectric (liquid is not needed) is a well-known cause of cable performance deterioration. Use of solid dielectric material is one solution to this problem, but it may not be the best one when all factors are considered. When a foam polyethylene core is used, integrity of the protective means must be maintained. In addition, the protective means should prevent water from migrating along the system.

The speaker quoted some statistics on corrosion of buried metals. In one 10-year study, 1/16-inch aluminum samples corroded (pitted) almost through in ten years.

Metal selection improves corrosion resistance. Copper is normally better in this respect than aduminum, but hydrogen sulfide can premeate the sheath and attack this metal.

Mr. Roberts concluded that the manufacturers are trying to provide a cable that will meet the industry's needs, and they have experience along these lines gained in other fields.

A session of questions, answers, and comments following the panel developed these points: Cable for use in ducts should be a type designed for direct burial (except for mechanical protection); it will get wet. There was no particular problem in Carmel with "snaking" of the coiled polyethylene duct during installation. System operators have to live with cable damage; it is a good idea to "educate people who dig." A thin plastic "parachute" trailing a pilot thread can be drawn through a duct with an industrial vacuum cleaner to pull a cable through a difficult routing.

Analysis of the Directional Tap in System Design

The relative merits of the directional tap for use in CATV systems were explored in a paper by Mr. S. W. Pai, vice-president of engineering, Craftsman Electronic Products, Inc.

The speaker began his presentation by stating that, although both its design and construction have been improved, the pressure tap has certain inherent limitations on its performance in a modern CATV system. He concluded that a better method of tapping off is needed, and the directional tap is the most feasible solution at present. Illustrative examples and experimental data were then presented to support this conclusion.

First, a numerical example was used to show these advantages for the use of sloped directional taps: (1) Uniform signal level is present at the input to the television set. (2) More taps can be installed with minimum signal loss. (3) Layout is made easier for the system designer; this is possible because the through loss of the tap has a slope similar to that of the cable, and the tap can be treated as an additional length of cable in making computations.

Measurements made in the frequency domain on directional-tap groupings were reported next. First the return loss on an 850-foot sample of .412 cable was measured with far-end terminations of 75 and 50 ohms. The results were as follows (the speaker added that this was not an average sample of cable):

	54 MHz	216 MHz	290 MHz
75 ohms	44 dB	44 dB	37.5 dB
50 ohms	26 dB	38 dB	36 dB

Nine directional taps were then added, with one end of the cable terminated. The results were:

54 MHz	216 MHz	290 MHz
35 dB	30 dB	25 dB

From this it was concluded that the nine taps introduced less mismatch than did the 50-ohm termination.

Next, all tap ports were left open, and the return loss at one end of the cable was measured with the other end properly terminated. The return loss was better than 25 dB across the VHF television band:

54 MHz	216 MHz	290 MHz
30 dB	26 dB	24.5 dB

All tap ports were then terminated, and two high-impedance backmatch taps (25 and 30 dB) were placed between the input and midpoint of the cable. The additional mismatch contributed by the backmatch taps caused return-loss decreases of 10 dB at 54 MHz, 18 dB at 216 MHz, and 10 dB at 290 MHz. Mr. Pai observed that this condition would be even worse under actual system conditions.

Other experiments were carried out to examine the directivity of directional and backmatch taps. Signal was injected into a tap port of a 10-dB directional tap (DT), and the level at a tap port of a 14-dB DT (these taps are two of the nine DT's in the test setup) was measured. The attenuation was 62 dB at 54 MHz and 67 dB at 290 MHz. A similar test performed on two 12-dB backmatch taps yielded attenuations of 35 dB at 54 MHz and 51 dB at 290 MHz.

In still another test, the .412 cable and all tap ports of the nine directional taps were terminated, and the return loss was measured from the end opposite that used in the earlier measurements. Then all tap ports were opened, and the return loss was measured again. The results were:

Tap Ports	54 MHz	216 MHz	290 MHz
Terminated	26 dB	23.3 dB	23.7 dB
Unterminated	25.6 dB	23.2 dB	24 dB

These results demonstrate the ability of the directional tap to reject reflections from the tap ports.

Other tests, in the time domain, were described briefly. The speaker reported that the results of these tests supported the conclusions drawn from the frequency-domain measurements.

The speaker concluded by pointing out that the illustra-

tions used were typical, and not necessarily absolute guidelines. He added, however, that in most cases they could be referred to in system-layout design.

Distortion, VSWR, and Reverse Transmission in Broadband Transistor Amplifiers

Brian L. Jones, of the Fairchild Semiconductor Research and Development Laboratory, presented a paper which gave some insight into the design and operation of transistor amplifiers. In this presentation, he showed the relationship among three facts about transistor amplifiers: (1) These amplifiers produce distortion. (2) They have a VSWR when inserted in a 75-ohm system. (3) If an amplifier is placed in a system backward, the signal is attenuated instead of amplified.

First, the nonlinear relationship between input voltage and output current of a typical transistor was shown. It can be shown mathematically that because of this nonlinearity, when two or more AM RF input signals are present, cross-modulation results. Thus the transistor forward transmission is nonlinear and produces distortion.

Next the question of reverse-transmission transistor linearity was explored. At low frequencies, the output current depends mainly on the base voltage. Output conditions have little effect on the input, and the reverse transmission is low. At high frequencies, however, "parasitics" enter the picture; the two main ones are emitter inductance and collector-base capacitance. The second of these is usually dominant, so attention was turned to it.

Collector-base capacitance is voltage-dependent, and thus the reverse transmission of the transistor is nonlinear. It follows that if a signal is present at the collector, a distorted signal current will flow out of the base. Part of this current returns to the base and is amplified by the transistor. Consequently the output impedance appears nonlinear, and cross-modulation and other distortion are produced. If the driving source has high impedance, the distortion is greater, since a smaller part of the distorted feedback current enters the external circuit and more of it returns to the transistor. Thus the distortion resulting from a signal at the output depends on conditions at the input.

Next it was shown that when reflections are present at the output of an amplifier, their effect is felt at the input because of the reverse transmission present in all real amplifiers. In a transistor amplifier, the reverse impedance is nonlinear, the reflected wave is distorted as it passes through the amplifier, and the amplified wave exhibits cross-modulation and other distortion. At this time it was also pointed out that the output impedance and VSWR depend on the source impedance connected to the input of the amplifier. Also, if the output receives reflections from its termination, and if the reverse transmission of the amplifier is considerable, reflections will be present at the input also.

The use of the scattering matrix to describe CATV equipment was discussed briefly. Scattering parameters deal in incident and reflected waves, and CATV systems can be considered in these terms.

Plots of input reflection coefficient vs reverse transmission were shown. One conclusion drawn from these was that as the gain of an amplifier increases, the reverse loss must be increased also, or the input will become excessively sensitive to output reflections.

The characteristics described are limitations imposed by the transistor. Mr. Jones said that his company is trying

to improve the devices used in linear broadband amplifiers, and preliminary results of the work indicate that considerable improvement over present devices is possible.

CATV Coaxial Cables Standardization?

The final paper of this session was a call for industry cable standards by Sidney A. Mills, vice-president, production and engineering, Ameco Cable, Inc.

Mr. Mills opened his remarks by pointing out the importance of insulated electrical cables in the CATV industry, even though their usefulness is usually obscured by the more "glamorous" components such as amplifiers and modulators. He saluted the industry pioneers who made use of existing military and commercial cables to bring CATV into being. He observed that these "imagineers" needed the ability to improvise and innovate, and that industry standards at that time would have been an inhibiting force.

Mr. Mills said that whether or not the state of the CATV art has reached the point where broad standards are possible for all components was beyond the scope of the paper. But, he said, it is his opinion that standards for CATV cables are both possible and necessary. He underscored this contention by quoting an estimate of 266 million feet of cable in use by 1971—double the present quantity. He added that the validity of this premise (the need for standards) is for the CATV industry to decide, and the purpose of his paper was not to promulgate standards, but to call attention to the variations in manufactured cable.

The speaker observed the final link between an "accumulation of exotic and expensive pieces of equipment" and the CATV customer's set is a "$2.50 piece of coaxial cable." He went on to say that over the years, changes in construction of this cable had been made (to reduce cost), but the product was still identified as "RG-59/U."

Results of an examination of 19 samples of RG-59/U cables used as CATV drop cables were summarized. It was stated that no two samples were identical in construction, and none met all the military specifications for this type of cable. Mr. Mills added that it was not his intention to infer that any of the cables were unsuitable for their intended service; rather, he wished to indicate that ". . . 'RG' is a nebulous designation for a very important component of the CATV industry."

The speaker observed that construction variations exist also in trunk and distribution cables, although they are not as prevalent as in drop cable.

Mr. Mills condemned the use of vague or unqualified descriptions of cable characteristics, saying that ". . . vague 'advertising copy' is hardly a satisfactory basis for sound engineering decisions." Practices cited were the use of average values without qualifying tolerances, use of attenuation graphs ". . . on fine paper with a broad pen . . . ," and use of the term "return loss" without precisely specifying frequency spectrum and test procedures.

Mr. Mills concluded his remarks with the observation that the wire and cable industry is capable of establishing suitable specifications for the design, production, and testing of present-day CATV cable. He added that experience in other industries indicates such standards should not impede progress; in fact, they have been the basis for advancements. The project, however, must be undertaken with the cooperation of both the manufacturer and the consumer. The result should be mutual agreement and widespread use of test methods, and universal understanding of the language and numbers used to describe CATV cable. ▲

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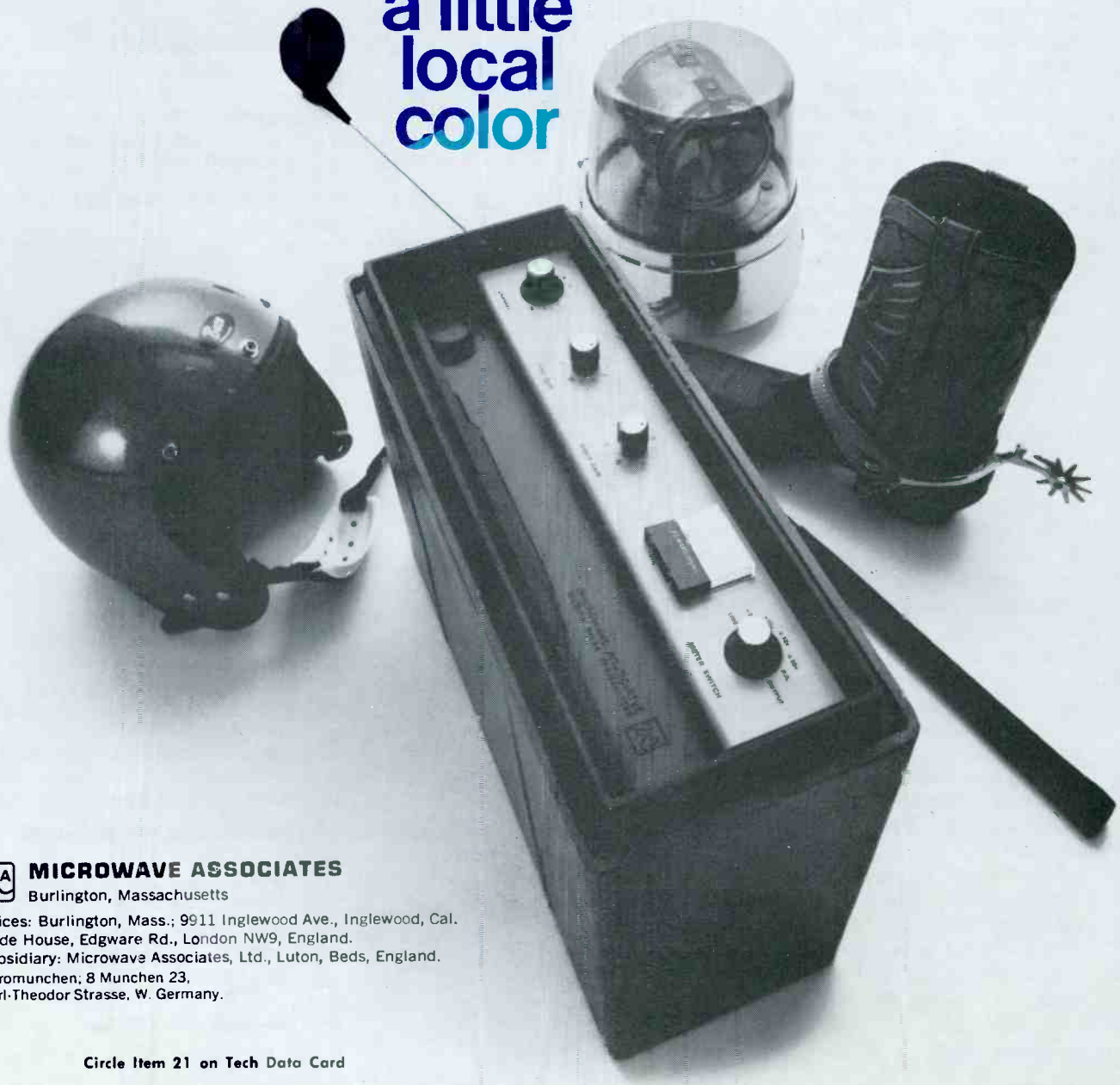

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Circle Item 21 on Tech Data Card

September 1967

We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

Study of New Developments Planned

The increasing demands on the radio frequency spectrum, especially those requiring broad bands of frequencies, have led the Commission to announce a study of the impact of new developments which may require the use of large amounts of the radio spectrum. The Land Mobile Radio Services are clamoring more insistently for additional frequencies -- which inevitably must come from space now assigned to television broadcasting -- and developments such as CATV and broadband data transmission, as well as modulation systems requiring broad channels, are attracting increasing attention.

The Commission is expected to issue a plan in the near future giving details of the nature and scope of studies to be conducted. The results of these studies may very well point the way to new patterns of broadcasting and communication.

Proposal Would Authorize Pay TV

A three-member panel of the Commission has submitted a report proposing the establishment of subscription television (STV) service to be conducted over regular television broadcast stations. Hearings on this proposal are planned in the early fall.

Under the proposal, STV authorizations would be granted only where five or more commercial television stations, including the STV station, provide Grade A service to a community. The STV station would also be required to provide a minimum schedule of free television programming. Only one STV station would be permitted in any given community.

Technical requirements for STV systems will be established after further study. Limitations would be imposed on the use of feature motion-picture films and sports events. No commercials would be permitted.

The commission report culminates a series of tests dating back to 1950. At present, the only broadcast station carrying STV programs is an experimental operation at Hartford, Connecticut.

CATV Regulation Picture Becomes Cloudier

The United States Court of Appeals for the District of Columbia circuit has upheld the authority of the Commission to regulate CATV systems. The case involved a CATV system in Toledo, Ohio.

This opinion is directly contrary to that of the Ninth Circuit Court of Appeals (southern California) which had ruled that the Commission has no authority under the law to establish any regulation of CATV systems (July 1967 Bulletin). The confusion arising from these conflicting decisions, by courts of equal stature, can be resolved only by the Supreme Court, and an appeal in the California case has already been taken.

Emergency Broadcast System Procedures Revised

The Commission has adopted a new Emergency Broadcast System (EBS) plan which modifies the original system in various respects. The modified plan spells out details of emergency action notifications and the method of activating the Emergency Broadcast System by the Office of Civil Defense.

Details of the modified plan are included in amended Subpart G of Part 73 of the Commission's Rules and Regulations governing the radio broadcast services. The FCC plans to distribute one copy of the bulletin to each station in the near future. Additional copies may be obtained from national, state, or regional offices of the Office of Civil Defense, or from local Civil Defense officials.

Short Circuits

A Kansas television station has been ordered to grant rebroadcast rights to another station as a condition for obtaining a translator license. . .The Commission has decided not to adopt a proposal to provide stereo sound for television -- there was virtually no interest in the proposal. . .NAB has urged the adoption of standards for radio-dial calibration. . .A new proposal would exempt educational television stations from the prohibition against the carriage of distant ETV signals on CATV systems in the top 100 markets. . . The U.S. Public Health Service and a manufacturer of color television receivers are still trying to locate 9000 sets capable of emitting excessive X-rays -- the culprits are 6EA4, 6EF4, and 6LC6 shunt-regulator tubes. . .The 17th Annual International Fall Symposium of the IEEE Broadcasting Group will be held at the Mayflower Hotel in Washington September 21-23.

Howard T. Head . . . in Washington

FRONT VIEW
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Circle Item 22 on Tech Data Card

NEWS OF THE INDUSTRY

INTERNATIONAL

Receives Emmy Award

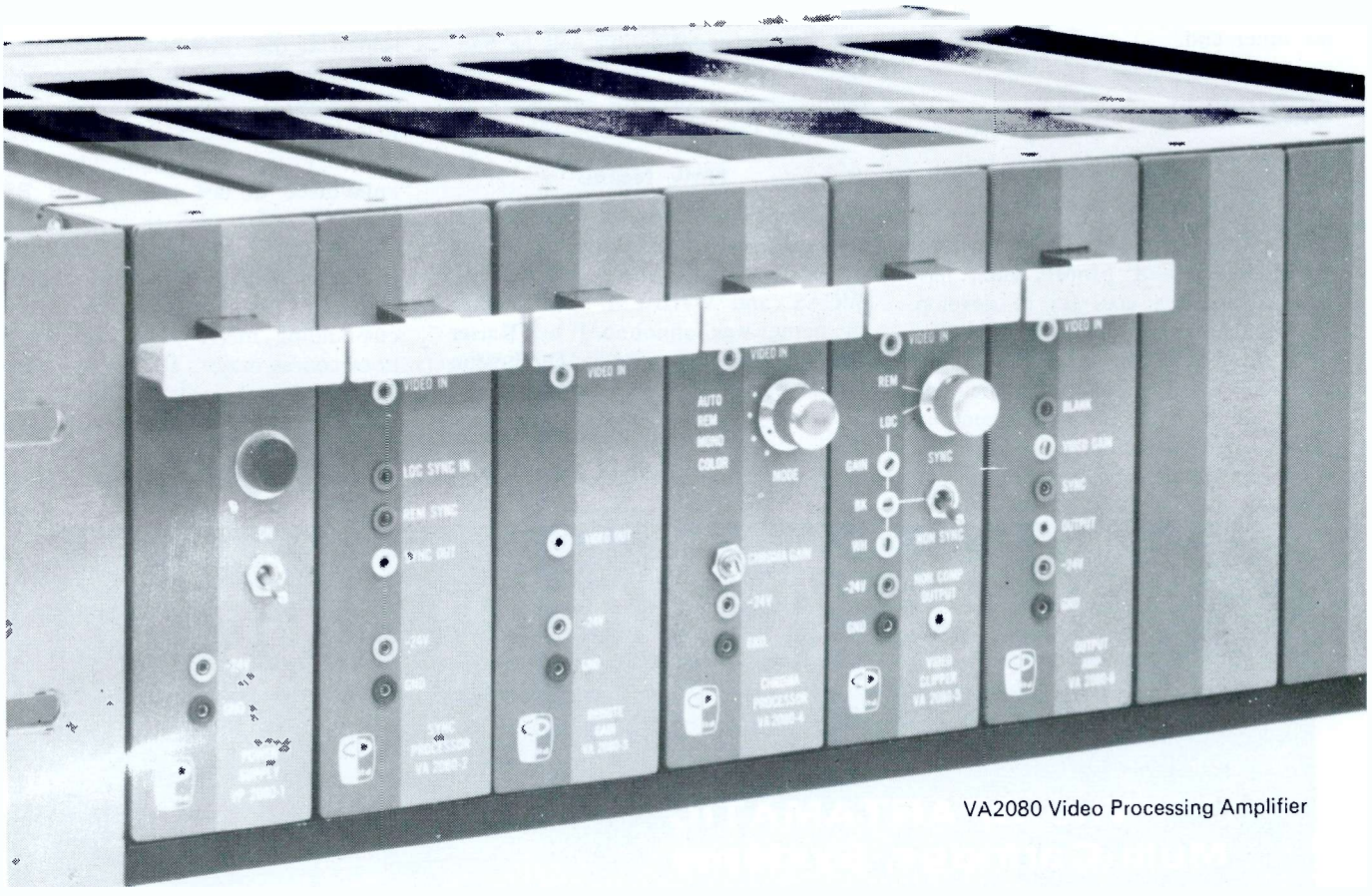
N. V. Philips of Holland received an Emmy award from the National Academy of Television Arts and Sciences for its development of the *Plumbicon* camera tube. The tube, honored particularly for its contribution to color TV broadcasting, will be manufactured in the United States by **Amperex Electronic Corp.**, a subsidiary of **North American Philips.**

Color Television in Germany

Color television in Germany had its official premiere in West Berlin at the 25th annual German Radio-Television Exposition, which began Aug. 25. This ten-day event was of interest also to the eleven other West European countries (including Britain) that have agreed to adopt the German PAL system for color TV. Even when France and the East Bloc countries headed by the Soviet Union use the alternative SECAM system, a "transcoder" will enable PAL sets to receive relayed SECAM programs, and vice versa.

Starting with the opening of the Radio-TV Exposition and continuing probably through fall 1968, German networks will provide an initial eight hours of color programs per week, four hours from each of two areas, aired at different times. The networks have invested some $12.5 million in color transmission facilities. Their color cameras are priced at $62,500, three times the cost of a comparable black-and-white camera, and their mobile units cost $625,000 each.

A special characteristic of the PAL system is that it always utilizes two scanning lines at the same time, using one to correct an error in the other. For example, the color signal for yellow is followed by an opposed signal for yellow that has been shifted 180 degrees. In the receiver, this second signal is immediately inverted to the correct phase. In the event of a shift in color, the aberration will be recorded in equal intensity by both lines, but these aberrations will be cancelled: if the original yellow assumes a greenish hue on the first line, it will appear as reddish yellow on the second. When the color signals of both lines are mixed, what appears on the screen is the pure yellow that represents their mean value. This process requires the use of a ceramic rod about 8-inches long to store the color signal of one line long enough to permit the second line to arrive. The electric signal entering one end of the rod is transformed into ultrasound, travels through the rod, and is trans-



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Circle Item 27 on Tech Data Card

formed back to an electric signal at the other end.

NATIONAL

To Develop Television Facility

The **F & M Systems Co.,** a division of **Fischbach and Moore, Inc.,** has been awarded a contract to develop a complete television studio facility in St. Louis for **CBS** television station KMOX-TV. The contract includes design of the system, procurement of equipment, fabrication of equipment where necessary, and installation and testing of the complete technical facility. Project coordination will be handled by the CBS television network engineering department on behalf of the CBS Television Stations division.

New Name

Kaiser-Globe Broadcasting Corp. is the new name of WKBG Inc., licensee of Boston area stations WKBG-TV, WCAS, and WJIB-FM. The change of name was announced by **Kaiser Broadcasting Corp.** and by **The Boston Globe,** equal owners of the stations.

Scholarship Award

The first annual **Visual Electronics Corp.** scholarship award will be presented at the 1967 convention of the National Association of Educational Broadcasters. This award will be the first of ten annual $1000 scholarships under Visual's program which was announced at last year's NAB Banquet.

The award will be presented to a college student who, in the opinion of the Scholarship Committee, shows outstanding merit as a communications course major. The three-member Committee, chaired by Dr. Samuel Becker, member of the NAEB Board of Directors, will also be comprised of one member from the National

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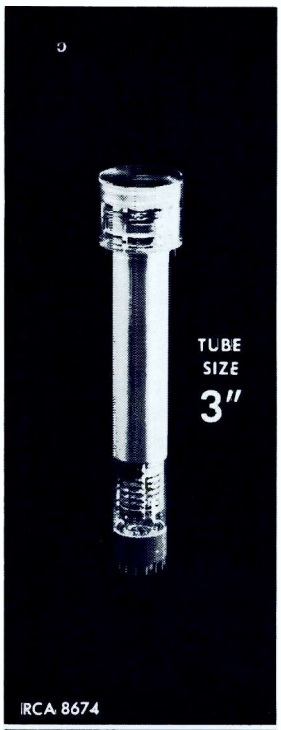
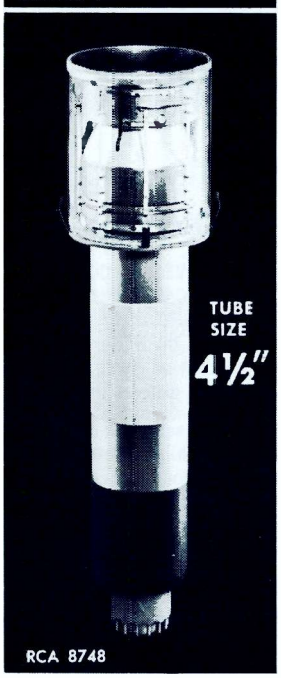


RCA 8674

TUBE TYPE NO.	TARGET MATERIAL	PHOTO CATHODE TYPE	REMARKS
5820A	glass	S-10	All-purpose tube for studio or remote use
8673	electronic conducting glass	RCA Bi-Alkali	Close-spaced target-mesh, long-life tube for studio use
8673/S	electronic conducting glass	RCA Bi-Alkali	Same as 8673, except 8673/S designates one of a matched trio of tubes for use in color cameras
8674	electronic conducting glass	RCA Bi-Alkali	Wide-spaced target-mesh, long-life tube for remote service
8674/S	electronic conducting glass	RCA Bi-Alkali	Same as 8674, except 8674/S designates one of a matched trio of tubes for use in color cameras



RCA 8748

TUBE TYPE NO.	TARGET MATERIAL	PHOTO CATHODE TYPE	REMARKS
4492	glass	S-10	Wide-spaced target-mesh for use in RCA TK-42 and TK-43 cameras at a target potential of 2.3 volts above cut-off — For TK-42 and TK-43 cameras
4536	electronic conducting glass	S-10	Close-spaced target-mesh for use in RCA TK-42 and TK-43 cameras at a target potential of 3 volts above cut-off — For TK-42 and TK-43 cameras
7389C	electronic conducting glass	S-10	Close-spaced target-mesh, for monochrome cameras
8748	electronic conducting glass	RCA Bi-Alkali	Close-spaced target-mesh, for long life in monochrome cameras
8749	electronic conducting glass	RCA Bi-Alkali	Wide-spaced target-mesh, for long life and high sensitivity in monochrome cameras

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ORGANIZATIONS

NAB

Grover C. Cobb, vice-president and general manager of KVGB, Great Bend, Kansas, has been elected chairman of the board of directors of the NAB. He succeeds John F. Dille, Jr., president of the Communicana Group of Indiana, •Elkhart.

In other activities, the NAB asked the FCC to modify its proposed rule pertaining to automatic logging of transmitters and antennas so that remote meters need be no more accurate than two percent (instead of the 0.5 percent proposed by the Commission). Other exceptions concerned the proposed requirements for the number of digits in the readout and for automatic placement of the decimal point.

The Radio Board of Directors adopted a resolution urging that standards be established for radio-set manufacturers regarding accuracy of dial calibrations.

SMPTE

Plans have been made for the 102nd Semiannual Technical Conference of the Society of Motion Picture and Television Engineers, to be held in Chicago's Edgewater Beach Hotel September 17-22. Papers to be given will cover such topics as aerospace and oceanography; an entire session will be devoted to moon-originated television from Surveyor spacecraft.

TRANSACTIONS

Dictaphone Corp. has announced completion of the acquisition of **Scully Recording Instruments Corp.**

Under terms of the acquisition agreement, Dictaphone aquires all of the assets of Scully in exchange for 55,400 shares of Dictaphone common stock.

Ball Brothers Research Corp. has acquired the business of **Miratel Electronics Co.**

Ball Brothers Research, an electronics and aerospace subsidiary of **Ball Brothers Co., Inc.,** began operation of Miratel as a division July 1.

Acquisition of the assets of **Edmonds Cablevision,** which provides CATV services for Edmonds, Wash., has been announced by **GT&E Com-**

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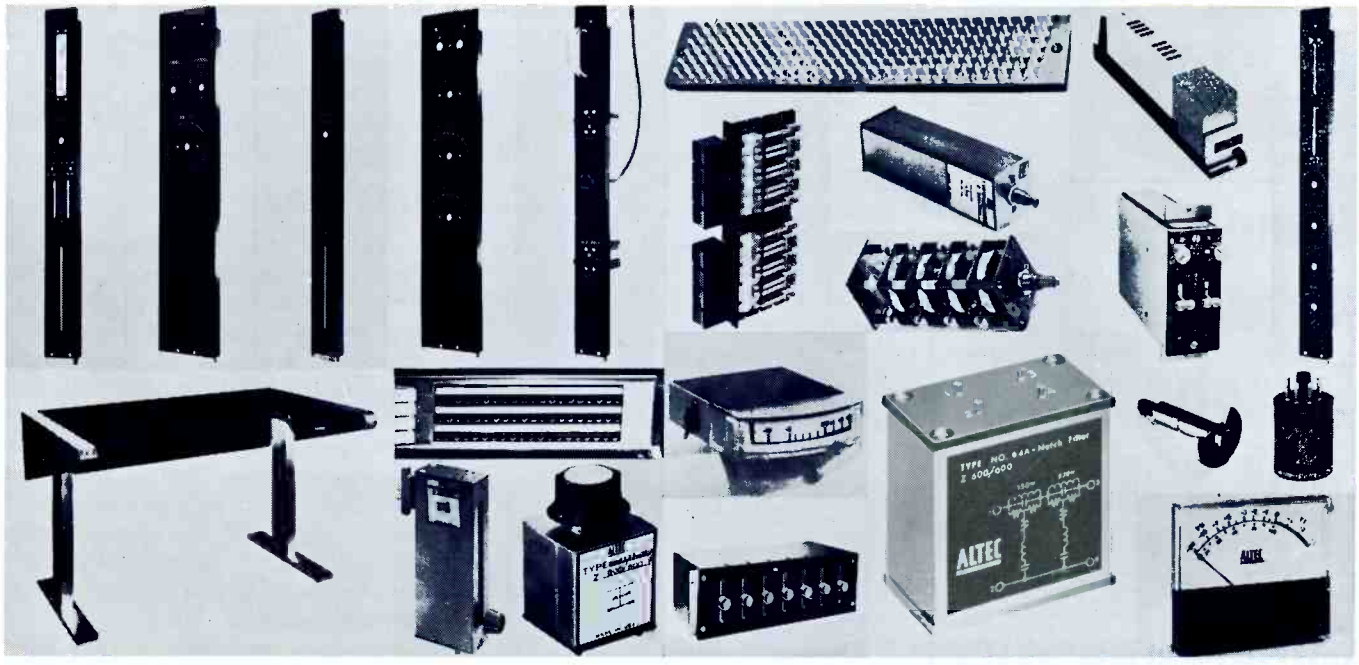
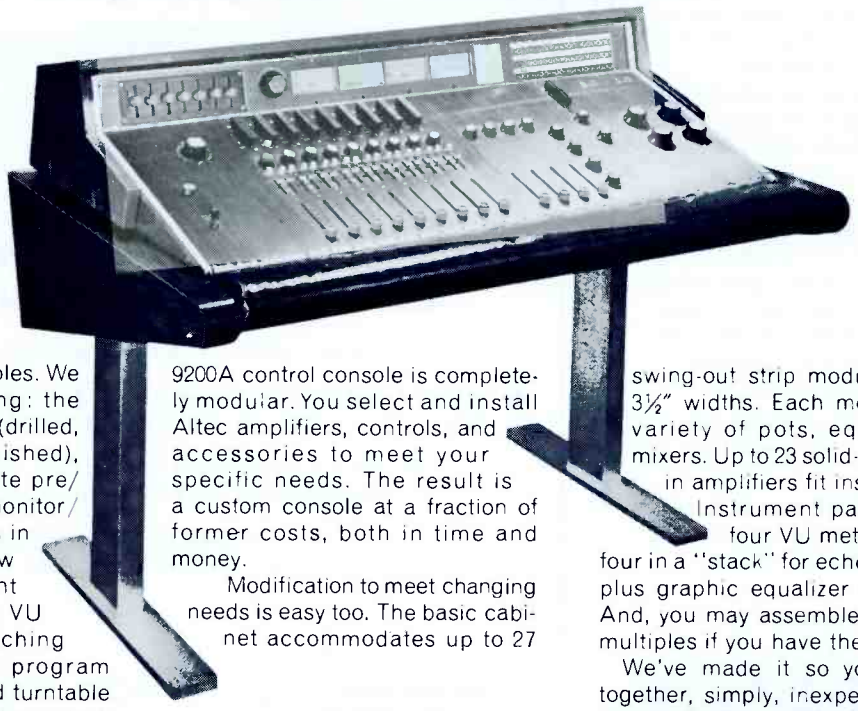


You put it together.



It's a new idea in custom consoles. We furnish just about everything: the basic cabinet and hardware (drilled, punched, and beautifully finished), plus your choice of solid-state pre/line/booster/program and monitor/cueing amplifiers; attenuators in any configuration; high and low pass filters; rotary or straight line controls; mixer networks; VU meter range extenders; matching networks; stereo pan pots; program equalizers; motion picture and turntable faders; slating and talkback keys; jack fields for any function; matching transformers; and any keys and switches you may need.

The big idea is this: This new Altec 9200A control console is completely modular. You select and install Altec amplifiers, controls, and accessories to meet your specific needs. The result is a custom console at a fraction of former costs, both in time and money.

Modification to meet changing needs is easy too. The basic cabinet accommodates up to 27 swing-out strip modules of 1¾" and 3½" widths. Each module accepts a variety of pots, equalizers, keys, mixers. Up to 23 solid-state Altec plug-in amplifiers fit inside the cabinet.

Instrument panel holds up to four VU meters for program, four in a "stack" for echo send channels, plus graphic equalizer and jack panel. And, you may assemble the consoles in multiples if you have the need.

We've made it so you could put it together, simply, inexpensively and just as you like it. And that's always a good idea. You'll get more ideas by calling your Altec Distributor, or for a very complete technical kit on the console, write Dept. BE-9

ALTEC LANSING

A Division of LTV Ling Altec, Inc., Anaheim, Calif.

Circle Item 27 on Tech Data Card

munications Inc., a subsidiary of **General Telephone & Electronics Corp.** Also acquired by GT&E was **Charleston CATV, Inc.,** which serves approximately 900 customers in Charleston, Ill.

Cox Broadcasting Corp. has announced an agreement under which Cox will sell its 50 per cent interest in a cable television system serving Findlay, Ohio to **Cablevision Enterprises, Inc.,** owner of the other 50 per cent.

Under terms of the agreement, Cablevision Enterprises, which has cable television operations in nearby Tiffin and Fostoria, Ohio, would acquire Cox's interest in the Findlay system for approximately $500,000.

PERSONALITIES

Robert L. Rooney has become station manager and chief engineer at **WOSC AM-FM,** Oswego-Fulton, New York.

Kenneth K. Kaylor has been appointed Western Regional Sales Manager for **Philips Broadcast Equipment Corp.,** subsidiary of **North American Philips Company, Inc.**

Caywood C. Cooley has been named Technical Director of Microwave and Cable Systems for **The Jerrold Corp.** In his new position, Mr. Cooley is responsible for all technical aspects of Jerrold's community antenna TV (CATV), master antenna TV, educational-instructional TV, closed-circuit TV, and microwave systems.

OBITUARY

Ward L. Berry, 56, president and a director of Ward Leonard Electric Co., died suddenly on June 16, 1967. Mr. Berry joined the company, founded in 1892 by his great uncle, H. Ward Leonard, in 1935. He was named assistant treasurer in 1946 and assistant secretary in 1947. He served as treasurer from 1948 to 1963 and was elected secretary and a vice-president in 1961. He was elected senior vice-president in January 1962 and became Ward Leonard's sixth president in September 1962.

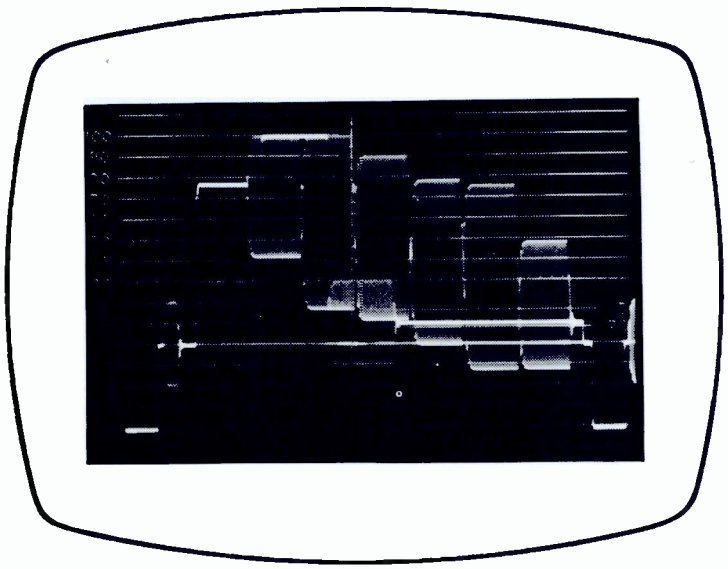
Mr. Berry was born in Cincinnati, Ohio, on June 12, 1911. He attended public schools in Cincinnati and the Phillips Academy in Andover, Mass. He received a B.A. degree from Cincinnati University in 1933. ▲

WHY

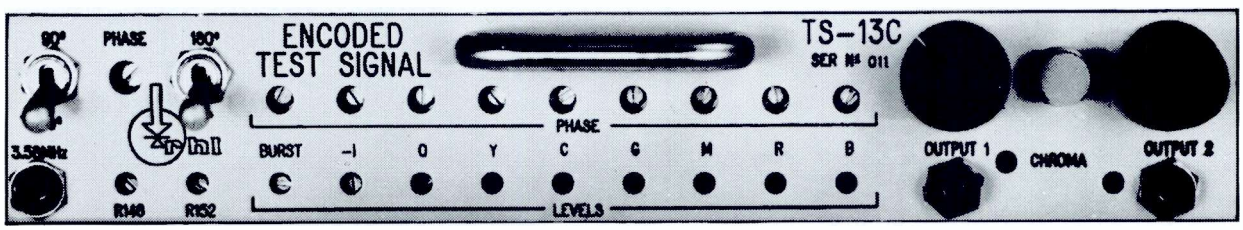
TIE UP VALUABLE PRODUCTION ENCODERS . . . ?

TEST

YOUR COLOUR SYSTEMS WITH



RHL COLOUR BAR GENERATORS



RHL Model TS-13 supplies ALL signals for rapid checks of colour television systems. The advantages of this new Colour Bar Generator include: all silicon solid state circuitry; modular plug-in construction; lower power consumption and separate supplies for all modules; standard rack mounting frame with minimum space requirements.

Plus this Exciting Feature
ENCODED TEST SIGNAL MODULE

Two outputs of the EIA standard RS-189 Composite Encoded Colour Bar Test Signal are provided by this remarkable unit. The test and adjustments of colour monitors, equipment and transmission paths can be performed anytime . . . at low cost. The signal may also be used with VIT systems.

Richmond Hill Laboratories' equipment is covered by a comprehensive 5 year warranty.

FOR COMPLETE DETAILS AND SPECIFICATIONS CONTACT

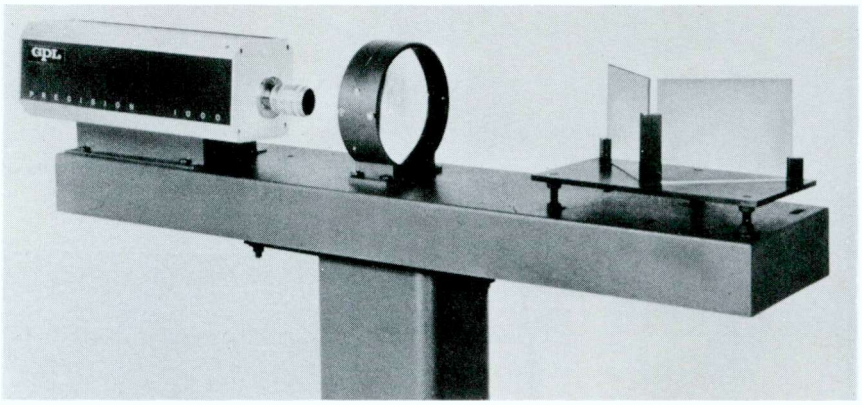
RICHMOND HILL LABORATORIES LIMITED

1610 MIDLAND AVE., SCARBOROUGH, ONT. PHONE: (416) 757-3631 TELEX: RHL TOR 02-29803

Circle Item 30 on Tech Data Card

NEW PRODUCTS

For further information about any item, circle the associated number on the Tech Data Card.

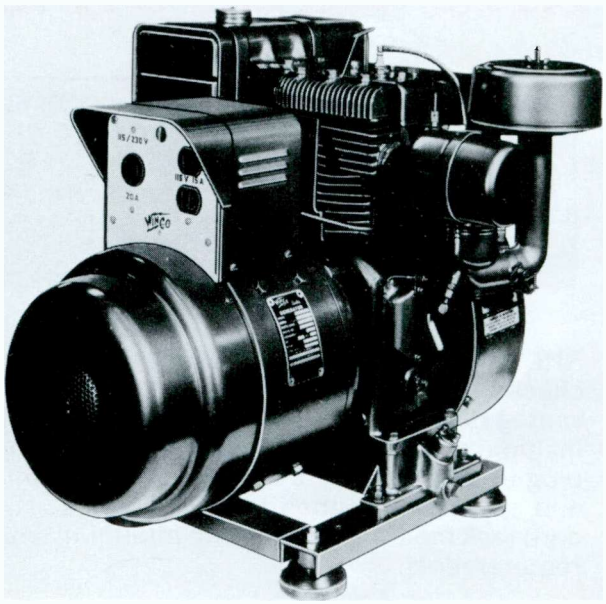


Film-Chain Camera

(50)

A new film-chain camera from the **GPL Div.** of **General Precision, Inc.** provides reproduction of 16 mm and 35 mm film, 2″ × 2″ slides, and 35 mm film strips. Called the Precision 1000 film chain camera, the system features the Precision 1000 camera with all-silicon, solid-state circuitry, plug-in modular construction, and lightweight functional design. Camera specifications include: horizontal resolution up to 1000 lines, 60-gauss focus field, and 42-dB S/N ratio. Major options and technical features of the camera include: adjustable gamma correction, composite or noncomposite video output, polarity reversal, separate mesh vidicons, automatic light compensation, and adjustable aperture correction.

Weight of the camera is 15 pounds. Its size, excluding lens, is 5¼″ × 5¼″ × 15″. The film-chain-camera control weighs 4¼ pounds and is 3½″ × 19″.



Portable Alternators

(51)

New *Winco* power alternators for generation of portable and standby electric power are offered by **Wincharger Corp.** These alternators are offered in two series; both are rated for 2500 watts at 60 Hz, are of 4-pole design, and operate at 1800 rpm. The 205BS series is powered by a Briggs & Stratton Model 233431 engine, the 205WS by a Model AENL Wisconsin engine. Both engines are of cast-iron construction with *Stellite* valves and valve rotators. The control box contains all controls and receptacles in a cluster protected by a rain shield.

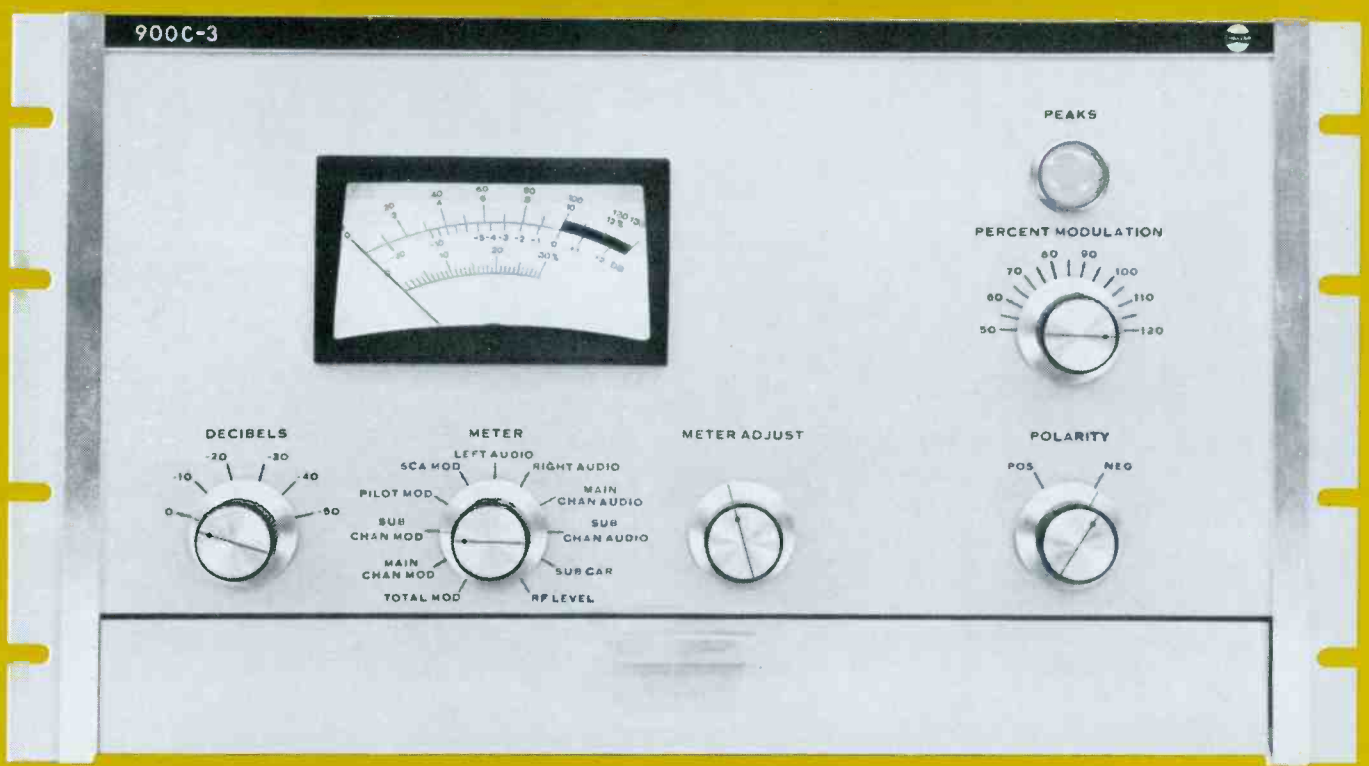
ARE YOU SURE your stereo signal will meet FCC requirements?

with Collins' 900C-3 Modulation Monitor, there's no question.

Collins' new FCC-Type Approved 900C-3 Modulation Monitor eliminates all uncertainty about your stereo signal. The 900C-3 continuously monitors and measures FM stereo emissions with a precision that leaves no doubt about whether you're meeting FCC requirements.

It's no surprise that Collins monitors were among the first approved by the FCC. Collins pioneered development of modulation monitoring techniques. Collins 900C stereo monitors have been in use more than three years.

For more information about Collins' FCC-Type Approved 900C-3 (FCC Type Approval No. 3-143) contact Broadcast Marketing, Collins Radio Company, Dallas, Texas 75207. Phone: (214) AD 5-9511.



COMMUNICATION/COMPUTATION/CONTROL

COLLINS

Circle Item 32 on Tech Data Card

COLLINS RADIO COMPANY / DALLAS, TEXAS • CEDAR RAPIDS, IOWA • NEWPORT BEACH, CALIFORNIA • TORONTO, ONTARIO
Bangkok • Frankfurt • Hong Kong • Kuala Lumpur • Los Angeles • London • Melbourne • Mexico City • New York • Paris • Rome • Washington • Wellington

reduction of seven pounds from earlier models. Indoor, all-weather, and explosion-proof models are available.

100-Watt Lab-Standard RF Wattmeter

(54)

The *Thruline* Model 4340 is a portable precision Directional RF Wattmeter contained in an 11" × 9½" × 6⅜" walnut case. A section of 50-ohm reference line for insertion into the user's coaxial system is connected to a 5½" mirror-backed taut-band meter in this **Bird Electronic Corp.** instrument.

A set of five 100-watt plug-in elements covers a frequency range from 2 to 1000 MHz. These units are compensated for temperature variations anticipated in an indoor ambient environment. Each element is furnished with a certificate listing fifty calibration points—ten power levels at five frequencies.

The measurement principle is based on the *Thruline* lumped-constant directional coupler, which samples mainline power either in the forward or reflected direction. The sample is rectified and the DC displayed on the 50-microampere meter. The plug-in elements are factory calibrated; the calibration potentiometer is accessible in the field, enabling facilities with calorimetric standards to perform periodic checks.

Stated accuracy at twenty-five frequencies and at the 10 cardinal scale divisions is ±3% of reading, based on the certificates furnished. Without charts, the specified uncertainty at any measurement does not exceed ±3% of full scale. The instrument is priced at $895.

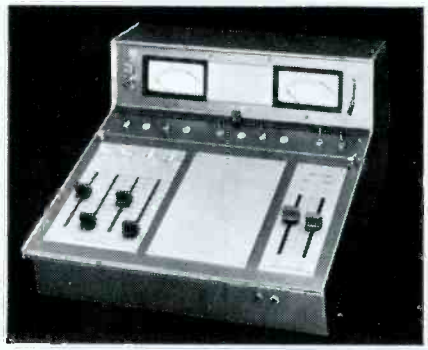
ZOUNDS! WHAT SOUNDS!

BC-31-B Stereo Monaural Console for AM, FM and TV.

All kinds of sounds, including every broadcast mode, from GE's transistorized line of versatile, reliable consoles.

Not often you'll find consoles that can stand the test of time as well as these can. Thoughtful design and construction is one reason—the best that can be drawn from GE's experience in all phases of broadcast equipment. And then there's the consoles' growth potential—their ability to adapt to your changing needs. For example, take a look at the...

BC-35-A Monaural Console—Maximum flexibility. Its four input mixer amplifier channels will function either as low- or medium-level inputs—a selector switch chooses. Two mixer buses, two program/monitor amplifiers, built-in cue facility, one VU meter with provision for adding second.



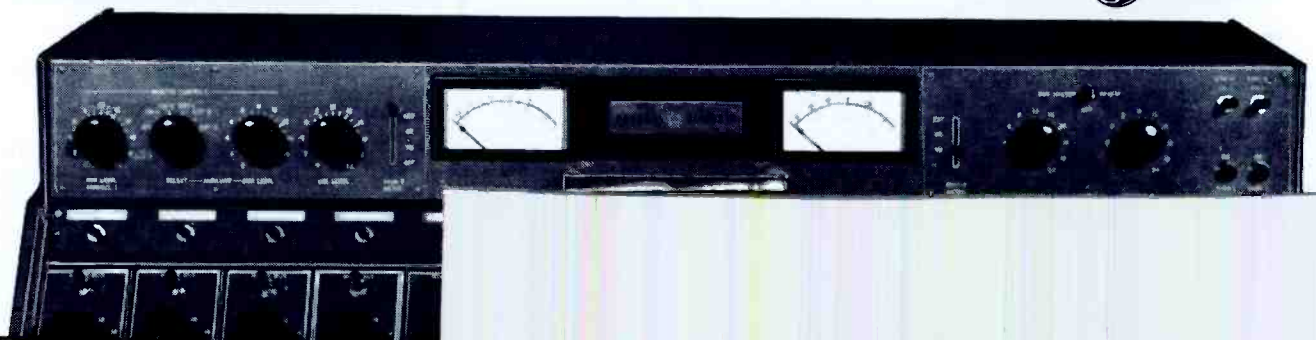
BC-31-T Monaural Console—widest range of inputs, controls and functions. Accepts up to 28 high/low level inputs, up to 14 mixers, depending on the modules you choose. Outstanding unit for TV studio or master control systems, recording, industrial and military uses.

BC-31-B Stereo/Monaural Console for AM, FM and TV. A tremendously versatile unit. Accepts additional modules as required, for up to 12 low-, 33 high-level inputs, 12 mixers. Basic unit accepts 6 each low- and high-level input modules. All with input selector switches to permit selection of various program sources. Intercom, and override to monitor amplifier input as well as many other features are also provided. All mixer modules contain a Ch. 1/Ch. 2 mixer level switch to permit the choice of either channel or bus. Easily converts from monaural to stereo. Stereo modules handle both monaural and stereo modes of operation. Best of all, stereo conversion can be made at any time, even after years of service. Truly one of the most adaptable, useful consoles you'll ever see.

BC-35-B Compact—Ideal for custom installations. Has eight input mixer amplifier channels and eight mixers. Otherwise, identical to BC-35-A

Write General Electric Co., Visual Communications Products in Electronics Park, Syracuse, N.Y. 13201 GE-49

GENERAL ELECTRIC

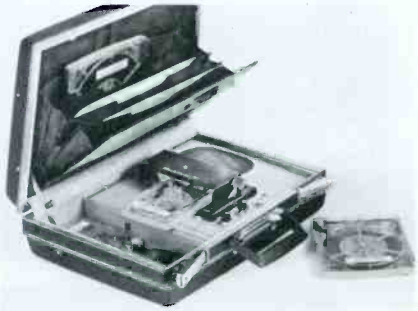


VU-Meter Panels

(55)

Three new VU-meter panels are being marketed by **Altec Lansing.** Designated Models 9708A, 9709A, and 9710A, these panels are for use in sound systems, consoles and control cabinets, recording studios, or broadcast monitors.

The 9708A panel has one VU meter, the 9709A panel has two VU meters, and the 9710A panel has three VU meters, for one-, two-, or three-channel operation, respectively. The controls are ganged together in the 9709A and 9710A panels so that all meters read at the same level. When 1.228 volts is applied to the instrument and the 3600-ohm series resistance, the VU meter indicates zero VU, or 100%. This represents 4 dB above one milliwatt in 600 ohms. The meters are designed to be unaffected by the presence of a relatively strong magnetic field.



Portable Cartridge Playback

(56)

The **Sparta Electronic Corp.** Model BP-22, a completely self-contained tape-cartridge audition unit, features a high-torque capstan drive motor and a large built-in speaker. The unit can be operated from AC power or a self-contained 12-volt rechargeable nickel-cadmium battery, which provides 2½

THE "KIND-HEARTED" SYNC GENERATOR

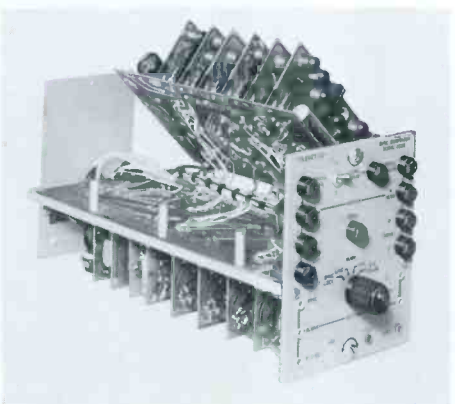
Color Sync Generator Package, Model 4230-A1

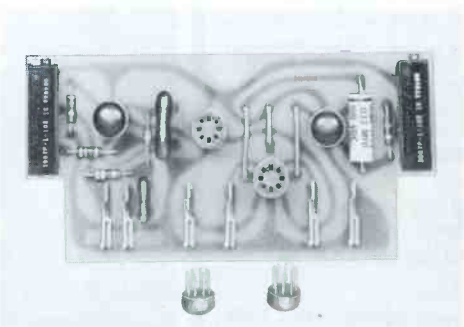
Most of today's sync generators use soldered-in microcircuits squeezed into a space that only a microbe could get in to repair. For very low priced generators, this is ideal—but MURDER for the broadcast engineers who have to maintain them. Here's why Telemet's new Model 4230-A1 is so "kind-hearted":

♥ PLUG-IN UNITS WITH PLUG-IN SUBASSEMBLIES. ♥ PLUG-IN INTEGRATED CIRCUITS. ♥ ADEQUATE FRONT PANEL TEST POINTS (COLOR CODED). ♥ BLUE RIBBON CONNECTORS. ♥ "STRAIGHT THRU" FORCED AIR VENTILATION. ♥ MINIMUM NUMBER OF INTEGRATED CIRCUIT TYPES. ♥ EXTREMELY RUGGED CONSTRUCTION. ♥ INCORPORATES THE BEST FEATURES OF ALL TELEMET SYNC GENERATORS.

The basic equipment (frame, power supply and sync generator) is $1,800. Plug-in accessories include: Model 3533-A1 Automatic Sync Lock Module; Model 3536-A1 Automatic Sub-Carrier Regenerator Module; Model 3534-A1 Color Standard Module with Proportional Oven; Model 3532-A1 Dot Grating Module.

Most of the engineers at this year's NAB Show who looked inside this sync generator—bought it...confirming that our heart *was* in the right place.





▲ Plug-In Integrated Circuits Simplify Maintenance
◀ Hinged Circuitry for Easy Access

GIANNINI SCIENTIFIC CORPORATION GIS

TELEMET COMPANY

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Circle Item 39 on Tech Data Card

ENGINEERS' TECH DATA

ANTENNAS, TOWERS & TRANSMISSION LINES

65. FORT WORTH TOWER—Subjects of literature are towers, passive reflectors, and equipment buildings.
66. GATES—Material describes the new Dual-Cycloid FM antenna with circular polarization, the KD-20A portable audio console, and the Dualux—a nine-mixer dual-channel console.
67. PHELPS DODGE—Eight-page Bulletin BR Issue 1 gives information on coaxial cable, rigid transmission line, and accessories for broadcast-station use; 16-page Bulletin IP-2 tells about coaxial-cable installation procedures.
68. RF SYSTEMS—New brochure has photographs and descriptions of various antennas and towers.

AUDIO EQUIPMENT

69. ACOUSTIC RESEARCH—Offered are frequency-response and distortion curves for all AR speaker systems, the AR-turntable instruction manual, and plans for building equipment shelves.
70. AMERICAN GELOSO—Six-page New Products Supplement on microphones, mixers, stands, speakers, and headsets has been made available.
71. FAIRCHILD RECORDING—New Bulletin describes Model 658A and new Model 658B compact reverberation systems.
72. INT'L NUCLEAR—Publications are for the Model TAA1 audio line amplifier, and the Model TPA1 regulated 24-volt power supply.
73. SWITCHCRAFT—Bulletin 172 describes a new, battery-operated, four-channel mixer, Model 307TR.
74. VEGA ELECTRONICS—The Vega/Syncron S-10 cardioid condenser microphone and the Vega-Mike wireless microphone systems are subjects of literature.

CATV EQUIPMENT

75. BENCO—Spec sheets detail information about the "Benavac" headend control unit, M-9A transistorized CATV amplifier, "Benpre" solid-state preamplifiers, "Benex-22" line extenders, and CATV line splitters and asymmetrical splitters.
76. PREFORMED LINE PRODUCTS—A new product for handling coiled strand or cable is subject of four-page bulletin "What They're Saying About the Chinese Coat Hanger."
77. TELEMATION—Four-page brochure is about the **News Channel** system for presenting 24-hour Associated Press news.

COMPONENTS & MATERIALS

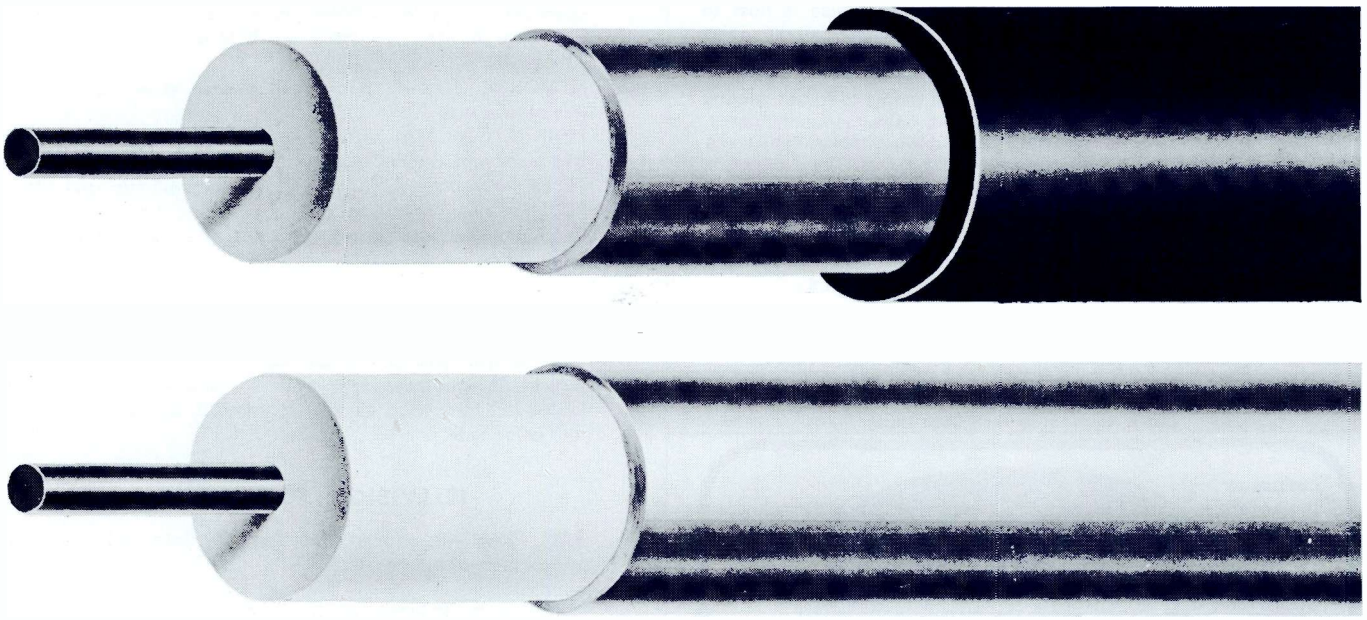
78. AEL—Four-page solid-state-switch brochure provides dimensions, electrical characteristics, and capabilities of complete switch line.
79. BARKER & WILLIAMSON—Eight-page catalog details instruments and components such as distortion meters, grid-dip meters, coaxial switches, coils, and filters.
80. BELDEN—56-page Catalog 867 covers line of wire and cable products.
81. CHERRY—A new miniature switch Series E22 is featured in brochure.
82. DIALIGHT—Specifications and drawings of two-terminal, subminiature indicator lights are given in 12-page Catalog L-178B.
83. HOYT—Catalog sheets describe line of volume-unit and other meters for new and replacement applications.
84. P. R. MALLORY—Three new technical bulletins are offered: Bulletin 4-81 details expanded line of computer-grade aluminum electrolytic capacitors; Bulletin 4-74B describes new lines of MTA and MTV molded-case electrolytic capacitors; and Bulletin 4-82 is about TIM (radial leads) and TAC (axial leads) molded solid-electrolytic tantalum capacitors.
85. TROMPETER—Catalog M-4 gives information on line of coax, twinax, and triax matrix and multipole, multithrow switches.

Superior E-X-T-E-N-D-E-D Spectrum Coaxials go all the way to 300 MHz...and beyond!

Now... a new 84 MHz segment available!

Controlled impedance uniformity over the extended range provides sufficient band width for up to 14 additional 6 MHz TV channels. You get 26 db minimum return loss (measured at a fixed 75 OHM termination) at any frequency. Both Coppergard and Alumagard feature Cell-O-Air® expanded polyethylene dielectric in aerial types. Coppergard features solid polyethylene dielectric in direct burial construction.

☐ CATV Systems ☐ ETV and ITV Programs ☐ CCTV for Business and Industry ☐ Data Transmission
☐ Remote Control Telemetering ☐ Alert and Alarm Systems ☐ Traffic and Highway Control Systems



Alumagard (seamless aluminum sheath)

Coppergard (corrugated copper shield)

Superior's Full Spectrum Coaxials — through 219 MHz — are also available in both aerial and direct burial types.

For detailed information and prices, write

SUPERIOR CABLE

SUPERIOR CABLE CORPORATION / HICKORY, NORTH CAROLINA 28601

Circle Item 44 on Tech Data Card

FILM EQUIPMENT

86. HOUSTON FEARLESS—Brochure outlines capabilities of motion-picture film processors, Labmaster for black and white and Colormaster for color.

POWER DEVICES

87. ACME ELECTRIC—The causes of voltage variation are explained in Voltrol Stabilizer Catalog 09, which also gives details about line of voltage regulators.
88. ONAN—Equipment requirements, power requirements, cost, and equipment location are elaborated upon in booklet titled "Standby Power . . . Who Needs It?"

RECORDING & PLAYBACK EQUIPMENT

89. AMPEX—Capabilities of the new Ampex video-tape duplicating center in Elk Grove Village, Illinois, are described in Brochure V66-280.
90. CONCORD—Sixteen-page brochure outlines features and operation of Model VTR-600 video tape recording system. Literature is also available on TCM-20 monitor/viewfinder TV camera.
91. MEMOREX—New 79 Series helical-scan video tape is subject of brochure.
92. MINNEAPOLIS MAGNETICS—Printed matter on replacement heads for professional tape equipment is available.
93. TELEX—Magnecord Model 1021 for monophonic and Model 1022 for stereophonic recording are described in brochure. The Viking Model 230 tape transport is subject of additional material.

REFERENCE MATERIALS & SCHOOLS

94. CLEVELAND INSTITUTE OF ELECTRONICS — Pocket-size plastic "Electronics Data Guide" includes formulas and tables for: frequency vs wavelength, dB, length of antennas, and color code.

TELEVISION EQUIPMENT

95. BALL BROS.—Spec sheet has technical data and descriptive information about the Mark VI-A and VI-AR special effects generators.
96. CLEVELAND ELECTRONICS — A 52-page quick-reference step-down die-cut catalog gives complete information on vidicon, **Plumbicon,** and image-orthicon deflection components.
97. COHU—Four-page "A Guide to Lens Selection for Cohu Television Cameras" (Data Sheet 6-322) is offered.
98. COLORADO VIDEO—Data sheet describes CVI Model 220-A video converter for changing "slow-scan" TV signals to 525-line standards for viewing on conventional monitors.
99. GENERAL ELECTRIC—A description of a new quality-control system used in the production of PE-250 live color cameras is given in a 20-page technical article "Advance Manufacturing Methods for Complex Broadcast Equipment."

TEST & MEASURING EQUIPMENT

100. JERROLD—New short-form Catalog SF-67 has capsule information on the company's entire range of RF test equipment.
101. SECO—Operating manual for the Model 107C tube tester is offered.
102. SIMPSON—16-page Catalog 2076 lists specifications for 15 different VOM's and other types of test equipment.
103. TRIPLETT—Literature describes the new Model 600 transistorized volt-ohmmeter which has FET circuitry and 11 megohms/volt input impedance.

TRANSMITTERS & ASSOCIATED EQUIPMENT

104. BAUER—Catalog sheet shows the Model FB-5V 5000-watt AM broadcast transmitter.
105. METRON—Spec sheet covers the solid-state Model 506B-1 AM modulation monitor.

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Professional Services

Classified

Advertising rates in the Classified Section are fifteen cents per word. Minimum charge is $2.00. Blind box number is 50 cents extra.

Equipment for Sale

CO-AXIAL CABLE Heliax, Styroflex, Spiroline, etc. Also rigid and RG types in stock. New material. Write for list. Sierra-Western Electric Co., Willow and 24th Streets, Oakland, Calif. Phone 415 832-3527 5-66-tf

Television / Radio / communications gear of any type available. From a tower to a tube. Microwave, transmitters, cameras, studio equipment, mikes, etc. Advise your needs—offers. Electrofind Co., 440 Columbus Ave., NYC. 212-EN-25680. 8-64 tf

CARTRIDGE TAPE EQUIPMENT
Completely reconditioned and guaranteed. Spotmaster Model 500 Record/Playbacks, $350.00. Model 505 Playbacks $250.00. 30-day money-back guarantee on all equipment.
BROADCAST PRODUCTS COMPANY
18804 Woodway Drive, Derwood, Maryland, 20855
(301) 942-1224 3-67-12t

For sale: three GE 4PE4C1—3" IO portable camera chains; new IO tubes under 30 hours each, various lenses—if desired. $5,000 each including monitoring and cable. Contact William Woods, Director-Engineering, WTTW-TV, 5400 N St. Louis Ave., Chicago, Ill. PH: 312/583-5000. 6-67-tf

Audio Equipment bought, sold, traded. Ampex, Fairchild, Crown, McIntosh, Viking. F. T. C. Brewer Company, 2400 West Hayes Street, Pensacola, Florida. 3-64-tf

Everything in used broadcast equipment. Write for complete listings. Broadcast Equipment and Supply Co., Box 3141, Bristol, Tennessee. 11-64-tf

"AUDIO EQUIPMENT — Whatever your needs, check us first. New and used. Ampex, Altec, AKG, EV, Fairchild, Neumann, Langevin, Rek-O-Kut, Uher, Viking. Send for equipment list." Audio Distributors, Inc., 2342 S. Division Ave., Grand Rapids, Michigan 49507. 6-66-tf

"Arcturus" Catalog
A Trusted Name in Electronics Since 1925
FREE Catalog. Electronic parts, tubes. Wholesale. Thousands of items. Unbeatable prices.
ARCTURUS ELECTRONICS BE
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RCA TS 30D Field Switcher. Like New, $600. Vital Industries, 3614 SW Archer Road, Gainesville, Florida 32601. 8-67-2t

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