A HOWARD W. SAMS PUBLICATION

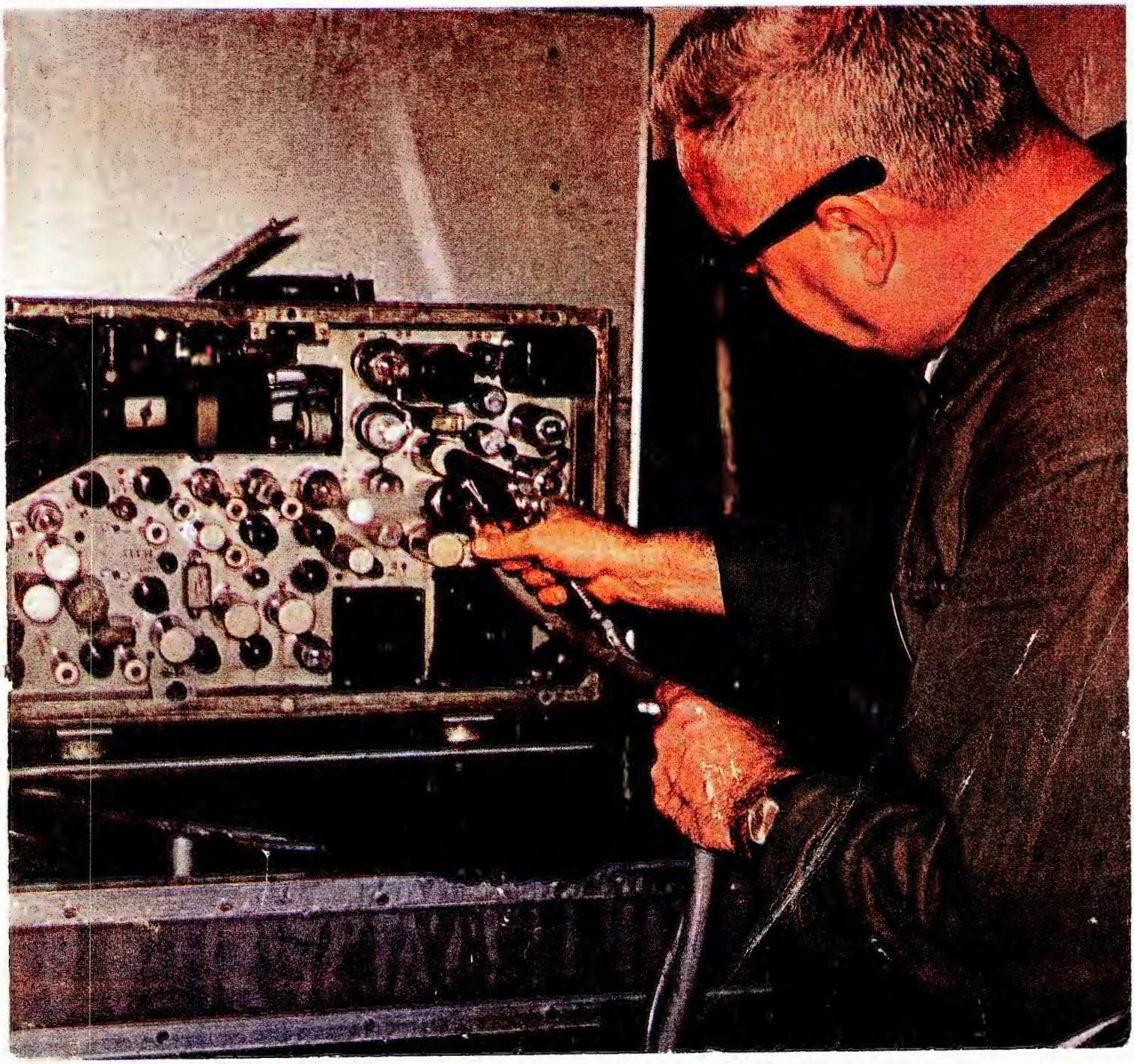
JULY 1963 75c

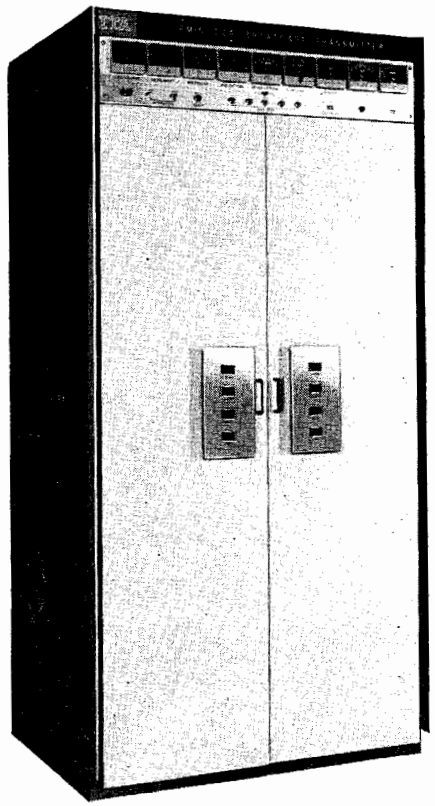
SPECIAL TEST and MAINTENANCE ISSUE

including:

Broadcast Engineering

the technical journal of the broadcast-communications industry





Quality

ITA 5 kw AM Transmitter

No other 5 kw AM transmitter matches ITA for quality features that are basic to the unit. It's the most compact 5 kw AM transmitter ever designed . . . yet, it remains fully accessible. Your best choice for efficiency and economy—check this line-up of features—AM's best 5 kw buy!

QUALITY FEATURES

- **High Efficiency PA Circuit**
- **Solid State Rectifiers**
- **Only 5 Tube Types**
- **Remote Control Provisions**
- **Power Cutback to 1 KW (Optional)**
- **Conventional High Level Modulation**
- **Automatic Recycling**

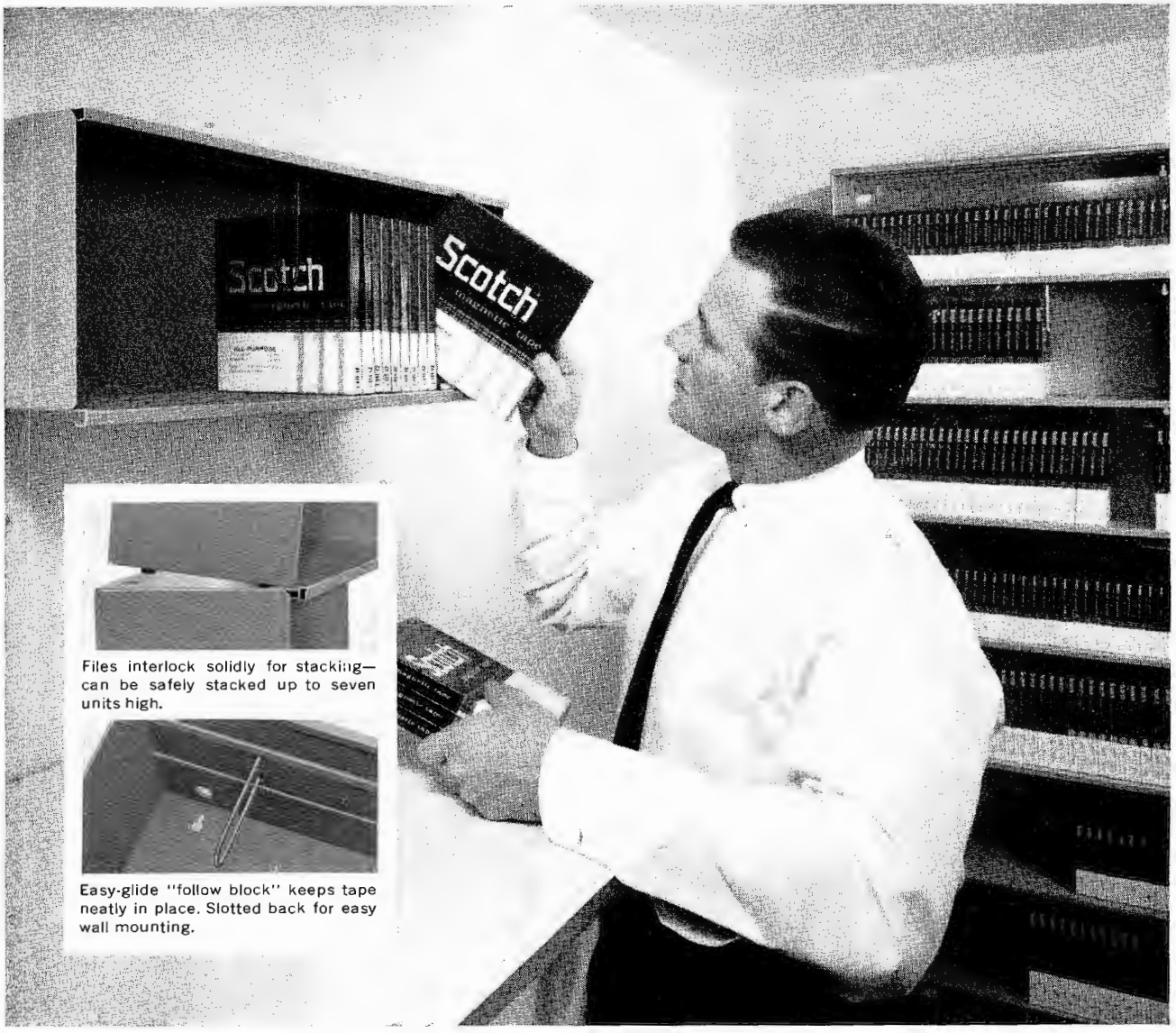
ITA

ITA ELECTRONICS CORPORATION

BROADCAST DIVISION • LANSDOWNE, PENNSYLVANIA

ITA

Circle Item 1 on Tech Data Card



Files interlock solidly for stacking—can be safely stacked up to seven units high.

Easy-glide "follow block" keeps tape neatly in place. Slotted back for easy wall mounting.

Hang it, stack it, however you use it...

the new Storette tape rack's a good deal!

Only $6.95 with SCOTCH® Professional Recording Tapes!

The Storette is the first quality tape storage rack ever offered at this special price . . . only $6.95 ($12.95 value) with your order of 36 rolls of "SCOTCH" Brand Professional Recording Tapes in either 5″ or 7″ size! The Storette was specially designed for storing tape—holds 36 boxes of either 5″ or 7″ reels, has a "follow block" for easy dividing. Sits on counter or shelf bookcase-style, lays on its back or hangs on wall. 9⅜″ high, 25″ wide, 8″ deep. All welded construction with smooth corners and edges. 2-coat gray baked enamel finish. Completely assembled. Units interlock for stacking—up to seven shelves high.

The special offer on the Storette tape rack is available with assortments of all popular professional "SCOTCH" Recording Tapes including *All Purpose*, *Extra Play*, *Double Length*, *High Output*, *Low Print* . . . in fact a tape for every professional need. See your supplier. (Please note that all tapes are offered by your supplier at regular industrial consumer maximum discount prices.) Larger storage cabinet holding up to 300 tapes also available. For information ask about CAB-1 unit.

the technical journal of the broadcast-communications industry

®Broadcast Engineering

Volume 5, No. 7 **July, 1963**

CONTENTS

FEATURES

DEPARTMENTS

PUBLISHER: Howard W. Sams **GENERAL MANAGER:** Mal Parks, Jr.

EDITORIAL: Executive Editor, Verne M. Ray; Editor, Forest H. Belt; Managing Editor, Stuart N. Soli; Consulting Editor, John H. Battison.

CIRCULATION: Manager, Pat Tidd; Assistants, Katherine Krise, LaVon Willard.

PRODUCTION: Manager, Robert N. Rippy.

ADVERTISING: Sales Manager, D. L. Milling; EAST: Charles Horner, Howard W. Sams & Co., Inc., 3 West 57th Street, New York, N. Y., Phone—MU 8-6350; MIDWEST—Hugh Wallace, Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis 6, Ind., Phone AX 1-3100; SOUTHWEST—C. H. Stockwell Co., 4916 West 64th Street, Mission, Kansas, Phone—RA 2-4417; LOS ANGELES 57, CALIF., Maurice A. Kimball Co., Inc., 2550 Beverly Blvd., Phone—DU-8-6178; SAN FRANCISCO, Maurice A. Kimball Co., Inc., 580 Market Street, Phone—EX 2-3365; PARIS 5, FRANCE, John Ashcraft, 9 Rue Lagrange, Phone—ODeon 20-87; LONDON W.C. 2, ENGLAND, John Ashcraft, 12 Bear Street, Leicester Square, Phone—WHitehall 0525; TOKYO, JAPAN, International Media Representatives, Ltd., Kisha Kurabu 14, 2-chome Marunouchi, Phone—(502) 0656.

SUBSCRIPTION PRICE: U.S. $6.00, one year; $10.00, two years; $13.00, three years. Outside U.S.A. add $1.00 per year for postage. Single copies, 75 cents.

BROADCAST ENGINEERING is published monthly by Technical Publications, Inc., an affiliate of Howard W. Sams & Company, Inc. Editorial, Circulation, and Advertising headquarters: 4300 West 62nd Street, Indianapolis 6, Ind.

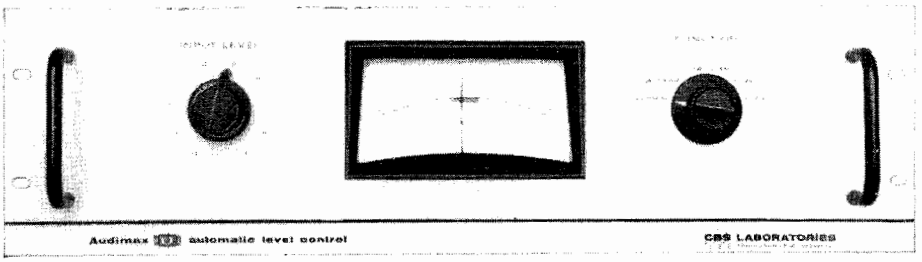
A HOWARD W. SAMS PUBLICATION

BPA

Well behaved transmitters

DON'T SHOUT

DON'T WHISPER!



Stay listenable with Audimax!

Undulating audio is not listenable! When it shouts—unpleasantness! When it whispers—strain! Every time your listener touches his volume control, you stand a chance of losing him! Audimax—the monitor with a memory—rides your output gain control with super-human speed. When levels are correct, gain remains constant—this is the Audimax Gain Platform. Audio output remains on a natural listening keel at maximum modulation. There's no distortion, compression, thumping or pumping. No audio "holes." Audimax is not a Compressor, Limiter or AGC. Audimax is a control computer, complete with memory and judgement. You merely set the Gated Gain Stabilizer to recognize noise and background effects, and electronics takes over. Proper levels are maintained; gain is held constant during pauses or returned to normal at standby—automatically. To get listener loyalty—and keep it—you need Audimax! It pays!

CBS LABORATORIES
High Ridge Road, Stamford, Connecticut
A Division of Columbia Broadcasting System, Inc.

Circle Item 4 on Tech Data Card

LETTERS
to the editor

DEAR EDITOR:

In the January issue, under the "Technical Talks" department, broadcast antennas were discussed from the standpoint of series and shunt feeding techniques.

I service several broadcast stations in the Intermountain area, and have a few shunt fed antennas to deal with. The one big problem with them is evident when increasing power. Since the reactance is often very high with a slant wire, a highly reactive capacitor with very large spacing must be used. It looks like the method of feed illustrated in the article would be the way to reduce this problem. By feeding the antenna up the middle of the tower at a quarter-wave point, approximately, it seems to me that the reactance could almost be eliminated. As I have no means for practical experimentation, I wonder whether you could give me any information on the construction of a feed line, and at what point to feed the antenna.

DANIEL W. COLTRANE
Chief Engineer, KRXX, Rexburg, Idaho

Consulting Editor John Battison answers your questions, Dan, along with Technical Talks, on page 28.—Ed.

DEAR EDITOR:

You did a fine job covering the NAB convention in the April issue of BE.

My article Cartridge Tape at Work also appeared in this issue. While you did a thorough job on the article, there were a few minor errors that I would like to point out.

The wiring diagram, Fig. 3, which shows the modifications necessary to use our reverberation unit, is electrically correct. The description of how it works (last paragraph on page 33), however, lists RY-2 as the auxiliary tone relay; in reality it is a new relay which we added to the tape machine.

In the wiring diagram, Fig. 4, the left ends of the two leads marked "to auxiliary start relay" should also be tied to a +24-volt DC source.

Your typesetter must have been in a hurry, because the last line on page 30 should be the last line on page 32. I am sure the readers would soon get it in the correct position.

I might also point out that our total number of recorded musical selections is now 2,300. We will rest there for a while, since we are in the process of phasing out some of the older numbers with new ones, to keep the library fresh and up to date.

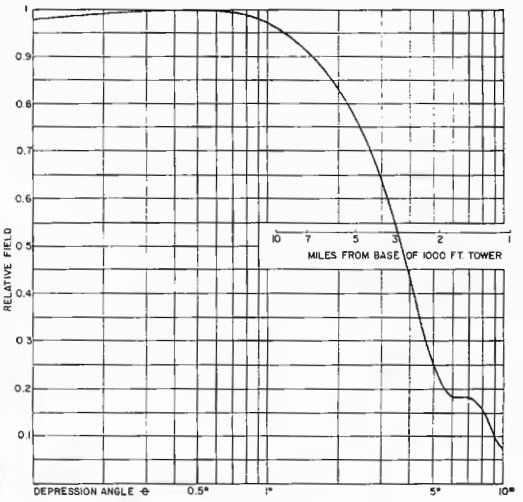
PATRICK S. FINNEGAN
VP/Chief Engineer, WLBC,
Muncie, Ind.

Thanks for advising us, Pat. Got to keep the ol' tapes rolling.—Ed.

CO.EL. Low Band TV Antennas Put The Signal Where You Want It . . . more economically. Here are some of the features that can improve your station signal, and reduce your expenditures: **Very Low VSWR Permits Transmission of Highest Quality Signal** - VSWR 1.04 or better ■ **Excellent Vertical Patterns** - provide uniform signal strength close to the antenna ■ **Suitable For Stacking** - standard antennas can be stacked with other antennas now in use . . expensive side-by-side mounting unnecessary with CO.EL. antennas ■ **Fast Economical Installation** - modular construction permits installation and check-out in less than a week, without need for ground check ■ **No De-Icers Required** - even with heavy icing conditions ■ **Expert Checkout Service** - by qualified antenna engineering specialists.

Let CO.EL. furnish you with information on an antenna for your requirements. Other CO.EL. products include: Broadband high band and UHF antennas, 10mc bandwidth FM antennas, towers, VSB filters, notch diplexers, filterplexers, harmonic filters, rigid transmission line, and microwave parabolic antennas.

Vertical pattern of CO-40L/M Antenna, Channels 2 - 6. Gain with this vertical pattern varies from 8.6 on Channel 2, to 10.1 on Channel 6.



How to get improved TV coverage for less!

This CO.EL. 8-Bay Broadband Dipole Antenna, Channels 2 - 6, is one of a 100 TV antennas installed in 21 countries.

co el

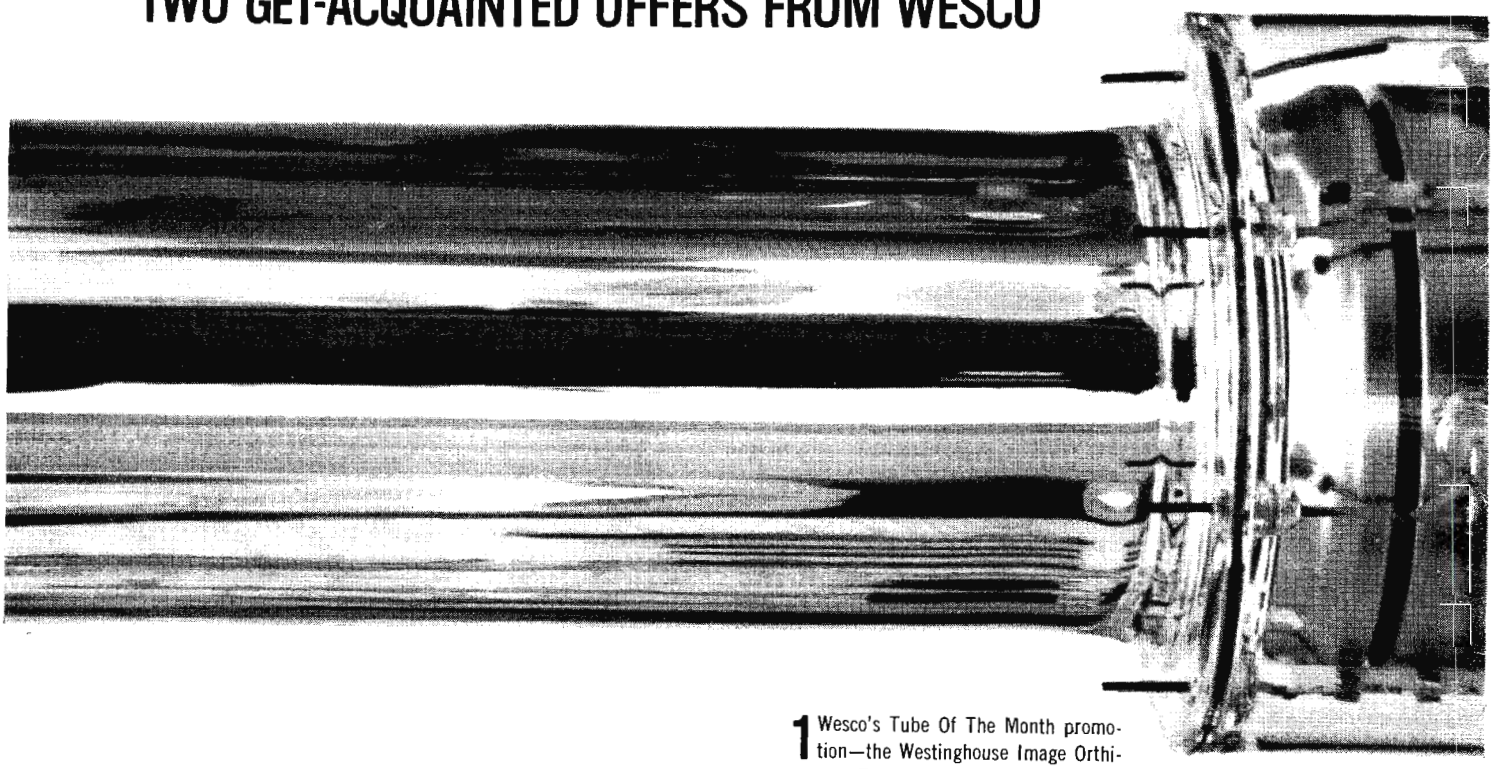
Specialists in Advanced Antenna Systems

24 CAROL ROAD, WESTFIELD, N. J. / AD 2-0250 / Cable: COELTENNA WESTFIELD

A Division of Complementi Elettronici S.p.A., Lacchiarella (Milan), Italy

Circle Item 6 on Tech Data Card

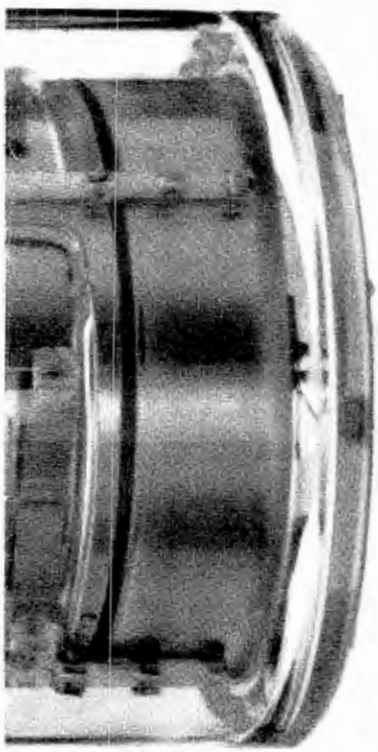
TWO GET-ACQUAINTED OFFERS FROM WESCO



1 Wesco's Tube Of The Month promotion—the Westinghouse Image Orthicon. The Type 7611 Tube illustrated here has a 1000 hour warranty. That means long life, to cut your replacement cost. Also your Wesco (Westinghouse Electric Supply Company) distributor has a complete line of Westinghouse Tubes to meet your needs.

2 A year 'round maintenance plan to meet your needs. Prompt service and fast delivery. Wesco offers replacement needs for 11,000 electronic and electrical products. Scan the listing, find the Wesco branch near you, and give them a call.

"KEEP THE WESCO NUMBER NEAR YOUR PHONE"



ARIZONA
Phoenix
Alpine 8-8211
2001 N. 23rd Ave.

Tucson
Maine 3-5821
1938 E. 18th St.

ARKANSAS
Little Rock
Franklin 2-5154
1915 E. 17th St.

CALIFORNIA
Concord
Mulberry 5-9270
Diamond Rd.

Fresno
Amherst 4-5091
2608 California Ave.

Hayward
Elgin 1-6442
21612-20 W. Blvd.

Long Beach
Hemlock 2-7431
901 W. Twelfth St.

Los Angeles
Madison 9-4161
905 E. 2nd St.

North Hollywood
Poplar 5-8916
13213 Sherman Way

Oakland
Templebar 4-9900
1696 W. Grand Ave.

Richmond
Beacon 5-8660
444 S. First St.

Sacramento
Hickory 4-6525
1730—14th St.

San Bernardino
Turner 9-9791
720 College Dr.

San Francisco
Underhill 1-5051
201 Potrero Ave.

San Jose
Cypress 7-5929
292 Stockton Ave.

CONNECTICUT
Hartford
527-8246
20 Queen St.

New Haven
Spruce 7-3601
178 Wallace St.

DELAWARE
Wilmington
Olympia 5-9611
400 S. Market St.

DIST. OF COLUMBIA
Washington
529-8700
935 Brentwood Rd. N.E.

FLORIDA
Fort Lauderdale
Jackson 4-6566
1223 N.E. Flagler Dr.

Jacksonville
Elgin 5-3445
1446 Haines St.

Miami
Newton 3-9881
3550 N.W. 33rd St.

St. Petersburg
7-4164
610—23rd St., S.

Tampa
223-4271
417 Ellamae Ave.

GEORGIA
Albany
Hemlock 2-1285
610 N. Washington St.

Atlanta
Trinity 4-2721
1299 Northside Dr. N.W.

Columbus
Fairfax 3-1816
1365 Warren Williams Rd.

Savannah
233-9682
580 Indian St.

IDAHO
Boise
342-3531
318 S. Capitol Blvd.

Idaho Falls
JA 3-2575
545 W. 19th St.

ILLINOIS
Chicago
Taylor 9-5000
113 N. May St.

Clearing
LU 6-2100
6233 S. Oak Park Ave.

Danville
Hickory 2-1901
603 N. Gilbert St.

Decatur
8-0941
2999 N. Woodford St.

Morton Grove
JU 3-0592
5814 Dempster St.

Peoria
673-0707
915 N. Adams St.

Rockford
398-3591
2121—15th St.

INDIANA
Evansville
Harrison 3-1152
1251 Diamond Ave.

Fort Wayne
H-1175
125 E. Murray St.

Hammond
Tilden 4-9400
6355 Indianapolis Blvd.

Indianapolis
Melrose 2-3301
1560 Stadium Dr.

Muncie
Atlas 4-6335
2315 N. Walnut St.

IOWA
Davenport
323-9966
1531 W. River Dr.

Des Moines
Amherst 2-3181
2515 Dean Ave.

Sioux City
5-7634
1005 Dace St.

Waterloo
234-7716
300 W. Third St.

KANSAS
Wichita
Lyric 1-3458
2940 S. Minneapolis Ave.

LOUISIANA
Baton Rouge
EL 7-0603
2511 Michelli Dr.

New Orleans
524-5411
2538 Poydras St.

Shreveport
423-4121
1535 Wilkinson St.

MAINE
Augusta
Mayfair 3-3844
98 Water St.

Bangor
942-6706
175 Broad St.

Portland
Spruce 2-6507
49-65 Diamond St.

MARYLAND
Baltimore
327-4300
1710 Edison Highway

Hagerstown
739-8550
408 E. Antietam

MASSACHUSETTS
Belmont
Ivanhoe 9-0811
12 Flanders Rd.

Boston
Hubbard 2-5300
375 Harrison Ave.

Springfield
Republic 4-3101
545 St. James Ave.

Worcester
757-5641
16 Brooks St.

MICHIGAN
Center Line
SL 8-4600
26636 Van Dyke Ave.

Detroit
Tyler 8-9000
2211 W. Edsel Ford Expressway

Flint
Cedar 8-1671
601 Kelso St.

Grand Rapids
Glendale 9-4664
511 Monroe Ave., N.W.

Lansing
Ivanhoe 4-8461
2730 Alpha St.

Saginaw
Pleasant 4-0483
220 S. Second St.

MINNESOTA
Duluth
Randolph 7-7422
330 S. First Ave., E.

Minneapolis
Federal 8-7001
515 S. Seventh St.

St. Paul
Capitol 7-6581
350 University Ave., E.

MISSISSIPPI
Jackson
Fleetwood 2-8354
325 S. Farish St.

MISSOURI
St. Louis
Central 1-4838
1011 Spruce St.

MONTANA
Billings
252-0176
302 N. 15th St.

Butte
792-2374
949 S. Montana St.

NEBRASKA
Omaha
345-8700
117 N. 13th St.

NEW HAMPSHIRE
Manchester
National 5-5456
140 Hayward St.

NEW JERSEY
Camden
Woodlawn 6-2668
1995 Ferry Ave.

Newark
Market 4-3900
555 South St.

Trenton
Owen 5-5421
578 Perry St.

NEW MEXICO
Albuquerque
247-3646
816 First St., N.W.

NEW YORK
Albany
Hemlock 8-7801
17 Warehouse Row

Hicksville
Wells 8-2800
69 Hazel St.

Long Island City
Stillwell 6-7700
29-50 Northern Blvd.

Rochester
Baker 5-5590
711 Exchange St.

Syracuse
Hempstead 7-8371
Teall Ave. & Arterial Rd.

Utica
Swift 7-0420
112 N. Genesee St.

Vestal
RA 9-1561
4301 Old Vestal Rd.

Watertown
788-7700
914 Water St.

NORTH CAROLINA
Asheville
Alpine 4-3271
142 Church St.

Charlotte
Franklin 5-3715
333 Dalton Ave.

Greensboro
272-5691
829 Huffman St.

High Point
2-1824
121 Mangum St.

Raleigh
Temple 4-8211
319 W. Martin St.

NORTH DAKOTA
Fargo
Adams 2-4446
405—14th St., N.

OHIO
Akron
Franklin 4-4141
600 S. High St.

Canton
456-8336
2830 Cleveland Ave., N.W.

Cincinnati
542-4300
4545 Chickering Ave.

Cleveland
432-2600
1101 E. 55th St.

Columbus
Axminister 4-5261
930 Williams Ave.

Dayton
Baldwin 4-0331
226 W. 5th St.

Mansfield
Lafayette 4-2711
41 E. Longview Ave.

Painesville
357-5578
189 Chester Street

Toledo
243-6184
1225 Indiana Ave.

Youngstown
743-4146
242 W. Wood St.

OKLAHOMA
Oklahoma City
Central 2-7101
500 N. Pa. Ave.

Tulsa
Temple 8-3344
6716 E. 12th St.

OREGON
East Portland
Capital 6-7361
2705 S.E. Ankeny

Medford
773-4556
1233 Court St.

Portland
Capitol 6-7361
3265 N.W. Yeon

PENNSYLVANIA
Allentown
435-7491
745 Union Blvd.

Erie
Glendale 4-8191
1107 Hess Ave.

Harrisburg
Cedar 8-9401
2550 Paxton St.

Johnstown
536-8761
75 Hickory St.

Philadelphia
Walnut 2-8950
141 N. Eleventh St.

Pittsburgh
322-5500
209 W. General Robinson St.

Reading
Franklin 6-7236
340 Buttonwood St.

Williamsport
322-6183
465 Hepburn St.

York
5556
24 Parkway Blvd.

RHODE ISLAND
Providence
Temple 1-7220
233 Harris Ave.

SOUTH CAROLINA
Columbia
Alpine 6-4941
717 Lady St.

Greenville
233-6201
111 Welborn St.

TENNESSEE
Knoxville
524-8622
403 E. 5th Ave.

Memphis
Jackson 7-9431
845 N. Main St.

TEXAS
Amarillo
Drake 2-6535
920 W. 9th Ave.

Beaumont
Terminal 3-6333
1655 Louisiana St.

Corpus Christi
Tulip 2-3351
110 N. Staples St.

Dallas
Riverside 2-9391
605 Latimer St.

Fort Worth
Edison 6-5611
205 N.E. Seventh St.

Houston
Capital 5-1341
1903 Ruiz St.

Lubbock
Porter 5-6396
605 Main St.

San Antonio
Capitol 7-7585
1119 Camden St.

UTAH
Ogden
Export 4-2691
2660 Lincoln Ave.

Salt Lake City
Davis 2-2441
210 Rio Grande St.

VERMONT
Burlington
University 4-9885
208 Flynn Ave.

VIRGINIA
Danville
792-2274
124 Trade St.

Newport News
247-6368
1426—27th St.

Norfolk
625-7451
1270 Bolton St.

Petersburg
Regent 2-1222
33 N. Crater Rd.

Richmond
Milton 3-0111
511 E. Byrd St.

Roanoke
344-3271
19th St. & Salem Ave.

West Richmond
282-9051
6107 W. Broad St.

WASHINGTON
Everett
Cedar 4173
3011 Broadway

Seattle
Main 3-7001
2233 Sixth Ave., S.

Spokane
Fairfax 8-3371
N. 1023 Monroe St.

Tacoma
Greenfield 4-9476
1325 S. Tacoma Way

Yakima
Glencourt 3-4701
210 W. "B" St.

WEST VIRGINIA
Clarksburg
Main 4-6311
315 N. 4th St.

Wheeling
Cedar 2-5120
1803 Eoff St.

WISCONSIN
Green Bay
Hemlock 5-3751
619 Main St.

Madison
Alpine 5-4867
110 N. Thornton Ave.

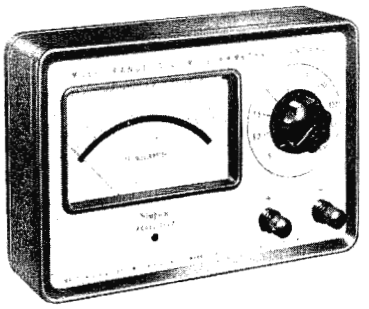
Milwaukee
Broadway 6-1800
546 N. Broadway

Westinghouse Electric Supply Co.

Circle Item 7 on Tech Data Card

A TEST EQUIPMENT CHECKLIST

*by Joseph A. Risse** — A discussion of the basic test instruments essential to any broadcast engineer, with a checklist for the chief engineer and station manager.



Typical of precision instruments is this Simpson laboratory standard meter.

Certain test instruments are essential in any broadcast operation, whether it be an AM, FM, or TV station, single station, group of stations, or network.

Other types of instruments are fairly common in all applications, but vary in the facilities they incorporate or the variety of the measurements for which they may be used. And yet other instruments are selected by the chief engineer or director of engineering on the basis of personal preference. Considered are the special conditions involved in the studio-transmitter or the station-group setup, or the particular requirements of the broadcast equipment involved.

*Director, School of Electronics, International Correspondence Schools, Scranton, Pa.

Examples of instruments common in all broadcast stations are volt-ohm-milliameters (VOM'S,) vacuum-tube voltmeters VTVM's, audio oscillators, grid dip oscillators, oscilloscopes, tube testers, and frequency meters. The instruments that are common but vary in their characteristics from one station or engineering setup to another include the noise and distortion meters, transistor/diode tester, transmission test set, RF bridge, etc. Those instruments whose characteristics are dictated by special conditions involved might include such items as a slotted-line setup for checking vswr, sweep-marker generator, and others.

Basic Checklist

A checklist of basic instruments for broadcasting might be helpful to the chief engineer of a new station or of a station, or stations, awaiting approval of a CP. It might also be helpful to the CE of an existing station as a reminder of what he might lack, or need to improve his maintenance program or the performance of his equipment.

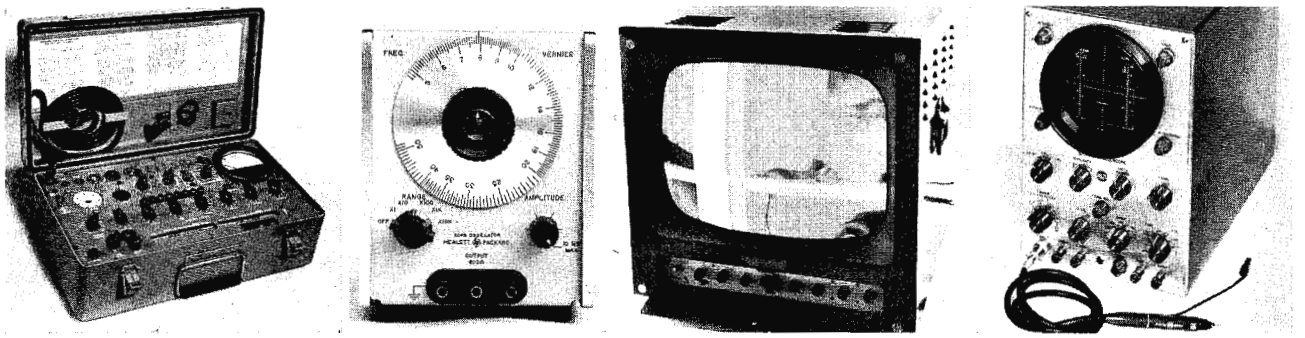
The checklist provided here is intended mainly for a medium-sized station, while those with the larger engineering facilities may surpass the lineup with quantity or special applications. Smaller operations can benefit from the listing since an indication of use is given for each item.

Some items in the following list might be considered as being more in the nature of operating or monitoring equipment than test equipment. However, some of these have been included anyway because of their importance in testing, trouble-shooting, and maintenance. One example is the calibrated demodulator in a television station. This is an item that is fairly essential in maintaining and adjusting a TV transmitter, and yet which is in continuous use during operation for observing the visual transmitter output and/or the input of the coax or waveguide to the antenna.

The list for the most part includes test equipment that is considered fairly general and essential, and used in practically any station, whether AM, FM, or TV.

Accessories

Many minor items, which are essential in making tests are not included in the listing because of the number in use and extensive variety. These include special cables, plugs, adapters, pads, attenuators, probes, standard-reference components, microscope, utility receivers, and so on. Some examples are audio



Shown, left to right, are a Western Reserve Electronics militarized tube tester, the Hewlett-Packard 204B Oscillator, a Conrac Video Monitor showing pulse-cross display, and an RCA WO-91A general purpose oscilloscope.

T or H pads of 3 db, 6 db, and 10 db, at 600/600, 30/600 or 50/600 ohms; 75-ohm TV terminations, etc. The exact nature and number of these miscellaneous items are dictated by the types of tests made, and whether or not the more elaborate test instruments are from one or several manufacturers.

Quantity Requirements

The number used of any particular instrument may vary from one situation to another. For instance, a radio station at which the studio and transmitter are located nearby each other probably will require fewer VOM's, and VTVM's than one in which these operating departments are located in separate buildings and possibly miles apart. A television station having its studio and transmitter facilities located together might be able to manage with only one wide-range oscilloscope, for example, while a station where these facilities are some distance apart would necessarily have to double requirement.

Another consideration is remote programming. A station that handles a full schedule of remote broadcasts would have to duplicate many of the standard instruments in their equipment inventory. Additional meters, oscilloscopes, signal generators, test sets, etc., might be required for portable use, as well as to facilitate the fuller maintenance program. Thus, one might consider the effect of the total number of operative devices in the broadcast system on the quantity requirements for test equipment.

In the equipment listing, there may be duplication, to a certain degree, because of the multiple facilities built into some items. For instance, a station having a sideband response analyzer might not require an rf sweep generator for transmitter checks. Similarly, some duplications of functions crop up in some of the other test and measuring instruments listed.

Table of general test equipment for broadcasting.

Instrument	Function
AF Voltmeter	Audio amplifier response measurement, preventive maintenance, troubleshooting
Audio oscillator	Provide signals for adjustment, calibration, troubleshooting, level checks, etc.
Calibrated receiver	Check coverage nulls
Capacitor checker	Preventive maintenance, troubleshooting, etc.
Clamp-on ammeter	Check for unbalance, abnormal power dissipation, etc.
Communications receiver	Calibration with WWV, check FM modulation, general use
Demodulator	Measurements and checks of monitors, transmitter output, diplexer, filterplexer, etc.
Diode-transistor tester	Preventive maintenance, troubleshooting, development work
Flutter meter	Measurement of tape, disc, and film transport wow and flutter
Frequency meter	Accurate measurement of main transmitter and link frequency, as per FCC requirements
Grid dip meter	General tuned-circuit, trap, and filter frequency adjustment and measurement
Impedance bridge	Measurement of L, C, R, and Z
Line matching transformers	Audio testing, hum reduction, noise isolation
Megger	Testing entrance cable and insulation resistance, ground resistance, etc.
Oscilloscope, mid-range	Distortion isolation, general troubleshooting, modulation checks, etc.
Noise and Distortion meter	Audio line, amplifier, and transmitter tests; proof tests
Q meter, RF bridge	Check of RF line, antenna, components; phasing; etc.
Resistance bridge	Measurement of audio and RF line and cables
RF sweep generator	Transmitter bandwidth and general response check and adjustment
Sideband response analyzer	Sweep alignment of transmitter visual circuits
Squarewave generator	Audio and video frequency and phase tests
Stereo FM monitor	Stereo channel separation and modulation measurement
Transconductance tube tester	Preventive maintenance
Transmission test set	Audio line, amplifier, and transmitter tests; proof tests
VOM, 20,000 ohms/volt	General tests and measurements, portable applications, above ground and floating measurements, resistance measurements
VTVM, with capacity and high voltage probes	General measurements, tests in hi-Z and high voltage circuits, development work, etc.

Significance of Canadian Practices, an added note

In compiling this list, I was guided partly by my own experience in medium and small station operations. However, I am also greatly indebted to several other sources. One of these is Scranton Broadcasters Inc., operators of WGBI AM-FM and WDAU TV, Chief Engineer Kenneth Cooke and Assistant Chief Engineer Stanley Zawislak, in particular; also from equipment lists provided by N. R. Olding, Operations Engineer of the Canadian Broadcasting Corporation, Montreal, Canada.

The CBC in Canada operates a large number of AM, FM and TV stations. The information received from them was felt to be of considerable importance in compiling the list for several reasons. Since the CBC operates stations from coast to coast in Canada, and since these operations are in some cases

• Please turn to page 35

AUDIO LEVEL DEVICES

*by Thomas R. Haskett** — Part Two. A discussion of compressors and averaging devices, their principles and features.

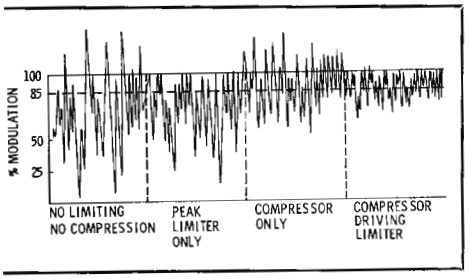


Fig. 1. Compressor and limiter effects.

Although a limiter can protect a transmitter against audio peaks, too much limiting (say, 20 to 30 db) can increase distortion to 3 or 4%. The limiter can't do anything about low passages, below its limiting threshold. During many programs low passages would be lost to some listeners if only a limiter were employed. To overcome such difficulties, the compressor was developed. The names are different—compressor, compressor - expander, AGC amplifier, averaging device, etc.—but the function is about the same in each case. Dynamic range is lessened by compressing peaks and expanding low passages.

Compressor Operation

While a limiter establishes a ceiling for peaks, as seen in Fig. 1, it doesn't affect low-level signals. The compressor pulls up these lows, but its peak limiting isn't too good. Fig. 2 shows why. The limiter's operating point (average signal level at input) is at or slightly above threshold, seldom higher. But the compressor normally works in the middle of its slope; since this slope often covers 30 db of input variation, greater-than-average signals are compressed more, and lesser-than-average signals are compressed less. The result is shown in Fig. 1, and it's precisely this latter action that gives the compressor an advantage over the limiter. However, this feature has a disadvantage, too. The compression ratio is low —roughly 3:1 for a compressor, compared with 10:1 or more for a limiter. Thus, a compressor's output is much more variable than a limiter's. Also, the attack and release times of a compressor determine its action. If the limiter-type dual-recovery circuit is used, gain reduction and return are functions of the program material, and the action is essentially that of a limiter. But if long time constants are used, the unit is essentially an average-level device, since short peaks don't affect the gain. Where time-constant switching is provided, its positions are usually marked **dual** and **average.**

Circuit Action

The basic circuit is shown in Fig. 3; note the similarity to the limiter circuit. V1-V2 is a variable-gain stage, generally a 6386 twin triode operated in push-pull. V3-V4 constitute a fixed-gain, push-

*Consulting Engineer, Michigan City, Indiana

Table of compressor and

Model	Attack Time msec	Release Time sec	Compr. Ratio	Input Level dbm	Output Level dbm	Gain db	Noise Level dbm	Frequency Response
Collins 26J-1 Auto-Level	11 or 62	0.9 or 5.2	1.6:1 to 5:1	−26 to +30	−24 to +30	41	−50	±1.0 db 50 to 15,000 cps
Collins 356E-1				−54 to +6	0 to +36	54		
Fairchild 666	30	0.3 to 30	2.8:1	−5 to +15	+13 to +25	30	−65	±1.0 db (40 db) 20 to (compr.) 15,000 cps
Fairchild 666A								
Fairchild 663	40	0.3 to 7.0	3:1	−35 to +25	+22	None	None*	±0.5 db 20 to 30,000 cps
Gates M-5167 Sta-Level	25	1.0 to 12	3.3:1	−44 to +24	+8 to +24	62	−45	±1.0 db (30 db) 30 to (compr.) 15,000 cps
GE BA-9-A Uni-Level	11 or 62	0.9 or 5.3	1.6:1 to 5:1	−54 to +6	0 to +36	54	−50	±1.0 db (30 db) 50 to (compr) 15,000 cps
GE BA-9-B Uni-Level								
ITA AGC-1A	25	5.0	7:1	−37 to +13	+20 to +34	57	−50	±1.0 db (50 db) 20 to (compr.) 20,000 cps
Langevin AM-5301 Leveline	0.1 to 11	0.5 to 3.0	1.6:1 to 5:1	−70 to −6	+26 or +37	53	−57	±0.5 db 20 to 20,000 cps
Quindar QCA-2	250	....	10:1	−52 to −18	−10	40	....	±3.0 db 250 to 4000 cps
RCA BA-25A	12.5	1.0	2.1:1 to 6.2:1	−80 to −25	−10 to +30	70	−46	±1.0 db 30 to 15,000 cps

*Passive circuit—no generated noise.

pull output stage, from which a portion of the signal is rectified by V4, the AGC diode. The resulting DC furnishes operating bias for the input stage. Unlike the limiter, which has a **fixed** threshold, the compressor threshold is usually **variable.** A pot across the B+ allows selection of various delay voltages to be applied to the diode cathode. No control voltage can be generated until the output signal exceeds this threshold voltage, of course. By changing the threshold, the input tube operating point is altered, and this, in turn, produces a different compression ratio. Hence, the range commonly found is 2:1 to 6:1. And this action must not be confused with the **signal** operating point; the latter is obtained by setting the signal-input level to the first stage. Between the diode and the signal-input an RC network provides attack and release times. As we've mentioned, this is often variable. Because the compression ratio is low, circuitry is less elaborate than for a limiter. Since compressors are always used **ahead** of limiters, and frequently at the console output, or even at an earlier point where levels are low, size is generally small compared with limiters. All compressors listed in Table 1 will match 600 ohms in and out.

Disadvantage

While the compressor overcomes one difficulty associated with the limiter, it introduces another. If a loud passage is followed by a very soft one, or a pause of several seconds duration, the compressor raises the gain. Only there's nothing to amplify but room noise, air-conditioner noise, and perhaps even tube noise! And if an old ET is being played, or a dusty LP, the surface noise gets expanded and listeners hear needle scratch in all its glory. This can be partially overcome by using less compression, but it defeats the purpose of employing an averaging device. (The solution to this problem will be covered in Part IV.)

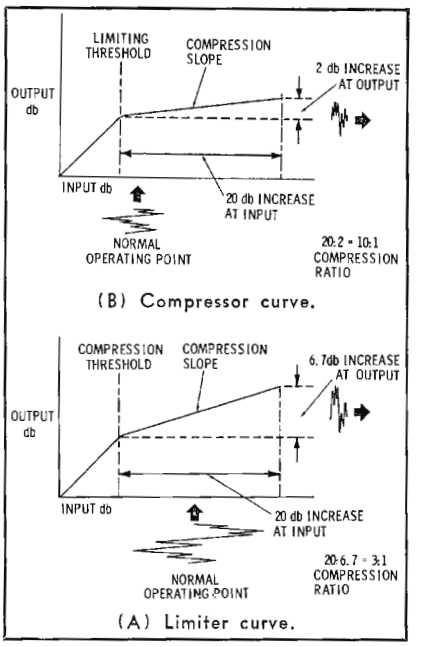


Fig. 2. Limiter and compressor curves.

Operating Practice

Operating practice today is to locate the compressor between the main console and the limiter, the limiter then driving the transmitter, as in Fig. 4A. What happens is that the gross variations in level by announcer-operators are corrected somewhat, and the limiter then only has to protect against peaks, and smooth out few of those. This hookup is especially desirable if a telephone line separates the studio and transmitter, since the compressor can then deliver a less erratic signal to that line, maintaining a better signal-to-noise ratio. Also, harmonic distortion divides between the compressor and the limiter; you get less with both than either alone.

• Please turn to page 36

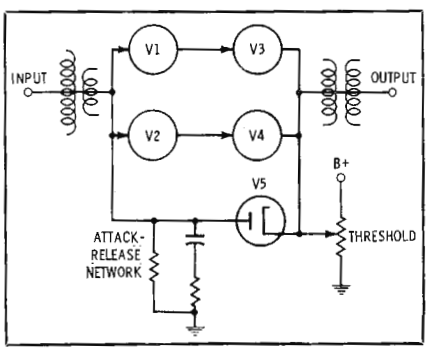


Fig. 3. Basic compressor circuit.

averaging device specifications.

Harmonic Distortion	Compr. Meter	Dimensions Width	Height	Depth	Price	Model
2.0% (30 db) 50 to (compr.) 15,000 cps	Yes	19"	5¼"	9"	$275.00	Collins 26J-1 Auto-Level
	No	3"	5⅜"	9"	130.00	Collins 356E-1
0.4% (40 db) 25 to (compr.) 15,000 cps	Yes	19"	3½"	6"	495.00	Fairchild 666
					399.00	Fairchild 666A
Below 0.3%	Yes	1½"	7"	4½"	158.00	Fairchild 663
1.0% (30 db) 50 to (compr.) 15,000 cps	Yes	19"	5¼"	7"	249.00	Gates M-5167 Sta-Level
2.0% (30 db) 50 to (compr.) 15,000 cps	No	3½"	5¾"	10¾"	140.00	GE BA-9-A Uni-Level
		19"	3½"	7½"	200.00	GE BA-9-B Uni-Level
1.0% (25 db) 35 to (compr.) 20,000 cps	Yes	19"	5¼"	7¾"	225.00	ITA AGC-1A
Below (25 db) 1.0% (compr.)	No	2⅝"	3"	10¼"	225.75	Langevin AM-5301 Leveline
10.0% (10 db) 150 to (compr.) 2500 cps	No	1¾"	1¾"	6"	90.00	Quindar QCA-2
Below 1.0% 30 to (30 db) 15,000 (compr.)	No	8⅜"	4 21/32"	12½"	225.75	RCA BA-25A

BROADCAST STATION SPARE PARTS INVENTORY

*by Patrick S. Finnegan**—How one station solved the tube and components inventory problem.

Fig. 1. Mercury rectifiers upright rack.

Time is all a broadcaster has to sell, and without a reliable signal, he has nothing. Down time is costly, both from lost advertising revenue and lost viewers or listeners. An audience will not stay long with a station which has an unreliable signal.

Show people have a code "The show must go on," which has been tacitly adopted by broadcasters. Any good engineer will try to "limp along" until sign off, rather than take the station off the air.

Keeping the station on the air depends not only on good maintenance practices, but also in having spare tubes and parts on hand. The engineer must ask himself the question, "Just what parts and tubes, and how many?" He will also, quite often, have to justify his decision to the station owners, because spare parts and tubes can represent a sizeable investment.

Over the years, the author has developed some methods regarding spare parts and tubes. It is not the intention of this article to outline a specific plan for others to follow, but rather to show how these methods have been utilized in meeting the problem of having the correct parts without too large an inventory.

*Vice Pres., Chief Engineer, WLBC-AM-TV, WMUN-FM, Muncie, Indiana.

Problems and Approach

The problem of spare parts multiplies with the number of equipment items. Our AM/FM/TV operations incorporate several related items, which provide their own problems. In this category would be: the automatic programmer on FM, which is leased; AM radio uses an extensive cartridge tape system, automatic time injector, CBS Netalert receiver, six two-way mobile radio units for rebroadcasts; television uses a Newswire facsimile machine, off/air network receivers; emergency power systems for AM/FM and an emergency operations booth.

Spare tubes will be discussed first, since they make up the bulk of spare parts. Tubes are divided into three categories; transmitting, special purpose, and small receiving-type tubes. We keep on hand at least one of each type transmitting tube. Where more than one of the same type is used, our stock is increased; past experience has shown a need for a larger stock. In this area, we have a "second line of defense." As tubes weaken and we cannot maintain power, they are replaced. These tubes are kept on hand as emergency spares. These also serve as guinea pigs during equipment troubles. When a tube blows, we have found it wise not to replace it with a new spare. Should something other than a defective tube have caused the first failure, the guinea pig will blow. In this way, nothing in the new-part inventory will be lost.

Mercury vapor rectifier tubes are treated in a slightly different manner. We try to keep a full complement of these tubes on hand, already "cooked" and stacked in racks (Fig. 1). When a rectifier fails, it is not always possible to tell immediately which one it is. Our procedure is to replace all tubes in the defective rectifier and get back on the air. After sign off, the defective one is weeded out, and the good tube, or tubes, replaced in the equipment.

Tube records on all large transmitting and special purpose tubes are a must. To be of any value, they must be accurate and up to date. Ready information can be obtained regarding spares on hand, plus the life and condition of those in service. This data and a quick check of the transmitters will give an indication of replacement and standby stock needs.

We retain the records of "deceased" tubes in a separate file. A study of these can help determine life expectancy and may point up deficiencies. For example, a tube type may have averaged 7,000 hours in the past, while the present average is only 4,000 hours. Deterioration of air ducts and leaks may be causing the shortened life, which would not be noticed in daily operations.

Tubes of the special purpose category would be image orthicon tubes and similar types. Accurate records are kept on these and, as

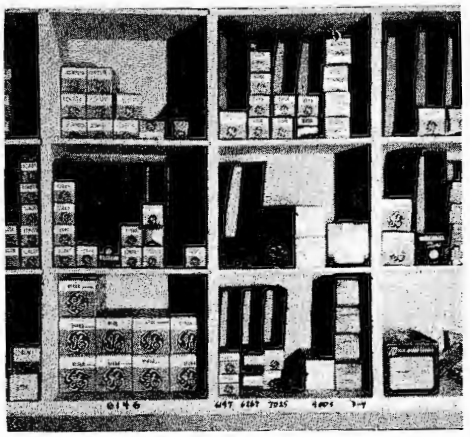


Fig. 2. Partial view of tube storage area.

Fig. 3. Studio and projection lamp storage.

before, we can anticipate needs. None of these types are kept in stock. Over the years, our stock of used tubes has grown. These will provide a reasonable picture, should a camera tube die unexpectedly. Or dinarily, a new replacement can be flown in overnight from the supply house. Video monitor picture tubes have a long life and seldom quit suddenly. In most cases, another monitor can be substituted. Therefore, we do not stock any picture tubes.

The third category is small tubes, and these require a different approach because there are so many of them (Fig. 2). Our method here is comprised of both experience and "guesstimate." The first step was cataloging all pieces of equipment which use small tubes. In the listing, each tube type and quantity is itemized. This information is readily obtainable from the instruction books. Totals were obtained of all tubes used, and an arbitrary figure of each type set up as a starting point. We carry a larger stock of the types which are difficult to obtain. In every case, we stock at least one of each tube type used, unless it is a piece of equipment which can wait, should it need a tube. The accompanying table shows a typical portion of our tube inventory list.

Again, we have a second line of defense. Quite often, when trouble develops in the middle of a program, the defective section is "shotgunned" with new tubes. Later, these tubes are tested and the weak or defective ones discarded. Those which are fair to good are either put back in the equipment or marked with a tag and placed in a special section of the spare tube stock. Eventually, these are used in non-critical circuits.

Equipment fuses, pilot lamps, silicon and germanium diodes, and transistors are treated the same as tubes.

The FCC requires replacement lamps be on hand for tower lighting. We keep enough lamps on hand to completely relamp both the radio and television towers.

Projections lamps for slide, film, and opaque projectors, studio lighting are all controlled with the same basic method as for tubes (Fig. 3).

Components

Component parts are more difficult to estimate. One has to lean heavily on experience with the individual piece of equipment, availability of parts, and the possibility of sustituting alternate equipment in an emergency. The best approach, we find, especially with new equipment, is to look for weak points and specialized parts. The necessity of maintaining continuous operation weighs heavily here. For example, in dealing with a new transmitter, a full complement of spare parts would be ordered immediately, and kept on hand. Future experience will then indicate which parts are vulnerable and how many to keep ahead. Maintenance of our television transmitter has shown that the contact springs and silvered mica discs in the cavities need frequent replacement. Even though these are expensive items, we keep a sufficient quantity on hand because they are specialized parts which can be obtained only from the manufacturer.

Of component items, such as resistors, capacitors, small coils, and controls, we keep a varied supply of standard values on hand. In most cases, where a resistor or capacitor must be replaced, and the exact value is not readily available, a combination of units will serve the purpose.

It is necessary, we have found, to maintain a rather large selection of hardware items in stock. These include machine screws and nuts, washers, lugs, studs, terminal strips, chassis material, shields, insulated tubing, etc.

Wire stock is one other important consideration. Since there are many different types of wires and cables used in our operation, we try to keep enough of the appropriate kinds to replace, if necessary, long runs which are suspected of opens and shorts (Fig. 4). We also keep a good quantity of hookup wire for repairs and construction.

Table—Typical excerpt from tube inventory page, showing receiving type tubes.

Tube Type	Use	Stock
6H6	11	3
6J6	10	4
6J7	16	5
6K7	2	1
6L7	4	2
6N7	1	1
6R7	1	1
6S4	3	2
6SL7	46	15
6SN7	45	15
6U8	17	6
6V3	5	2
6Y6	44	12
7AG7	39	6
12AT7	87	20
12AU7	37	11
12AX7	18	10
12AY7	1	1
89	2	2
921	1	1
1620	10	1
5670	4	2

Machines

Audio tape machines sooner or later require a replacement of the capstan motor. We keep a spare motor of each type for our program machines.

We use an outside service contract for our film projectors. While parts are included in the contract, we keep a good supply on hand. When something needs replacement, these parts are used and the service company then replenishes our stock. Since most of these are specialized

• Please turn to page 37

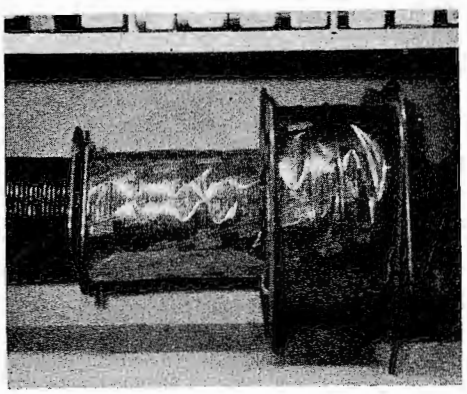


Fig. 4. Portion of wire and cable storage.

SPECIALIZED TEST AND MEASURING INSTRUMENTS

A product review of some test equipments which have specific applications in broadcast stations and recording facilities.

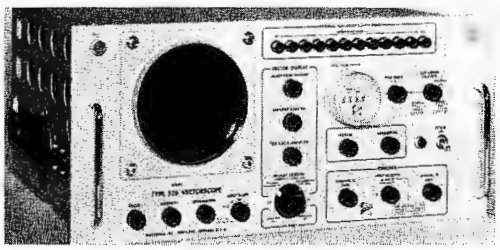
While radio and television stations and recording studios employ certain basic test equipment of the type usually found where electronic work is being performed, there also is a need for many more specialized instruments used in the more critical measurements, especially where FCC rules and regulations are concerned.

Some of these instruments are employed during routine maintenance, while others are more often employed when a proof-of-performance is conducted, when new systems are installed, during the design of equipment, and for calibration and critical adjustment of operational devices. Some representative test and measuring instruments are shown here.

Radio Corp. of America — TV Sideband Response Analyzer Type BW-5B

The BW-5B is a device for tuning the over-coupled broadband RF circuits of TV transmitters, and measuring their amplitude response characteristic. It contains a video sweep oscillator, and can be used in adjusting video circuits.

Specs: RF input, frequency, 55.25-83.25 mc and 175.25-211.25 mc, voltage, .5 to 1.0V; Z, 51 ohms; output, hi Z oscilloscope input; video sweep, 0 to 2V p-p, 10-0-10 mc width.



Tektronix — Type 526 Color-Television Vectorscope

The 526 vectorscope greatly reduces the time and effort involved in making extremely accurate relative phase and amplitude measurements of chrominance information in the N.T.S.C. color video signal.

AD-YU Electronics Lab., Inc. — Precision Phase Generator and Frequency Standard, Model 208A

The 208A consists of a tuning fork oscillator, filter circuit, phase shifters, and two cathode followers. It may be used for phase measurement of unknown networks, calibration of phase measuring devices, phase measurement, and as a frequency standard.

Specs: phase range, 0 to 360°; indication, direct reading on three dials; repeatability, better than 0.05°; resolution, less than 0.025°; freq. range, 50 to 1500 cps; accuracy, 0.15° absolute; output signal, 0.05 volt to 7.5 volts rms; output Z, 300 ohms. **Price,** $685.

Sprague Electric Co. — Model 500 Interference Locator

The Model 500 is an easy-to-operate instrument intended for the rapid location of radio and TV interference sources; it is also highly effective in preventive maintenance programs.

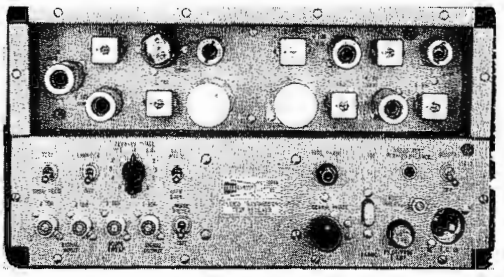
Specs: freq. range, 550 kc to 220 mc in 6 bands; sensitivity, 5 microvolts min.; antenna systems, VHF dipole and directional loop; input connection, coaxial; pwr supplies, 115/230 VAC, 50-60 cps, or battery. **Price,** $460.

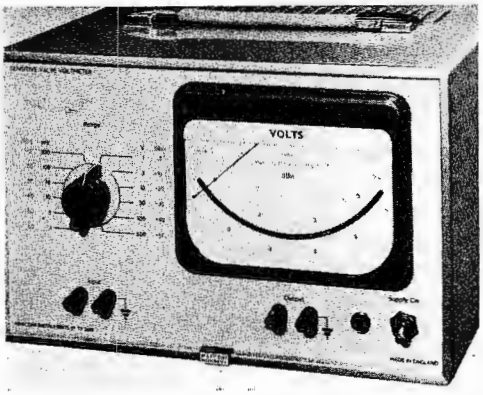
Specs: phase accuracy, ± 1.5° by vector presentation, ± 1° by null technique; phase resolution, better than 0.1° at 3.58 mc; saturation measurements, ± 2% on graticule, closer when comparing two signals. **Price,** $1665.

Telechrome Manufacturing Corp. — Model 1004-B Video Transmission Test Signal Receiver

The Model 1004 is designed to provide rapid and accurate measurements of differential phase and differential gain characteristics of video facilities. The series responds to the standard stairstep test signal modulated with 3.58 mc.

Specs: input, composite video, .5 to 2 volts p-p; output, demodulated sensitivity, .5 volts for 2.5° differential phase; differential gain, 10%; accuracy, 0.25° differential phase, 1% differential gain.

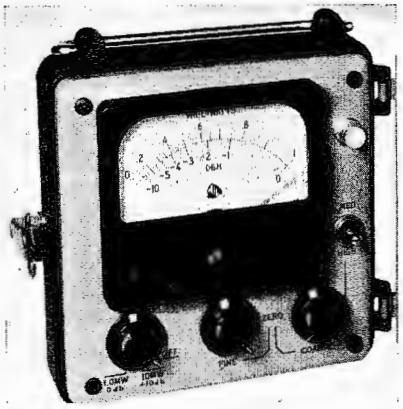




Marconi Instruments — Sensitive Valve Voltmeter, TF2600

The TF2600 voltmeter is intended for measuremnt, detection, amplification, or level control of signals over wide ranges of frequency and voltage. The direct output of microphones and recording heads can be measured to provide determination of frequency characteristics.

Specs: voltage ranges, 0 to 300 volts in 12 steps, 1-3-10-30-100-300 mv, and 1-3-10-30-100-300 volts fs; dbm, —72 to ± 52; freq., 10 cps to 10 mc; input Z; 10 megohms; amplifier volt gain, 150.



Cutler-Hammer, AIL Div. — RF Power Bridge, Type 51

The type 51 employs the principle of the self-balancing bridge, combined with advanced transistor circutry, and can be used with most of the available 200-ohm thermistors. It is used to rapidly measure microwave power under a wide variety of conditions.

Specs: range, 0 to 1 mw, 0 to 10 mw, —10 to 0 dbm, 0 to +10 dbm; accuracy, ± 5%, thermistor data, 200 ohms, neg. temp. ref, 0 to 18 ma bias; battery, 9-volt. **Price,** $220.

Daven — Noise Measuring Set Model 34-C

The 34-C is a portable, battery operated instrument for accurately performing audio frequency noise and transmission measurements. Cross talk, signal level, gain loss, transmisison level, and acoustic sound level can be readily determined.

Specs: input Z, 600 ohms to 500K, balanced or unbalanced; range, down to —85 dbm; freq., 50 to 10,000 cps depending on test circuit used; weighting, 8 test configurations; inputs, 7 sets of jacks; measurements range, more than 20 range combinations.

Riker Industries, Inc. — Modular Video Test Sets

Thes modular units are fully transistorized, employ logic circuits, require minimum power, are interchangeable, provide two outputs (isolated 50 db), and are available in more than 20 models, among which are: multiburst generator, linearity generator, stair step generator, $\sin^2$ generator, tape reference generator, test signal driver, sync & blanking adder, pulse regenerator, sync generator, sync lock, video and pulse DA's, and others.

Jerold Electronics — AY-50B Attenuator

The AV series attenuators are of the variable switch type, incorporating precision, carbon - deposited resistors and rotary coaxial switches with wiping, self-aligning contacts.

Specs: range, 0 to 62.5 db in 0.5 db steps; freq., DC to 500 mc; insertion loss, 0.3 db at 230 mc, 0.6 db at 500 mc; max VSWR, 1.2 to 230 mc, 1.4 to 500 mc; Z, 50 ohms; pwr. dissip., 0.5 watts.

Varo, Inc. — Flutter & Wow Meter, FL-3D

The FL-30 is designed for use in maintenance, repair, and calibration of audio and music tape recording instruments, and data recording systems. It meets the requirements for measuring flutter and wow as determined by the Standards Committee of the I.R.E.

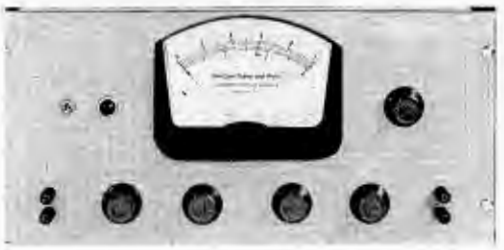
Specs: carrier freq., 3000 cps; flutter response, 250 cps with no more than 3 db attenuation, reference 75 cps; 0.1 vrms to 0 dbm; input Z, 100,000 ohms; scale range, 2% and 0.5 % f.s.; accuracy 10%.

Audio Instrument Co., Inc. — Intermodulation Meter Model 168

The model 168 combines a two-tone signal generator, intermodulation analyzer, and a vacuum-tube voltmeter. It operates over a wide range of frequencies, and allows distortion at the high and low bands to be measured independently.

Specs: freq. low, 60 cps, or from 40 to 200 cps; freq. high, 2, 7, and 12 kc, or from 2 to 20 kc; voltage ratio, 4:1 and 1:1; sig. gen. Z, 600 ohms; sig. gen. out, ± 8 dbm; analyzer in Z, 500K; analyzer in volts, .66 volts min.; IM ranges, 1, 3, 10, 30% f.s.; vm ranges, 0.03, 0.1, 0.3, 1, 3, 10, 30, 100 volts; vm accuracy, 3%, 40 cps to 40 kc. **Price,** $425.

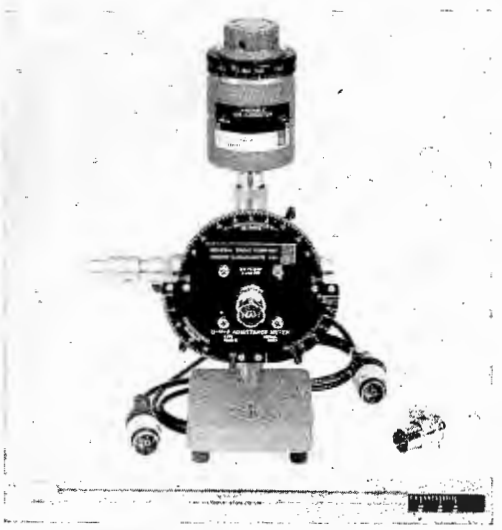
Specialized Test Equipment



Amplifier Corp. of America — Sensitive Flutter Meter

This sensitive measuring device is engineered to comply with the IRE standards for flutter and wow measurement in all types of tape recorders and playback equipment, including 33⅓, 45 and 78 rpm discs and 16 and 35 mm optical and magnetic sound film.

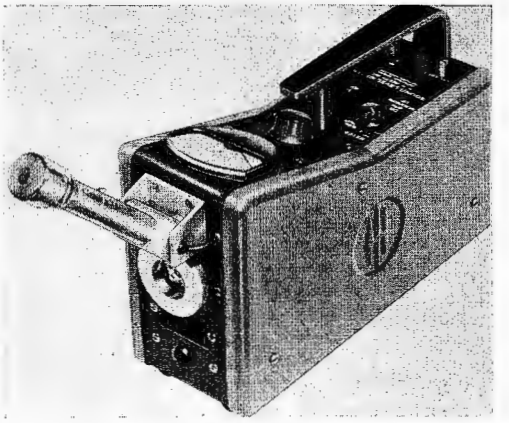
Specs: input volts, 0.001 to 300 volts; input Z, .5 meg; range, 0.01 to 3%; accuracy, 2% f.s.; response rate, 0 to 250 cps; test freq., 3,000 cps ± 5%. **Price,** $495.

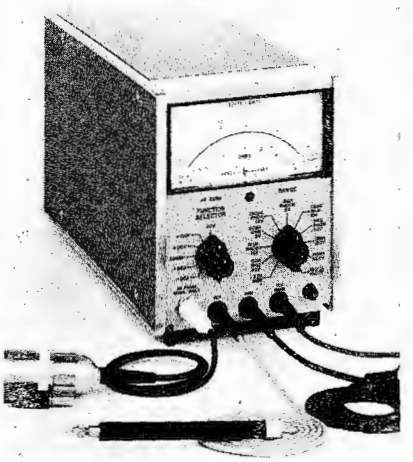


H. H. Scott, Inc.—Type 412 Sound Level Meter

The type 412 is used to precisely measure noise in terms of sound pressure level. It can be used as a portable amplifier, voltmeter, and attenuator in the audio frequency range.

Specs: range, 24 to 150 db (0.0002 dynes 1 cm^2 ASA std. ref.); freq., 5 cps to 30 kc; standards, meets all ASA noise measurement standards; microphone, ceramic type accurate from —20°C to 80°C.





Hewlett-Packard Co.—410C Electronic Voltmeter

The 410C is a versatile general purpose instrument for measuring AC and DC voltages, direct current, and resistance. It employs a photoconductor chopper amp.

Specs: voltage, ± 15mv to ± 1500v f.s. in 11 ranges; DC accuracy, ± 2%; DC input resistance, 10 to 100 megohms; current, ± 1.5 microamps to ± 150 ma f.s. in 11 ranges; current accuracy, ± 3%; resistance, 10 ohms to 10 megohm, ± 5%; AC voltmeter, 0.5v f.s. to 300v in 7 ranges; AC frequency, 20 cps to 700 mc. **Price,** $300; AC probe, $60.

General Radio — Type 1602-B UHF Admittance Meter

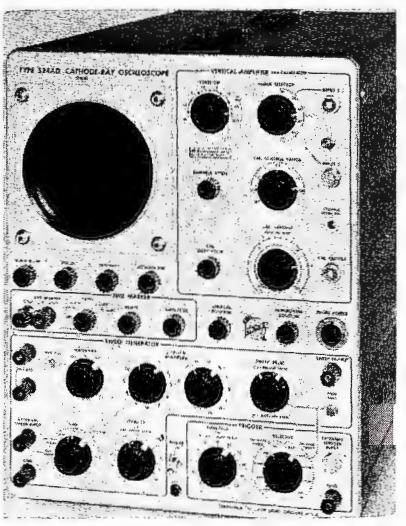
The 1602-B is a null-type impedance measuring instrument for coaxial systems, including antennas, lines, and components. It can be used in adjusting a network to a predetermined admittance, for matching, and VSWR measurements.

Specs: admittance range, approx. 0.01 to 10,000 millimhos; VSWR, ratio of less than 1.2; freq. range, 40 to 1500 mc; accuracy, approx. 3%. **Price,** $325.

Tektronix — Type 524 AD Television Oscilloscope

The Type 524 AD is a self-contained instrument with the characteristics desirable in the maintenance and adjustment of television transmitter and studio equipment. It enables the engineer to observe any portion of the television picture.

Specs: freq. response, DC to 10 mc, from 0.15 v/cm to 50 v/cm, 2 cps to 10 mc from 15 v/cm to 50 v/cm; transient response, 35 nsec rise-time; sweep range, 0.1 μsec/cm; time markers, 0.05 sec, 0.1 μ sec, 200 pips per line, and 40 pips per line; sweep delay; DC-coupled unblanking; variable duty-cycle amplitude calibrator. **Price,** $1300.



Ballantine Laboratories — RF Millivoltmeter, Model 340

The model 340 is a sensitive, wide-band, true-rms voltmeter which enables the user to make measurements on either sinusoidal or badly distorted signals with consistant results. Signal voltages are measured by a probe, connected to the meter by 3 feet of cable.

Specs: voltage range, 300 μv to 3 volts in 8 ranges; freq., 0.1 mc to 1,000 mc, calibrated to 700 mc; input Z, 1 meg to 25k; mean square DC output, 0.1 to 1.0 volt. **Price,** $760.

This is KTRK-TV's new broadcasting station in Houston, Texas. The exclusive use of Belden camera, audio, and control cables by this ABC affiliate helps assure KTRK of continuous, highly efficient programing.

Looking over part of this 155,000-foot Belden wire and cable installation are Byron Turner, Salesman, Sterling Electronics (left), Jess Mitchell, KTRK Engineer (center), and Bill Donahoe, Belden Territory Salesman. They are standing in front of a Belden wired control panel in one of the many KTRK studios.

All of the wire and cable for this installation was placed through Sterling Electronics—one of Belden's Houston distributors.

Belden

WIREMAKER FOR INDUSTRY
SINCE 1902 — CHICAGO

power supply cords • cord sets and portable cordage
electrical household cords • magnet wire • lead wire

155,000 ft of Belden Audio, Camera, and Control Cable helps keep KTRK-TV on the air

For all TV and radio broadcasting, recording studios, remote control circuits, and similar applications, Belden manufactures the most complete line of application engineered wire and cable. Call your Belden electronics distributor for complete specifications.

8-10-2

Circle Item 8 on Tech Data Card

MAINTENANCE OF A SMALL TV STUDIO

*by George C. Sitts** — A modification of the usual maintenance plan, for application in a small ETV operation.

Although there will always be big TV, the day of the small television operation is upon us. The sudden boom in UHF applications, the increase in closed circuit ETV installations, and the proposed 2,000-mc ETV band all indicate this fact. With this in mind, it might be well to revise some of the present studio maintenance practices in order to find a workable maintenance program for the small studio.

One mark of the small station is its concern with finance. In the small station it is necessary to strike a balance between ideal maintenance and financially practical maintenance with a limited staff. The financial problem was previously almost unknown to the TV engineer since the profits generally allowed even the poorest stations to afford both back up or standby equipment, and all necessary technical help to keep the stations up to peak performance.

In big TV there are usually one or more maintenance men on duty at all times who make repairs when needed, while remaining time is used to check and double check the equipment. In small television operations there are fewer maintenance men because of the expense and because the smaller size of the operation doesn't warrant them. These men are being replaced instead by standby equipment designed to be switched or patched into use by semi-skilled operators.

In order to insure proper functioning of both regular and standby equipment, a specially tailored system of maintenance must be set up in the small station. Just such a system was planned and tried at the ETV project in Cortland, New York. At Cortland there is a technical staff of one chief technician with the necessary knowledge to maintain and repair the TV system, and two other semi-skilled student technicians who also double as camera men and studio crew. They are required to maintain a two studio, eight-hour-day educational television operation.

After several hit-and-miss tries at maintaining the system with this staff, considering the normal amount of equipment failures, it was decided a rigid schedule was needed to prevent small symptoms from growing into large troubles. At the same time the schedule had to allow the limited staff enough time to repair equipment and carry out other duties. In general, the system as it was developed is as follows:

Morning Checkout

Each morning of operation the first technician to arrive turns on the camera power supplies. Before programming begins, each technician makes certain equipment checks, which include:

1. Audio. The main microphone channels in each studio are checked by oral count to insure operation. The tape recorder and turntable audio are checked by a music test.
2. Optical. The film chain is run up and punched on master monitor; slide alignment is noted.
3. Video. Cameras are run up on a test pattern, electronic focus is set, and resolution is noted mentally (Fig. 1).
4. Line. Following the above checks of studio gear, test pattern and music tape are

*Chief Technician, Cortland, New York Instructional Television Studio.

Fig 1. Student technician making a check of camera resolution.

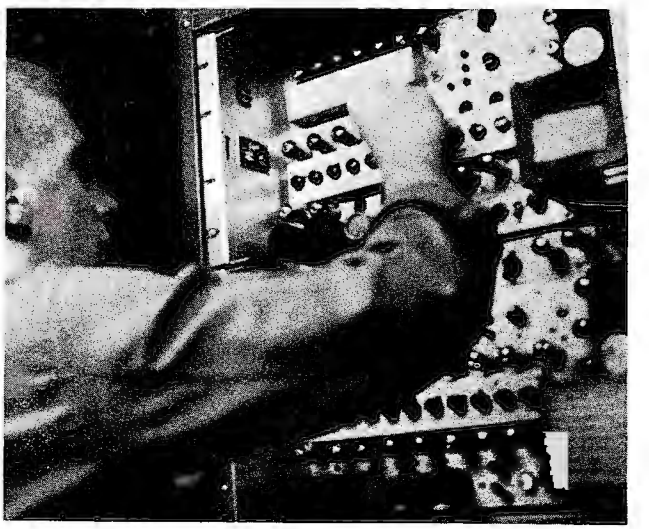


Fig. 2. Standby video equipment being checked for readiness.

The Electro-Voice Model 642
Cardiline Microphone Earns

THE FIRST ACADEMY AWARD FOR MICROPHONE DESIGN IN 22 YEARS!

Today's movies, radio, TV and recordings sound better, thanks to a microphone design that has revolutionized sound pickup techniques. It is the Electro-Voice Model 642 Cardiline® ultra-directional microphone.

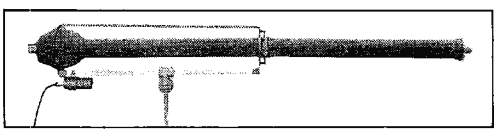
The E-V 642 has contributed so much to motion picture sound that on April 8, 1963 it was presented the coveted Academy Award certificate by the Academy of Motion Picture Arts and Sciences—the first such award to a microphone in 22 years!

Film sound engineers found the unique 642 Cardiline design sharply reduced effects of noise and distance. They obtained clear, crisp sound under circumstances previously thought impossible.

The 642 is another major achievement by Electro-Voice in the art and science of electro-acoustics. This engineering leadership extends equally to professional and commercial sound, home high-fidelity recording and reproduction—even to phonograph needles and cartridges.

No matter what your interest in sound, look to Electro-Voice for the consistently superior engineering that means award-winning performance for you.

Model 642
$390.00 list



The E-V Cardiline* principle is also found in the famed 7-foot long E-V Model 643 ($1,560.00) and the popular Model 644 for critical commercial sound installations ($110.00.) All prices list, less normal trade discounts.

*T.M. Reg., Patents Applied For

Circle Item 9 on Tech Data Card

Electro-Voice®

"ACADEMY AWARD-WINNING SOUND"

ELECTRO-VOICE, INC., Dept. 731V, Buchanan, Michigan

Enter my subscription to "Microphone Facts", the FREE E-V newsletter on professional microphone applications.

Name_____

Company_____

Address_____

City_____ State_____

punched to the transmitter and checked on the transmitter output monitor. In Cortland, the system is closed circuit with the transmitter leased from the telephone company; therefore, further checks of the transmitter are not made.

This entire morning checkout takes less than fifteen minutes.

Daily Maintenance

Between programs, when time permits, or at the end of programming, the following daily maintenance is done:

1. Film Chain. The film gate is cleaned, the f stops and focus settings are checked, slides and film are aligned, and filter settings are checked.
2. Camera. Sizing, focus, and f-stop settings are checked. Resolutions of each camera are checked and recorded.
3. Studio. Headsets are checked for broken or frayed wires, all studio lights are checked to assure operation, and camera tally lights are checked.
4. Pulse Generator. The pulse cross is observed on master monitor, pulse count is taken and recorded and pulse widths are noted.

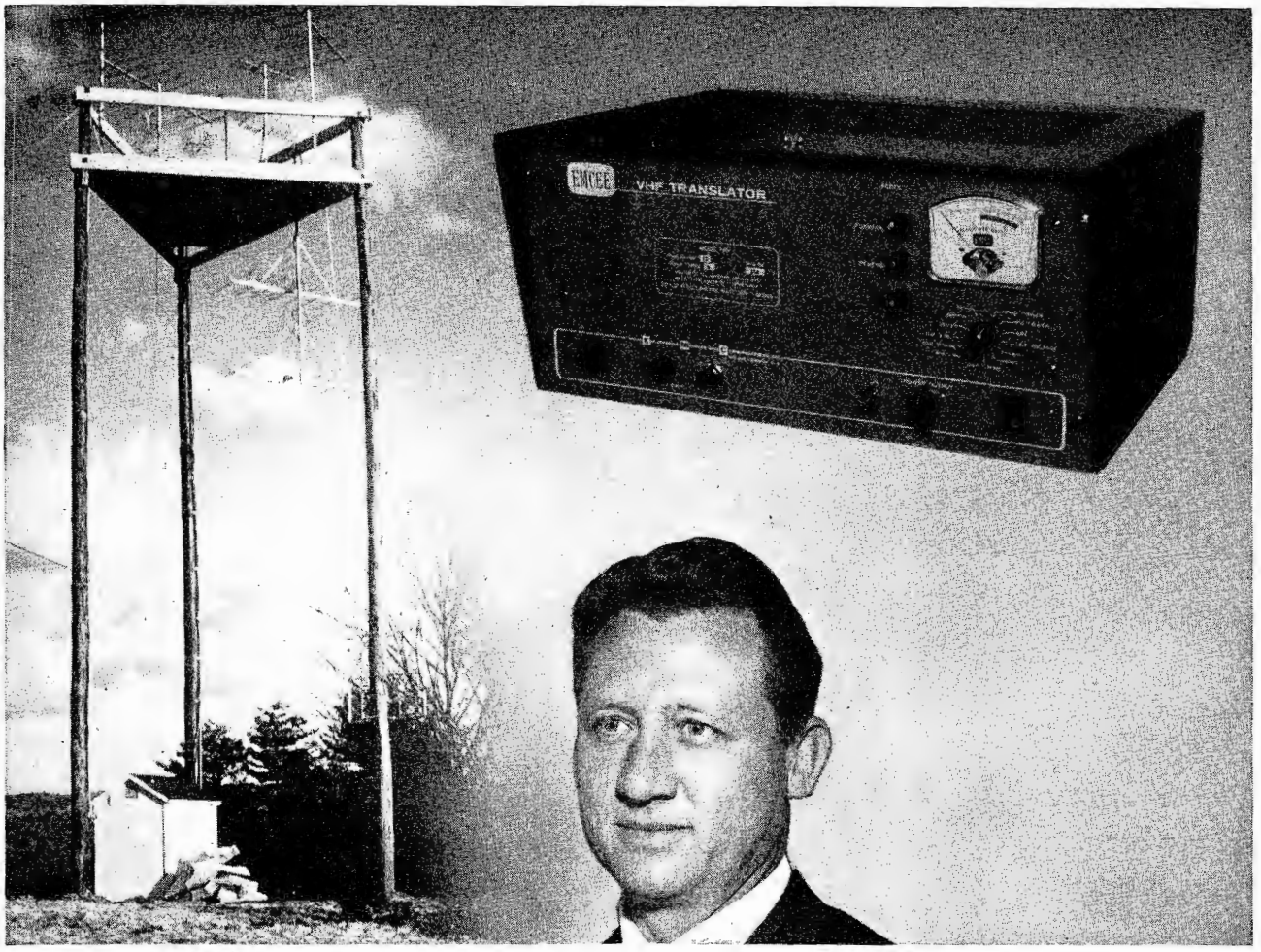
Because the technicians double as cameramen, it happens that many of the above checks are made during operation of the equipment. For instance, tally lights and studio lights can be checked while in actual use; lens settings and headsets can be checked while waiting for programs to begin.

Weekly Maintenance

Along with the above daily maintenance, certain maintenance is done on a weekly basis. This includes:

1. Video. The camera CRO monitors, and the master CRO of each studio are calibrated to the station's 1.5-volt standard. One camera is swept with a sweep generator and correctly aligned. This is done on a rotating basis so each camera is checked about once every eight weeks. At the same time, that camera channel is also swept through to the telephone equipment for a bandwidth check on the remainder of the video system.
2. Standby Rotation. The spare pulse generator is checked for pulse widths, counts, and timing, and then put into service (Fig. 2). Likewise the spare AGC amplifier is balanced, set up, and put into service. The pulse generator and AGC taken out of service are checked and terminated. Resolution of standby cameras is checked and they are rotated into service.
3. Audio. In the audio system, a frequency response is run on the main mike channels with the checkpoints of 100, 1,000 and 10,000 cycles being recorded. Hum and noise levels of the microphones are checked by hanging them in a quiet studio with all studio lights on. The noise level is recorded with the gain set at predetermined levels; this most nearly simulates actual operating conditions. Following this, noise, other than microphone type, is checked by dummy loading each mike channel with a resistor equal to its characteristic impedance, and recording hum and noise levels at maximum volume level. This rather unusual check was developed to indicate the extent of electronic noise with relation to actual live microphone noise pickup. The hum and noise levels of the turntables and tape recorders are checked in a

Fig. 3. Field strength meter used to check signal received at schools in the system.



EMCEE TRANSLATORS BRING KLAS-TV TO 7,000 MORE VIEWERS

Says Bob McKenzie, Chief Engineer, KLAS-TV, Las Vegas, Nevada.

In Las Vegas and throughout the U.S., more and more knowledgeable people are turning to EMCEE Translators as the logical means of extending TV coverage . . . efficiently and economically. These unattended, rebroadcast transmitters reach more people at lower installation cost and maintenance than any other system. Community service organizations seeking to improve TV or bring TV to their area and broadcasters wanting to fill in shadow areas . . . all should investigate the EMCEE Translator System. These systems are available for VHF or UHF . . . from 1 watt to 100 watts . . . from individual area service to multi-hop regional systems . . . as an equipment package or installed by one of EMCEE's many franchised dealers. Whatever is needed, the logical choice is EMCEE . . . the world's largest manufacturer of VHF and UHF translators and accessories.

Write for information on . . .

- UHF Translators—20W & 100W
- VHF Translators—1 Watt & up

Accessories

Multiple Output Amplifiers • Low Noise Pre-Amplifiers • Filters • Power Splitters • Transmitting Antennas • Also Low Power UHF Transmitter.

ELECTRONICS, MISSILES AND COMMUNICATIONS, INC.

262 East Third Street • Mount Vernon, New York • 914 MO 8-3012

Electronics, Missiles & Communications, Inc.
262 East Third Street • Mount Vernon, New York • B-7

Gentlemen: Please rush

- ☐ Free planning package including data sheet, complete installation check list, coverage calculation form.
- ☐ Detailed Specifications of UHF Translators.
- ☐ Detailed Specifications of VHF Translators.

NAME_____

ADDRESS_____

CITY_____ STATE_____

Circle Item 11 on Tech Data Card

similar manner. They are connected to their respective inputs and noise levels are noted.

4. Power. The DC voltages and currents from the various power supplies are checked and recorded. The incoming AC line voltage is checked before and after the voltage stabilizer output current is checked. These readings are compared to the stablizer ratings to insure operation within the tolerance.
5. Mechanical. Camera controls and rack units are vacuum cleaned and dusted, and at the same time are examined for damaged components. This is one of the most valuable practices, since many times leaking capacitors or chokes, or burned resistors are noted and changed before they can change value enough to impair the unit's service. The setting of each control is checked in this process of cleaning, and any controls set at their extremes are noted, since this generally indicates a component failure or misadjustment elsewhere. Camera pan heads are leveled, and the picture is checked for level on a test pattern with any corrections being made by turning the vidicon yoke. Pan and tilt mechanisms, along with dolly wheel bearings, are oiled as needed. The turntable needles are examined for wear and breaks, and are properly aligned in their head pole piece. Since a variable speed turntable is used for music programs, the speed checkpoints of 33⅓, 45, and 78 RPM are checked with a strobe disk and marked on its speed control. The turntable idler wheels are cleaned, and the turntable rims are cleaned with carbon tetrachloride to remove any collected dust or oil. The tape recorder heads are cleaned, demagnetized, and checked for wear, the capstan and idler wheels are cleaned, and tape take-up tension is checked.
6. Optical. Although it is sometimes necessary more often, at least once a week all camera and projector lenses are cleaned. At the same time the glass in the optical multiplexer and the face glasses on each vidicon tube are also cleaned. This is done with lens tissue and a standard antistatic lens brush.
7. Signal Strength. In order to insure the delivery of the RF signal to the various schools involved, one school each week is checked for signal strength delivered to the classroom (Fig. 3). Also a monthly check is made on the input signal to each school's distribution amplifier. Since this same technical staff is responsible for receiver maintenance, the in-classroom inspection allows them to check the alignment of the classroom receivers.
8. Maintenance. In order to further speed repairs, when a piece of equipment is operating incorrectly, all tubes in the section in doubt may be be replaced. These tubes are then put aside to be checked later. Therefore, part of the weekly schedule is to check these tubes, to file the good ones, and to discard the poor ones. The entire maintenance system is written on mimeographed work sheets which only require filling in blanks, or initialing by the technicians. When a trouble is noted it is checked in a "trouble" column of the maintenance worksheet. If the trouble is serious it may be corrected immediately. If not, it is worked on later in the day. This allows the student technicians an opportunity to do a majority of the maintenance themselves with a minimum of supervision, and at the same time insures the chief technician that the work is being done.

Although the plan is still being changed occasionally, results thus far have shown equipment realiability to be improved, and off the air time reduced. In addition, the technicians have acquired skill in maintaining the equipment, and the technical costs have been kept at a minimum. ▲

KEEP STATION PERFORMANCE UP...MAINTENANCE COSTS DOWN

with Telechrome† Transistorized Video Broadcast and Test Equipment

Model 3508A1 Video Transmission Test Set now with 1/2 T pulse*

†Brand name

FEATURES:

- Rack mount or portable.
- Carrying case contains 1¾" utility drawer which can be removed for installation of an EIA Sync Generator (Model 3507A1), is pre-wired for sync generator.
- All controls conveniently located on front panel.
- Operates from self contained non-interlaced sync, plug-in EIA Sync Generator, or external EIA Sync and Blanking.
- VIT Operation—when used with external VIT Keyer, provides vertical interval test signals through a high impedance (line bridging) output.
- Low distortion multiburst—plug-in oscillators permit optional selection of frequencies to 12 MC.
- Preset 3, 5 and 10-step stairsteps with variable APL and 3.58 MC sub-carrier on all modes.
- * 2T, T and 1/2T(.250,.125 and.062 μsec) Sine squared pulses. Window signal also sine-square filtered.

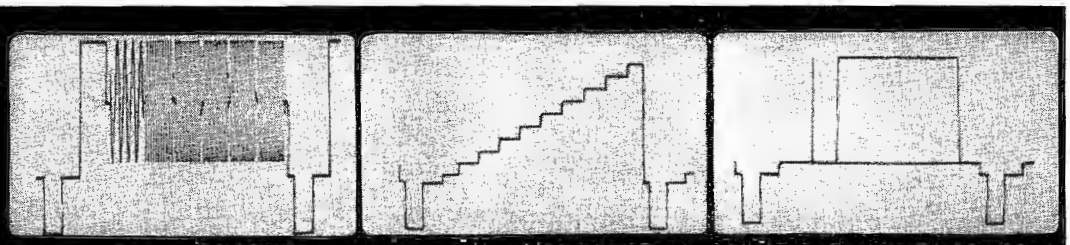
TELEMET COMPANY

A Giannini Scientific Co.

AMITYVILLE, NEW YORK: 185 DIXON AVENUE, (516) 541-3600
SANTA ANA, CALIF: 2509 SOUTH BROADWAY, (714) 546-2881

NOW — condensed into one small lightweight portable unit — fully transistorized.

- **Multiburst**
- **Stairstep**
- **Sine Squared Pulse & Window**
- **Optional EIA Sync Generator**



Multiburst Signal-Line Rate-Internal Sync | 10-Step Signal-Line Rate-Internal Sync | Sin² & Window Signal-Line Rate-Internal Sync

Circle Item 14 on Tech Data Card

ENGINEERS' EXCHANGE

Modulation Peaks

by D. K. Haahr, Product Quality Engineer, Collins Radio Co., Cedar Rapids, Iowa.

An equipment evaluation program at radio station KWLC and KDEC re-emphasized the importance of an accurate indication of positive and negative modulation peaks. Equipment tests seldom require more than 100% modulation and use an oscillator or music as program source; the difference between positive and negative peaks is normally not noticeable.

Voice modulation does have a pronounced difference in peaks; therefore, mikes should be polarized for greatest modulation on positive peaks. The present trend of high-average - modulation programming makes it desirable to understand, and have a simple method of checking, modulation peak polarity.

The following standard devices are used to make the test:

1. An RF source capable of more than 100% AM modulation (transmitter).
2. A method of measuring positive and negative AM peaks.
3. A tone modulating source.
4. A display of the modulated RF envelope (scope) is desirable.

An unmodulated RF envelope is as shown in Fig. 1. In Fig. 2, one cycle modulates the RF envelope 100%, showing positive peak (A) and negative peak (B) of equal amplitude. Further increase in modulation in Fig. 3, results in no positive peak distortion, and overmodulation on the negative peak. The distortion caused by overmodulation increases the effective carrier level by (C), which is called **positive carrier shift.** Beyond 100% modulation, positive peak (D) is increased with no limiting factor except transmitter capacity; however, negative peak (E) can increase only by the amount of positive carrier shift (C). This is the clue to identifying peak polarity and may be verified by observing the positive and negative indications on the modulation monitor as the modulation is varied.

The **negative carrier shift,** (F), in Fig. 4, with 100% modulation, is a transmitter modulation problem that causes clipping of positive peak (G) and decreases the level.

The overmodulation in Fig. 5 added to the positive peak clipping results in no carrier shift and no indicated difference between positive (H) and negative (I) peaks on the modulation monitor; but it may be detected on a scope.

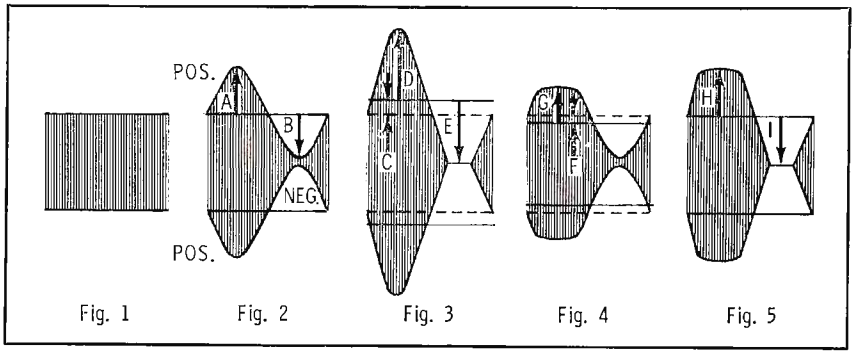


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

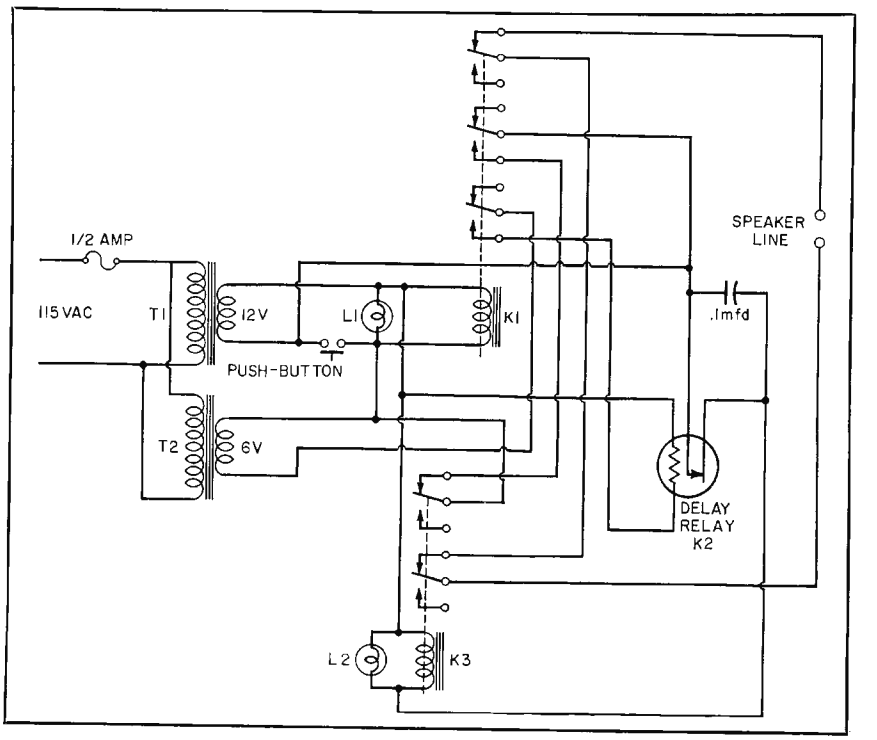
Auto Speaker Muter

by Dave Schmidt, Chief Engineer, KNOW, Austin, Texas.

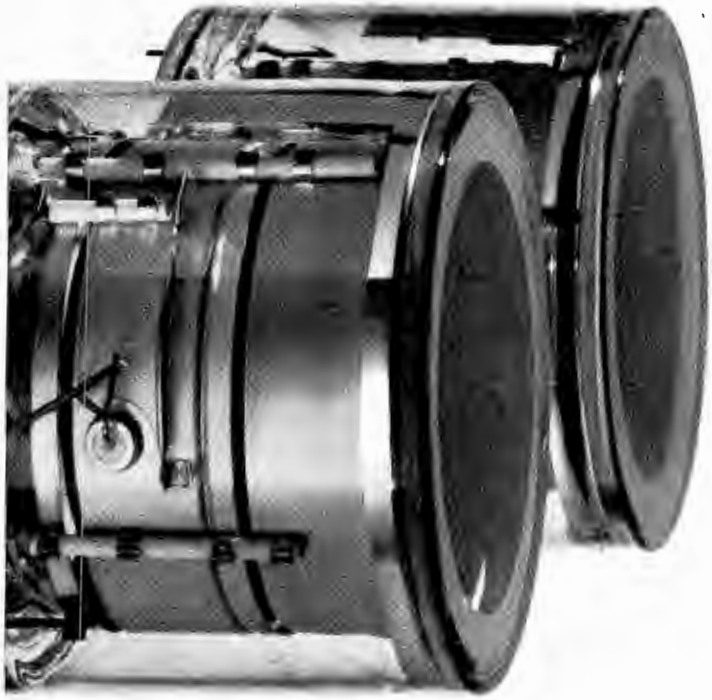
At KNOW, we have always had a problem I'm sure other stations have had. The speaker in the control room bothers the announcer when a newsman calls in a story, rather lengthy at times, with which he is not concerned, or when atmospheric conditions allow other stations to skip in.

The automatic speaker muter is the solution. Now, when the announcer is annoyed with strange sounds from the mobile speaker in the control room, he merely pushes a button and forgets about it. In approximately 4 minutes the speaker comes back on automatically.

Let's look at the circuit. When the pushbutton is pressed, 12 volts AC from T1 is applied to K1, a 12-volt AC 3PDT relay, which holds in after the button is released. At the same time 18 volts AC, the sum of T1 and T2, is applied to the heater of K2, a delay relay (Amperite 26N0120 or equivalent). Also the speaker line is broken. As soon as approximately 4 minutes has elapsed, and the delay relay normally-open contacts close, 12 volts AC is applied to the coil of K3, a 12-volt AC DPDT relay. When K3 closes, K1 is released, the voltage is taken off of the heater of K2, and the speaker line is broken once again. When the delay contacts open, in about 15 seconds, K3 is released, turning the speaker back on. Pilot lights are bridged across the coils of both relays to operate indicator lights—when they are off, the speaker is on.



It's a fact... G. E.'s 7629 and 8092 image orthicons are highly sensitive, long-lived tubes... up to 9000 hours and more...



signal-to-noise ratios, however, were a bit low...

(36:1 and 34:1 average)

Now, in the "A" versions, we've quieted them down...

(to 48:1 and 37:1)

HOW? ... with design improvements utilizing semiconductor target material. G. E.'s new I.O.'s are designated the GL-7629A and GL-8092A ... why don't you try one in your camera? In fact, try the whole line of newly improved G-E image orthicons: G-E Type GL-5820A, S:N—48:1/GL-7293, S:N—45:1/GL-7629A, S:N—48:1/GL-8092A, S:N—37:1/GL-8093, S:N—55:1. **For your free facts folder,** containing data and application notes on the expanding line of G-E image orthicons and vidicons, write to General Electric Company, Room 8005, Owensboro, Kentucky, or call your nearest G-E Industrial Tube Distributor, today!

Progress Is Our Most Important Product

GENERAL ELECTRIC

Circle Item 15 on Tech Data Card

ACOUSTICS IN BROADCASTING

Technical Talks —
Acoustics, an important part of broadcasting and recording, is sometimes neglected; here's a look at problems and solutions.

In today's world of music on tape and record, as used extensively by both AM and FM stations there seems to be, unfortunately, little attention paid to the acoustical value of sound in broadcasting. Even the live element—television—operates in a world of what is essentially "close-up speech" surrounded by flat, hard (or reasonably so) surfaces. In television the last of our really live media, there is very little attention paid to the niceties of quality sound reproduction. Don't take this as a blanket indictment of broadcasting—far from it; but it stems mainly from reflections induced by reference to various texts while preparing this month's discussion of acoustical problems.

The broadcasting world of today rests so strongly on the foundation laid by radio, that it is quite instructive to pause for a moment from our preoccupation with stereo FM and TV, and reflect on the lack of attention paid by many stations today to the problems of audio. It would probably not be unrealistic to say that a good number of AM stations and "hi-fi" FM stations have paid very little attention to this important part of operation. With a diet of discs and tape and an occasional "live" broadcast of news, or some FCC inspired "local live" production (picked up in the station manager's office), the tendency is to let the recording companies become the audio experts.

Although the foregoing may sound like torpedoing our own ships, it is **not** intended to be a "crack" at anyone—or even at our own broadcast industry practices. Today, it is very difficult for the small local station to make any really serious attempts at live music pickup. Even if musicians' fees were not preclusive, the demand is not present among the sponsors, and generally the best that can be done is a live shot from a local dance floor or a high school band "playing" in an untreated auditorium.

As a result of this trend we have a new breed of engineers who have less reason to know much about acoustics and the problems of pickup under various sets of conditions. Too, they have less reason to concern themselves with the design factors in planning a new studio facility because the extent of the live work will be from the announce booth and the remote pickup unit. Yet, for many of these installations the results will be adequate judged on the average transistor, "cigarette pack size" radio, or small table radio.

Why then waste magazine space talking about the days that have passed?

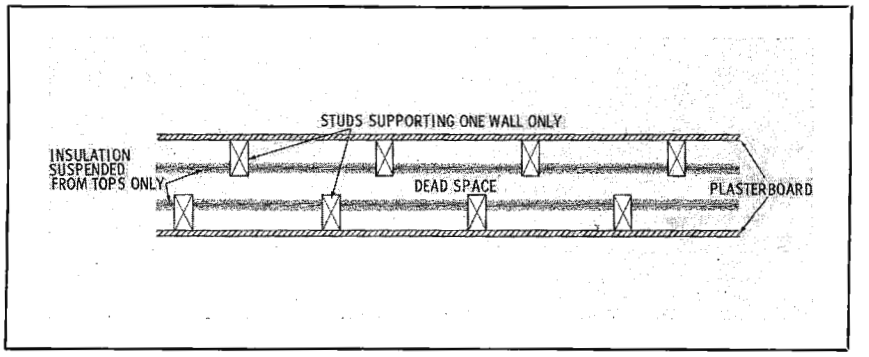
Merely because most of the engineers who have graduated into radio since World War II must have an interest in audio (sic), or they would not have chosen such a raucus way of making a living!

As I said earlier, I was looking at some old reference books, and in one, written by John Mills in 1935, ("A Fugue in Cycles and Bels," D. Van Nostrand Company, Inc., 1935) I came across some interesting material which revived my interest in aural facilities and which I recommend to any readers interested in sound. Copyright laws prevent me from quoting from this book to any extent, but I believe that one piece of information may safely be reprinted without a visit from the local U. S. Marshal. It is something that many of us may have forgotten and concerns the different interpretations put upon the word **harmonic** by engineers and musicians.

To an engineer a harmonic is a term in a series representing N times the fundamental frequency; such as the sixth harmonic being six times the fundamental. Whereas, to a musician a harmonic is a fundamental note, together with all its overtones; thus **his** harmonics are not pure! If a musician speaks of the third term in a series he is re-

In a recent letter, a reader asked for more information on using axial feed lines for shunt-fed towers. This is a broad subject, but a general approach would be to take the feeder coax up the center of the tower, and attach it to a cross member about 0.39 to 0.4 wavelength from the ground. The outer conductor should be grounded to the base of the tower. This system should result in a reductiou in the reactance of around 300 ohms, which generally exists at the input to a slant wire fed antenna. This type of connection produces a more circular antenna pattern, and a more uniform field. The best performance is generally obtained when a lower impedance line works into an antenna of 0.25 wavelength.

J. H. B.



Cross sectional view of a sound insulating wall.

We wouldn't risk our artists to any other tape...why should you?

It's a ticklish business recording the world's greatest artists! You never know which take will capture that one magic performance! RCA Victor engineers must be able to depend on every inch of master recording tape to deliver the absolute ultimate in quality performance. That's why RCA Victor Recording Engineers use Red Seal Magnetic Recording Tape. In fact, Red Seal Tape was specially developed for their use.

In one of the newest, most modern plants in the country, Red Seal Tape is manufactured to the highest quality specifications in the industry — and it's now available for your recording requirements!

Quality control-tested for frequency response, distortion, drop-out noise, print-through, Red Seal Tape is also mechanically tested for coating thickness, anchorage, layer-to-layer adhesion, aging, cupping, slitting tolerances. Every inch has the same magnetic properties, the same recording-bias characteristic, so you can use tapes interchangeably!

Get all the details, fill in the coupon now.

RCA VICTOR

The most trusted name in sound

Magnetic Tape Products Marketing
RCA Victor Record Division
155 East 24th Street
New York 10, N. Y.

Please rush me specifics on RCA Red Seal Magnetic Tape including all essential physical and magnetic characteristics.

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

CITY..... ZONE... STATE.....

Circle Item 32 on Tech Data Card

ferring to the second overtone (or harmonic), but we of the engineering fraternity immediately think of the third harmonic as being three times the fundamental. If you should be able to locate this book anywhere you will find more of such often forgotten, but valuable, information.

Despite the apparent lack of great interest in acoustic matters there are times when it is necessary for a station engineer to accept responsibility for new audio facilities in the station, and these include the building character as well as the electronic facilities. In the halcyon days of radio we built studios suspended within other rooms with complete sound isolation; but today this can seldom be done for reasons of cost, and because there is so little real use for such facilities. Also building methods have changed and it is more usual than not to find dry wall construction in which sheets of plasterboard are fastened to the studs, and a hollow space left between.

If a new building is being planned internal walls made of cinder block will prove quite good as sound insulators. If this type of construction is used it should be faced with one of the many good acoustic tiles available today to provide adequate sound control and echo reduction. Hard surfaced material should not be used, nor should highly reflecting enamels. In one station that I visited I was proudly shown a new studio that had been quite well treated with **Celotex** and then painted with two coats of high gloss enamel! This is one of the easiest ways to defeat the purpose.

Even with the amazingly good insulation obtained with today's dry wall construction there are certain precautions that should be taken if telegraphic transmission is to be avoided. This is actual sound conduction via the beams, joists, and studding of the building frame. Cases are on record in which an obstinate "knock" was traced to an air compressor reaching the microphone via the beams and studs. If dry walls are to be used it is mandatory to double the thickness to at least twice the usual, and instead of using common studs to which are fastened **both** sides of the wall, separate ones should be used secured at the top and bottom. These studs should be the normal "2 by 4" and staggered so that only one side of each stud is supporting a wall as shown in the illustration of a cross-sectional view.

Between the two walls rock wool batting can be hung loosely to provide additional deadening. It is best to suspend this material from the top only so that it can hang free and not be compressed, which reduces its value. In some cases of stubborn noise from a teleprinter perhaps or some similar staccato noise, ceiling insulation between the ceiling plate and the joists can be used.

Irrespective of the degree of sound control used there will probably be times when it is desirable to vary the "liveness" of the room. Now, liveness has no connection with sound insulation, and is a purely local condition under the control of the operator, whereas insulation is a matter of construction. I feel that the best possible job of isolating, insulating, and deadening the room should be done first, and then local control can be introduced to achieve the desired amount of reverberation. One way of doing this is to leave a portion of the wall covered with a hard surface, and

have a curtain that can be pulled over it as required. Also the introduction of the glass in the control room, or other studio, windows will provide a "live" reflecting surface.

In the case of a television studio, good control can be obtained with drapes made of Hessian or sackcloth. When we were building KAVE-TV, which had to be a low cost operation, the studio was constructed of cinder blocks; chicken wire was employed to hold batts of insulation over the upper part of the studio walls and ceiling. This gave excellent basic conditions, and for handling the lower part of the walls we hung long drapes from a height of about 10 feet down to the floor. In front of these drapes was the operating area. Certain shows used painted drops, and these gave an interesting variation to the sound timbre. Construction between the studio and the control room and the rest of the building was standard cinder block.

The major stations in the AM and FM field have beautifully acoustically engineered studios with movable polycylindrical diffusers and reflectors. The CBS Liederkranz Studio in New York is an excellent example of thorough attention to details of movable sound control surfaces.

Most of us are familiar with the phenomenon of excellent singing in the bathroom, but poor reception by the rest of the family when trying it in the living room! Often, the enhanced response in the bathroom is produced by the small room with a resonance in the middle of the average man's register! This can be checked by singing or humming a scale in the room. Generally a tone can be found at which the sound reinforcement caused by the room resonance is very apparent. The same thing happens in studio design where studio reverberation and resonance have to be carefully controlled to prevent unwanted and deleterious effects which will unfavorably alter the characteristics.

It is possible to gauge the effect of size on standing wave resonances by taking into account the distance between the two surfaces. The lowest frequency at which a standing wave can be produced is the frequency whose wavelength is equal to twice the distance between the surfaces. This figure can be found by dividing 1,120 by twice the distance between the reflecting surfaces.

Another kind of resonance is that produced by the individual portions of the studio walls and floors, as well as by the structure itself—to a very limited extent. In some studios and large auditoria which have reputations as beautiful locations for sound, the construction of the forum adds a lot to the effect. Wood panelling can vibrate at certain frequencies, thus adding an extra timbre to the music.

If the three dimensions of a studio are computed in the ratio of the cube root of two, a pleasing distribution of resonances can be obtained. In the case of small rooms a ratio of height to length of about 1:1.4 will give a very acceptable sound. I had thought about discussing large hall reverberations and volume, and absorbing area material including the effect of the 4.6 square feet of absorbing area contributed by each average body in an auditorium. But it seems that there is so little demand these days for such material that I have omitted it. If any readers care to write for more information on that subject I shall be glad to furnish it. ▲

NEWS OF THE INDUSTRY

Electronic Device Speeds Checking of Patterns

An unusual method of checking attenuation patterns has been developed by a Monterey Park, Calif., engineering firm, using an electronic distance-measuring device. The instrument, called a Tellurometer "Micro - Distancer," transmits high-speed impulses from a master unit to a remote, which can be up to 40 miles away, and records the elapsed time in billionths of seconds. These readings are then converted in miles, feet and inches, to a very high degree of accuracy. **Aerial Control Geotronics,** which specializes in unusual distance-measuring assignments, set its master Tellurometer unit atop the television transmission tower for Station KGUD in Santa Barbara. The remote unit operator was carried aloft in a helicopter and kept moving down a radial line until he had reached the 20-mile limits of the station's license. At 500-foot intervals, the strength of the station's signals were determined with an attenuation device and simultaneously a distance measurement made with the Tellurometer instrument for location plotting purposes. Eight radial lines in all were run out from the tower. The crew used a boat to carry several lines across a body of water. The assignment took a fraction of the time ordinarily required for such an operation and at considerable cost saving.

Sale of NonTV Business Planned

TelePrompter Corp. announced today that it plans to sell its electronics manufacturing operations to a private group of investors. Irving B. Kahn, chairman and president, said the plan was unanimously approved at a special meeting of its Board of Directors, subject to approval by the stockholders. "Although the businesses we plan to sell are well on their way to aggregating about $2.5 million worth of sales in 1963, or about 40% of the corporation's anticipated total volume," Mr. Kahn stated, "the current profitability and growth rate of our Community Antenna Television Systems and other closely related businesses, and the tremendous potential of pay television require the undiverted focus of our management. We have finally decided, therefore, to solidify our position in the CATV industry and speed up our entry into the pay television field, to the exclusion of most of our other unrelated current business operations." The businesses to be sold involve the manufacture of the Conley continuous loop magnetic tape cartridges, Weathers high fidelity components, and the basic TelePrompTer branded products which are in wide use in broadcasting, industry, government and education. The new purchasers have not been identified nor the purchase price disclosed.

SMPTE Meeting

Morton H. Read of Bay State Film Productions, Springfield, Mass., has been named program chairman for the 94th Convention of the **Society of Motion Picture and Television Engineers.** The convention will be held Oct. 13-18 at the Somerset Hotel in Boston. Mr. Read is serving under SMPTE's Papers Committee Chairman, **C. Loren Graham** of Eastman Kodak's Color Technology Department, Rochester, N. Y., and the Society's Editorial Vice-President, **Herbert E. Farmer** of the University of Southern California. Associated Program Chairman is **Lowell Wentworth,** also of Bay State Film Productions. **Rodger J. Ross** of Canadian Broadcasting Corp., Toronto, is Associate Chairman for papers from abroad.

Type Approval Granted

McMartin Industries, Inc., Omaha, Neb., has received type approval on its new TBM 3500 FM Modulation Monitor. The unit operates in conjunction with the McMartin TBM 3000 Frequency Monitor to provide a complete basic station monitor as required by the FCC. According to Ray McMartin, president, the combination is the first and only complete basic monitor which has passed FCC testing under modern regulations. The TBM 3500 is accurate within ±½ db, from 50 to 75,000 cps. and therefore is capable of monitoring all modulation, including FM stereo and SCA Multiplex. The peak flasher is extremely fast, responding to pulses with duration as short as 10 milliseconds. Distortion is less than 0.5%.

Andrew Opens Dallas Office

Andrew Corporation, Chicago, Ill., announces the opening of a sales engineering office in Dallas, Texas. The new facility is intended to provide direct engineering and product assistance to the communication industry in southern and southwestern states. Mr. H. L. Woodbury has been appointed district manager of the Dallas district office. His extensive engineering background in antennas and transmission lines will be of interest to system design engineers in the area. Andrew now has district offices in Boston, New York, Washington, D. C., Chicago, Dallas, Los Angeles and Toronto.

CONTRACTS and REPS

CBS Orders Marconi TV Cameras

The largest single order for 4½" image orthicon television cameras ever to be placed in the U. S. has been awarded to **Marconi's Wireless Telegraph Co.** by **Columbia Broadcasting System Television Network.** The contract, for 44 Marconi Mark IV camera channels, with transistorized preamplifiers, was awarded after an extensive series of evaluation tests. Twenty-nine of these, to be delivered between July and November of this year, are for the new CBS Broadcast Center in New York City. Six others are for the CBS News facility in Washington, D. C., while nine, to be delivered in July, will go to equip two studios in the network's Television City in Hollywood, Calif.

CECO Appoints Rep.

CECO, State College, Penn., announces the appointment of **Lorber Instrument Division** as Sales Engineering Representative for Ohio, Michigan and Western Pennsylvania. Lorber Instrument, headed by Mr. Harold Lorber, has offices in Cincinnati, Cleveland, and Detroit. Lorber will handle both the standard and custom amplifiers manufactured by CECO. CECO specializes in low noise wide band amplifiers in the frequency range from a few cycles to over 1,000 mc.

Mexican Net Buys Transmitters

Purchase of three 25-kilowatt television transmitters by **Telesistema Mexicano, S.A.,** Mexican TV network, was announced today by Don Emilo Azcarraga and Romulo O'Farrill, Jr., owners and operators of the network, and Charles R. Denny, Vice President and Managing Director, **RCA International Division.** The new RCA transmitters are expected to be in operation before the end of this year in Mexico City, handling broadcasts on Channels 2, 4, and 5, Mr. Azcarraga said. He noted that a similarly powered transmitter was being installed for Channel 3, atop a 12,000-foot mountain at Guanajuato, some 150 miles north of Mexico City. Mr. Denny said that all of the news transmitters are suitable for color television broadcasts and will operate in accordance with Mexican standards, which are the same as those used in the United States.

Radio Stations Sold

Radio Station **WARN AM & FM,** Fort Pierce, Florida, has been sold by South Jersey Broadcasting Co. to C & P TV, Inc., New York. WARN-AM operates on 1330 kc with 1 kw day and 500 watts night; the FM is on 98.7 mc. **KAVE AM & TV,** Carlsbad, N. M., 1240 kc, 250 watts, has been sold by Voice of the Caverns, Inc., headed by Ed Talbott of KROD-TV, El Paso, Texas. The purchaser is John Deme of Hartford, Connecticut, owner of Radio Station WINF. **KFEQ AM & TV,** St. Joseph, Mo., and **KILK AM,** Jefferson City, Mo., have been sold to Mid-States Broadcasting Corp. of East Lansing, Mich., owners and operators of WSWM-FM, East Lansing, and WQDC-FM, Midland, KFEQ-TV is a CBS affiliate operating on channel 2; KFEQ-AM is a 5-kw full-time on 680 kc; KLIK is a 5-kw daytimer on 950 kc.

PERSONALITIES

The appointment of **Mr. Hank Steenbeke** to the position of assistant product manager, Special Purpose Tubes, was announced by **Mr. John Messerschmitt,** chairman, Management Committee, **Tube Division, Amperex Electronic Corp.**

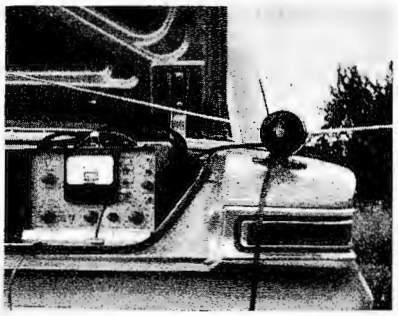
Francis H. Stelter, Jr., has been promoted to manager of Government Communications for **Raytheon Company's** Communications and Data Processing Operation.

Robert J. Weismann, formerly manager of manufacturing for **Ampex Corporation's** video and instrumentation division, has been named manager of engineering for the division succeeding Meyer Liefer, resigned. The announcement was made today by **C. Gus Grant,** vice - president - general manager, video and instrumentation division.

Kenneth B. Boothe has been named manager of sales for **Vitro Electronics,** producers of Nems-Clarke equipment, and will be responsible for all sales activities, including direction of sales representatives throughout the country.

Stanley P. Lapin, director, Industrial Products Division, **Adler Electronics, Inc.,** New Rochelle, N. Y., has been named Electronic Industries Association alternate on the Educational Media Council, EIA Educational Coordinating Committee Chairman **Ben Edelman,** Western Electric Co., has announced.

Election of **Allen S. Austin** as chairman of the board and chief executive officer and of **Harold A. Anderson** as president and general manager of **The Austin Co.,** Cleveland-based international engineering and construction firm, was announced today by the company whose former chairman, **George A. Bryant,** died on April 21, 1963.



NEXT MONTH

Cleaning up the broadcast operation with . . .

TRACING TELEVISION INTERFERENCE

Follow an experienced broadcast engineer as he tracks down troublesome interference sources.

FM STEREO PROOF MEASUREMENTS

Here's how to make the measurements on xmtr and generating equipment to meet the FCC specs.

AM-FM NETWORKING TECHNIQUES

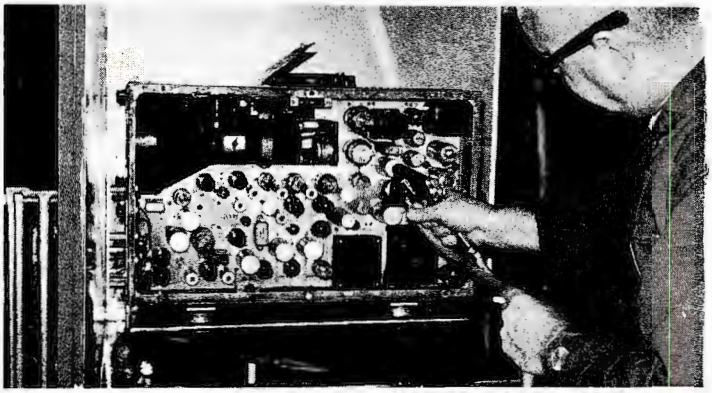
Discussion of local AM and FM networks, and equipment for relay and remote pickup.

TELEVISION OFF/AIR PICKUPS

One station's solution to the problems of picking up and re-broadcasting TV signals.

PLUS: Many other features, items, and departments of current interest, including the ever popular Engineers' Exchange.

Reserve your issues now, and receive the Broadcast Engineers' Maintenance Guide free of charge, by filling out and sending in the convenient subscription card.



About the Cover

This month's cover shows the pioneer electronic broadcast equipment laundry at NBC's center of New York field operations in Long Island City. Now, Monday is washday at NBC, though you'd be likely to find cameras and other apparatus being washed and dried there almost any day. It all started when William Trevarthen, vice president, operations and engineering, visited the Tektronix Corp., where he saw maintenance men washing their scopes with a solution of water and detergent. Bill shuddered at this violation of ancient dogma, but observed no sparks or explosions—the process seemed to work. What, then, were the possibilities of adapting this principle to NBC's operations? Why not build a laundry for cameras, control units, and the vast assortment of other devices housed at the center? To satisfy the rigorous demands of one assignment after another, Courtney Snell, chief of remote operations, and his staff can't afford breakdowns and failures. Up to this point, Frank Bierling, the maintenance supervisor, and his mates had solved every problem, except one—dirt and grime, gathered along the roads traveled by the mobile units, continued to cause trouble. It was decided to build a metal crib equipped with a steel turntable, and an ordinary spraying compressor capable of 30 pounds pressure for the washing. After conducting tests, it was found that any low-sudsing cleaner would deliver satisfactory results. Next, Bierling, aided by studio engineer William Klages, designed and built a drying cabinet big enough to hold several pieces of equipment. It is lined with sheet aluminum and has double doors in front. Two exhaust fans were mounted on top to draw out the moisture laden air, and twelve one-inch apertures were drilled in the base to permit air circulation.

The heat requirements necessitated considerable study and experimentation, since wet parts result in shorts, and drying too fast at too high a temperature may cause breakdown of capacitors and damage to insulation. A temperature of 140° was found just about right; at this heat, equipment will dry thoroughly in 24 hours. Two thermostats were installed; one to control the temperature at 140°, and a protective relay to cut off the heat at 160°. Now that the NBC electronic equipment laundry is working perfectly, field manager Snell is confident that his new process is a most important advance in preventive maintenance. By keeping equipment bright and sparkling, many breakdowns due to accumulations of dirt can be avoided, and short circuits are less likely to occur. Asked to estimate the cost of his new TV laundry, Snell put the figure at something under $300. The priceless, intangible factors he didn't mention are the inventiveness and skills of the men who designed the system and put it into successful operation.

Checklist

(Continued from page 11)

widely separated, the operation and maintenance must be highly organized and standardized. Also, due to the number of stations operated, the Corporation has been forced to determine and analyze just what the basic needs are for test instruments in radio and television stations.

Television in Canada has expanded rapidly in the past several years; their broadcast engineers and manufacturers have contributed significantly to the development and analysis of equipment and standards, particularly through the IRE and SMPTE. They analyze very closely each major test equipment item and each testing technique before its use is adopted. For example, CBC has considered very closely the merits of the sine-squared test signal for the analysis of video circuit response. This is a test signal that has been known to most U.S. telecasters for 10 years or more but which has not been widely used. In Canada, the sine-squared signal, and other vertical interval and multi-frequency burst signals are transmitted regularly. They originate in Toronto TV Master Control and are available in CBC stations in Montreal, Halifax, Winnipeg, and Calgary.

Select with Care

A final comment with regard to this checklist. Like most similar lists, it should be considered mainly as a guide. The chief of a planned radio-TV setup, unless fully experienced with test equipment, would be wise to visit several other stations before purchasing any test equipment. Discuss the matter of required test equipment and ask for suggestions. Talk with the manufacturers of broadcast equipment, with your consulting engineer, and anyone else that might be helpful. To have accurate and reliable test equipment is essential in broadcasting, but good equipment is expensive. It would not be difficult to waste several thousand dollars of your stations money by purchasing items that might never be used due to duplication, or because they are too elaborate for your needs, or because they do not meet the requirement. ▲

Audio Level Devices

(Continued from page 13)

Another attractive job for the compressor is shown in Fig. 4B, in series with a permanent, unattended remote line, and preferably **at** the remote location. The wide variations in level at the scene will be converted into a more easily-managed signal before being put on the TelCo line.

The **ducker,** or **automatic fader,** is a favorite at stations with semi-automated operation. The turntable or tape output is mixed with the announce mike preamp output, setting the announce mike gain from 10 to 15 db higher than the turntable; this combined signal is then fed to the compressor. (This can be done at the console.) When it's desired to announce over music, the announcer simply opens his mike—the compressor will pull down the combined signal, the music being 10 or 15 db below voice.

Some stations use a mixerless studio operation for announcers, wherein it's only necessary to start and stop turntables and tape machines and open the mike switch. All gain-riding is done by the averaging device, and the motor-start switches trigger relays which open and close the signal channels from the turntables. As illustrated in Fig. 4C, no console is actually needed, since the preamp outputs can be tied together by fixed pads and the common leg fed to the compressor. For a simple setup involving only two turntables (or an automatic disc player) and one or two cartridge machines, such an arrangement simplifies controls for nontechnical announcers. Some stations even go so far as to dub all music on tape; then three cartridge machines and a mike are all the announcer needs to operate.

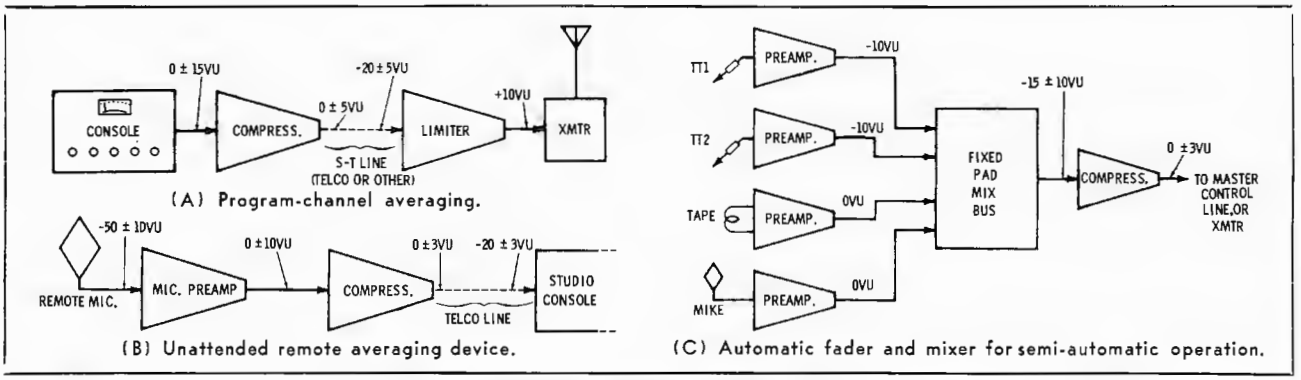


Fig. 4. Compressor application block diagrams.

mobile remote broadcasts and fixed station use in areas of high background noise has been announced by **Shure Brothers, Inc.,** Evanston, Ill. Called the 488 Sono-Bar, the device provides highly intelligible speech communication while cancelling out unwanted noise. Ideal for use in airplanes, helicopters, and mobile units, the microphone employs the controlled reluctance cartridge, and a rubber lip guard mounted on the perforated grill to ensure proper user placement. The unit is available in four versions—high Z, low Z, transistorized for replacement of carbon units, and FAA Certified for aircraft applications. All models are lightweight and equipped with coiled cords and push-to-talk switches. They are priced $57.50, $57.50, $62.50, $72.50, respectively.

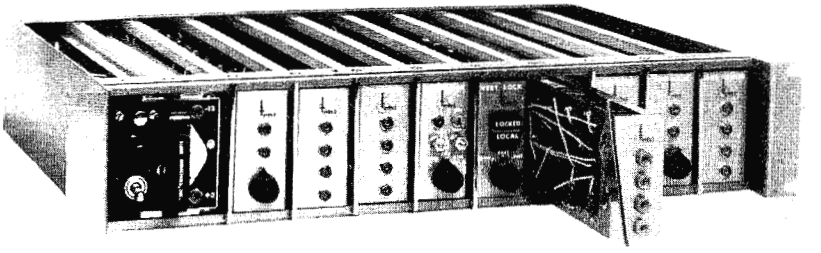
Circle Item 36 on Tech Data Card

tion, from 1,000 to 5 megohm, with tolerances down to ±5%. For special applications, the unit is also available as a constant impedance bridged "T" configuration. Prices range from $2.08 to $6.45, depending on quantity and configuration.

Circle Item 37 on Tech Data Card

Photographic Lighting System

A compact, lightweight, professional photographic lighting system that provides control of light output and color temperature was introduced recently by **Sylvania Electric Products, Inc.** The system (model SG-63) consists of a newly designed Sun Gun® Photo Light and a solid-stage electronic control for light output and color temperature. The light (model SG-63A) is equipped with a powerful 1000-watt, high-silicon halogen



Special Effects Generator

Designed for television studio control rooms, a new unit from **Riker Industries, Inc.,** Huntington Station, N. Y., electronically produces unlimited numbers of visual effects instantaneously which were once possible only by costly film processing sometimes requiring days or weeks to produce. Changing from one video scene to the next may be accomplished in patterns such as circles, squares, diamonds, diagonals, and in fact almost unlimited other shapes. Other "effects" such as "fading" from scene to scene and inserting a picture within another (montage) are also possible with the equipment. These inserts include such effects as a tiny girl dancing in the palm of a hand, cars driving in the air, etc. Simultaneous "wipes and inserts" are also possible. Included in the system is the ability to move or position these effects anywhere on the TV screen by a control called a "joy stick." All functions are packaged in modules which may be plugged in as required; the system is expandable so that each user may acquire only those facilities which are desired. The all-transistor system mounts in a standard equipment rack and is only 3½ inches high requiring 20 watts of power. Prices range from $1,610 to $4,660, depending on the modules.

Circle Item 38 on Tech Data Card

to changing equipment needs. Our basic number of stock tubes is also adjusted up or down as our original guess usually proved wrong.

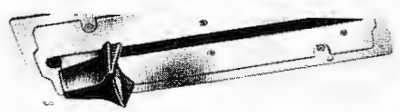
At first, we tried to have a separate list which showed the tubes used during the month. This system failed, because often, under stress of getting the program back on the air, the tubes used did not get noted on the list. The principle was good, because one would only have to use this list to keep the stock up to normal.

We now use the monthly inventory method; it takes more time but is more effective. Our man simply checks the number of tubes on the shelf against his chart and notes how many are short. He also does this for the lamps, fuses, etc. A list is then made of what tubes and parts are needed to bring the spares stock up to normal.

Our workshop has many shelves, cabinets, and containers for tubes and parts. Labeling and grouping is important for quick location. Even though one can't label each compartment for every item in it, a general label, such as "cavity parts," will suffice.

In any good inventory system appropriate records must be kept, the parts must be stored where they can be located easily, and the old stock used up first.

It is important that only one man be assigned this duty, so that better control can be achieved. He is allowed some judgment in making a determination of which types are moving and make the appropriate adjustments. ▲



grees Kelvin at 120 volts. The halogen lamp has exceptionally high light output for its tiny size and maintains its light and color temperature throughout its entire life. The photo light, weighing only 3½ pounds, can be held in the hand, and it is equipped with a universal post clamp with a maximum opening of 1½ inches for easy mounting on a light stand or pole. The head is fully adjustable through a 90 degree range. The electronic control for light output and color temperature, designated the Sylvac Control (model SV-9) plugs into a standard 120-volt AC outlet and the photo light plugs directly into the control.

Circle Item 39 on Tech Data Card

High-Power Cable

Andrew Corp., Chicago, Ill., has designed and produced the largest flexible, air dielectric cable available for high-power communications systems. Type H9-50 ohm features inherent flexibility of Heliax construction with its new large size and power handling capacity of 826 kw peak. The convoluted inner and outer conductors made of high conductivity copper permit bending around obstructions, simplifying installation and eliminating electrical discontinuities found in broken length installations. Produced in continuous lengths, type H9 is available in 1,000 foot reels. Splice

free construction provides low VSWR up through 950 mc. Flanged end fittings made for the cable mate with 6⅛ inch EIA standard flanges and inner connectors.

Circle Item 40 on Tech Data Card

ENGINEERS' TECH DATA SECTION

AUDIO & RECORDING EQUIPMENT

60. BAUER ELECTRONICS CORP. — Bulletin describes Peak Master limiting amplifier.
61. BROADCAST ELECTRONICS — Data sheets present full line of cartridge tape equipment, programmers, phase monitor, and automatic sequencing equipment.
62. CBS LABORATORIES — Illustrated technical bulletin describes Audimax II RZ, automatic level control for broadcasting and recording.
63. EMPIRE—Brochure shows Troubador turntable and equipment, and 880 cartridge.
64. FAIRCHILD RECORDING EQUIPMENT CORP. — Technical bulletin details slide-type attenuator which boasts low noise and constant impedance characteristics; price list covers professional audio equipment.
65. GOTHAM AUDIO CORP.—Brochures, catalogs, and other pieces cover reverberation units, turntables, tape machines, audio cables, and other audio products including linear motion deposited carbon pots, microphone, and disc recording equipment.
66. INTERNATIONAL RADIO & ELECTRONICS CORP.—Full information is available on Crown BX800 tape recorder.
67. MICHIGAN MAGNETICS, INC.—Catalog sheet provides specifications for "B" line of record/playback heads for use in two track stereo systems.
68. MIDWESTERN INSTRUMENTS — Latest Magnecord catalog presenting a full line of audio tape instruments for recording sound professionally.
69. REEVES SOUNDCRAFT — Guide lists line of recording tape and gives specifications for each type of material used.
70. SHURE BROTHERS—Complete illustrated catalog presents line of professional microphones, phono cartridges, and equipment.
71. SOUND CORP. OF AMERICA—Data sheets present tape cartridges, automatic playback units, and complete background music system.
72. SPARTA ELECTRONIC CORP.—Bulletin covers 24-hour service and prices for all lengths of Fidelipac tape cartridges; cartridge and studio equipment is also included.
73. SUPERSCOPE, INC. — Complete 16-page catalog lists features and specifications of the Sony tape recorder line and includes data on condenser microphones.

COMPONENTS & MATERIALS

74. AMPHENOL - BORG ELECTRONICS CORP.—16-page application manual contains construction information, assembly procedures, mating of connectors, and contact removal.
75. ARNOLD MAGNETICS — Technical data sheet illustrates and discusses line of modules, including decade transformers, resistors, capacitors, and inductors.
76. BELDEN MANUFACTURING CO. — 1963 wire and cable catalog covers complete line of wires and cable for electronics, and includes wide variety of types for broadcasting, audio, and recording applications.
77. BERGER ELECTRONICS CORP.—Literature covers line of wire and cable ties and straps.
78. THE BRISTOL CO.—Folder explains applications of socket screws.
79. CENTRALAB — Brochure covers line of packaged electronic circuits and describes the manufacturing process used in their fabrication.
80. DRAKE—Folder provides information on Bi-Pin cartridge lamps for control units and other instrument applications.
81. DuPONT—20-page illustrated bulletin covers the story of Teflon and its applications.
82. ELECTRO SWITCH CORP. — Ready-to-install rotary switches for a wide variety of applications are described in an 8-page catalog.
83. FOURJAY INDUSTRIES — Spec sheet describes new Sheerline wall enclosures designed for indoor or outdoor use.
84. KURMAN INSTRUMENTS CORP. — Catalog 63-3 lists stock relays for immediate delivery.
85. MILO ELECTRONICS CORP. — Catalogs on RCA industrial tubes, power tubes, and receiving tubes, and G.E. image orthicons.
86. SANGAMO ELECTRIC CO.—Catalog describes extensive line of fixed capacitors, including ordering information, as well as data on pricing.
87. SYLVANIA—Data sheet summarizes company's capabilities in flange-mounted mica and solderable kovar glass waveguide windows.
88. TUNG-SOL—Product bulletin presents data on subminiature lamps for instrument and indicator applications.

RADIO & CONTROL ROOM EQUIPMENT

89. WALLACH & ASSOCIATES, INC.—Bulletin shows cabinets for LP and tape storage; also covered are film strip cabinets, and combination units.

STUDIO & CAMERA EQUIPMENT

90. BOSTON INSULATED WIRE CO.—Brochures cover 33-conductor camera cables and connectors for various foreign and domestic cameras, as well as teflon insulated coaxial cables.
91. GENERAL ELECTRIC—Characteristics and operating data for five types of television broadcast image orthicons are given in brochure.
92. TELEVISION ZOOMAR CO. — Bulletins cover image orthicon lenses and lenses for vidicon cameras.

TELEVISION EQUIPMENT

93. KLIEGL BROS. — Catalogs describe lines of television lighting equipment and control systems.
94. SARKES TARZIAN — Catalog lists solid-state television equipment, including cameras, switchers, and other devices.

TEST EQUIPMENT & INSTRUMENTS

95. EICO ELECTRONIC INSTRUMENT CO., INC.—Catalog sheet details im/harmonic distortion meter and AC vtvm, giving specs and availability information.
96. HICKOK ELECTRICAL INSTRUMENTS CO.—Bulletins describe FM stereo generator, tube testers, electronic volt-ohmmeter, and true vtvm vom & capacitance meter.
97. SECO—Data sheet gives specs and data on transistor/tunnel-diode analyzer and SCR tester.
98. TEKTRONIX, INC. — 1963 abridged catalog covers scopes and other instruments used in broadcasting and electronics.
99. WESTINGHOUSE — Bulletin describes portable wattmeters designed for general laboratory and field testing of panel board instruments.
100. WESTON INSTRUMENTS & ELECTRONICS DIV., DAYSTROM, INC.—Twelve-page illustrated brochure describes line of light-beam portable wattmeters, and ammeter and voltmeter standards.

TRANSMITTER & ANTENNA DEVICES

101. CO.EL. — Catalogs describe broadband dipole antennas, FM antennas, UHF slot antennas, filters, and diplexers.
102. GENERAL ELECTRONICS LABS, INC. — Informative catalog sheet covers Autolog transmitter logging system, and discusses improvements added thereto as a result of a year's field operation.
103. GENERAL MICROWAVE CORP. — Data bulletins review microwave devices including power meter adapters, thermistor mounts, frequency meters, noise generator, universal power leveler.
104. HUGHEY & PHILLIPS — Bulletin describes complete new line of tubeless, compensated, photo-electric control units for tower lighting, which meet FCC-FAA requirements.
105. ITA ELECTRONICS — AM, FM, and TV transmitters; audio consoles, monitors, and logging equipment are covered in bulletins.
106. JAMPRO ANTENNA CO.—Two catalogs cover VHF TV antennas and high gain broadband FM antennas giving full technical information.
107. JERROLD ELECTRONICS CORP. — Data sheet presents information on new transistorized single-channel preamp for 12-channel CATV systems.
108. MICRO-LINK CORP. Brochures cover 10.5 to 10.7 kmc and 12.2 to 13.6 kmc fixed microwave equipment; also price list of microwave devices and microwave information reports.
109. MOSELEY ASSOCIATES — Bulletin presents direct FM exciter and ten watt educational transmitter, FCC type accepted, for use with stereo and SCA generators.
110. PENTA LABORATORIES, INC.—Data sheet provides specifications on the type PL-8295A ceramic beam pentode, which can be used to replace the type PL-8295 beam tetrode.
111. RAYTHEON CO.—Spec sheet details KTR-1000K/R 1-watt microwave relay equipment for FM transmission of color TV signals and audio; 15-page illustrated booklet, entitled "Microwave Path Surveys and Site Selection," is also available.

MISCELLANEOUS

112. PIC DESIGN CORP.—Spur gear design slide-chart gives tolerance and performance specs of fine pitch gears and gear tooth data for standard pitches 24 to 200.

Professional Services

VIR N. JAMES
CONSULTING RADIO ENGINEERS
Applications and Field Engineering
232 S. Jasmine
Phone: (Area Code 303) 333-5562
DENVER 22, COLORADO
Member AFCCE

JOHN H. BATTISON & ASSOCIATES
CONSULTING RADIO ENGINEERS
TV-AM-FM & Microwave Applications and Installations
Specializing in all forms of communications engineering.
422 Washington Bldg. Washington 5, D. C.
Phone ST 3-3484
Established 1954

Classified

Advertising rates in the Classified Section are ten cents per word. Minimum charge is $2.00. Blind box number is 50 cents extra. Check or money order must be enclosed with ad.

The classified columns are not open to the advertising of any broadcast equipment or supplies regularly produced by manufacturers unless the equipment is used and no longer owned by the manufacturer. Display advertising must be purchased in such cases.

PERSONNEL

Single man, seeking association radio, recording studio, etc., wherein fine recording, sound, and test equipment will be asset. Ampex, Neumann, Pultec, Fairchild, McIntosh equipment. Hewlett-Packard test instruments. Studied music, acoustics, electronics on university graduate level. Years of practical experience remote, studio, high-quality P.A. Write for details. Prefer Tidewater section of Virginia; family home Mathews County. Self-employed Ohio fifteen years. Want to work WITH, not FOR! Willing to expand facilities if necessary. Box 143, Chagrin Falls, Ohio. 7-63 1t

EQUIPMENT FOR SALE

Commercial Crystals and new or replacement crystals for RCA, Gates, W. E., Bliley and J-K holders; regrinding, repair, etc. BC-604 crystals. Also A. M. monitor service. Nationwide unsolicited testimonials praise our products and fast service. Eidson Electronic Company, Box 96, Temple, Texas. 9-61 tf

USED TV EQUIPMENT FOR SALE—Specialists in RCA Types. Many bargains in stock. TK-30's, TK-11's, Power Supplies, Monitors, etc. Our exclusive refurbishing process Guarantees Satisfaction. Write, Wire or call for prices.
TELEQUIP CORPORATION, 319 East 48th St., New York 17, N. Y., PLaza 2-8885—PLaza 2-9037. 2-63-6t

GOVERNMENT SURPLUS, NEW 10 CM. WEATHER RADAR SYSTEM—Raytheon, 275 KW peak output S band. Rotating yoke P.P.I. Weather Band 4, 20 and 80 mi. range. Price $975 complete. Has picked up clouds at 50 mi. Wt. 488 lbs. Radio Research Inst. Co., 550 5th Ave., New York, New York. 7-63 6t

SLIGHTLY USED MAGNECORD 414 CONTINUOUS TAPE PLAYER . . . complete with amplifier and carrying case; cost when new, $705.00; asking $350.00. Carl LaFleur Co., Food Brokers, 410 Asylum St., Hartford, Conn. 7-63 1t

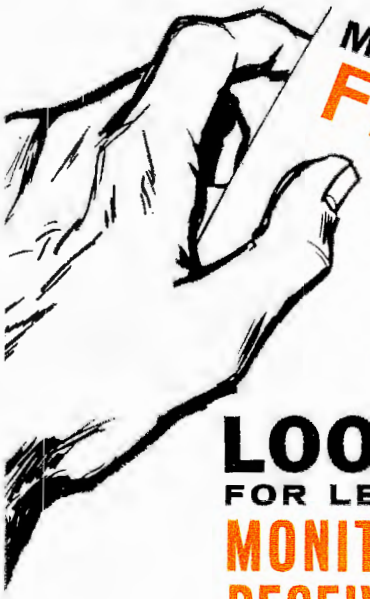
TRANSMITTING TUBES FOR SALE — Immediate Delivery on 6076 Power Tetrodes, at $200 each. 3X2500F3 — $175, 4W20000A — $1815, 450TL — $25, 4-125A — $22.50, 872A — $5.25, 575A — $15.50. Many Others. Brand New. 1,000 hour warranty. Write or call Calvert Electronics, Inc., Dept. BE-7, 220 E. 23rd St., New York 10, N. Y., (212) OR 9-1340. 7-63 3t

TWO ROBINSON PRECISION BELT DRIVE RECORDING LATHES, 16" PLATTEN, THREE SPEEDS, TEN PITCHES. CONDITION, LIKE NEW. $450.00 EACH. SEND FOR PHOTO. ROBINSON RECORDING LABORATORIES, 1015 CHESTNUT ST., PHILADELPHIA &, PENNA. 215-WA-2 1875. 7-63 1t

Transmission line, styroflex, heliax, rigid with hardware and fittings. New at surplus prices. Write for stock list. Sierra Western Electric Cable Co., 1401 Middle Harbor Road, Oakland 20, California. 6-61 tf

WE BUY USED TV AND RADIO EQUIPMENT, LET US KNOW WHAT YOU HAVE TO DISPOSE OF, WRITE
TELEQUIP CORPORATION, 319 East 48th St., New York 17, N. Y. 2-63-6t

Advertisers' Index



Memo To:

FM: *Station Managers*
Station Owners
Chief Engineers

McMartin

LOOK TO
FOR LEADERSHIP IN
MONITORS, MULTIPLEX AND RELAY RECEIVERS AND AUDIO

By outstanding performance, dependability and economy, McMartin built FM multiplex and audio products have earned a reputation for leadership. McMartin experience and engineering are continually at work developing new products and improving present ones to be of greater service to the industry.

TBM-4000 McMartin

FM/SCA MULTIPLEX MONITOR

The most versatile instrument of its kind for monitoring all main channel modulation and SCA Multiplex operating characteristics. The only Monitor which directly reads crosstalk.

McMartin TBM-3000 and TBM-3500

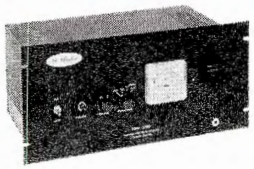
TBM-3000 is a completely self-contained frequency monitor, and the TBM-3500 a self-contained modulation monitor. The 3000 used in conjunction with either the 3500 or 4000 fulfills the FCC requirements for station monitors.

McMartin

MULTIPLEX RECEIVERS

Proven performance and reliability . . .

More than 9,000 in use throughout the world.



McMartin

TBM-1000/2000 FM/SCA Multiplex Re-Broadcast Receivers

Ideal for area network relays . . .defense networks and off-air monitoring.

McMartin

8 & 32 watt
TRANSISTOR AMPLIFIERS
LT 80A & LT 300

McMartin is the world's largest producer of amplifiers for the commercial background music industry.

originality by

McMartin Industries, Inc.
605 North 13th Street Omaha, Nebraska
Code 402 — 342-2753
In Canada Sold By: Canadian Marconi Company, Montreal 16, P. Q.

Circle Item 31 on Tech Data Card

What Station Men are saying about

THE RCA "*TRAVELING WAVE*" ANTENNA

At WMTW-TV, Poland Springs, Me.
Parker Vincent, Chief Engineer, says:

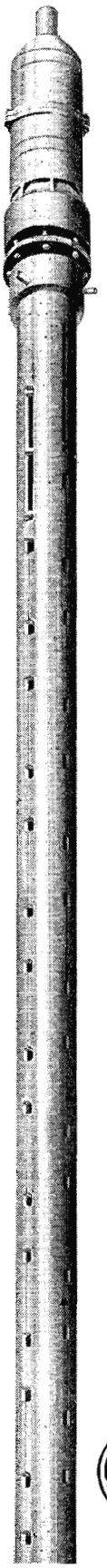
"We decided on our Travelling Wave TV Antenna for the specific purpose of operation under the severe icing conditions we encounter on Mt. Washington (N.H.). We could not operate without it. Aside from the special properties of strength and ability to operate within a radome, the field of the antenna is very uniform."

At KROC-TV, Rochester, Minn.
Robert W. Cross, Chief Engineer, says:

"During installation and erection of our Travelling Wave Antenna, I was most favorably impressed with the mechanical simplicity and ease of assembly. Subsequent electrical check-out of the antenna and its 1300-ft. transmission line proved it to have the lowest VSWR of any system encountered."

At KTSM-TV, El Paso, Texas
Karl O. Wyler, President, says:

"I believe that KTSM-TV was one of the first stations to order the RCA Travelling Wave Antenna. It has been in service on Range Peak since December 1959, and we are completely pleased with its performance. We like it because there is practically no maintenance, no bolts to tighten, and fewer inspections. Overall efficiency is very good."



At WLOS-TV, Asheville, Greenville, Spartansburg
Mitchell Wolfson, President, says:

"WLOS-TV is extremely well satisfied with the Travelling Wave Antenna installation. Physical and electrical advantages met every promise and the increased signal strength throughout the station's 82-county, 6 state area exceeded all expectations."

At KGIN-TV, Grand Island, Nebraska
D. Raymond Taylor, Chief Engineer, says:

"Field strength measurements show that the signal far exceeds the predictions of the FCC 50/50 Field Strength Curve. Reports from viewers on the fringe area substantiate these measurements. The standing wave ratio is very good and no ghosting is present."

At KOAM-TV, Pittsburg, Kansas
Leo S. Stafford, Chief Engineer, says:

"I have viewed KOAM-TV from some 85 miles away and was amazed at the picture quality. The antenna has increased our area coverage by 63 percent, while at the same time it gives us 316 ERP on less transmitter power. This reduces primary power requirements and increases tube life."

Favorite Antenna of High-Band Stations!

CH 7	CH 8	CH 9	CH 10	CH 11	CH 12	CH 13
CJAY	KGHL	KLRN	KROC	CHCH	KCND	CKCO
KCMT	KSWS	KTSM	KXTV	KCBD	KEYC	KMSO
KOAM	WKBT	WAFB	WCBB	KGIN	KFVS	KOVR
WNAC	WMTW	WWTV	WIS	WBAL	KNMT	KSOO
WPBN	WOOD		WLBN	WLWA	KTVH	WGAN
WTRF	WQAD		WPTT		KVAR	WIBW
WXYZ	WXGA				WEAT	WJZ
					WMEB	WLOS
					WPRO	WOKR
						WOOD

If you want more facts about this VHF High-Band Antenna, your RCA Broadcast Representative can help you. Or write RCA Broadcast and Television Equipment, Building 15-5, Camden, New Jersey.

The Most Trusted Name in Television