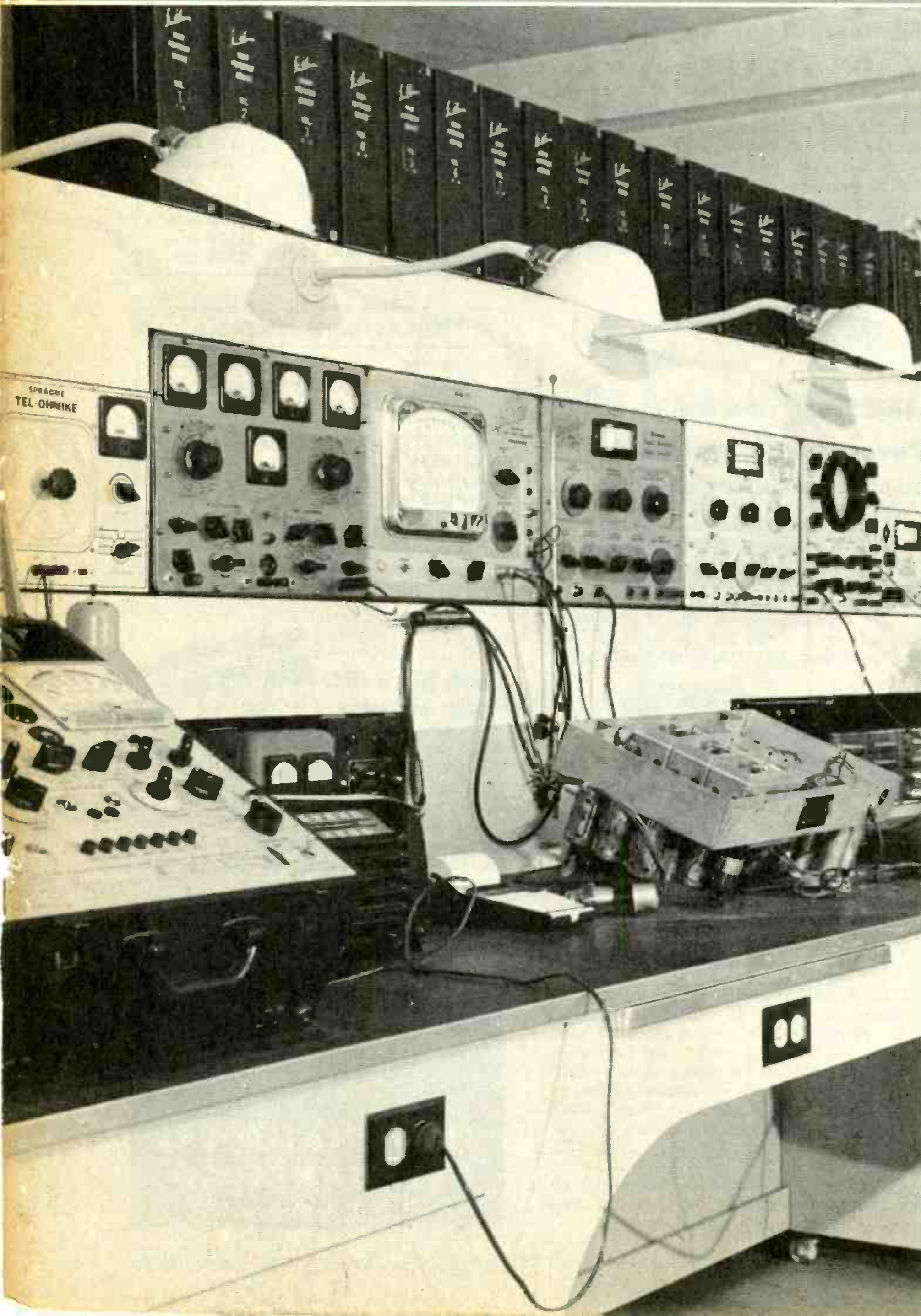
Howard W. Sams

PF PHOTOFACT

INDEX

AND TECHNICAL DIGEST



Jan. • Feb. • 1953
including
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COVERING PHOTOFACT FOLDER SETS 1 THRU 194

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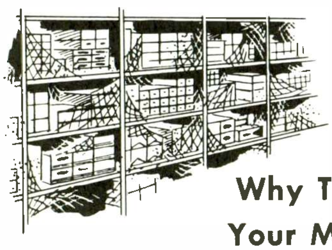
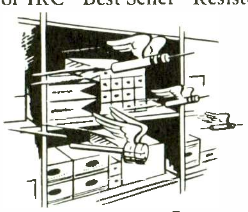
HOW TO PLAN FAST-MOVING INVENTORIES AND REDUCE OBSOLESCENCE WITH IRC "BEST SELLERS"



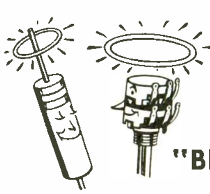
Why Tie-up Your Money in Stagnant Stocks?

Resistors on your shelves won't bring you a cent—until you put them to use. If they're lazy movers they tie-up your money and your shelf space. And if they're shelf-squatters—gathering dust month after month until they become obsolete—they're actually money wasted. Yet a lot of servicemen continue to stock slow-moving parts because they haven't thought about the advantages of IRC "Best Seller" Resistors and Controls.



For Fast Stock Turnover Invest in IRC "BEST SELLERS"

It's just as easy—easier in fact—to stock fast-moving, money-making parts as it is to load up with shelf-squatters. And it's certainly a lot more profitable. All you have to do is tell your Distributor's salesman that you want a realistic, commonsense inventory based on IRC "Best Sellers". He'll know what you mean, because ten-to-one your Distributor's own inventory is based on those very fast-moving parts.

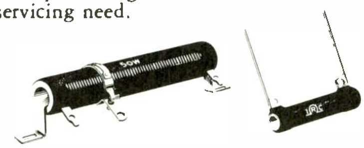


What Do We Mean by "BEST SELLERS"?

"Best Seller" Resistors and Controls are those you use most often in radio and TV servicing. They're the indispensables—the ones you'll want on hand at all times. Of course there are others you'll need on occasion. But the great majority of parts essential in radio and TV divides into relatively few classifications regardless of brands or models of sets. Although IRC makes resistors and controls for *every* replacement need, careful analysis shows the greatest movement among a limited number of types and ranges. These "Best Sellers", listed here, provide a realistic base for establishing your parts inventory.

IRC Advanced BT Filament Type Resistors

In television sets you'll find more IRC Type BT's than any other types or makes of resistors. Fully insulated, they combine extremely low operating temperature and *superior power dissipation*. Not only do they *easily* meet the stiff requirements of television, they also *beat* Army-Navy Specifications in most characteristics. IRC supplies Advanced Type BT Resistors in a complete variety of ranges and sizes to meet every servicing need.



IRC Fixed and Adjustable Power Wire Wound Resistors

These rugged, long-life resistors are specially engineered for dependable heavy-duty performance. Unlike ordinary resistors, IRC PWW's need no derating; they carry full wattage in any range. Special coating gives faster heat dissipation, and special lead-lug arrangement permits easier installation in crowded chassis. IRC Power Wire Wounds are available in a full range of sizes and resistance values and terminal types.

Widest Replacement Coverage with Minimum Control Stocks

Most adaptable of all radio-TV technicians' volume controls, IRC Type Q Controls give you full replacement coverage with only nominal control stocks. IRC's exclusive Knob Master Shaft fits most push-on knobs without alteration except cutting to length. And IRC's Interchangeable Fixed Shaft feature allows fast control conversion to suit almost any radio or TV set. Handy IRC Volume Control Cabinet is the ideal way to buy and stock Q Controls. Cabinet stock of 18 controls handles over 90% of your single carbon control replacements.

Here are Your IRC "BEST SELLER" Resistors and Controls listed in order of popularity

TYPE BT RESISTORS

Type	Value
BTS ½ watt	0.1 meg.
BTS ½ watt	0.47 meg.
BTS ½ watt	22,000 ohms
BTS ½ watt	1.0 meg.
BTS ½ watt	1000 ohms
BTS ½ watt	10,000 ohms
BTS ½ watt	1500 ohms
BTS ½ watt	0.22 meg.
BTS ½ watt	4700 ohms
BTS ½ watt	100 ohms

POWER WIRE WOUND RESISTORS

Type	Value
1¾A 10 watts	10,000 ohms
1¾A 10 watts	5000 ohms
1¾A 10 watts	1000 ohms
1¾A 10 watts	200 ohms
1¾A 10 watts	100 ohms
1¾A 10 watts	75 ohms
1¾A 10 watts	15,000 ohms
1¾A 10 watts	2000 ohms
1¾A 10 watts	1500 ohms
1¾A 10 watts	2500 ohms

REPLACEMENT CONTROLS

Stock No.	Ohms	Taper
Q13-133	0.5 meg.	C
Q13-137	1.0 meg.	C
Q11-133	0.5 meg.	A
Q11-137	1.0 meg.	A
Q13-139	2.0 meg.	C
Q11-123	50 K	A
Q13-137X	1.0 meg.	H
Q11-128	0.1 meg.	A
Q13-139X	2.0 meg.	H
Q13-130	0.25 meg.	C

Cash in on IRC "BEST SELLERS"

Ask your IRC Distributor to set up a sensible inventory for you, based on these fast-moving units. Also, get Catalog Bulletins DC1, DC5 and DC8 on these parts from your IRC Distributor—or send postcard to us for your copies. IRC "Best Sellers" can save you money!

IRC

Wherever the Circuit Says -ww-

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423 N. Broad Street, Philadelphia 8, Pa.

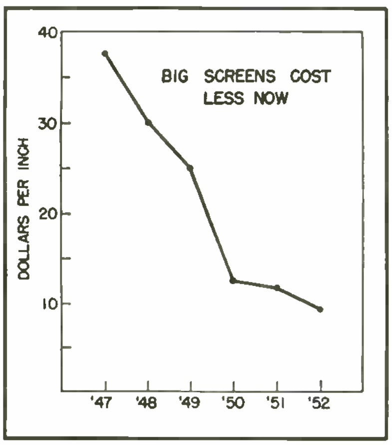
Pick of the Trade

MORE MARKETS—The industry's outlook for new markets in 1953 varies from as few as 25 to a top of 65.

With 18.7 million TV sets now in use, the industry could "get along" without new markets. From 60 to 75 per cent of all sales represent natural replacement of 7, 10, 12, 14 and 16-inch sets traded in for 20-inch and larger screens. There is a market developing for second sets. Owners keep the old smaller set for the bedroom, child's room or recreation room and buy one for the parlor.

★ ★ ★

DESPITE recent TV receiver price increases, due to rising labor and material costs, television's cost today in terms of picture size is lower than ever before. As is shown in the chart, this has been true in every year since 1947. Today the average price per screen inch is less than $10, while in 1947 it was about $40. A 7-inch screen cost $300 then, but today 20 and 21-inch sets are available for $200, giving three times the screen size for 1/3 less cost.



The predominant TV picture for 1953 will probably be the 21-inch size.

★ ★ ★

There are now 95 radio-TV-phonograph manufacturers, the highest number since 1950.

Electronics, December, 1952

★ ★ ★

SERVICE MEN have found that better music is the concern of hundreds of thousands of folks. Shops across the nation have begun to stress audio, and to feature facilities for complete installation and servicing, as well as custom building. Modernization of old amplifiers and allied phono systems has proved to be quite an item, prompting many to specialize in conversions.

Audio has really begun to march on, and with quite a stride.

L. W., in *Service*, November, 1952

★ ★ ★

MORE THAN 75 MILLION RADIO SETS, and 17 million TV sets were made in the five years from 1947 through 1951.

Auto set production rose from 17% of the total radio output in 1947 to 36 percent in 1951.

In 1947 home sets accounted for 70 percent of total production, while in 1951 for only 53 percent.

Console and consolette television production increased from 21 percent of the total in 1947 to 52 percent in 1951, largely at the expense of table model TV receivers.

Industry Statistics, from RTMA Industry Report

ABOUT THE COVER: For complete story about the cover on this issue, see More or Less, Page 126.

PF PHOTOFACT INDEX AND TECHNICAL DIGEST

VOL. 3 • NO. 1 JANUARY-FEBRUARY, 1953

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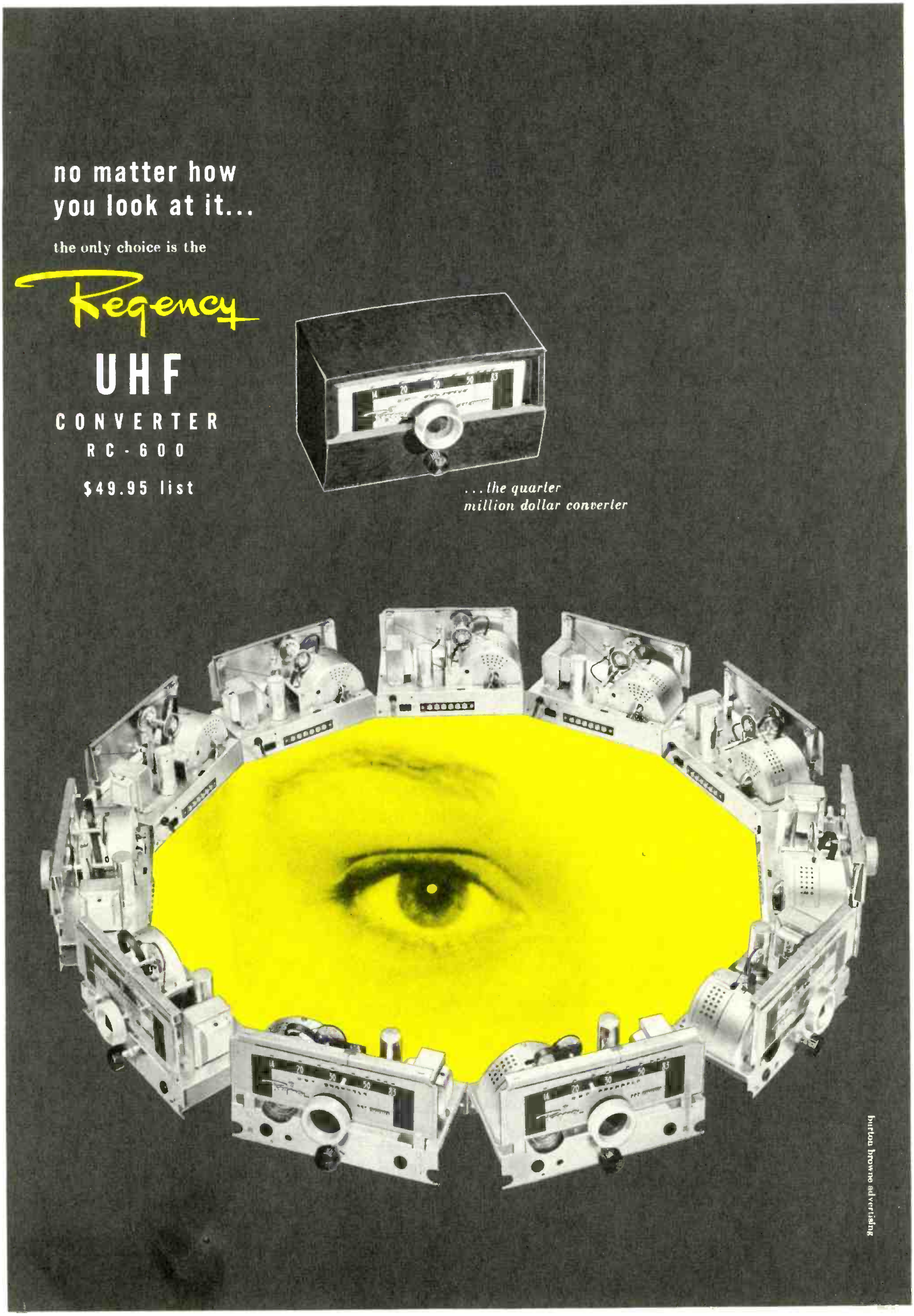
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MILTON S. KIVER
President, Television Communications Institute

Shop Talk

A chart was printed recently in the March, 1952 issue of Sylvania News which shed a good deal of light on certain aspects of UHF operation. This table, reprinted here, gives the transmission line loss in db per 100 feet for today's most commonly used transmission lines. It shows not only what happens to line loss as the frequency is raised, but also how each line is affected by the weather. And it brings forth this very revealing fact: That the 300-ohm flat twin-lead line which is so extensively used for VHF installations would be generally unsuitable for UHF operation should it become wet. At 500 mc, which is only at the doorstep of the UHF-TV band, the attenuation of the line, wet, is 20 db compared to 3.2 db when dry. Can you imagine what would happen to all but very powerful signals when it rained?

In contrast to this, consider the 300-ohm tubular line. (A sample of this is shown in Figure 1.) Its db attenuation at 500 mc, when the weather is wet, rises only to 6.8 db.

The reason for this difference in behavior is explained by the tubular line manufacturer as follows. (See Figure 2.) In the flat twin lead line the field of energy exists, in large measure, outside of the polyethylene ribbon and hence will be affected by dielectric changes such as coating the ribbon with water. Other agents which also have an effect on line attenuation include snow, salt spray, and dirt.

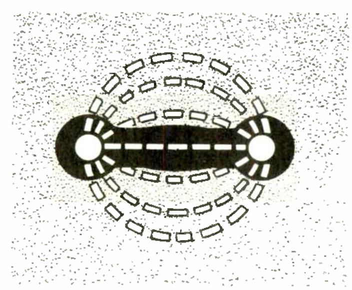
In the tubular twin lead, the polyethylene plastic is shaped so that the field of energy set up between the two conductors is largely confined within the surface of the plastic. This thus prevents changes in atmospheric conditions from affecting the line to the same extent as the flat twin lead.

From the viewpoint of attenuation, the 450-ohm open wire line is tops. Its .78 db at 500 mc and only 1.1 db at 1000 mc is below that of the other lines. Unfortunately, this line is the most difficult one to work with physically and for this reason is not used more widely. Its 450-ohm impedance is somewhat of a hindrance, too, since most antennas and receivers are designed for 300-ohm. However, this is not as serious as you might at first believe. There are practically no television receivers in which the input impedance remains constant at 300 ohms for all channels. The same is true of your so-called 300-ohm twin lead or your 300-ohm antennas. Thus, simply connecting the 450-ohm open line to the receiver directly, will frequently give you as good results as you would obtain by carefully matching the line to an impedance transformer and then making the connection to the receiver.

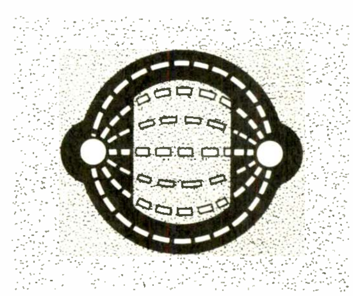
A 375-ohm open-wire line was announced just as this article was being published and from the characteristic data made available by the manufacturer (The Gonset Company),

Figure 1. Amphenol Tubular 300-Ohm Line. (Courtesy American Phenolic Corporation.)

most of the service man's objections to the 450-ohm line appear to be overcome. For one thing, the 375-ohm value is close enough to 300 to permit direct connection without concern over mismatch. Also, the closer spacing of the two lines (1/2 inch) should permit easier handling. Attenuation at 500 mc is 1.9 db (dry) and 3.1 db wet. At 1000 mc, the dry attenuation rises to approximately 3.0 db.



FLAT TWIN LEAD



TUBULAR TWIN LEAD

Figure 2. Illustrating the Reason Why Flat Twin Lead Possesses a Greater Attenuation When Wet Than Tubular Twin Lead.

TABLE 1

Transmission Line Loss - - - DB Loss Per 100 Feet

TYPE	100 MC Wet	100 MC Dry	500 MC Wet	500 MC Dry	1000 MC Wet	1000 MC Dry
450 ohm open wire*	...	0.35	...	.78	...	1.1
300 ohm tubular	2.5	1.1	6.8	3.0	10.0	4.6
300 ohm flat	7.3	1.2	20.0	3.2	30.0	5.0
RF-59U	...	3.8	...	9.4	...	14.2
RF-11U	...	1.8	...	5.0	...	7.6

*Estimated values - unknown for wet conditions.

A visual method of checking impedance match is given in the review section of this column. With a sweep generator and a scope you can determine for yourself how well components, marked with the same impedance, match over a range of frequencies. The results are almost certain to change your outlook on stated impedance values.

The remaining transmission lines in Table 1 are two coaxial cables, the RG-59U and the RF-11U. Attenuation loss remains constant with weather conditions and the RG-11U is seen to compare favorably with the 300-ohm flat twin lead. The RG-59U attenuation is quite high for UHF work and should only be employed if it is absolutely necessary.

There are a number of features which will crop up concerning UHF-TV and wherever possible these will be covered in this column or in other sections of the Photofact Index. Our object is to keep all readers informed as quickly and as fully as possible of any UHF developments of interest.

While it is frequently unnecessary to carefully match 450-ohm impedances to 300-ohm impedances, the same is not true when a 75-ohm impedance is to be connected to a 300-ohm impedance. Here a careful match should be made because of the great disparity between the two values and also because 300-ohm impedances are usually balanced while 75-ohm impedances are not. One favorite matching network is shown in Figure 3. It consists of two quarter-wave sections of 150-ohm twin lead transmission line. (The length is generally chosen to be one-quarter wave long at the lowest operating frequency.) If it is desired to match 300 ohms at one end to 75 ohms at the other, then the two lines would be connected as shown in Figure 3. At the 75-ohm end the two lines are connected in parallel. Thus, two 150-ohm impedances in parallel produce a resultant impedance of 75 ohms.

At the other end of the lines, they are connected in series, producing the necessary 300 ohms. The impedance at one end can be balanced while it is unbalanced at the other end and the match is still effective. Or both ends can be balanced, or unbalanced, as desired.

This arrangement is simple, convenient, and quite easy to produce. Hence its popularity.

At the time of this writing, only the Portland, Oregon UHF station is on the air and there has not been any extensive test of UHF, either for receivers, test equipment, or antennas. However, from reports drifting back from there, a number of useful opinions can be formed.

1. The placement of an antenna, both horizontally and vertically, is quite critical. This means that you not only have to probe along the roof, but you have to determine what the best height is, too. UHF field strength meters are, as yet, unobtainable but existing VHF field strength meters, like the Approved and Simpson units, use a Standard Coil tuner. This means that by inserting appropriate UHF strips, the same instrument can be used on VHF and UHF.

2. Watch the routing of unshielded lead-in lines very carefully. Both flat and tubular twin-lead have been used in Portland although the recently developed tubular twin lead is the preferred line. In either event, keep the lines away from metal surfaces, pipes, eaves, downspouts, vents, etc. Use stand-off insulators to keep the line firmly in place. Also avoid sharp bends. If a rather abrupt change in direction is necessary, try to use a gradual bend.

3. It is poor practice (even at VHF frequencies) to find that the lead-in line you estimated for the job was too short and that an additional length must be added. Breaks such as these in the line set up standing waves with resultant loss in signal.

4. Keep lead-in lines from separate VHF and UHF antennas away from each other. Any undesirable UHF signals picked up by the VHF array can be transferred to the UHF lead-in line by simple contact. Generally a distance of 6 inches is sufficient to prevent this transfer. (This fact that signals can be transferred from one lead-in line to another by placing them close to one another may be unknown to some service men. You might keep this fact in mind the next time you have one antenna and two television receivers to drive. Use one lead-in to bring the signal to one set. Then take a lead-in line from the other set and place it up against the first line. Scotch tape will serve to hold the lines together. Good results are obtainable if sufficient signal is available.)

5. If a shielded lead-in is required, use RF-11U in preference to RG-59U.

6. The type of antenna to use will often present a problem. Combination arrays will, in general, be more economical than separate

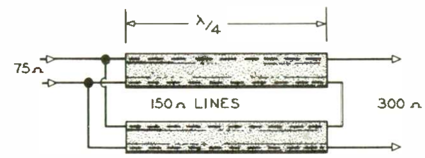


Figure 3. An Impedance Matching Transformer Using Transmission Lines.

VHF-UHF arrays. However, make sure that the combination array will receive the signals you want received. Whenever you combine two antennas possessing widely differing responses, a certain amount of loss will be occasioned by both sections. If the combination antenna stems from the basic "V" array, then the angle of the antenna rods which is best for VHF reception will not oridnarily be best for UHF reception. By the same token, the best angle for UHF reception most often does not provide optimum VHF reception. And, as is most common, when you select a compromise intermediate position, then reception in both regions suffer.

The same logic will apply to all dual purpose arrays. Accept glowing reports with a grain of salt until you have had occasion to check for yourself in an actual test. The service men in Denver can tell you quite a story of a VHF-UHF array that was presented to them in glowing terms. Subsequent investigation showed the antenna to be quite unsuitable for UHF. Undoubtedly, more instances of this sort will appear.

The arrival of UHF will also bring to the service man the responsibility of servicing UHF converters. From the series of articles that have been running in this and previous issues of the Photofact Index, readers are fairly familiar with the circuitry of many UHF converters. The incoming signal is brought through a preselector circuit to a crystal mixer where it combines with a locally generated oscillator voltage. The difference frequency, generally falling within channels 5 or 6, is then amplified by a cascode (or similar) amplifier and transferred to the VHF receiver input for treatment as any incoming VHF signal.

Converter circuits are simple and they are not expected to present any unusual servicing difficulties. Tubes would be a first item to check, together with the crystal mixer which, even at this early date, has already shown itself to be a frequent

♦ ♦ Please turn to Page 93 ♦ ♦

When was the last time

you were knocked

on your 

It won't happen again with the

 MERIT

A PF INDEX UHF COVERAGE

and your TEST EQUIPMENT

W. William Hensler

One of the things that is of extreme interest to the service technician, as far as UHF is concerned, is test equipment. Many service technicians have mastered the art of employing their test equipment in VHF alignment work, only to find that a new spectrum of frequencies places an even greater demand on the equipment which he now has.

The frequency spectrum for Channels 14 through 83 is from 470 to 890 megacycles. This, of course, is far beyond the range of alignment generators commonly employed for VHF alignment. The question that immediately comes to mind is - "Can I still use this equipment or will it soon be obsolete?" The answer should be obvious. This type of equipment will still retain its importance in service work. There will be more and more VHF stations coming on the air, and obviously Channels 2 through 13 will be with us from now on. This situation may be likened to the introduction of sweep generators for alignment of FM receivers. In this case, a new band of frequencies was opened up, but it did not lessen the requirements of an AM generator for alignment of broadcast receivers.

The next question that comes to the mind of a service technician is - "Will it be necessary for me to purchase a UHF sweep and marker generator to properly service UHF receivers or converters?" At this time, many of the manufacturers supplying units which provide UHF reception recommend that the units be exchanged, or returned to the factory whenever it is definitely determined that alignment is required. This runs a parallel to the recommendations which were made for VHF tuners at the start of mass television production. At that time there was very little test equipment available to the service technician which provided a signal strong enough for tuner alignment. As a consequence, very little tuner alignment was being done. After the test equipment manufacturers made available suitable equipment for this work, the service technician could align and re-adjust tuners, which prior to that time might have been returned to the factory.

It is very possible that a similar situation will exist on UHF tuning units. Since many of the manufacturers are now recommending that these units be returned for alignment, they will possibly continue to do so until the servicing field has suitable equipment available to do this type of work.

How can it be determined whether a UHF tuner requires alignment if no signal is available for checking purposes? In many cases, the present VHF equipment can be used for this purpose. Other than the frequencies involved, the theory behind the operation of the UHF tuner is no different than that employed for VHF reception. The fact that, in most cases, a silicon diode is used as a mixer, instead of a vacuum tube, does not change the basic theory of operation. Normally in the UHF tuner, there will be found two preselector circuits and an oscillator circuit. In those cases where the harmonics of the fundamental oscillator frequency are used, an additional tuned circuit may be employed to tune these harmonics. Thus, it can be seen that there are approximately the same number of tuned circuits present per channel as there are in the VHF tuner.

One manufacturer sets forth the following requirements of the necessary equipment to perform UHF alignment -

1. A UHF sweep generator with a range of 470 to 890 megacycles.

2. A VHF sweep generator with a range from 70 to 90 megacycles.

3. A UHF marker generator for locating 480, 630, and 840, megacycles.

4. A VHF marker generator capable of supplying 72.5, 76.5, 82.5, 88.5 and 92.5 megacycle signals.

5. A high gain oscilloscope.

6. A milliammeter with 0-5 ma. range.

7. A resistive pad for terminating the sweep generator cable.

8. A 300 ohm balanced detector.

This appears to be a pretty big order, but after careful study of the requirements, only Items 1 and 3 present any real problems. The requirements set forth in Items 2 and 4 are very easily satisfied with conventional VHF sweep generator equipment. The rest of the items are usually readily available except for Item 8. This detector can be constructed very easily, however, and the value of the components used will be defined in the service information covering the piece of equipment that requires alignment. Usually it will also be stated that if such alignment equipment is not available, no attempt should be made to align the receiver or converter.

What can be done about Items 1 and 3? Of course, equipment designed to operate within this range of frequencies can be purchased. At the present time, however, such equipment is not available at a cost consistent with the economy of the majority of the service shops. As was the case of the VHF tuner alignment equipment, however, the test equipment manufacturers will undoubtedly realize the need for such equipment and will strive to make it available to the servicing trade.

Let us investigate the possibilities of existing equipment in fulfilling the requirements of Items 1 and 3 to provide a stop-gap measure of servicing UHF receivers and converters. All sweep generator equipment designed for VHF alignment provides signals which cover the IF frequencies as well as all 12 channel frequencies. The high band, from channel 7 through 13, extends from 176 megacycles to 216 megacycles. It is the harmonics of these frequencies for the most part which are to be considered for UHF alignment purposes.

The method used in any given piece of equipment in obtaining these frequencies will determine to a great

Bill Clemens says—

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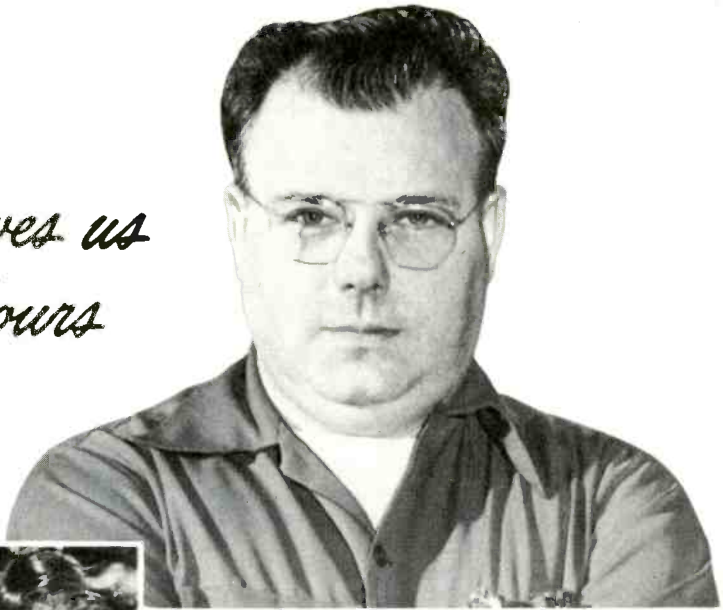
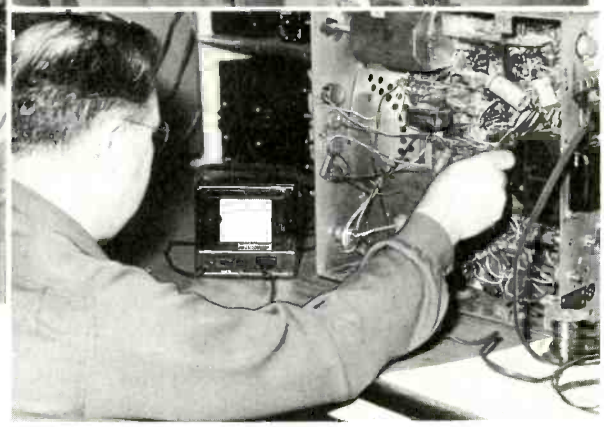
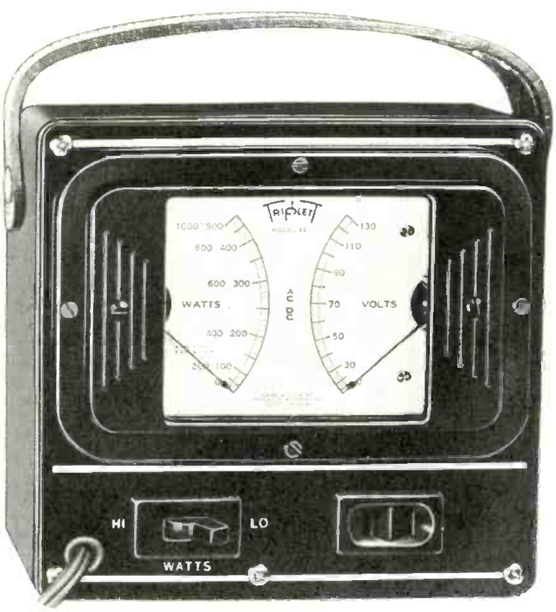
"TRIPLETT 660 saves us 50 to 100 man hours per month."



1. **ISOLATING THE TROUBLE**—Plug the power cord of the chassis into LOADCHEK and note the reading. With your eye on the large meter remove the rectifier tube and you can tell immediately which side of the tube the trouble is on. You have already eliminated 50% of your probing time.



2. **LOCATING THE SHORT**—With Loadchek you can quickly check the shorted side, part by part, without laying down tools or picking up test leads. Here, the trouble was a short in the transformer, spotted without having to warm up set. Overloads are found the same way.



Locates trouble in a hurry

The above pictures illustrate but one of the many time-saving uses of Triplett 660 Loadchek. This versatile instrument accurately measures power consumption, enables you to see instantly any deviation from normal load, without disconnecting a single part . . . finds trouble in a hurry.

For Radio and TV servicing—for almost any kind of electrical trouble-shooting—LOADCHEK saves hours of painstaking work every day. At its moderate cost no service technician can afford to be without it. Try one today—and see! Write for free booklet.

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Triplett

extent the success which can be had in using these harmonics.

A review of the basic theory of operation of the sweep signal generator should be helpful in understanding the problems encountered when using these harmonics. Figure 1A is a simplified block diagram of a typical sweep generator employing a sweep driven oscillator with a variable center frequency. At one setting of the sweep frequency range selector, the fundamental frequency of the sweep oscillator is employed. In order to extend the range of the selector. The beat between the FM oscillator and the fixed frequency oscillator produces both the sum and different frequencies. Thus, the range of the equipment is extended. The exact frequency range of the sweep driven generator and the fixed frequency oscillator varies considerably in equipment of different manufacture. As would be expected, however, the frequency range which is provided by the fundamental FM oscillator frequency will usually be of greater amplitude than those provided by the beat frequency method. This is particularly true of the harmonics of those beat frequencies.

To illustrate the various frequencies which are employed in several of the popular brand signal generators, let us review the following chart which lists the range of the FM oscillator.

1. 75 to 115 megacycles.
2. 60 to 120 megacycles.
3. 140 to 260 megacycles.

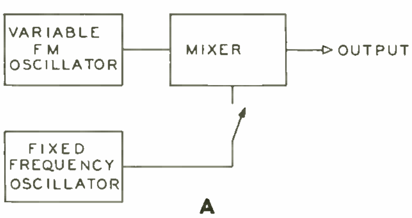


Figure 1A. Block Diagram of Sweep Generator Employing a Variable Center Frequency FM Oscillator.

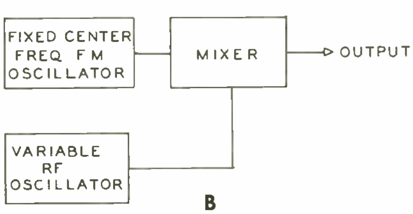


Figure 1B. Block Diagram of Sweep Generator Employing a Fixed Center Frequency FM Oscillator.

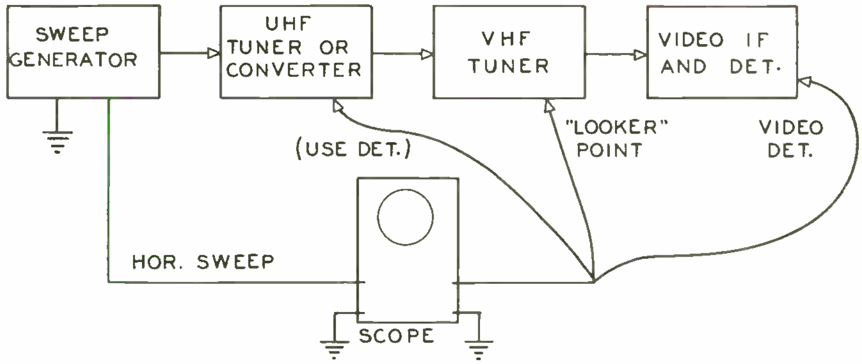


Figure 2. Block Diagram Illustrating the Various Response Curve "Take-off" Points.

Keeping in mind that the UHF range extends from 270 to 890 megacycles we can determine what order of harmonics will be required of the these listed oscillators to produce the desired frequencies. In the case of Number 1, the eighth harmonic will be required to produce the upper limit of the UHF band since the seventh harmonic of 115 megacycles would be only 805 megacycles. In the case of oscillator Number 2, the eighth harmonic would also be required since the seventh harmonic would extend only to 840 megacycles. In the case of Number 3, only the fourth harmonic need be used since the upper limit of the fundamental frequency is at 260 megacycles. The fourth harmonic of this frequency would produce a 1040 megacycle signal.

Another system employed by many test equipment manufacturers to obtain a variable FM signal is illustrated in Figure 1B. With this method an FM oscillator having a fixed center frequency is employed. The output of this FM oscillator is beat against a variable RF oscillator and thus produces the desired FM signal.

What does this mean in the way of useability of these various pieces of equipment? Does it mean that some cannot be used for UHF alignment purposes? To the contrary, it is possible to use all of the listed equipment for this purpose, although it is true, that the eighth harmonic signal is of much lower amplitude than that of a lower order harmonic.

Our experience in using the equipment, however, has shown that a useable signal is available. In the case of any equipment, where a high order of harmonic must be used, greater care must be exercised in making sure that the correct harmonic is being used. Another problem, which presents itself; is that of marker signals, which might be even more confusing in the first few attempts at performing this alignment work. The marker problem will be discussed later.

Since the amplitude of the harmonic signal is low, the first consideration in performing an alignment is that of selecting a point in the receiver from where a useable, detected signal which is to be fed to the scope can be taken. Figure 2 shows, by means of a block diagram, the various points in the receiver where the scope can be connected. The first point shown is at the output of the UHF tuner or converter. This applies particularly to these cases where a converter is used. The signal at the output of the converter is not a detected signal, making necessary the use of some form of detector, preferably of the balanced type. Such a unit can be constructed using a germanium diode. The schematic of a typical unit of this type is shown in Figure 3. This detector has a 300 ohm balanced input with an unbalanced output. By connecting this detector to the output terminals of the converter, a detected signal representative of the passband of the converter can be had. Such a test setup usually does not provide a signal of sufficient amplitude to be useable, however, whenever harmonics are used as the signal source. In the event that this setup is tried, a scope having exceptionally high gain must be used if any degree of success is to be obtained.

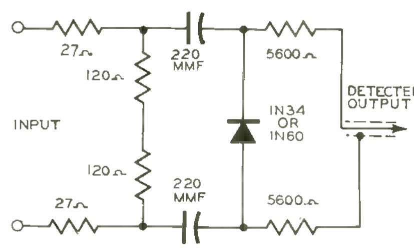


Figure 3. A Balanced Input Detector.

The second takeoff point shown in Figure 2 is at the "looker" point on the VHF tuner. This particular point can be used only in those cases where a double conversion type of system is being employed. This situation will exist in practically all cases where a converter is being used with a conventional VHF receiver. In those cases where the VHF tuner functions as an IF amplifier, the VHF mixer in the tuner is converted to an amplifier stage. With it no longer functioning as a detector (mixer), there is no detected signal at the "looker" point.

Even though the signal at the "looker" point has a greater amplitude than that at the output of the UHF tuning device, it still is too weak to be usable with most signal and scope combinations. It is recommended that this setup be tried with your own equipment. A few trials will show whether or not it is practical. If at first the patterns obtained are confusing, or do not appear to be the correct ones, it would be wise to get the equipment set up by means of the following procedure and then move the scope connection back to the "looker" point and check the results.

The third point, shown in Figure 2, is at the video detector. In practically every case a usable signal can be obtained at this point. There are, however, a few very important considerations which must be borne in mind when using this method of alignment. It must be remembered that, since the VHF tuner and the video IF amplifier are being used for signal amplification, any misalignment of these circuits will be reflected in the response curve at the video detector. This should present no serious problem because these circuits should be properly aligned for correct operation of the receiver. It is wise to check the alignment by injecting a signal at the input of the VHF tuner at whatever channel is being used for the double conversion process (usually 5 or 6). When the UHF tuner or converter is properly aligned, the waveform at the video detector will be identical to that obtained when the signal was injected at the input of the VHF tuner.

Another point to keep in mind is that of bias considerations for the video IF stages as well as the RF amplifier in the VHF tuner. It is advisable to apply the same amount of bias as specified for video IF alignment. In those cases where a usable pattern cannot be obtained with this amount of bias, it can be reduced, taking special care to see that no

SWEEP AND MARKER GENERATOR FREQUENCY CHART

The purpose of this chart is to show several sets of frequencies whose harmonics produce the desired signals for UHF alignment work. The figures are presented in four columns (A, B, C and D) so that a reference system can be set up to show which set of figures should be used on each channel for any given type of signal generator. The frequencies shown for each channel cover a sufficient range so that almost all VHF generators can be used in connection with the frequencies shown.

The channel numbers are listed in the left column. The lower frequency limit, video carrier, sound carrier and upper frequency limit are shown in the next column. Columns A, B, C and D list the frequencies whose harmonics produce the desired frequencies shown in the second column. The numeral in parenthesis indicates what order of harmonic produces the desired UHF signal.

The highest frequencies shown in columns A, B, C or D which fall within range of the signal generator should be used. It is suggested that, after it is determined which column should be used for each channel to obtain the sweep signal, that column be boxed-in with blue pencil. The same thing can then be done for the marker frequencies, using a red pencil. After this is done, the chart will be very easy to use with your own signal generators. Elsewhere in this article is a discussion on the use of several brands of sweep and marker signal generators in connection with this chart. The discussion points out which columns should be used with each instrument.

Column C presents frequencies which are especially suited for use with TV-FM sweep generators covering the twelve VHF channels and the FM band. All frequencies shown in Column C fall within the range of such generators.

Column D contains frequencies from 94 to 120 megacycles which can be supplied by many AM generators now in the field. By using this type of generator as an auxiliary marker generator, markers can be provided throughout the UHF range. With some generators the 7th and 8th harmonics are quite weak and produce low amplitude markers which are rather difficult to see. Maintaining a maximum gain setting of the scope will aid in making the marker visable.

On some channels, two of the columns have the same frequencies listed. This was done to permit coverage of all 70 UHF channels using a minimum number of columns for any given signal generator.

It is suggested that the accompanying text be carefully read in order to better understand the procedure involving the use of this chart.

CHANNEL NO.	FREQ. (MC)	Dial Settings (MC) A	B	C	D
14	470	235 (2)	156.67 (3)	94 (5)	94 (5)
	471.25	235.63 (2)	157.08 (3)	94.25 (5)	94.25 (5)
	475.75	237.88 (2)	158.58 (3)	95.15 (5)	95.15 (5)
	476	238 (2)	158.67 (3)	95.2 (5)	95.2 (5)
15	476	238 (2)	158.67 (3)	95.2 (5)	95.2 (5)
	477.25	238.63 (2)	159.08 (3)	95.45 (5)	95.45 (5)
	481.75	240.88 (2)	160.58 (3)	96.35 (5)	96.35 (5)
	482	241 (2)	160.67 (3)	96.4 (5)	96.4 (5)
16	482	241 (2)	160.67 (3)	96.4 (5)	96.4 (5)
	483.25	241.63 (2)	161.08 (3)	96.65 (5)	96.65 (5)
	487.75	243.88 (2)	162.58 (3)	97.55 (5)	97.55 (5)
	488	244 (2)	162.67 (3)	97.6 (5)	97.6 (5)
17	488	244 (2)	162.67 (3)	97.6 (5)	97.6 (5)
	489.25	244.63 (2)	163.08 (3)	97.85 (5)	97.85 (5)
	493.75	246.88 (2)	164.58 (3)	98.75 (5)	98.75 (5)
	494	247 (2)	164.67 (3)	98.8 (5)	98.8 (5)
18	494	247 (2)	164.67 (3)	98.8 (5)	98.8 (5)
	495.25	247.63 (2)	165.08 (3)	99.05 (5)	99.05 (5)
	499.75	249.88 (2)	166.58 (3)	99.95 (5)	99.95 (5)
	500	250 (2)	166.67 (3)	100 (5)	100 (5)

Sweep And Marker Generator Frequency Chart (Continued).

CHANNEL NO.	FREQ. (MC)	Dial Settings (MC) A	B	C	D
19	500	250 (2)	166.67 (3)	100 (5)	100 (5)
	501.25	250.63 (2)	167.08 (3)	100.25 (5)	100.25 (5)
	505.75	252.88 (2)	168.58 (3)	101.15 (5)	101.15 (5)
	506	253 (2)	168.67 (3)	101.2 (5)	101.2 (5)
20	506	253 (2)	168.67 (3)	101.2 (5)	101.2 (5)
	507.25	253.63 (2)	169.08 (3)	101.45 (5)	101.45 (5)
	511.75	255.88 (2)	170.58 (3)	102.35 (5)	102.35 (5)
	512	256 (2)	170.67 (3)	102.4 (5)	102.4 (5)
21	512	256 (2)	170.67 (3)	102.4 (5)	102.4 (5)
	513.25	256.63 (2)	171.08 (3)	102.65 (5)	102.65 (5)
	517.75	258.88 (2)	172.58 (3)	103.55 (5)	103.55 (5)
	518	259 (2)	172.67 (3)	103.6 (5)	103.6 (5)
22	518	259 (2)	172.67 (3)	103.6 (5)	103.6 (5)
	519.25	259.63 (2)	173.08 (3)	103.85 (5)	103.85 (5)
	523.75	261.88 (2)	174.58 (3)	104.75 (5)	104.75 (5)
	524	262 (2)	174.67 (3)	104.8 (5)	104.8 (5)
23	524	262 (2)	174.67 (3)	174.67 (3)	104.8 (5)
	525.25	262.63 (2)	175.08 (3)	175.08 (3)	105.05 (5)
	529.75	264.88 (2)	176.58 (3)	176.58 (3)	105.95 (5)
	530	265 (2)	176.67 (3)	176.67 (3)	106 (5)
24	530	265 (2)	176.67 (3)	176.67 (3)	106 (5)
	531.25	265.63 (2)	177.08 (3)	177.08 (3)	106.25 (5)
	535.75	267.88 (2)	178.58 (3)	178.58 (3)	107.15 (5)
	536	268 (2)	178.67 (3)	178.67 (3)	107.2 (5)
25	536	268 (2)	178.67 (3)	178.67 (3)	107.2 (5)
	537.25	268.63 (2)	179.08 (3)	179.08 (3)	107.45 (5)
	541.75	270.88 (2)	180.58 (3)	180.58 (3)	108.35 (5)
	542	271 (2)	180.67 (3)	180.67 (3)	108.4 (5)
26	542	271 (2)	180.67 (3)	180.67 (3)	108.4 (5)
	543.25	271.63 (2)	181.08 (3)	181.08 (3)	108.65 (5)
	547.75	273.88 (2)	182.58 (3)	182.58 (3)	109.55 (5)
	548	274 (2)	182.67 (3)	182.67 (3)	109.6 (5)
27	548	274 (2)	182.67 (3)	182.67 (3)	109.6 (5)
	549.25	274.63 (2)	183.08 (3)	183.08 (3)	109.85 (5)
	553.75	276.88 (2)	184.58 (3)	184.58 (3)	110.75 (5)
	554	277 (2)	184.67 (3)	184.67 (3)	110.8 (5)
28	554	277 (2)	184.67 (3)	184.67 (3)	110.8 (5)
	555.25	277.63 (2)	185.08 (3)	185.08 (3)	111.05 (5)
	559.75	279.88 (2)	186.58 (3)	186.58 (3)	111.95 (5)
	560	280 (2)	186.67 (3)	186.67 (3)	112 (5)
29	560	280 (2)	186.67 (3)	186.67 (3)	112 (5)
	561.25	280.63 (2)	187.08 (3)	187.08 (3)	112.25 (5)
	565.75	282.88 (2)	188.58 (3)	188.58 (3)	113.15 (5)
	566	283 (2)	188.67 (3)	188.67 (3)	113.2 (5)
30	566	283 (2)	188.67 (3)	188.67 (3)	113.2 (5)
	567.25	283.63 (2)	189.08 (3)	189.08 (3)	113.45 (5)
	571.75	285.88 (2)	190.58 (3)	190.58 (3)	114.35 (5)
	572	286 (2)	190.67 (3)	190.67 (3)	114.4 (5)
31	572	286 (2)	190.67 (3)	190.67 (3)	114.4 (5)
	573.25	286.63 (2)	191.08 (3)	191.08 (3)	114.65 (5)
	577.75	288.88 (2)	192.58 (3)	192.58 (3)	115.55 (5)
	578	289 (2)	192.67 (3)	192.67 (3)	115.6 (5)

overloading occurs. A good habit to form in this connection is to keep the gain of the scope at maximum (whenever possible) and inject only enough signal from the signal generator to provide a normal pattern on the scope with normal bias applied.

Termination of the output cable of tne signal generator is of extreme importance in UHF alignment work. An improperly terminated cable may result in a very distorted pattern and ultimately cause improper alignment. Some instruments have a terminating box which can be adjusted to provide the desired unbalanced or balanced output. Those generators having no termination box or terminating resistance in the cable will require the addition of a non-inductive resistor at the output terminals. Usually a value from 50 to 100 ohms will be required. By referring to the instruction manual, the output impedance of the generator can be determined, which will indicate the proper terminating resistance to be used. Some manufacturers have devices, either incorporated in the output cable or as an accessory item, which provide the means of obtaining the desired balanced output. For example, the Simpson Model 479 and 480 instruments employ a cable having a termination box, which, by changing the jumpers on the box provides the desired output impedance. The Triplett 3434A is supplied with two output cables - one having an unbalanced output, the other having a balanced output, with the terminating resistors in the cable. In the way of an accessory item, Hickok supplies their type 75 termination pad which makes possible a balanced or unbalanced output by means of reversing the plug incorporated in the pad.

Many of the UHF tuners or converters have an unbalanced input. When this is the case, the unbalanced cable can be used, providing the proper terminating resistor has been added. In those units having a balanced input or requiring the use of a "balun", which is an impedance matching device for converting an unbalanced input to a balanced input, a pad which will provide a balanced output should be used in connection with the signal generator. If the signal generator to be used does not have a balanced output, a pad can be constructed very easily. Such a unit is shown in Figure 4. All resistors used in constructing this pad must be carbon resistors. To calculate the value of the resistors to be used, the first step is to determine the output impedance of the signal generator, which is represented by Rz in the formula. This is usually stated in the operating manual supplied with the signal generator. For example, let us assume that the signal generator has an output impedance of 50 ohms - the value Rz would be 50 ohms. The other two resistors could then be calculated from the formula, 150 minus one-half Rz, which would be 150 minus 25 or 125 ohms. Thus, the value of the two resistors leading to the output terminals would be 125 ohms each and the value of Rz would be 50 ohms. Such an arrangement provides a balanced output at 300 ohms. The values of these resistors are not as critical as it would appear that they might be. Thus the nearest standard value to the calculated value can be used. For example, in the previously discussed illustration the value of Rz could be 47 ohms. The value of the other two resistors could be 120 ohms. Although these do not conform exactly to the calculated values, no difference in performance can be noted.

Let us go through the procedure for setting up the equipment for UHF alignment. It is suggested, that on the first attempt, that a properly aligned converter be used so the user can be more assured of proper results. Let us assume that the converter to be checked is designed to provide an output on channel 5 or 6, and that the desired channel for alignment is channel 5. The first step would be to connect the signal generator to the antenna terminals of the receiver, connect a scope across the video detector load and inject a sweep signal at channel 5. Apply proper bias to the AGC line in the receiver and observe the output wave form. If the receiver is properly aligned, a standard, convential IF alignment pattern will be obtained. Also it should be noted whether the high frequency side of the pattern is at the right or left. This pattern should be in the same relative position when checking the UHF converter unless, of course, there is an inversion in the signal generator itself between ranges. Normally this

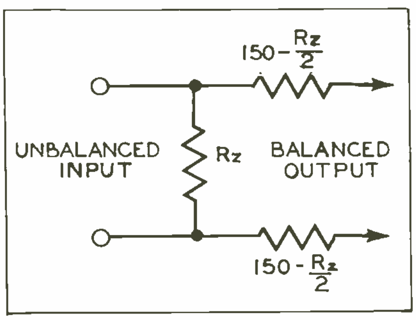


Figure 4. An Unbalanced-to-Balanced Pad.

Sweep And Marker Generator Frequency Chart (Continued).

CHANNEL NO.	FREQ. (MC)	A	B	C	D
32	578	289 (2)	192.67 (3)	192.67 (3)	115.6 (5)
	579.25	289.63 (2)	193.08 (3)	193.08 (3)	115.85 (5)
	583.75	291.88 (2)	194.58 (3)	194.58 (3)	116.75 (5)
	584	292 (2)	194.67 (3)	194.67 (3)	116.8 (5)
33	584	292 (2)	194.67 (3)	194.67 (3)	116.8 (5)
	585.25	292.63 (2)	195.08 (3)	195.08 (3)	117.05 (5)
	589.75	294.88 (2)	196.58 (3)	196.58 (3)	117.95 (5)
	590	295 (2)	196.67 (3)	196.67 (3)	118 (5)
34	590	295 (2)	196.67 (3)	196.67 (3)	118 (5)
	591.25	295.63 (2)	197.08 (3)	197.08 (3)	118.25 (5)
	595.75	297.88 (2)	198.58 (3)	198.58 (3)	119.15 (5)
	596	298 (2)	198.67 (3)	198.67 (3)	119.2 (5)
35	596	298 (2)	198.67 (3)	198.67 (3)	99.33 (6)
	597.25	298.63 (2)	199.08 (3)	199.08 (3)	99.54 (6)
	601.75	300.88 (2)	200.58 (3)	200.58 (3)	100.29 (6)
	602	301 (2)	200.67 (3)	200.67 (3)	100.33 (6)
36	602	301 (2)	200.67 (3)	200.67 (3)	100.33 (6)
	603.25	301.63 (2)	201.08 (3)	201.08 (3)	100.54 (6)
	607.75	303.88 (2)	202.58 (3)	202.58 (3)	101.29 (6)
	608	304 (2)	202.67 (3)	202.67 (3)	101.33 (6)
37	608	304 (2)	202.67 (3)	202.67 (3)	101.33 (6)
	609.25	304.63 (2)	203.08 (3)	203.08 (3)	101.54 (6)
	613.75	306.88 (2)	204.58 (3)	204.58 (3)	102.29 (6)
	614	307 (2)	204.67 (3)	204.67 (3)	102.33 (6)
38	614	307 (2)	204.67 (3)	204.67 (3)	102.33 (6)
	615.25	307.63 (2)	205.08 (3)	205.08 (3)	102.54 (6)
	619.75	309.88 (2)	206.58 (3)	206.58 (3)	103.29 (6)
	620	310 (2)	206.67 (3)	206.67 (3)	103.33 (6)
39	620	310 (2)	206.67 (3)	206.67 (3)	103.33 (6)
	621.25	310.63 (2)	207.08 (3)	207.08 (3)	103.54 (6)
	625.75	312.88 (2)	208.58 (3)	208.58 (3)	104.29 (6)
	626	313 (2)	208.67 (3)	208.67 (3)	104.33 (6)
40	626	313 (2)	208.67 (3)	208.67 (3)	104.33 (6)
	627.25	313.63 (2)	209.08 (3)	209.08 (3)	104.54 (6)
	631.75	315.88 (2)	210.58 (3)	210.58 (3)	105.29 (6)
	632	316 (2)	210.67 (3)	210.67 (3)	105.33 (6)
41	632	316 (2)	210.67 (3)	210.67 (3)	105.33 (6)
	633.25	316.63 (2)	211.08 (3)	211.08 (3)	105.54 (6)
	637.75	318.88 (2)	212.58 (3)	212.58 (3)	106.29 (6)
	638	319 (2)	212.67 (3)	212.67 (3)	106.33 (6)
42	638	319 (2)	212.67 (3)	212.67 (3)	106.33 (6)
	639.25	319.63 (2)	213.08 (3)	213.08 (3)	106.54 (6)
	643.75	321.88 (2)	214.58 (3)	214.58 (3)	107.29 (6)
	644	322 (2)	214.67 (3)	214.67 (3)	107.33 (6)
43	644	322 (2)	214.67 (3)	92 (7)	107.33 (6)
	645.25	322.63 (2)	215.08 (3)	92.18 (7)	107.54 (6)
	649.75	324.88 (2)	216.58 (3)	92.82 (7)	108.29 (6)
	650	325 (2)	216.67 (3)	92.86 (7)	108.33 (6)
44	650	325 (2)	216.67 (3)	92.86 (7)	108.33 (6)
	651.25	325.63 (2)	217.08 (3)	93.04 (7)	108.54 (6)
	655.75	327.88 (2)	218.58 (3)	93.68 (7)	109.29 (6)
	656	328 (2)	218.67 (3)	93.71 (7)	109.33 (6)

Sweep And Marker Generator Frequency Chart (Continued).

CHANNEL NO.	FREQ. (MC)	Dial Settings (MC) A	B	C	D
45	656	328 (2)	218.67 (3)	93.71 (7)	109.33 (6)
	657.25	328.63 (2)	219.08 (3)	93.89 (7)	109.54 (6)
	661.75	330.88 (2)	220.58 (3)	94.54 (7)	110.29 (6)
	662	331 (2)	220.67 (3)	94.57 (7)	110.33 (6)
46	662	331 (2)	220.67 (3)	94.57 (7)	110.33 (6)
	663.25	331.63 (2)	221.08 (3)	94.75 (7)	110.54 (6)
	667.75	333.88 (2)	222.58 (3)	95.39 (7)	111.29 (6)
	668	334 (2)	222.67 (3)	95.43 (7)	111.33 (6)
47	668	334 (2)	222.67 (3)	95.43 (7)	111.33 (6)
	669.25	334.63 (2)	223.08 (3)	95.61 (7)	111.54 (6)
	673.75	336.88 (2)	224.58 (3)	96.25 (7)	112.29 (6)
	674	337 (2)	224.67 (3)	96.29 (7)	112.33 (6)
48	674	337 (2)	224.67 (3)	96.29 (7)	112.33 (6)
	675.25	337.63 (2)	225.08 (3)	96.46 (7)	112.54 (6)
	679.75	339.88 (2)	226.58 (3)	97.11 (7)	113.29 (6)
	680	340 (2)	226.67 (3)	97.14 (7)	113.33 (6)
49	680	340 (2)	226.67 (3)	97.14 (7)	113.33 (6)
	681.25	340.63 (2)	227.08 (3)	97.32 (7)	113.54 (6)
	685.75	342.88 (2)	228.58 (3)	97.96 (7)	114.29 (6)
	686	343 (2)	228.67 (3)	98 (7)	114.33 (6)
50	686	228.67 (3)	171.50 (4)	98 (7)	114.33 (6)
	687.25	229.08 (3)	171.81 (4)	98.18 (7)	114.54 (6)
	691.75	230.58 (3)	172.94 (4)	98.82 (7)	115.29 (6)
	692	230.67 (3)	173 (4)	98.86 (7)	115.33 (6)
51	692	230.67 (3)	173 (4)	98.86 (7)	115.33 (6)
	693.25	231.08 (3)	173.31 (4)	99.04 (7)	115.54 (6)
	697.75	232.58 (3)	174.44 (4)	99.68 (7)	116.29 (6)
	698	232.67 (3)	174.50 (4)	99.71 (7)	116.33 (6)
52	698	232.67 (3)	99.71 (7)	174.50 (4)	116.33 (6)
	699.25	233.08 (3)	99.89 (7)	174.81 (4)	116.54 (6)
	703.75	234.58 (3)	100.54 (7)	175.94 (4)	117.29 (6)
	704	234.67 (3)	100.57 (7)	176 (4)	117.33 (6)
53	704	234.67 (3)	100.57 (7)	176 (4)	117.33 (6)
	705.25	235.08 (3)	100.75 (7)	176.31 (4)	117.54 (6)
	709.75	236.58 (3)	101.39 (7)	177.44 (4)	118.29 (6)
	710	236.67 (3)	101.43 (7)	177.50 (4)	118.33 (6)
54	710	236.67 (3)	101.43 (7)	177.50 (4)	118.33 (6)
	711.25	237.08 (3)	101.61 (7)	177.81 (4)	118.54 (6)
	715.75	238.58 (3)	102.25 (7)	178.94 (4)	119.29 (6)
	716	238.67 (3)	102.29 (7)	179 (4)	119.33 (6)
55	716	238.67 (3)	179 (4)	179 (4)	102.29 (7)
	717.25	239.08 (3)	179.31 (4)	179.31 (4)	102.46 (7)
	721.75	240.58 (3)	180.44 (4)	180.44 (4)	103.11 (7)
	722	240.67 (3)	180.50 (4)	180.50 (4)	103.14 (7)
56	722	240.67 (3)	180.50 (4)	180.50 (4)	103.14 (7)
	723.25	241.08 (3)	180.81 (4)	180.81 (4)	103.32 (7)
	727.75	242.58 (3)	181.94 (4)	181.94 (4)	103.96 (7)
	728	242.67 (3)	182 (4)	182 (4)	104 (7)
57	728	242.67 (3)	183.50 (4)	183.50 (4)	104 (7)
	729.25	243.08 (3)	183.81 (4)	183.81 (4)	104.18 (7)
	733.75	244.58 (3)	184.94 (4)	184.94 (4)	104.82 (7)
	734	244.67 (3)	185 (4)	185 (4)	104.86 (7)

is not the case, but should the generator be so designed, this fact should be kept in mind.

The next step is that of connecting the converter to the receiver. Use a short piece of 300 ohm line for making the connection between the output of the converter and the input of the receiver. Many manufacturers of converters supply a length of lead which has been cut to the proper length to provide optimum performance with that particular converter. If such a lead-in is supplied, it should be used. Next connect the output of the signal generator to the input of the UHF converter, using a properly terminated cable.

There are two basic types of converters. One being the single channel, or switch type unit which provides reception on one or two channels. The other type being the all-channel converter which provides reception for all channels from 14 through 83, this being the continuous tuning type.

Let us assume that in the aforementioned set-up we are using a single channel type UHF converter, and let us assume that the unit is to be aligned to channel 27. Since the generator is not calibrated directly on the dial for an output at channel 27, it is necessary to determine what frequency will provide harmonics that fall in the channel 27 band. The Sweep and Marker Generator Frequency Chart which is included as a part of this article is intended to show these frequencies.

As an aid in determining which column of figures should be used, we have included in this article instructions for the use of several makes and models of signal generators, pointing out the correct column of frequencies to be used over the entire UHF range, as well as the band to be used on that particular instrument. We have also pointed out a few of the interference problems which might be encountered as a result of using the harmonics at the output of the signal generator cable.

It is suggested, that after the proper column to be used in any given group of channels is determined, this column be boxed-in with a red pencil, for instance, since only this group of figures will apply to your signal generator. For example, let us assume that the frequencies to be used with your particular signal generator on channels 14 through 44 fall in column B. By drawing a box

Sweep And Marker Generator Frequency Chart (Continued).

CHANNEL NO.	FREQ. (MC)	Dial Settings (MC) A	B	C	D
58	734	244.67 (3)	183.50 (4)	183.50 (4)	104.86 (7)
	735.25	245.08 (3)	183.81 (4)	183.81 (4)	105.04 (7)
	739.75	246.58 (3)	184.94 (4)	184.94 (4)	105.68 (7)
	740	246.67 (3)	185 (4)	185 (4)	105.71 (7)
59	740	246.67 (3)	185 (4)	185 (4)	105.71 (7)
	741.25	247.08 (3)	185.31 (4)	185.31 (4)	105.89 (7)
	745.75	248.58 (3)	186.44 (4)	186.44 (4)	106.54 (7)
	746	248.67 (3)	186.50 (4)	186.50 (4)	106.57 (7)
60	746	248.67 (3)	186.50 (4)	186.50 (4)	106.57 (7)
	747.25	249.08 (3)	186.81 (4)	186.81 (4)	106.75 (7)
	751.75	250.58 (3)	187.94 (4)	187.94 (4)	107.39 (7)
	752	250.67 (3)	188 (4)	188 (4)	107.43 (7)
61	752	250.67 (3)	188 (4)	188 (4)	107.43 (7)
	753.25	251.08 (3)	188.31 (4)	188.31 (4)	107.61 (7)
	757.75	252.58 (3)	189.44 (4)	189.44 (4)	108.25 (7)
	758	252.67 (3)	189.50 (4)	189.50 (4)	108.29 (7)
62	758	252.67 (3)	189.50 (4)	189.50 (4)	108.29 (7)
	759.25	253.08 (3)	189.81 (4)	189.81 (4)	108.46 (7)
	763.75	254.58 (3)	190.94 (4)	190.94 (4)	109.11 (7)
	764	254.67 (3)	191 (4)	191 (4)	109.14 (7)
63	764	254.67 (3)	191 (4)	191 (4)	109.14 (7)
	765.25	255.08 (3)	191.31 (4)	191.31 (4)	109.32 (7)
	769.75	256.58 (3)	192.44 (4)	192.44 (4)	109.96 (7)
	770	256.67 (3)	192.50 (4)	192.50 (4)	110 (7)
64	770	256.67 (3)	192.50 (4)	192.50 (4)	110 (7)
	771.25	257.08 (3)	192.81 (4)	192.81 (4)	110.18 (7)
	775.75	258.58 (3)	193.94 (4)	193.94 (4)	110.82 (7)
	776	258.67 (3)	194 (4)	194 (4)	110.86 (7)
65	776		194 (4)	194 (4)	110.86 (7)
	777.25		194.31 (4)	194.31 (4)	111.04 (7)
	781.75		195.44 (4)	195.44 (4)	111.68 (7)
	782		195.50 (4)	195.50 (4)	111.71 (7)
66	782		195.50 (4)	195.50 (4)	111.71 (7)
	783.25		195.81 (4)	195.81 (4)	111.89 (7)
	787.75		196.94 (4)	196.94 (4)	112.54 (7)
	788		197 (4)	197 (4)	112.57 (7)
67	788		197 (4)	197 (4)	112.57 (7)
	789.25		197.31 (4)	197.31 (4)	112.75 (7)
	793.75		198.44 (4)	198.44 (4)	113.39 (7)
	794		198.50 (4)	198.50 (4)	113.43 (7)
68	794		198.50 (4)	198.50 (4)	113.43 (7)
	795.25		198.81 (4)	198.81 (4)	113.61 (7)
	799.75		199.94 (4)	199.94 (4)	114.25 (7)
	800		200 (4)	200 (4)	114.29 (7)
69	800		200 (4)	200 (4)	114.29 (7)
	801.25		200.31 (4)	200.31 (4)	114.46 (7)
	805.75		201.44 (4)	201.44 (4)	115.11 (7)
	806		201.50 (4)	201.50 (4)	115.14 (7)
70	806	100.75 (8)	201.50 (4)	201.50 (4)	115.14 (7)
	807.25	100.91 (8)	201.81 (4)	201.81 (4)	115.32 (7)
	811.75	101.47 (8)	202.94 (4)	202.94 (4)	115.96 (7)
	812	101.5 (8)	203 (4)	203 (4)	116 (7)

around all of the figures in that column which applies to your test equipment, it is very easy to find the correct frequency when setting up for any channel. This same thing can be done for the remaining channels.

Let us return to our alignment set-up for our single channel converter. Referring to the Sweep and Marker Generator Frequency Chart, we see that channel 27 operates between 548 and 554 megacycles. Let us assume that the particular signal generator employed in this set-up specifies that column B be used. This shows that the center frequency will be approximately 184 megacycles. The (3) indicates that the third harmonic of this frequency will produce the desired UHF frequency. After setting the center frequency at approximately 184 megacycles, a response curve should be visible on the scope. You will note, however, that the width of the response curve is quite narrow. This is brought about by the fact, that, since we are using the third harmonic of the sweep signal, the total frequency being swept is three times as great as the amount that is swept at the fundamental frequency. This makes it necessary to reduce the amount of frequency deviation to a point only about 1/3 as wide as is required when using the fundamental frequency. Do not adjust the sweep deviation to too small a value or the sides of the pattern will not be visible. A typical response curve is shown in Figure 5.

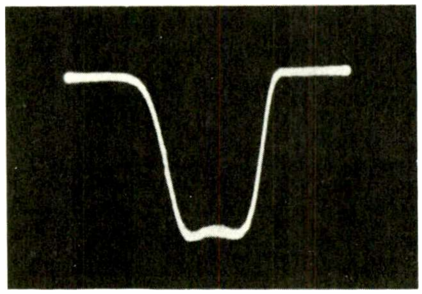


Figure 5. Typical Response Curve.

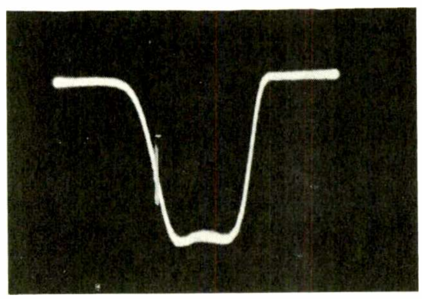
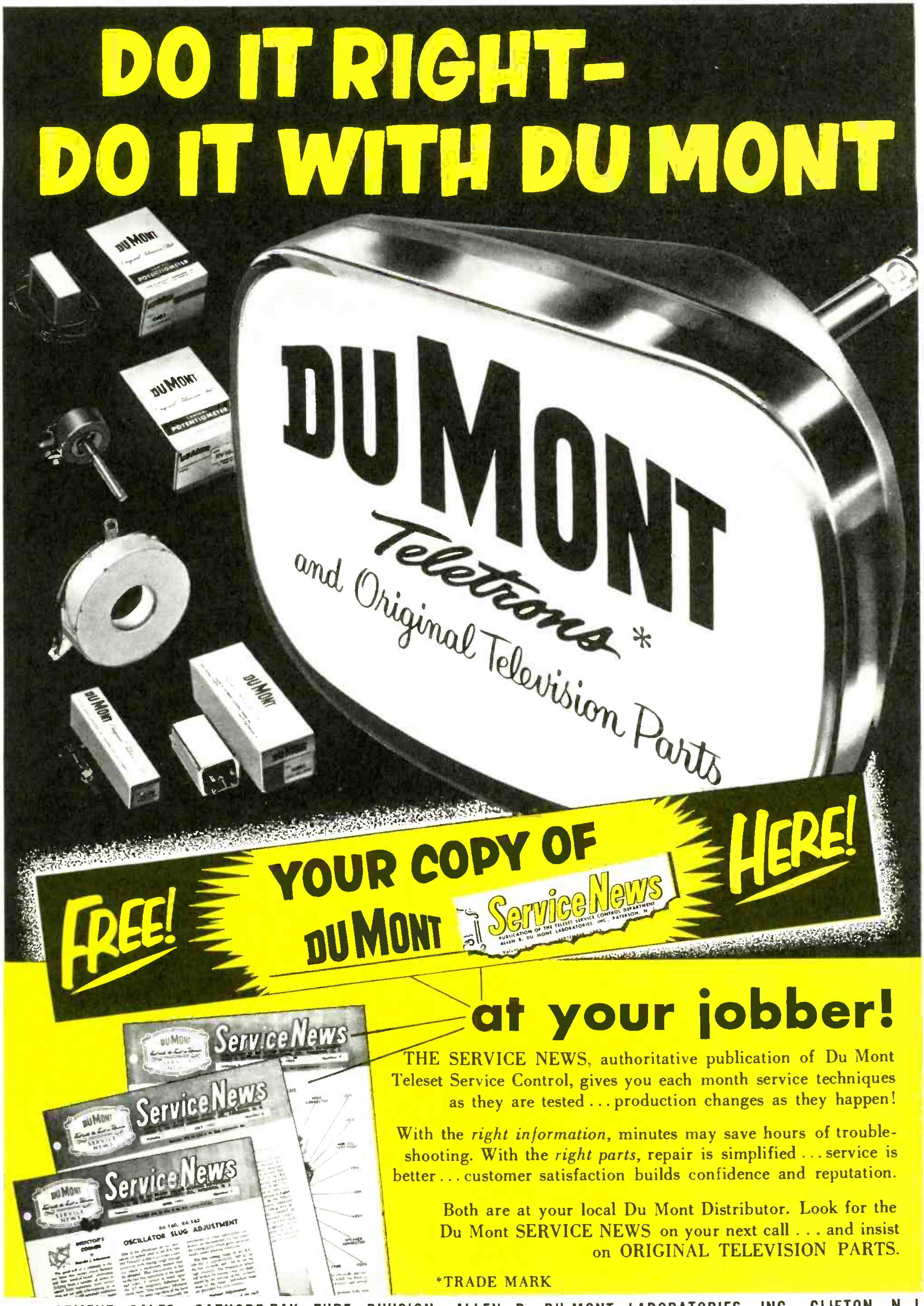


Figure 6. Response Curve Showing Marker at 50% Point.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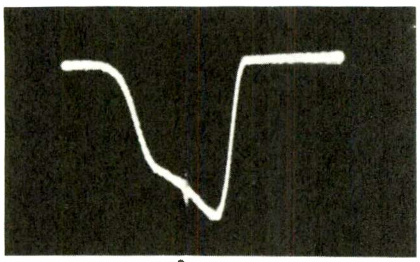
Sweep And Marker Generator Frequency Chart (Continued).

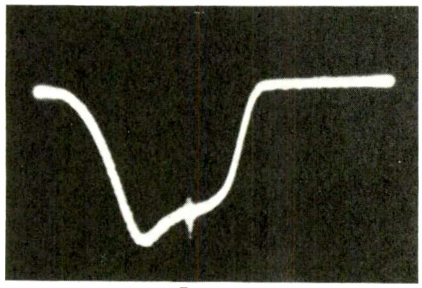
CHANNEL NO.	FREQ. (MC)	Dial Settings (MC) A	B	C	D
71	812	101.5 (8)	203 (4)	203 (4)	116 (7)
	813.25	101.66 (8)	203.31 (4)	203.31 (4)	116.18 (7)
	817.75	102.22 (8)	204.44 (4)	204.44 (4)	116.82 (7)
	818	102.25 (8)	204.50 (4)	204.50 (4)	116.86 (7)
72	818	102.25 (8)	204.50 (4)	204.50 (4)	116.86 (7)
	819.25	102.41 (8)	204.81 (4)	204.81 (4)	117.04 (7)
	823.75	102.97 (8)	205.94 (4)	205.94 (4)	117.68 (7)
	824	103 (8)	206 (4)	206 (4)	117.71 (7)
73	824	103 (8)	206 (4)	206 (4)	117.71 (7)
	825.25	103.16 (8)	206.31 (4)	206.31 (4)	117.89 (7)
	829.75	103.72 (8)	207.44 (4)	207.44 (4)	118.54 (7)
	830	103.75 (8)	207.50 (4)	207.50 (4)	118.57 (7)
74	830	103.75 (8)	207.50 (4)	207.50 (4)	118.57 (7)
	831.25	103.91 (8)	207.81 (4)	207.81 (4)	118.75 (7)
	835.75	104.47 (8)	208.94 (4)	208.94 (4)	119.39 (7)
	836	104.5 (8)	209 (4)	209 (4)	119.43 (7)
75	836		209 (4)	209 (4)	104.5 (8)
	837.25		209.31 (4)	209.31 (4)	104.66 (8)
	841.75		210.44 (4)	210.44 (4)	105.22 (8)
	842		210.50 (4)	210.50 (4)	105.25 (8)
76	842		210.50 (4)	210.20 (4)	105.25 (8)
	843.25		210.81 (4)	210.81 (4)	105.41 (8)
	847.75		211.94 (4)	211.94 (4)	105.97 (8)
	848		212 (4)	212 (4)	106 (8)
77	848		212 (4)	212 (4)	106 (8)
	849.25		212.31 (4)	212.31 (4)	106.16 (8)
	853.75		213.44 (4)	213.44 (4)	106.72 (8)
	854		213.50 (4)	213.50 (4)	106.75 (8)
78	854		213.50 (4)	213.50 (4)	106.75 (8)
	855.25		213.81 (4)	213.81 (4)	106.91 (8)
	859.75		214.94 (4)	214.94 (4)	107.47 (8)
	860		215 (4)	215 (4)	107.5 (8)
79	860	215 (4)	215 (4)	107.50 (8)	107.5 (8)
	861.25	215.31 (4)	215.31 (4)	107.66 (8)	107.66 (8)
	865.75	216.44 (4)	216.44 (4)	108.22 (8)	108.22 (8)
	866	216.50 (4)	216.50 (4)	108.25 (8)	108.25 (8)
80	866	173.2 (5)	216.50 (4)	108.25 (8)	108.25 (8)
	867.25	173.45 (5)	216.81 (4)	108.41 (8)	108.41 (8)
	871.75	174.35 (5)	217.94 (4)	108.97 (8)	108.97 (8)
	872	174.4 (5)	218 (4)	109 (8)	109 (8)
81	872	174.4 (5)	218 (4)	174.40 (5)	109 (8)
	873.25	174.65 (5)	218.31 (4)	174.65 (5)	109.16 (8)
	877.75	175.55 (5)	219.44 (4)	175.55 (5)	109.72 (8)
	878	175.6 (5)	219.50 (4)	175.60 (5)	109.75 (8)
82	878	175.6 (5)	219.50 (4)	175.60 (5)	109.75 (8)
	879.25	175.85 (5)	219.81 (4)	175.85 (5)	109.91 (8)
	883.75	176.75 (5)	220.94 (4)	176.75 (5)	110.47 (8)
	884	176.8 (5)	221 (4)	176.80 (5)	110.5 (8)
83	884	176.8 (5)	221 (4)	176.80 (5)	110.5 (8)
	885.25	177.05 (5)	221.31 (4)	177.05 (5)	110.66 (8)
	889.75	177.95 (5)	222.44 (4)	177.95 (5)	111.22 (8)
	890	178 (5)	222.50 (4)	178 (5)	111.25 (8)

The tuner now being adjusted is of the single channel type. To effect proper alignment, it is necessary to adjust the oscillator so that the video carrier marker is at the 50% point on the IF response curve as shown in Figure 6. It is also necessary to adjust the two preselector circuits, or whatever number is being used in this particular converter, to provide maximum aplitude and proper wave shape. Since the passband of the preselector circuits are much greater than 6 megacycles in most cases, all that it is necessary to do is to adjust for maximum amplitude. A slight tilt will be noted as the adjustment is made above and below the correct frequency. This is shown in Figures 7A and 7B, which have the preselectors tuned above and below resonance. For the most part, however, correct adjustment is made when the maximum amplitude point is found.

It may be noted that there are several response curves on either side of the correct one. These may be caused by a heterodyning action of the VHF local oscillator, or UHF local oscillator against the output of the signal generator which produces other FM signals. They may also be caused by harmonics of the fixed center frequency FM oscillator as employed in the type generator illustrated in Figure 1B. When this type of interference is encountered it will be noted that the response curve in question does not move as the sweep frequency dial is tuned. This is because of the center frequency of the



A



B

Figure 7. Waveforms Resulting From Preselector Circuits Being Tuned Too High (A) and Too Low (B). Note Tilt of Response Curve.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Sweep And Marker Generator Frequency Chart (Continued).

CHANNEL NO.	CHANNEL FREQ.(MC)	CHANNEL NO.	CHANNEL FREQ.(MC)
2	54	8	180
	55.25		181.25
	59.75		185.75
	60		186
3	60	9	186
	61.25		187.25
	65.75		191.75
	66		192
4	66	10	192
	67.25		193.25
	71.75		197.75
	72		198
5	76	11	198
	77.25		199.25
	81.75		203.75
	82		204
6	82	12	204
	83.25		205.25
	87.75		209.75
	88		210
7	174	13	210
	175.25		211.25
	179.75		215.75
	180		216

FM oscillator does not change with the tuning of the FM oscillator dial. Such a response curve is shown in Figure 8A. The curve at the right is a result of the harmonic of the FM oscillator. The smaller curve at the left is the desired response curve. After changing the sweep generator dial setting, the waveform at 8B was obtained. Note the curve on the right did not move, but the other curve did shift. In those cases where this type of interference falls within a range in which it is desirable to make an adjustment, the stationary harmonic can be used. As an example, a signal generator having a fixed center frequency FM oscillator operating at a 114 megacycles will produce interference on and near channel 30. Since the frequency deviation can be set so that this harmonic covers several adjacent channels, alignment can be made on the harmonic of this fixed center frequency oscillator itself.

One of the chief interference problems that will be encountered in converter alignment is caused by the fundamental output of the FM generator falling in either channel 5 or 6. With the VHF tuner tuned to either of these channels, and the signal generator operating at that fundamental frequency, sufficient signal goes through the converter and is accepted by the VHF tuner that a response curve of channel 5 or 6 is seen on the scope. This type of interference is illustrated in Figure 9. The response curve of channel 5 is shown at the left of the pattern and UHF response curve is on the right. Note that the UHF response curve is much narrower than the channel 5 curve due to the use of a harmonic of the signal. The same situation exists on those converters which have a channel 10 output, except that only those frequencies falling within channel 10 will cause this type of interference.

The same precaution as pointed out in connection with sweep generators must also be exercised with the marker generator. Since harmonics of the marker generator must be employed to provide markers in the UHF range, there is a possibility that the fundamental frequency of operation of the marker generator may fall within channels 5, 6 or 10, whichever the case might be, and cuase erroneous marker pips, or it may even completely swamp the FM signal.

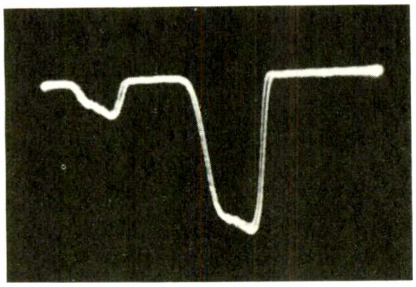
Marker Injection -

Now let us consider the problem of injecting the marker for purposes of determining the correct frequency setting of the oscillator of the UHF converter or tuner. As in the case of the sweep generator, harmonics of the marker generator must be used. Since many harmonic and beat frequencies are present in the circuit, care must be taken to be sure that the marker being viewed is the correct one. There are three simple tests which can be made to determine this:

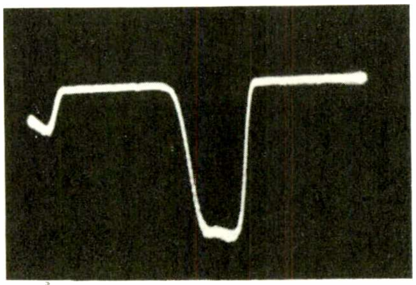
1. The marker should shift on the pattern when the marker generator dial setting is changed.

2. The marker should stay stationary on the pattern as the sweep generator center frequency is changed. (The pattern and marker will move together.)

3. The marker should not move to left or right on the face of the scope tube as the UHF and/or VHF tuning knob is turned.



A



B

Figure 8. Interference Caused by Harmonic of Fixed Center Frequency FM Oscillator (Large Curve at Right). Note Shift of UHF Response Curve At A and B While Large Curve Remanins Stationary.

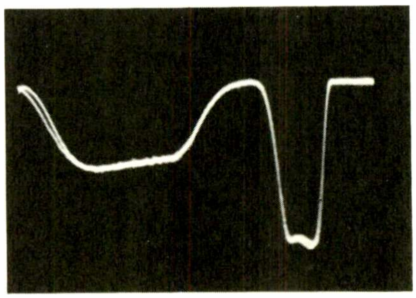


Figure 9. Channel 5 Response Curve at Left, UHF Response Curve at Right.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If the marker fulfills all three of these requirements, you can be assured that it is the correct marker.

A discussion of what these tests mean might be helpful in understanding the procedure for making them. In the case of Step 1, it is obvious that the marker pip should move on the response curve when the marker generator frequency is varied. There are some cases, however, when a marker will be visible which will not move on the response curve when the marker generator is varied, thus indicating an incorrect marker. This marker is usually caused by a harmonic of either an RF oscillator in the signal generator, or a harmonic of the local oscillator in the VHF tuner, or it may also be caused by a beat between any two of the many frequencies which are present in the entire tuning system.

The test prescribed under Step 2, that of shifting the center frequency of the FM oscillator, causes the response curve to move left or right on the face of the scope tube. The marker, however, should remain at the same relative point on the response curve. The reason that this must be so, can be more easily understood, if it is remembered, that the marker signal represents that of the transmitter, and that the response curve is fixed by the resonance of the tuned circuits in the receiver. Thus, as the center frequency of the sweep generator is varied, the marker stays in the same relative position on the response curve even though the response curve moves right or left. If the marker should move on the response curve, either forward or backward, it is an indication that the marker is an incorrect one.

Step 3 states that the marker must not move to the right or left on the face of the scope tube as the UHF and/or VHF tuning knob is turned. Again assuming that the marker represents a transmitted signal, a tuning of the UHF or VHF tuning knob causes the response curve to shift from one side to the other with respect to the transmitted signal. This, of course, is a normal condition. In some cases where an incorrect marker is being viewed, the marker will appear to move ahead of the response curve. In other words, as the tuning is done and the response curve moves to the left, - the marker may also move to the left, but at a faster rate.

These three steps for checking the marker are very easy to perform and the operator should get into the habit of making the checks at each channel. After doing them a few times it will be found that they can be done very quickly. Figure 10 illustrates these three steps in chart form.

The Sweep and Marker Generator Frequency Chart included in this article is presented to show the settings of the generator which will provide a harmonic which falls in the UHF range for use as a marker. Column D is so designed that it can be used with signal generators having a fundamental frequency range extending up to 120 megacycles. Some examples of this type of instrument are the Jackson 641 or 641A and the Triplett 3433. Only those generators having this frequency range at the fundamental frequency should be used. Many instruments are calibrated up to these frequencies, but operate on the harmonics of a lower frequency oscillator. If an attempt is made to use this type of instrument, the high order of harmonics being used are of low amplitude and are not practical for use throughout the UHF range.

Some sweep generators incorporate a built-in marker generator which is suitable for UHF use. For convenience in determining which column of frequencies should be used, we have included under the discussion of marker and sweep generators, instructions for the use of this chart with some of the popular sweep generators. It was previously

♦ ♦ Please turn to Page 97 ♦ ♦

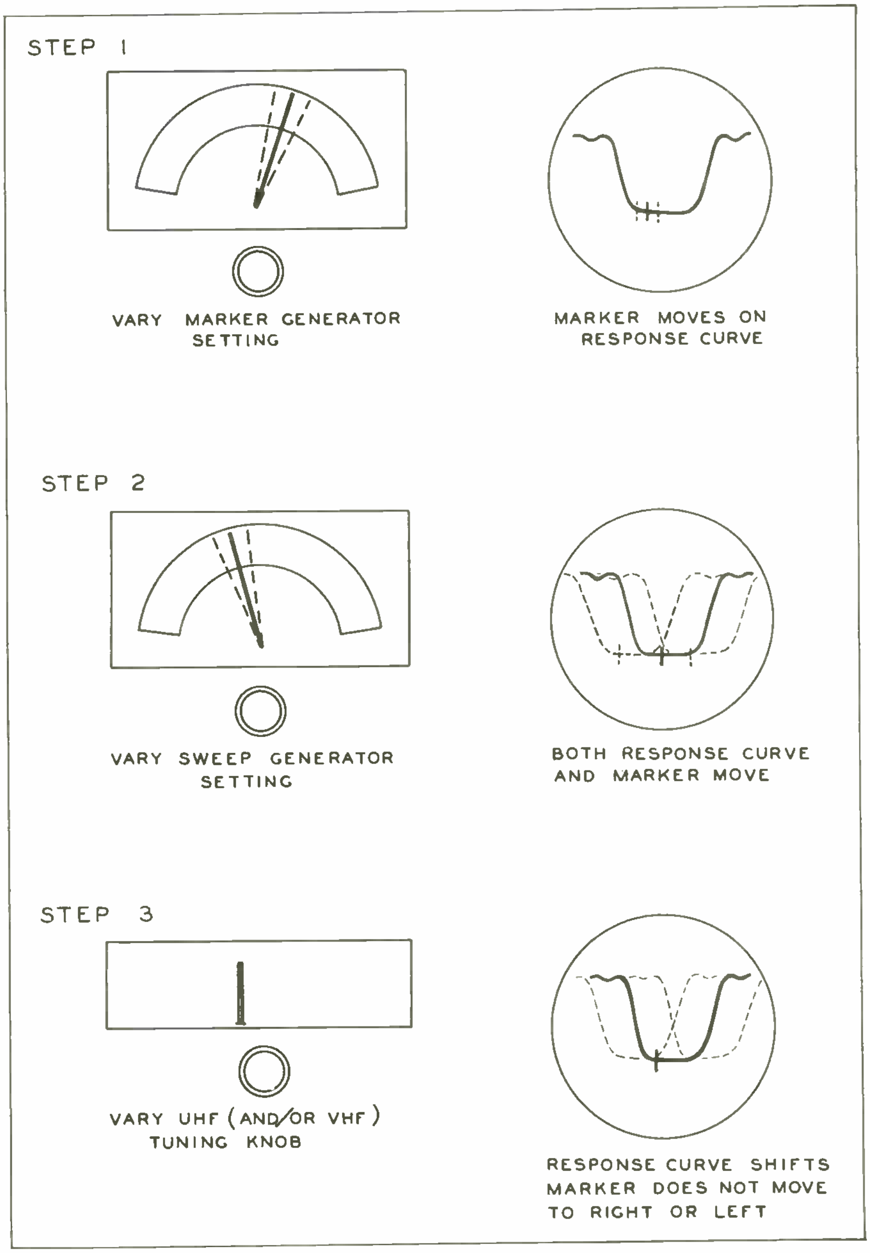

Figure 10. The Three Steps For Checking For Correct Marker.

A PF INDEX UHF COVERAGE

ANTENNAS

by GLEN E. SLUTZ

The advent of UHF on the television scene has been accompanied by a few design changes in receiving antennas. The changes have been necessary because it has been found that, except in strong signal areas, reception of UHF signals with VHF antennas is not very satisfactory. The gain of VHF antennas is quite variable over the UHF range (470 mc to 890 mc), and their directivity characteristics are poor at the higher frequencies. Annoying reflections and "ghosts" and generally poor performance have been experienced in trials conducted in the field.

A number of the UHF antennas which have appeared on the market to meet the demand for clear dependable reception are smaller and lighter than their VHF predecessors. This is understandable in the light of the shorter wavelengths involved in the UHF band. For example, a half wavelength at channel 7 frequency is approximately 33 inches while a half wavelength at channel 61 is only slightly over 7-1/2 inches. Spacings between elements are correspondingly less in UHF antennas than in VHF arrays. All of these features contribute toward a lighter antenna and one offering considerably less wind resistance. Installation requirements of these UHF antennas from the standpoint of structural strength are likewise less stringent.

A certain percentage of the new antennas are appearing either arrayed in combination with larger VHF antennas or as modifications of existing VHF antennas. The manufacturers are claiming all-channel coverage (2 to 83) for these arrays. They are of a size and weight comparable to VHF antennas alone, and therefore the advantage of lightness and smallness, previously mentioned in connection with UHF antennas, does not hold true in their case.

UHF reception is being obtained on five general types of antenna designs.

1. V-Dipole.

2. Rhombic.

3. Yagi.

4. Conical.

5. Fan Dipole.

Of these, the first four have their counterparts in the VHF field; the last one is a newcomer, although actually it could be considered a member of the conical family of antennas.

V-Dipole -

The type of antenna which goes under the name of "V-dipole" is distinctive because of its extremely broadband response, particularly at narrow angle settings of the V. The longer each side of the V becomes, compared to the operating wavelength, the narrower the angle between the two sides must be made to achieve the best directivity and gain. However, the choice of the narrower angles for the higher frequencies (UHF) does not affect the operation on the lower bands (VHF) by a serious amount. Therefore, the V-dipoles are well suited for all-channel reception.

Figure 1 is a photograph of the "Ultra V-Beam" (Model UHF 500) manufactured by the JFD Manufacturing Co., Inc. This antenna features two V's mounted in line horizontally. The V's are connected by open-wire phasing line in the form of two support bars. The open ends of the V's are turned toward the TV transmitter for strongest reception of the direct signal. The manufacturer states that this antenna will give sharp directivity and thereby minimize noise and co-channel interference. The insulators are made so that the elements can be set in either of two positions. The position making the widest angle in the V's, according to the manufacturer, will result in the antenna having high gain on the VHF channels. The position in which the angle is narrower will provide good reception on all UHF and VHF channels from 2 to 83.

The elements which make up the V's are constructed of 3/8" aluminum tubing reinforced with wooden dowels, and the support bars are made of 1/2" aluminum tubing.

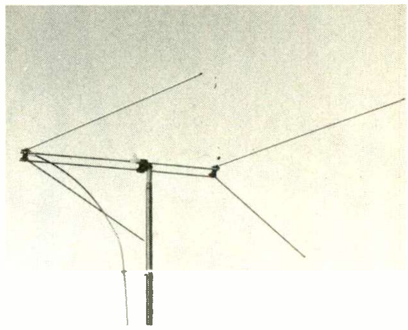

Figure 1. JFD Ultra V-Beam, Model UHF 500. (Sample Courtesy of JFD Manufacturing Co., Inc.)

Figure 2 shows the "U-Vee" (Model TV-130) manufactured by the Ward Products Corp. This antenna is also a form of the V-dipole. It features a pair of V's with provision for three different angular settings for the V's. Position #1 is the widest angle (90 degrees) and is recommended for reception of VHF signals only. Position #3, the narrowest angle (45 degrees), is for the high end of the UHF band (channels 46 to 83). The intermediate setting, position #2, is a 60 degree angle for installations

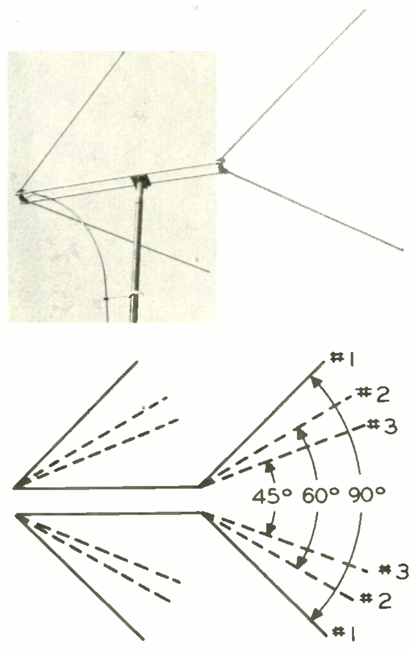

Figure 2. Ward U-Vee, Model TV-130. (Sample Courtesy of Ward Products Corp.)

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where all-channel coverage of VHF and UHF is desired. These instructions are according to the manufacturer's literature on this antenna. High gain and sharp directivity are also emphasized in the manufacturer's literature.

Figure 3 is the "Trombone" (Model TV-132), also produced by the Ward Products Corp. It consists of four V's mounted on support bars that are bent back on themselves in a manner which undoubtedly was the inspiration for the name - "Trombone". The insulator mounts for each V are constructed similar to those in the Ward "U-Vee" antenna; they provide three positions for adjusting the V angle. However, only two of these positions are recommended in the manufacturer's instructions. The widest angle (90 degrees) is advised for all four V's when reception of VHF only is desired. For all-channel (2-83) reception or UHF alone, the widest angle is recommended for the rear pair of V's (those nearest the bend) while the intermediate angle (60 degrees) is specified for the front pair of V's. As with all V-dipoles, the antenna is directed so that the V's open toward the transmitting station.

Near the looped end of the support bars on the Trombone there are three positions where connection to the transmission line may be made. The choice of the best feed position depends on the range of frequencies desired, and instructions with the antenna tell the proper position to use.

An all-channel array manufactured by the LaPointe-Plascomold Corp., producers of the Vee-D-X line of antennas, is shown in Figure 4. This antenna goes under the name of the "Ultra-Q-Tee". The manufacturer emphasizes that it is a single antenna with a single transmission line and it will receive all 82 channels. The antenna uses a multisection printed circuit filter as an isolating component between the VHF and UHF sections. This printed circuit unit permits both sections to be operated on the same transmission line, according to the manufacturer.

Going from left to right in the photograph of Figure 4, the V-dipole is the driven element of the UHF section; the straight element, which is next on the crossboom, acts both as a reflector for the UHF section and as a director for the VHF antenna; next is the VHF antenna composed of three closely spaced elements of varying lengths, and last is the reflector element for the VHF section.

The JFD Manufacturing Co., Inc., makes an antenna called the "UHF Double-Vee" (Model UHF 100). It features two V's stacked one above the other. According to the manufacturer, this antenna delivers superior broadband reception across the entire UHF spectrum, and stacking the V's tends to eliminate ghosts, ground reflections, and other interference. The angles of the V's are fixed at 55 degrees while the lengths of the dipole elements are 55 inches. The vertical separation of the two V's is approximately 1/2 wavelength at the lowest operating frequency, which in the case of the UHF band is 470 megacycles. A phasing section connects the two V's, and the transmission line is attached to the midpoint of the phasing section.

Radio Merchandise Sales, Inc. (RMS) has announced a V-dipole antenna composed of two V's mounted in line horizontally in a beam type arrangement. This antenna is designated as Model VA- and is precut to specific channels. The channel number would be specified following the hyphen in the model number.

Another antenna built on the V-dipole principle is the "Ultra Vee" (Model 404) made by Channel Master Corp. The two V's are stacked one above the other; and, according to the manufacturer, the antenna combines good UHF gain with low VHF gain. The Ultra Vee is pictured in Figure 5.

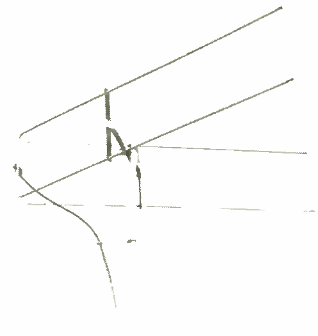


Figure 5. Channel Master Ultra Vee, Model 404. (Sample Courtesy of Channel Master Corp.)

Rhombic -

The rhombic never quite gained the popularity of many of the other types of antennas used to receive VHF. This was principally due to its size and the large space required for its installation. For example, a typical rhombic designed for reception on channels 2 to 13 has diagonal measurements of 40 feet and 16 feet. In the UHF band, however, wavelengths are shorter and the size of the rhombic can be correspondingly less. In UHF, therefore, a small sized rhombic may come into increasing use.

Figure 6 is a photograph of a rhombic antenna being produced by the JFD Manufacturing Co., Inc., for use in the UHF band. The acute angle which is formed by the sides of the rhombic is approximately 50 degrees. The element lengths correspond closely to those in the VHF V-type antennas.

The rhombic features narrow-beam horizontal directivity; for this reason, the manufacturer recommends its use where buildings, trees

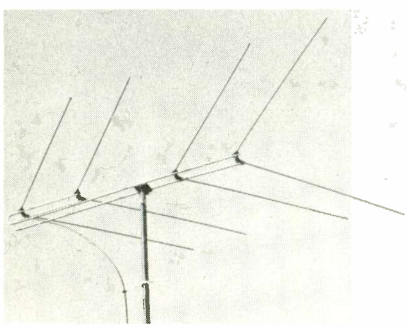


Figure 3. Ward Trombone, Model TV-132. (Sample Courtesy of Ward Products Corp.)

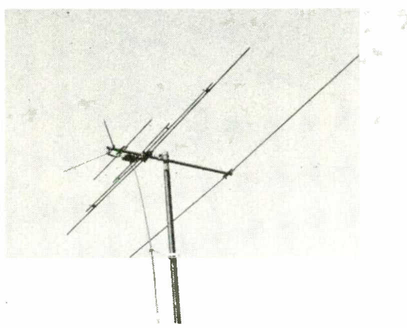
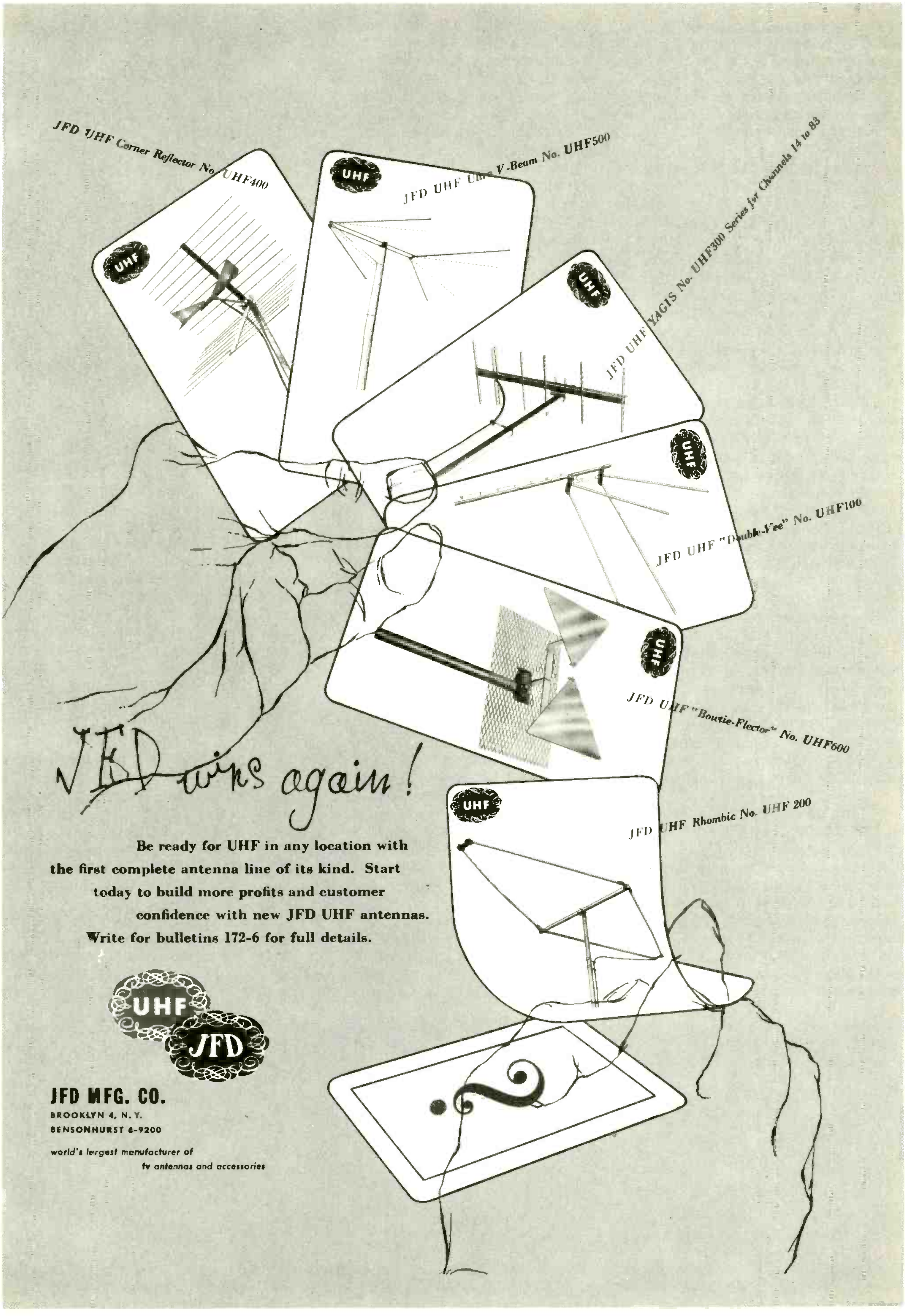


Figure 4. Vee-D-X Ultra Q-Tee. (Sample Courtesy of LaPointe-Plascomold Corp.)

Figure 6. JFD Rhombic, Model UHF 200. (Photograph Courtesy of JFD Manufacturing Co., Inc.)


JFD UHF Corner Reflector No. UHF400
UHF
JFD UHF V-Beam No. UHF500
JFD UHF YAGIS No. UHF300 Series for Channels 14 to 83
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and other obstructions cause reflections. The gain of the rhombic rises in step with increasing frequency; a property which compensates somewhat for the greater signal losses at the higher end of the UHF spectrum. The UHF rhombic in Figure 6 is directed so that the corner of the rhombic feeding the transmission line is farthest away from the station being received.

Yagi -

The Yagi is an antenna composed of a driven element and one or more director and reflector elements. All are mounted parallel to each other in the same horizontal plane. Generally the driven element is a folded dipole approximately a half wavelength long. The directivity of a Yagi is very sharp and its gain is high. However, it has a narrow frequency response; and in the UHF band, a coverage of nine or ten channels for a certain sized Yagi might be considered a better-than-average frequency span.

Figure 7 is a photograph of a UHF 6-element Yagi antenna (Model UHF 300) which is produced by the JFD Manufacturing Co., Inc. There are eight of these antennas; each is cut for a different group of UHF channels. The antenna which is designed to receive the channels near the high frequency end of the UHF band is quite small and the elements are short. The other antennas get progressively larger since they are made for the reception of lower frequency channels with longer wavelengths. Groups of from seven to ten channels are received by each antenna.

Telrex, Inc, has announced a Yagi antenna for use with UHF. It is the "UHF Duplex Yagi" (Model 300) pictured in Figure 8. There are four elements in the array; two of them are folded dipoles coupled by means of a phasing section. The manufacturer claims an average gain of 9 db for this antenna and emphasizes flat terminal impedance, exceptional directivity, and a gain curve which rises with frequency.

Figure 7. JFD UHF Yagi, Model UHF 300. (Sample Courtesy of JFD Manufacturing Co., Inc.)

Radio Merchandise Sales, Inc., (RMS) makes a line of Yagi antennas which are cut to specific UHF channels. The five element model is called the "Quintette" (Model TY-); the "Yardarm" (Model TYL8-) is the eight element job; and the "Pinpointer" (Model TYL10-) is a ten element Yagi. In the model number the channel would be specified following the hyphen.

La-Pointe Plascomold Corp. (Vee-D-X) has announced a new combination UHF-VHF antenna under the name, Ultra Q-Tee Suburban, which features a VHF section similar to the one in their Ultra Q-Tee model (Figure 4). The UHF section, however, is an 8-element Yagi antenna. The Yagi, according to the manufacturer, has broadband coverage and high gain. The Ultra Q-Tee Suburban requires only one transmission line and includes eight printed circuit channel separators in its construction.

Conical -

The conical family embraces a rather wide variety of antennas. The fan dipoles which are discussed in the next section of this article actually belong in the general category of conicals but are given special treatment because of their particular application to UHF reception.

The true conical is constructed of two cones having the same axis of revolution and whose tips come together to feed the transmission line. Most of the antennas now called "Conical" are actually conical sections, which have most of the good features of the true conical without the bulkiness and high wind resistance of the latter.

Figure 8. Telrex UHF Duplex Yagi, Model 300. (Sample Courtesy of Telrex, Inc.)

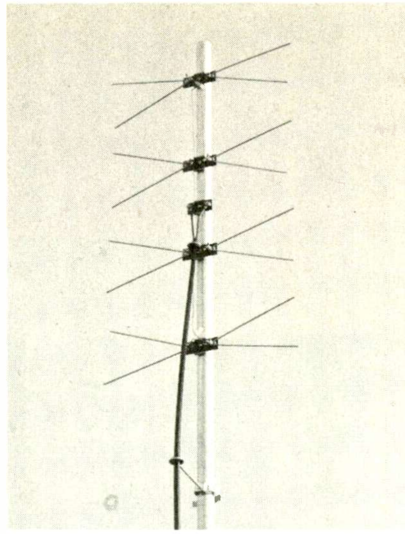

Figure 9. Taco UHF 4-Bay Fan-Type Antenna, Catalogue No. 3005. (Sample Courtesy of Technical Appliance Corp.)

The principal advantage of antennas in this group is their broad frequency response characteristic, which makes them very useful when multi-channel coverage is desired. They also have a relatively high gain and a fair degree of directivity.

A UHF antenna built on the conical principle by Technical Appliance Corporation (Taco) is shown in Figure 9. This is a 4-bay fan-type antenna (Catalogue No. 3005). It is two-directional; in other words, it will receive equally from front and back. Each bay consists of elements arranged in the shape of an "X". The bays are connected by open wire phasing line, the line being crossed over itself to feed the top and bottom bays. The transmission line is connected to the center of the phasing section. Each "X" is approximately 16 inches wide and the total height of the 4 bays measures slightly over 2-1/3 feet. These measurements give some idea of the small size of this antenna. According to the manufacturer the antenna will give between 7 and 11 db gain (above a reference dipole) across the entire UHF spectrum.

Telrex, Inc. is producing three types of conical antennas. The "UHF Conical-V-Beam"* (Model 1X-500)

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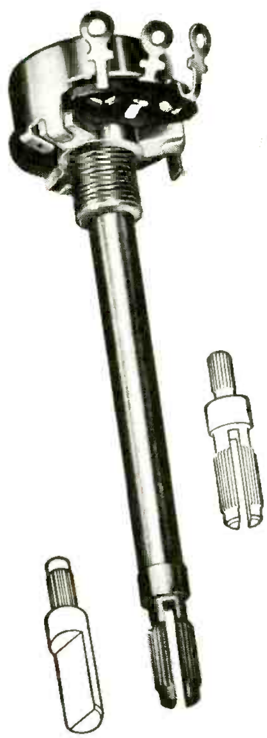

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shown in Figure 10, is designed for reception of UHF signals and the "UHF Double Conical-V-Beam" (Model 400) shown in Figure 11, is intended for operation over all 82 channels. The manufacturer claims for the latter antenna an average gain of 4 db in the VHF range and 8.5 db in the UHF range. Both of these antennas incorporate V dipole principles along with their conical design. The third antenna by Telrex is the "UHF 4XTV" (Model 200-2) which consists of a balanced, in-phase vertical stacking of two conical bays. Reception of UHF only is advised for this antenna. Gains up to 12.1 db are claimed.

Radio Merchandise Sales, Inc. (RMS) includes in their line a conical antenna (Model CVA-500) which they call the "Conical V Fringe-leader". This antenna is made to receive all 82 channels and combines the conical principle with the V-beam style of antenna design.

Fan Dipole -

The group of antennas which we are arbitrarily placing under the classification of fan dipoles are actually members of the conical group. However, the relatively large number of these fan dipoles together with their single application to UHF reception merits their separate consideration in this report.

A fan dipole consists of two triangular pieces of metal mounted with apexes confronting each other and joining the transmission line. The fan dipole is very often referred to as a "bow-tie" because of its resemblance to this article of apparel. Its size will vary somewhat but will usually be slightly over a foot in overall length. Very often reflecting surfaces are employed with this antenna to increase its directivity. The fan dipole has some gain over a simple half-wave dipole but its use has generally been confined

Figure 10. Telrex VHF Conical-V-Beam*, Model 1X-500. (Sample Courtesy of Telrex, Inc.)

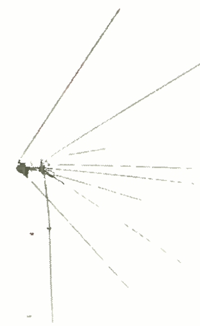

Figure 11. Telrex UHF Double Conical-V-Beam*, Model 400. (Sample Courtesy of Telrex, Inc.)

* Registered Trademark of Telrex, Inc.

to strong signal areas where reflections are at a minimum. Two or more fans may be stacked vertically to achieve added gain when necessary. The fan does possess excellent bandwidth and is frequently preferred for this characteristic alone.

Figure 12 is a photograph of the "Reflecto-Fan" (Model 4402) produced by the Walter L. Schott Co. (WALSCO). It consists of a pair of fan dipoles, each having a reflector screen, stacked one above the other. A phasing section connects the two fans and the transmission line is fed at the midpoint of the phasing section. The manufacturer claims that this antenna has gains of 5.5 to 8 db, above a reference dipole, across the UHF spectrum. Also it is maintained by the manufacturer that the screen reflector provides good directivity, both in the horizontal and vertical plane and that this feature will eliminate reflected ghosts and noise in almost all locations. The single fan with reflector has the model number 4400. The 4-bay stack is Model 4404.

WALSCO has announced other fan dipole types. The Model 4450 is a fan dipole with a corner reflector screen. It is pictured in Figure 13. The corner reflector provides increased directivity. The manufacturer claims gains of 10 to 13 db over the UHF band for this antenna. Another antenna by WALSCO is their Horn antenna (Model 4430) which is designed for both UHF and VHF. The manufacturer lists the gain of the horn on VHF as from 1 to 3 db and the gain on UHF from 8 to 12 db.

The JFD Manufacturing Co., Inc., has announced various styles of fan dipole antennas in their line. The UHF 600 is a straight bow-tie with screen, which, according to the manufacturer, delivers between 4 and 6 db gain in the single array, with the gain

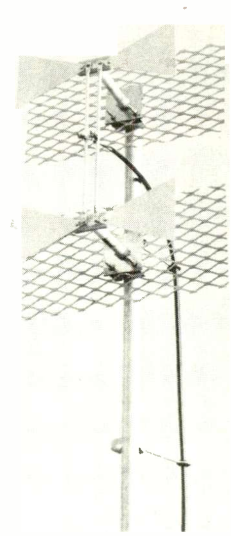

Figure 12. WALSCO Reflecto-Fan, Model 4402. (Sample Courtesy of Walter L. Schott Co.)

climbing as frequency increases. JFD also has a corner reflector type (Model UHF 400). This fan dipole antenna offers up to 12 db in gain, it is stated, and features sharp directivity and broadband reception over the UHF spectrum.

An all-channel 2-83 antenna is JFD's JETenna* 283 which combines a conical VHF antenna with a fan dipole to receive UHF signals. The manufacturer states that this antenna will be widely used in multi-channel and UHF-VHF sections. The gain of the VHF conical section is about 9db and the fan dipole's gain is between 4 and 5 db according to the manufacturer.

Another company which is producing fan dipole antennas is the Channel Master Corp. Their Ultra Fan (Model 413) is a conical VHF antenna with a fan-front for UHF reception. The manufacturer claims high gain over all 82 channels for this antenna. An isolating filter accord-

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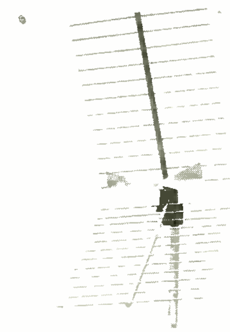

Figure 13. WALSCO Corner Reflector, Model 4450. (Photograph Courtesy of Walter L. Schott Co.)

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A PF INDEX UHf COVERAGE

TRANSMISSION LINES & ACCESSORIES

by GLEN E. SLUTZ

Operation in the new band of television frequencies from 470 to 890 megacycles, known as UHF (ultra-high-frequency), calls for more critical attention to losses between antenna and receiver than is observed in operating with the VHF television channels. Because the frequencies in the new band are so much higher, the dielectric losses in materials are greater, and the adverse effects of weather are more pronounced. In general, the quality of a UHF antenna installation must be of the highest, in order to insure satisfactory, dependable reception.

Among transmission lines there are several candidates for UHF use. The principal requirements are; that the line chosen, must have a low amount of loss per unit length, it should show a minimum increase in this loss when wet, and the amount of stray pick-up along its length should be as little as possible.

Flat 300 ohm ribbon twin-lead, a very popular transmission wire in VHF work, meets the UHF requirement of low loss per unit length, approximately 3 db per hundred feet at 530 megacycles. However, the disadvantage in using this type of line is its poor performance when wet or when resting next to wet wood or metal surfaces. Also it is subject to interference and noise pick-up since it is not shielded. UHF reception is rarely affected by man-made noise however, so this is no serious detriment to the use of this line.

Another transmission line, which is more promising for UHF, is the 300 ohm tubular twin-lead pictured in Figure 1. This line, while it is made of the same polyethylene from which ribbon twin-lead is fashioned, is shaped in the form of a hollow tube with the conductors embedded in opposite sides of the tube. Such a construction results in very little difference in attenuation between dry and wet conditions. Wet tubular line has approximately the same attenuation figure as ribbon lead when dry, namely, about 3 db per hundred feet at 530 megacycles.

In preparing tubular line for connection to the antenna terminals it may be cut back in the manner shown in Figure 1. The length of the cut back section will seldom need to exceed 1-1/2 to 2 inches. In all cases, however, the open end of the hollow tube should be sealed shut. This is done in order to keep the moisture inside the tube at a minimum. Sealing may be accomplished with either a hot soldering iron, or a flame of some sort. When the ployethylene reaches a sticky consistency, it can be pressed in over the opening in the end of the line to form a tight seal. Even with the line closed off in this manner, moisture does condense inside the tube over a period of time. Provision for this eventuality is made by making a "drip loop" in the line prior to its entry into the dwelling. Then a small hole is made through the tube at the bottom of the loop to allow any moisture to drain out.

The 300 ohm tubular line which is pictured in Figure 1 is made by American Phenolic Corp. (Amphenol). It is designated as 14-076 in their catalogue. There is another slightly smaller tubular twin-lead, listed under the number of 14-271. The principal difference in the two types is the higher RF power rating of the 14-076, which makes it suitable for some transmitting applications.

Open wire transmission line, such as that illustrated in Figure 2, features low loss, and maintains high operating efficiency under adverse weather conditions. However, it is more difficult to install than many of the other types of transmission

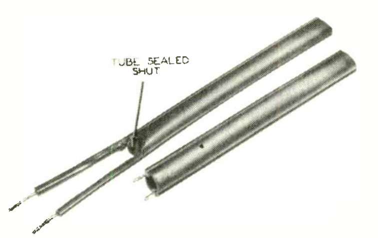


Figure 1. 300 Ohm Tubular Twin-Lead. (Sample Courtesy of American Phenolic Corp.)

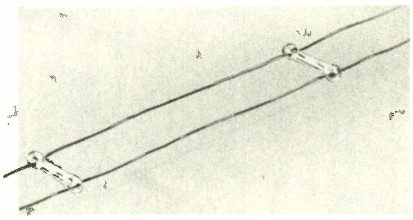


Figure 2. Open Wire Transmission Line. (Sample Courtesy of T. V. Wire Products Co.)

lines. The separators are constructed of an insulating material, usually polystyrene, and the wires are spaced approximately an inch apart. The characteristic impedance of this type of line is generally between 450 and 500 ohms, and it is therefore adviseable to use some sort of matching arrangement when connecting to 300 ohm terminations. Very often a satisfactory match to 300 ohms may be made by removing the last three spacers in the open wire line and tapering the wires gradually down to the separation distance of 300 ohm line before making the connection.

A third type of transmission line which may be employed in UHF installations is the all-weather line developed by the Anaconda Wire and Cable Co., and the RCA Service Co., Inc. It is known as Anaconda ATV-270, and details of its construction may be seen on the photograph of Figure 3. The conductors are high strength copperweld, and they are surrounded by polyethylene spiral threads which act to center the wires in their individual polethylene tubes.

♦ ♦ Please turn to Page 118 ♦ ♦

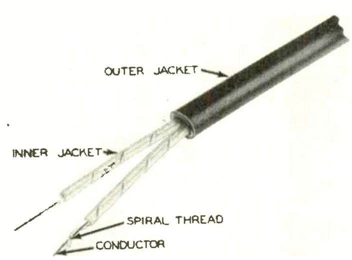
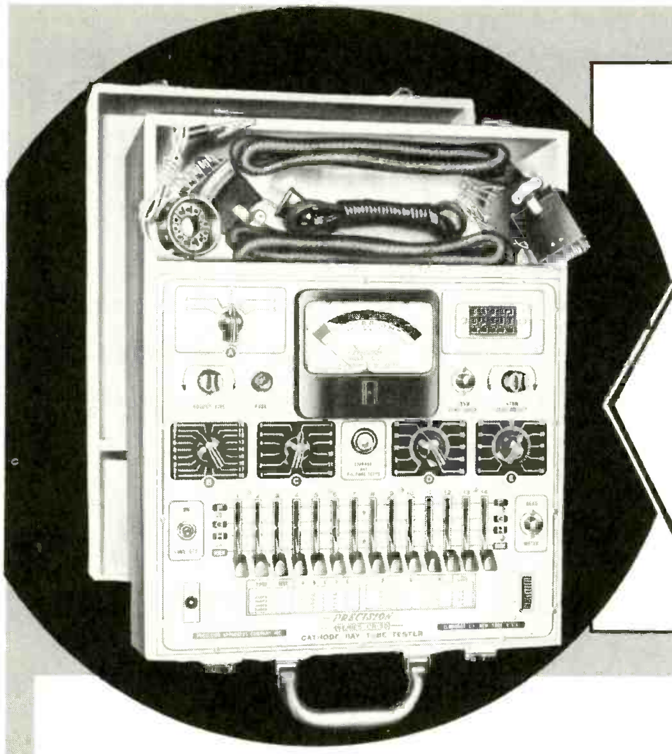


Figure 3. Anaconda ATV-270. (Sample Courtesy of Anaconda Wire and Cable Co., and the RCA Service Co., Inc.)



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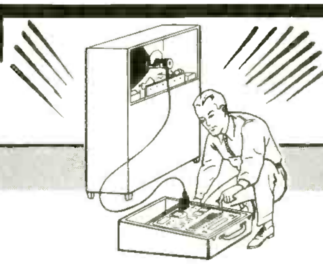

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The Precision CR-30 should not be confused with mere adapters connecting to ordinary receiving tube testers which were never designed to meet the very specialized needs of CR tube checking. Similarly, it is not to be confused with neon-lamp units or similar devices of limited technical merit and which do not check all CR tubes or all tube elements.

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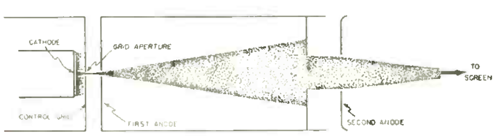

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A PF INDEX

UHF COVERAGE

A description of circuits and equipment for Ultra High Frequency reception.

by MERLE E. CHANEY

MOTOROLA MODEL TC-101 (Ch.TT-19)

Motorola Model TC-101 is a two-tube, continuously tuned UHF converter containing its own power supply. Used in conjunction with a television receiver capable of receiving channels 5 or/and 6, any available UHF television signal may be tuned. A photo of the Model TC-101 is shown in Figure 1.

Two front panel controls operate the Model TC-101 converter. The control on the right is the three-position function switch. Switch positions are marked "OFF - VHF - UHF". The circular tuning dial on the left is marked with UHF channel designations from 14 through 83, and is gear-driven by the shaft holding the tuning knob. More than eleven complete revolutions of the tuning knob are required to tune through the UHF TV band, providing an adequate degree of band-spread throughout this frequency spectrum.

On the back of the cabinet (see Figure 2) are two sets of antenna terminal strips. The VHF antenna connects to one strip marked "VHF" and the UHF antenna to the other strip marked "UHF". A length of 300-ohm twin lead, terminating in spade lugs, extends through the rear of the cabinet. The spade lugs connect to the antenna terminals on the television receiver.

In some instances where the UHF signal is very strong, it is possible to receive UHF stations with a VHF antenna. A jumper connector must be used in this case. The jumper consists of a short length of 300-ohm twin lead with a 150-ohm resistor in each lead. In those cases where a UHF antenna is required, the jumper should be discarded, and the UHF antenna lead connected to the converter UHF antenna terminals.

A photo of the chassis, Figure 3, illustrates parts location in the TT-19 chassis. The cover is removed from this unit, showing all the tuned circuit elements contained in a box-like enclosure. This provides the required shielding. RF tuning is accomplished through the use of a quarter wave coaxial line, made up of the tubular structure shown in Figure 3 and labeled "M1". Immediately below the tube-like RF tuning unit is the oscillator tuner. The RF and oscillator tuner sections are ganged and driven by a rack and pinion gear, which in turn is linked by a series of gears to the tuning control shaft.

Another chassis view of the TT-19 UHF converter is shown in Figure 4.

The functional circuit for the TT-19 UHF converter is shown in the schematic diagram in Figure 5. A UHF signal is fed into a 300-ohm balanced input. It is then loop-coupled to the coaxial-transmission-line type of RF tuning unit. Since a shorted 1/4 wave transmission line is resonant at a specific frequency, it acts as a tank circuit when tuning a UHF signal. An adjustable inner core is used to provide capacitive loading

Figure 1. Motorola Model TC-101 (Ch. TT-19) UHF Converter.

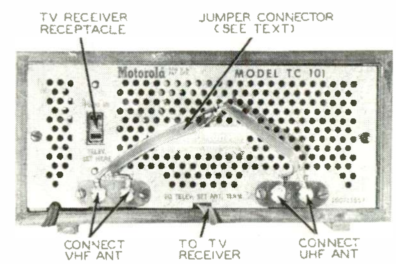


Figure 2. Rear View of Motorola Model TC-101 (Ch. TT-19).

for changing the electrical length of the transmission line. This presents an effective 1/4 wavelength on any desired frequency within the UHF TV band. Tracking in the line is provided by two adjustments (C4, C5) by capacitively loading the line at the low- and mid-frequency positions.

A crystal mixer, type CK-710, is tapped into the transmission line. Beating the oscillator signal with the incoming signal at the mixer provides an intermediate frequency.

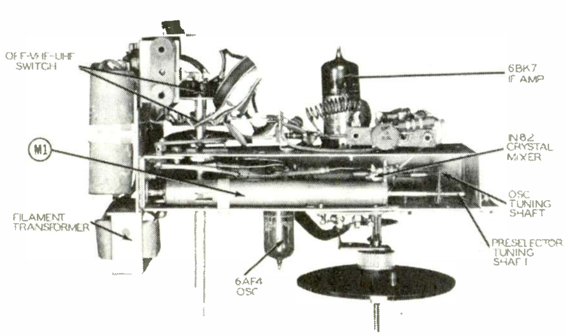


Figure 3. Top Chassis View of Motorola Converter.

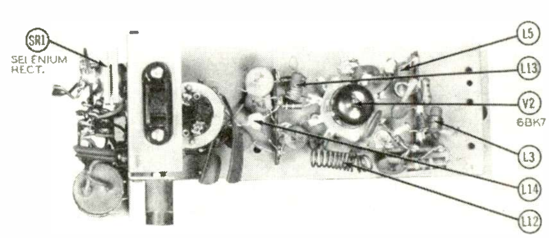


Figure 4. Bottom Chassis View of Motorola Converter.

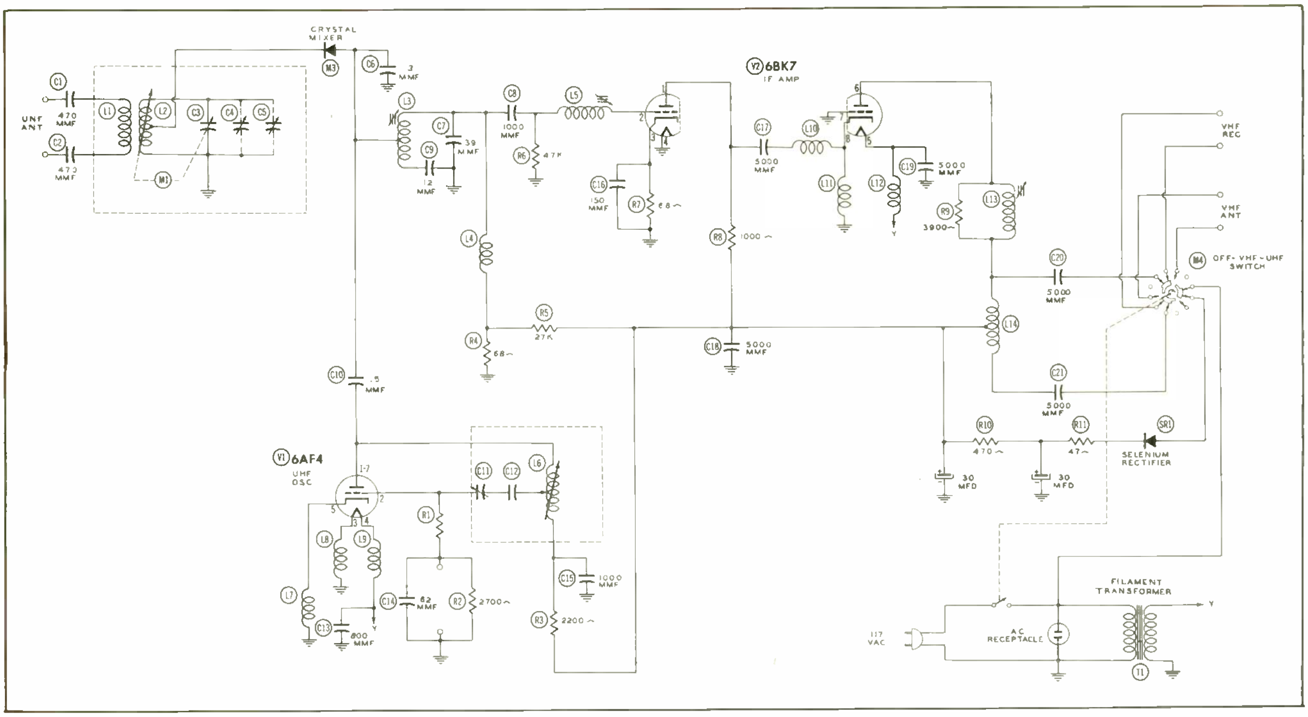


Figure 5. Schematic of Motorola Model TC-101 (Ch. TT-19).

The oscillator portion consists of a 6AF4 tube, employing a series-tuned modified Colpitts circuit. Metalized windings formed on a glass tubing make up the oscillator coil. Also at one end of the tubing, adjacent to the oscillator windings, is a solid metalized section. Two cores inside the glass tube are adjusted by the tuning mechanism for varying the oscillator frequency.

Note on the schematic (Figure 5) that a variable capacitance (C11) is shown in series with a fixed capacitance (C12) which connects to a variable tap on the oscillator coil (L6). A glance at the physical construction of the oscillator-tuned circuits may not readily indicate how this is accomplished. C11 is the capacitance existing between the solid metalized section on the glass tubing and the inner core. As the core is moved in or out of the tube, the capacitance is varied.

C12 is in series with C11 and is shown as a fixed capacitance connected by a variable tap to the oscillator coil. This is explained in the following manner: C12 is formed by the capacitance existing between the second core in the glass tube and the metalized windings making up the oscillator coil. Since the capacitance of C12 is essentially constant, it acts as a fixed capacitor moving along the coil as the circuit is tuned.

Oscillator alignment is accomplished by adjusting the oscillator slug cores. To prevent "suck-out" within the tuning range, a series of copper rings are formed at the end of the core which adjusts the oscillator coil inductance. Their purpose is to keep the self-resonant frequency of the unused portion of the inductance higher than the desired operating frequency.

A wide-band IF amplifier stage employing a 6BK7 tube compensates for the use of a losser type mixer. This stage passes frequencies over the range covered by channel 5 and 6 and feeds through the function switch to the converter terminals marked "TO VHF TUNER".

The converter output is 300-ohm balanced-line and when connected to a TV receiver tuned to channels 5 or 6, UHF signals can be received.

MOTOROLA UHF CONVERTER KITS TK-17M, TK-19M, TK-20M, TK-22M, TK-23M, TK-24M

These Motorola Converter Kits are designed for installation in those Motorola sets that are provided with a UHF cutout cover plate. This plate is located on the cabinet midway between the On-Off-Volume-Contrast Control and the Channel Selector Switch.

The operation of these converter units is identical to the Motorola Converter Unit Model TC-101 (Ch. TT-19) previously described. However, the converter kits do not have their own power supply, since they obtain the required operating voltages from the receiver in which they are incorporated.

The difference between the converter kits is in the required hardware, knobs and filament transformer. Kits designed for installation in Motorola receivers having parallel-wired filaments do not include a filament transformer. The transformer is supplied only with kits to be installed in receivers with series-wired filaments.

Installation procedures are included with each kit and no difficulties should be encountered if the proper kit is obtained for the television receiver.

Some of the Motorola receivers are equipped with a socket under the chassis to provide power to the converter. In these cases, the converter power cable is plugged into this socket. For those receivers that do not have this socket, a socket with leads is included with the converter kit. The exception to this is when the TK-22M is installed in a Motorola TS-119D chassis. Connector plug and socket are not used, and the converter leads are soldered directly into the circuits.

The table below identifies which converter kits are to be used with each Motorola receiver.

KIT	DESIGNED FOR MOTOROLA TV CHASSIS	MODEL UHF TUNER USED	TYPE FILAMENT IN TV CHASSIS
TK-17M	TS-214, 228, 236, 307 351, 401 (discard included fil. trans.)	TT-28M	Parallel
	TS-314, 315, 325, 326 (use included fil. trans.)		Series
TK-19M	TS-292, 324, 395, 408	TT-52M	Parallel
TK-20M	TS-400, 410	TT-57M	Series
TK-22M	TS-119D	TT-27M	Parallel
TK-23M	TS-216	TT-31M	Series
TK-24M	TS-501	Tk-35M	Parallel

To control converter operation, an arm and link assembly is mounted between the converter switch and the tuner channel selector shaft. When the chassis is installed in the cabinet, the UHF-VHF switch lever is placed over the shaft and into slots in the arm and link assembly. A name plate marked UHF-VHF shows in which position the UHF-VHF switch lever should be set for the desired reception.

These converter kits are designed to accept UHF signals when the VHF channel selector switch is set at channels 5 or 6. With the UHF-VHF switch in UHF position, stations are tuned in with the UHF tuning dial.

RCA MODELS U1A AND U1B

RCA Models UIA and UIB are small, compact, single channel UHF converters designed for installation on existing VHF receivers. Primarily designed for RCA receivers, these UHF units are also readily adaptable to other makes of receivers. A photo of Model UIA (Figure 6) shows the VHF-UHF switch and the adaptor cable and socket. Components inside the chassis unit are shown in Figure 7.

These units are powered by voltage taken from the audio output stage of the television receiver. To accomplish this, the units are supplied with a 52-inch cable attached to an adaptor socket. The adaptor socket is plugged into the audio output tube socket and the output tube is then plugged into the adaptor. In this way, filament and B+ power is available to the converter unit.

Model UIA employs a 7-pin adaptor socket for sets using 6AQ5, while Model UIB has an octal socket for use in sets having a 6K6GT or 6V6GT audio output tube.

To install one of these converters mount the converter on the back cover of a television receiver with the adjustment screws facing up. It is important that the converter be mounted on the receiver in such a position that it may be reached either from the side or the top of the cabinet. This allows easy access to the VHF-UHF switch on the converter. Mount the VHF antenna terminal strip on the back of the cabinet.

To install the converter power cable, remove the back cover of the television receiver, remove the audio output tube, and insert the adaptor socket into the output tube socket. Then insert the output tube into the adaptor socket. The spade lug on one of the cable leads should be fastened under any convenient screw to provide the ground connection. Replace the back cover on the television cabinet, making sure that the power cable is not pinched.

The next step is to connect the UHF antenna to the UHF antenna socket of the converter. Then disconnect the VHF antenna leads from the receiver, and connect to the VHF antenna terminal strip from the converter. The output leads from the converter now connect to the antenna terminal strip on the receiver.

With the unit installed, it is necessary to preset the tuner adjustments to receive the desired UHF station. A table included in PHOTOFACT Folder Set 190-12, gives the number of turns which the primary (A1), secondary (A2), and oscillator (A3) adjustments should be turned to preset the unit to any UHF channel. The tabulation assumes that the converter is aligned to 670MC, which adjustment is established originally at the factory. It is important that these alignment adjustments be made with the cover on the unit.

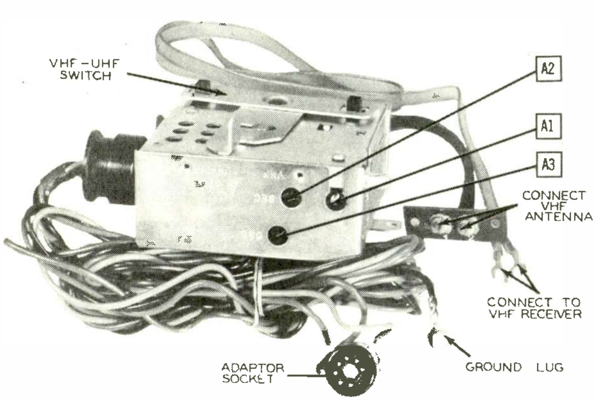


Figure 6. RCA Model U1A.

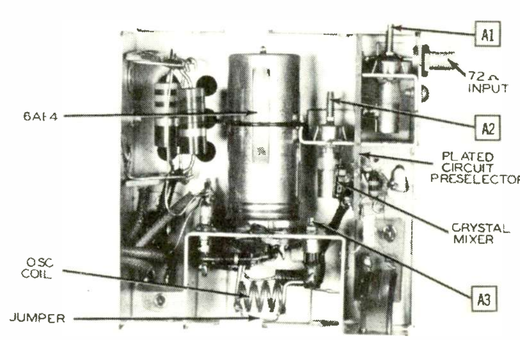
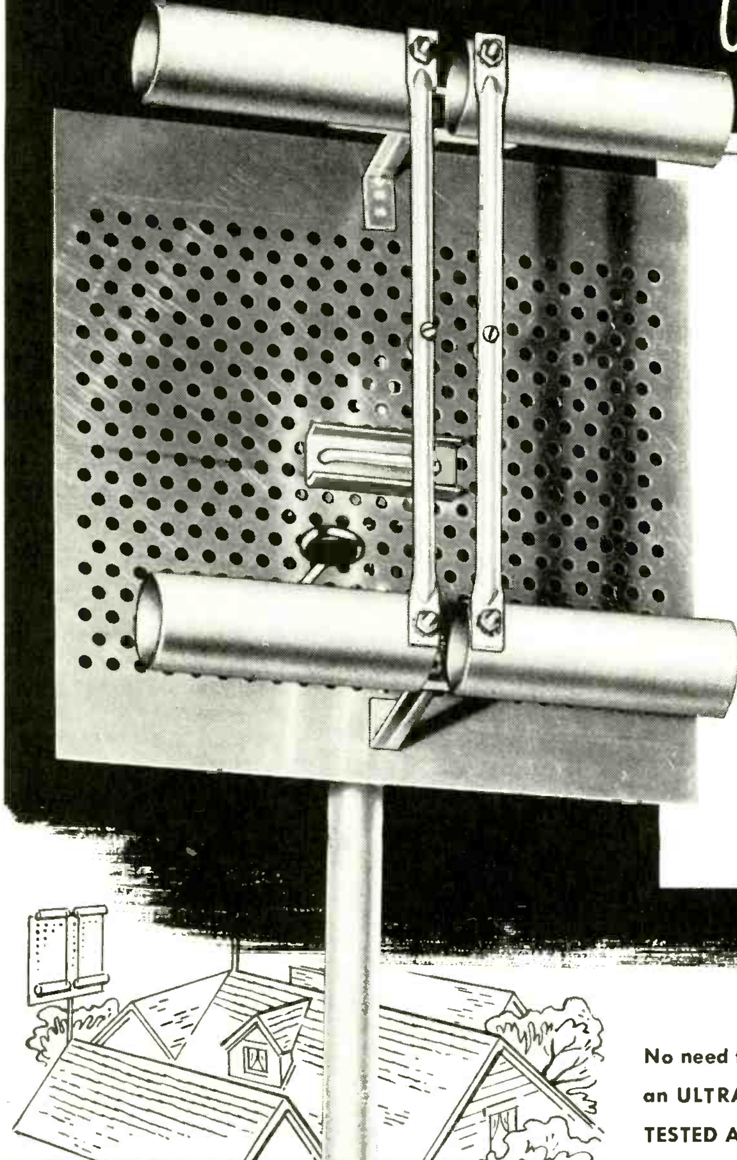


Figure 7. Inside the RCA Model U1A.

why guess?



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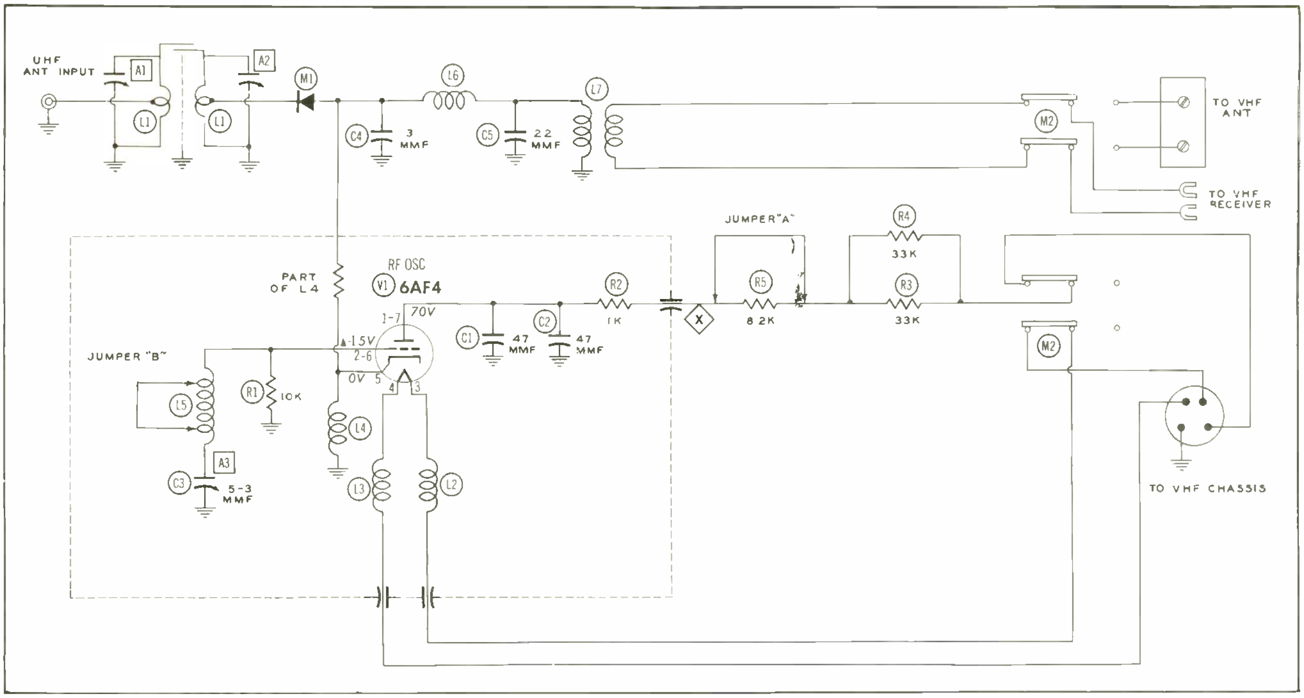


Figure 8. Schematic of RCA Model U1A.

If the desired channel lies between channels 14 and 44, the jumper across the oscillator coil L5 should be removed. For receiving channels between 45 and 83 the jumper is left on the coil.

After the converter unit alignment is changed to accept an available UHF signal, the television receiver should be turned on and the channel selector knob switched to channel 5 or 6, whichever is not used in that area. The converter is switched to UHF position, the VHF receiver fine tuning knob is turned to mid-position, and the volume control turned until background noise is heard. Final adjustments are then made by turning the oscillator adjustment screw A3 until sound is obtained and by adjusting A1 and A2 for best picture and sound.

Under some conditions, interfering beats may result between the UHF signal and harmonics of the VHF oscillator. Should this condition occur, one remedy is to turn the fine tuning control of the TV receiver for elimination of the beat, and adjusting the UHF oscillator adjustment (A3) for best picture and sound. In some situations, a harmonic beat can be eliminated by switching the VHF tuner to any sound channel from 2 to 6 and re-adjusting the UHF oscillator for best picture and sound.

Approximately one minute of warmup time should stabilize the oscillator to a point where the receiver fine tuning control can tune in a station, without the necessity of readjusting the UHF oscillator.

VHF reception is provided by switching the converter switch to VHF position. In this position, the television receiver can function in the usual manner for reception of stations between channels 2 and 13.

A schematic of the UIA and UIB models is shown in Figure 8. A UHF signal is fed to a double-tuned preselector circuit. It is interesting to note that the inductance L1 consists of a plated-circuit on a plastic base. The preselector inductances are tuned by A1 and A2. From this circuit the signal is applied to the crystal mixer. Also applied to the mixer is a signal from the UHF oscillator. The signal is applied from the 6AF4 oscillator cathode through a decoupling resistor to the mixer. C4 is an RF filter, L6 a peaking coil, and C5 a fixed trimmer across the primary of the output transformer, L7. By transformer action the intermediate frequency signal is applied through the selector switch to the leads connecting to the TV receiver antenna input terminals.

The plate load for the oscillator is R2. R3, R4 and R5 are voltage dropping resistors. The unit is designed to have a potential of 60 to 90 volts present at the junction of R2 and R5. The value of the applied B+ voltage at the power cable determines whether R5, or R3 and R4 should be shunted by a jumper. Also an additional or different value resistor may be used as in parallel with R3 to obtain the desired voltage. PHOTOFACT Folder 190-12 points out the proper jumpers to use when connecting this converter to RCA receivers.

RCA MODEL U2

The RCA Model U2, shown in Figure 9, is a self-contained 2-

Figure 9. RCA Model U2.

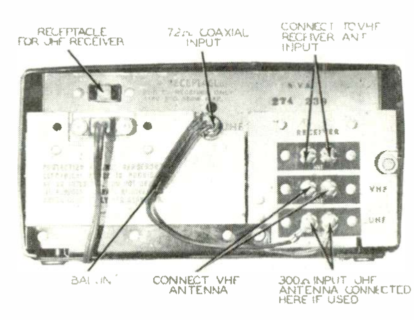
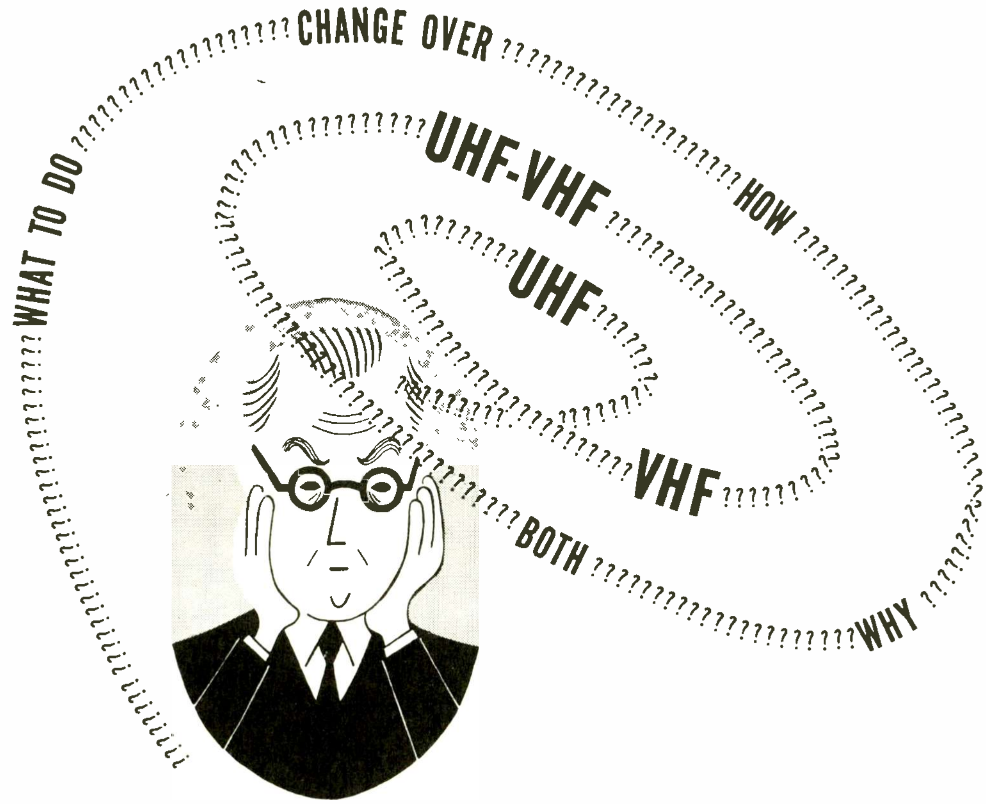


Figure 10. Photo of Back of U2 Converter.



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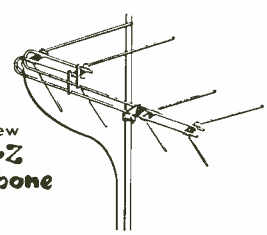

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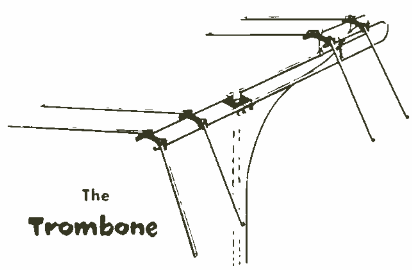

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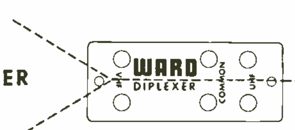

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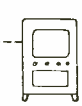

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1148 Euclid Avenue • Cleveland 15, Ohio *In Canada: Atlas Radio Corp., Ltd., Toronto, Ont.*

channel UHF converter. It employs two tubes, a crystal mixer, and a selenium rectifier. When connected to a television receiver tuned to channels 5 or 6, either of two UHF stations may be received. The unit is designed to be preset at the time of installation to any two UHF stations within the receiving range.

Any one of three types of antenna systems may be employed. If the UHF signal is strong at a given location, it is possible to use the present VHF antenna to receive UHF signals. The Model U2 will also accommodate UHF antenna systems employing either a 300-ohm twin lead transmission line or a 72-ohm coaxial line. The rear view of the converter, Figure 10, shows the three antenna terminal strips and the antenna input fitting for 72-ohm coaxial lines.

Selection of the preset UHF channels is accomplished with the selector switch, marked "OFF-VHF-UHF1-UHF2". To accomplish channel selection with a switching device, two identical preselectors are used along with two identical oscillator circuits. The mixer and IF amplifier are common to both UHF circuit outputs.

Electrically, the U2 converter employs lumped constants in both the RF and oscillator tuned circuits. Lumped constants consist of inductors and capacitors possessing their own physical identity. At the frequencies of UHF television, circuits employing lumped constants are physically quite small. Also, since this unit provides for all adjustments to be preset, certain advantages of compactness and simplicity are achieved.

The input impedance of the converter is 72 ohms. A coaxial fitting is provided for connecting a 72-ohm coaxial transmission line. When this type of line is not employed, and the transmission line from the antenna is the 300-ohm type, a "balun" or matching stub is used. The "balun" supplied with the U2 consists of two lengths of 150-ohm line of fixed dimensions, so connected that correct matching between a 300-ohm line and the 72-ohm input impedance of the converter is achieved.

The UHF signal fed to the converter input is coupled by a 3 mmf. capacitor to a terminal on the selector switch and through a shoe on the switch wafer to one of the preselector circuits. Note that the three wafers on the selector switch

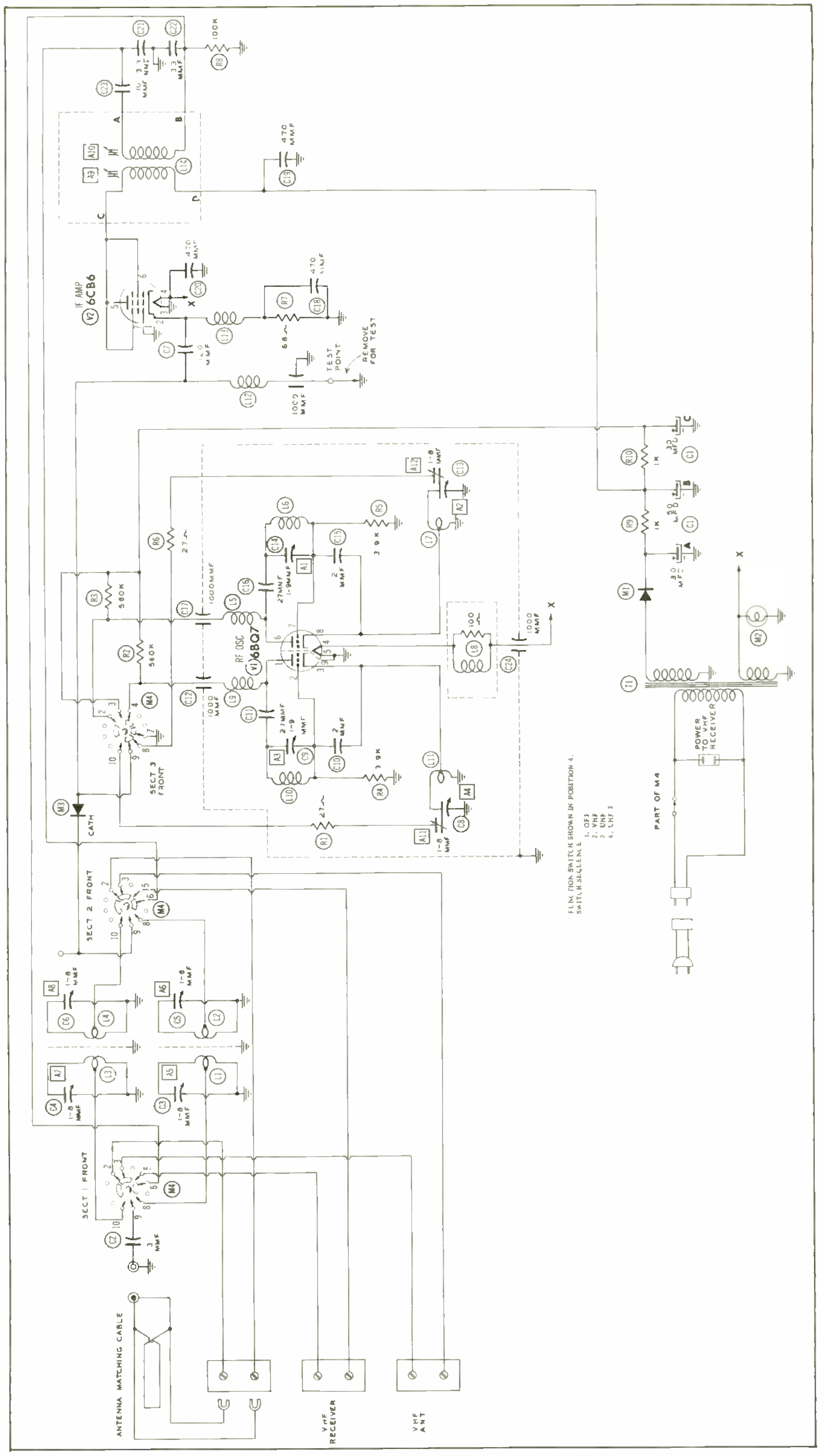

Figure 11. Schematic of RCA Model U2.

protrude slightly through cutouts in the chassis so as to locate the switch contacts immediately adjacent to the desired tuned circuit. A shield is situated between the first and second preselector circuit. Coupling between these circuits is provided by a small slot in a portion of the shield. The signal from the second preselector circuit is fed to the series connected crystal mixer through the switch contacts on the selector switch. The schematic of the U2 is shown in Figure 11.

Figures 12 and 13 show parts placement in the U2 converter.

The oscillator portion of the receiver is contained in a shielded compartment in one corner of the chassis. A type 6BQ7 dual triode

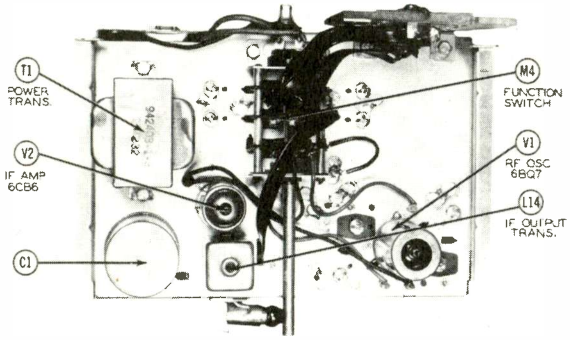

Figure 12. Top Chassis Photo of Model U2.

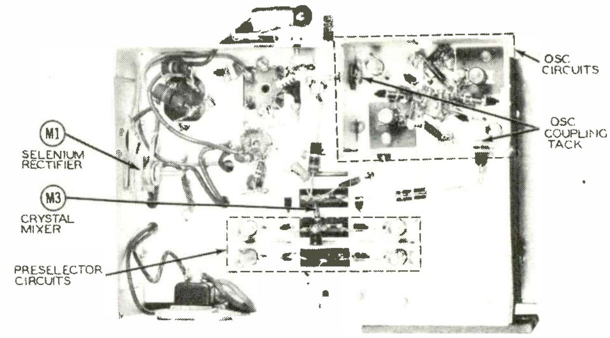

Figure 13. Bottom Chassis Photo of Model U2.

functions as a twin oscillator tube. Only one oscillator section is energized at any one time. This is determined by the setting of the selector switch. Both oscillator-tuned circuits are identical. The fundamental frequency of the oscillator sections is between 200 and 300 megacycles. Harmonic tank coils positioned adjacent to the oscillator's tank circuits are tuned to the second harmonic (400 to 600 megacycles) of the fundamental to cover the lower half of the UHF TV band. The upper half of the band is tuned by using the third harmonic (600 to 900 megacycles) to the oscillator frequency. Coupling the harmonic signal to the crystal mixer together with the applied input signal yields the desired intermediate frequency at the mixer output.

Maintaining the oscillator injection voltage at the correct value for each channel to obtain desired crystal current of .75 milliamperes is vital to efficient converter performance. A large metal-headed tack extends through the oscillator compartment wall to provide pickup from the harmonic tank circuit. The spacing of this tack in reference to the harmonic tank determines the crystal mixer injection current. A wire lead on top of the chassis may be unsoldered for inserting an 0-5 milliammeter when measuring crystal current. The tack is adjusted for the desired .75 ma. reading and is then soldered in position. This adjustment should be made with the oscillator compartment shield in place and with the circuits tuned to receive a station, but with no signal present. Do not adjust the injection to compensate for a defective oscillator tube or crystal.

The mixer output signal is capacitively-coupled to the IF amplifier stage. This stage employs a 6CB6 pentode tube, triode-connected, in a grounded-grid circuit. Twelve megacycle bandwidth is maintained in the amplifier output covering the frequencies of channels 5 and 6.

RCA MODEL U70

The RCA Model U70, shown in Figure 14, is a UHF converter which is continuously tunable over the full UHF TV band. It is designed to operate with any television receiver capable of receiving channel 5 or 6.

Two front panel controls are employed on the Model U70, the function switch and the tuning control.

Three types of antenna systems may be used with the converter to receive UHF signals. In some locations where signals are strong, it may be possible to use the VHF antenna system to pick up UHF signals. UHF antenna systems may be used that have either 300-ohm transmission line or 72-ohm coaxial line. When 300-ohm transmission line is used, it is connected to the appropriate terminals at the back of the unit, and a "balun" is connected between the 300-ohm line and the 72-ohm input of the converter.

Converter tuning is accomplished by varying capacity in the

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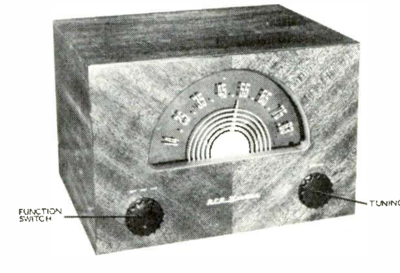

Figure 14. RCA Model U70.

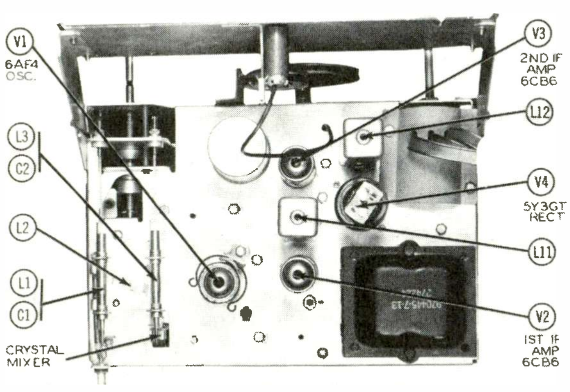

Figure 15. Top Chassis View of U70.

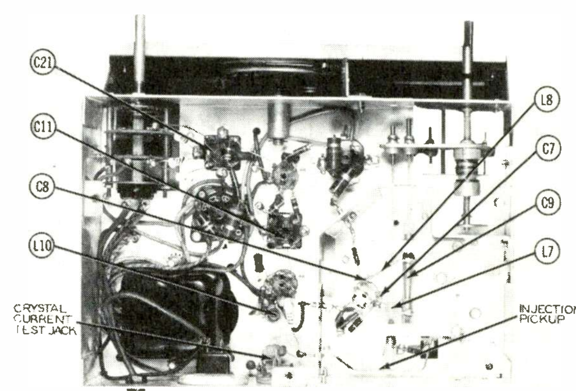

Figure 16. Bottom Chassis View of U70.

GLOSSARY OF UHF TV TERMS

A PF INDEX UHF COVERAGE

ATTENUATION: A decrease in the intensity of electrical energy.

BALUN: A device used with UHF devices to match a 300 ohm balanced line to a 72 ohm coaxial input.

BALANCED LINE: A twin-lead transmission line that operates with both lines at the same level above ground.

BALANCED OUTPUT: A property of a UHF tuning system whereby the output connections are at the same potential above RF ground and designed for use with a balanced line.

BANDPASS FILTER: A combination of one or more inductors and capacitors selected to permit certain frequencies to pass unattenuated while blocking other frequencies.

BANDPASS: The characteristic of an RF circuit to pass uniformly a definite range of frequencies.

BANDWIDTH: The limitations of a tuned circuit to pass uniformly a range of frequencies.

BOW TIE: A fan dipole antenna used as a UHF antenna. It consists of two triangular pieces of metal, mounted with their apexes coming together and feeding a transmission line.

BROADSIDE ARRAY: An antenna having the elements mounted in the same plane with the maximum sensitivity in a direction perpendicular to that plane at the center of the array. The currents in all elements are in phase.

COLINEAR ARRAY: An antenna having the elements mounted end-to-end in a straight line.

CRYSTAL DIODE: A form of detector employing silicon, germanium or other substance possessing the property to pass a current in only one direction.

CRYSTAL MIXER: A device employing a crystal diode as a mixer in a superheterodyne circuit to obtain a beat frequency signal from two applied signals.

CRYSTAL NOISE: Interference covering a wide band of frequencies, also called random noise. It is generated within a crystal diode mixer when driven by an injection voltage from the local UHF oscillator. Crystal noise is also referred to as temperature noise.

CASCODE CIRCUIT: A circuit employing two triode stages in series, with the first a conventional grid driven stage and the second employing a grounded grid. Commonly used as an IF amplifier stage in a UHF tuning device.

CHARACTERISTIC IMPEDANCE: A term used in connection with transmission lines. A transmission line of infinite length presents the same impedance to the source if the line is terminated at any point on its length with a resistor, or load, equal to the impedance of the line. Impedance of a transmission line is a fixed value and depends on the spacing and the dimensions of the conductors. Also called surge impedance or line impedance.

CONCENTRIC RESONANT LINE: A section of transmission line, usually 1/4 wave length long, employed in tuned circuits. It is usually formed into a cylindrical shape to facilitate tuning by sliding contacts, and to reduce space requirements.

CONVERSION GAIN: An increase of the signal level in the mixer output, of a superheterodyne circuit, over that of the applied signal. This condition is common to circuits employing a vacuum tube mixer.

CONVERSION LOSS: A decrease of signal level in the output of a mixer circuit over that of the applied signal. This condition is present in UHF tuner units employing crystal mixers.

CROSS-MODULATION: An interference, with a desired received signal by an undesired signal from a station operating on a nearby channel. This interference is minimized because of the RF selectivity in the preselector.

COAXIAL LINE: A type of transmission line employing a conductor placed inside a circular metal tube.

CAVITY RESONATOR: A tuned resonant circuit used in UHF and higher frequency applications.

CORNER REFLECTOR: A type of UHF antenna which features a reflecting screen surface consisting of several parallel elements arranged in two intersecting planes. The driven element of the antenna lies within the angle formed by these planes.

DOUBLE CONVERSION: A method for reducing an incoming signal to the desired intermediate frequency by a double-step process employing two local oscillators and two mixers. In practice, most of the separate UHF converter units employed with television receivers utilize this system.

DECIBEL (db): A unit of measurement to determine the ratio between two levels of power, voltage, or current.

DISTRIBUTED CONSTANTS: Capacitance, inductance and resistance existing throughout the area of a circuit as opposed to lumped constants existing in separate components.

DRIP LOOP: A loop formed in a transmission line at a point where it enters a building. Condensation of moisture and water that may form on the line will drip off at the loop and thus will not enter the building.

END-FIRE ARRAY: An antenna having the elements mounted parallel, and with the currents out of phase. The best sensitivity is in a direction on the plane of the elements and at right angles to the center of the elements.

FAN DIPOLE: An antenna constructed of two metal triangles lying in the same plane with apexes coming together to feed a transmission line. (Also "BOW TIE".)

IMAGE FREQUENCY: The image frequency is equal to the local oscil-

♦ ♦ Please turn to page 117 ♦ ♦

A PF INDEX

UHF TUBES

COVERAGE

by

merle e. chaney

To date, there are two tubes that have been developed specifically for UHF television receivers. These are the 6AF4 and the 6AN4. Both are 7 pin miniature types employing double grid and plate connections to reduce lead inductance.

The chief items of concern in the engineering of tubes for UHF were cost of the finished product, efficiency, and compatibility to current design practice. To produce a tube to operate at ultra high frequencies was not a particularly difficult problem. Many years prior to UHF television, tubes had been developed to operate at microwave frequencies. Since these were primarily used for industrial or specific applications, the cost factor was not a primary concern.

On the other hand, it was necessary to remain mindful of the end purpose of the product. That is, tubes acceptable for television receivers would be those whose relative cost and adaptability to current production techniques closely paralleled that of present type tubes.

The 6AF4 is at present the most popular tube for use as the UHF local oscillator. It was developed through adaptation of an earlier tube design (6F4), whose characteristics and features were essentially those desired. The 6F4 is an acorn type oscillator triode for use at frequencies up to approximately 1200 megacycles. Its design ratings closely approximate those desired in a UHF oscillator tube.

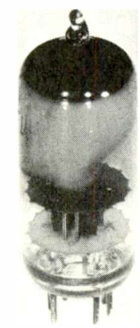

Figure 1. 6AF4

It was not difficult then, to incorporate the desired features of the 6F4 acorn tube into the standard

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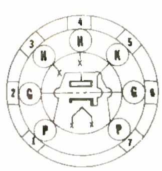
Sylvania Type 6AN4

U H F AMPLIFIER-MIXER



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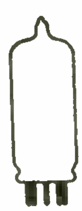


PHYSICAL SPECIFICATIONS

Base	Miniature Button 7 Pin
Bulb	T-5½
Maximum Overall Length	1¾"
Maximum Seated Height	1½"
Mounting Position	Any
Basing	7DK

RATINGS

Heater Voltage	6.3 Volts
Maximum Plate Voltage	300 Volts
Maximum Plate Dissipation	4 Watts
Maximum Cathode Current	30 Ma.
Maximum Heater-Cathode Voltage (DC or Peak)	100 Volts
Maximum Grid Circuit Resistance:	
Fixed Bias	0.1 Megohm
Cathode Bias	0.5 Megohm

TYPICAL OPERATION

Class A Amplifier

Heater Voltage	6.3 Volts
Heater Current	225 Ma.
Plate Voltage	200 Volts
Cathode Bias Resistor	100 Ohms
Plate Current	13 Ma.
Transconductance	10,000 µmhos
Amplification Factor	70
Grid Voltage for Ib = 20 µa	−7 Volts

MIXER SERVICE

Plate Voltage	125 Volts
Cathode Bias Resistor	270 Ohms
Plate Current	7 Ma.
Oscillator Injection Voltage (RMS)	1.4 Volts
Conversion Conductance	2900 µmhos

APPLICATION

Miniature high mu triode designed for use as a grounded grid amplifier or mixer in u h f television applications.

U H F Oscillator Sylvania Type 6AF4

MECHANICAL DATA

Bulb	T-5½
Base	Miniature Button 7-Pin
Basing	7DK
Cathode	Unipotential
Mounting Position	Any

ELECTRICAL DATA

HEATER CHARACTERISTICS

Heater Voltage	6.3 Volts
Heater Current	225 Ma

DIRECT INTERELECTRODE CAPACITANCES (Unshielded)

Grid to Plate	1.9 µµf
Input	2.2 µµf
Output	0.45 µµf

RATINGS (Design Center Values)

UHF Oscillator Service

Plate Voltage	150 Volts Max.
Plate Input	2.5 Watts Max.
Plate Dissipation	2.25 Watts Max.
Negative Grid Voltage	50 Volts Max.
Grid Current	8 Ma Max.
Cathode Current	28 Ma Max.
Heater-Cathode Voltage	80 Volts Max.
Grid Circuit Resistance	
Fixed Bias	Not Recommended
Cathode Bias	0.5 Megohm Max.

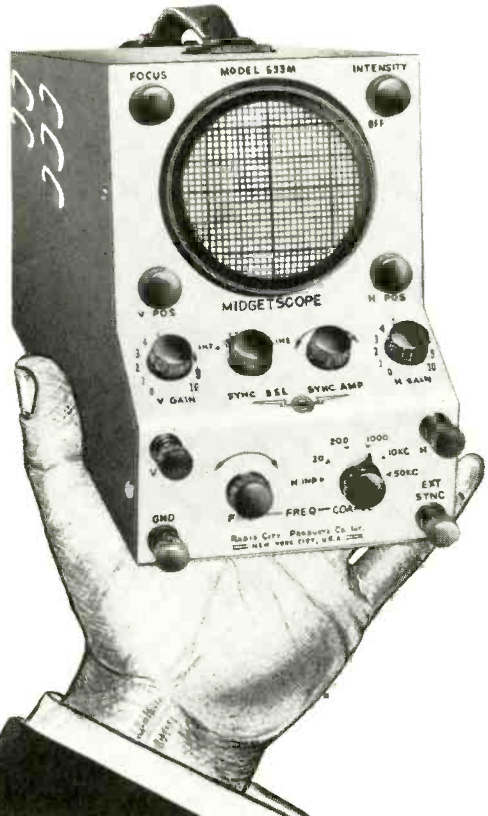
AVERAGE CHARACTERISTICS

Class A_1 Amplifier

Plate Voltage	80 Volts
Cathode Bias Resistor	150 Ohms
Plate Current	16 Ma
Transconductance	6600 µmhos
Amplification Factor	15
Plate Resistance	2270 Ohms

TYPICAL OPERATION (Oscillator at 950 mc)

Plate Voltage	100 Volts
Grid Voltage (Self Bias)	−4 Volts
Grid Resistor	10000 Ohms
Plate Current	22 Ma
Grid Current (approx.)	400 µamps



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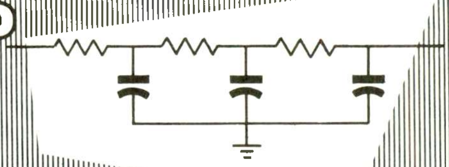

BY C. P. OLIPHANT

(Part 1)

The purpose of the vertical section of the television receiver is to provide a linear, vertical sweep which is synchronized with the vertical scanning in the camera at the transmitter. To accomplish these requirements, a circuit consisting of a filter network, a synchronized oscillator and a saw-tooth generator is employed. The saw-tooth pulse produced by this circuit, is either a current or voltage wave shape, depending upon the type of deflection being employed. A saw-tooth sweep voltage must be applied to the picture tube when electrostatic deflection is used. In electromagnetic deflection, a saw-tooth sweep current must be used, since deflection of the beam is accomplished by an electromagnetic field produced at the neck of the picture field.

Vertical Pulse Filter -

After the sync pulses have been separated from the composite signal they must pass through a filter network to separate the vertical and horizontal pulses. The most common method of filtering the vertical sync pulse is through the use of a low-pass filter. Figure 7-1 is representative of a single-stage low-pass filter. This network, which is known as an "integrating" circuit, consists of a series resistance (R) and a capacitance (C), with the output being taken from across the capacitance.

In order to understand the operation of an integrating network, a brief discussion of the transmitted vertical pulses should be given. Figure 7-2 represents the vertical sync pulse interval and the leading and trailing equalizing pulses. Vertical blanking begins immediately after the last horizontal line of each field and continues for 15 to 22 lines. This time is to allow the beam to be returned from the bottom to the top of the screen. The vertical blanking period includes six leading equalizing pulses, six serrated vertical pulses and six trailing equalizing pulses. These are then followed by the horizontal synchronizing pulses.

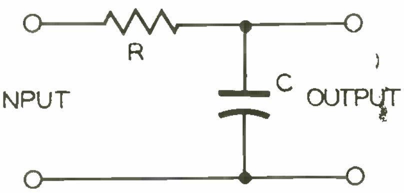

Figure 7-1. A Single-Stage Low-Pass Filter.

The equalizing pulses are for the purpose of allowing the vertical pulse to produce equal synchronizing voltages for both the even and odd fields. The serrated vertical pulse is the pulse that is integrated to provide a triggering voltage to synchronize the vertical oscillator.

In order to show how the integrating network of Figure 7-1 is able to filter the vertical sync pulse from the horizontal sync pulse, the circuit in Figure 7-3A is employed. At the instant switch S1 is closed, a current begins to flow through resistance R and charges the capacitor C. The capacitor will continue to charge until its charge tends to reach the voltage of the battery. This condition will hold until switch S1 is opened and switch S2 is closed. At this time the capacitor will discharge through resistance R and switch S2.

The charging and discharging time of the capacitor is determined by the values of R and C. The larger the values of R and C, the longer the charging and discharging time will be. This time is known as the time constant (RxC) of the circuit. The charging and discharging times are equal. The voltage curve (A) of Figure 7-3B shows the voltage across C during the charging and discharging intervals.

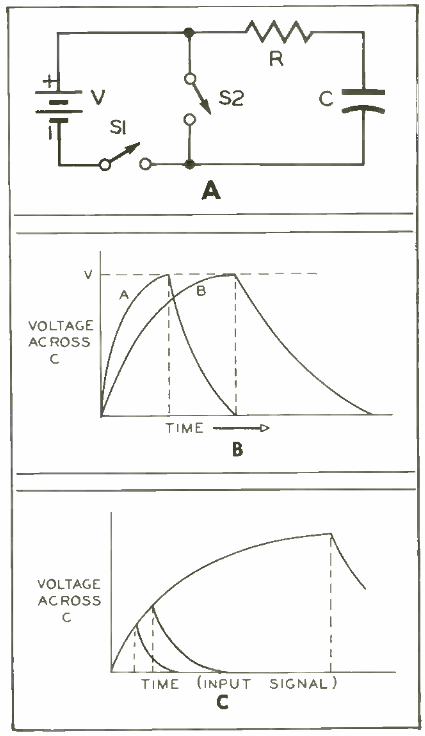

Figure 7-3. Operation of An Integrating Network. (A) Integrating Network With an Applied Voltage. (B) Voltage Across Capacitor C, Plotted Against Time. (C) Voltage Across C With Input of Varying Time.

The voltage curve (B) in Figure 7-3B is the result of either

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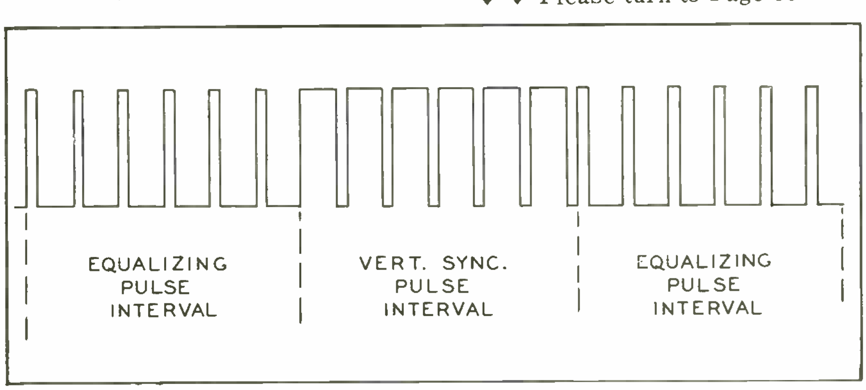

Figure 7-2. Vertical Sync Pulse Interval With Leading and Trailing Equalizing Pulses.

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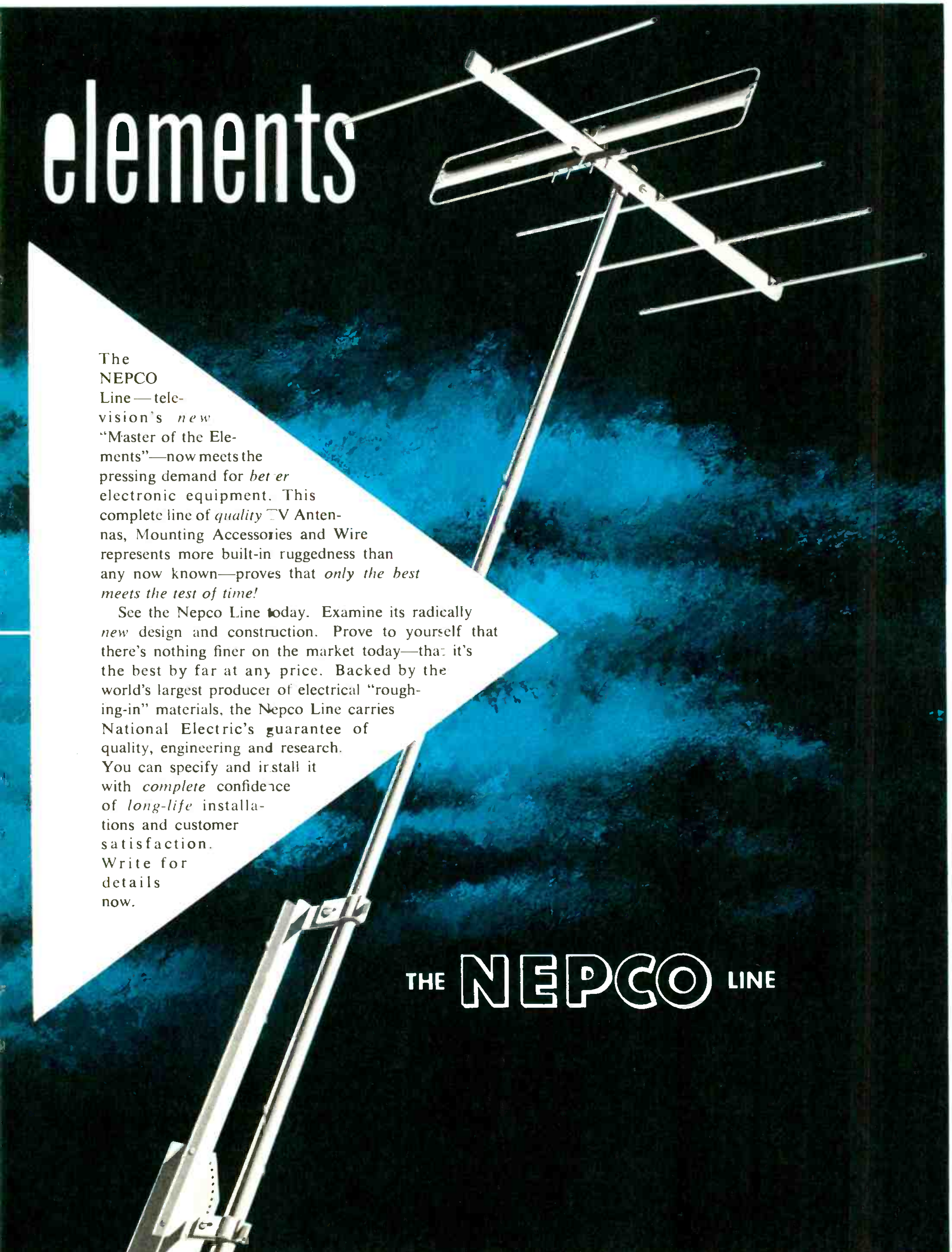
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tends to prevent the erratic control of vertical retrace by random noise or static pulses. The time constant of each single section is designed to be equal to, or greater than, the duration of one vertical sync serration (27 microseconds).

Figure 7-6 shows the input and output waveforms of Figure 7-5. The waveform of Figure 7-6A was taken at point W1 and represents the signal as it appears at the output of the sync separator and sync amplifier circuit. The waveform, at this point, contains both the horizontal and vertical sync pulses. The vertical pulses appear as widely spaced, sharp spikes. A large portion of the waveform is due to the action of the synchronized oscillator.

Figure 7-6B shows the waveform as it appears at the output of the integrating network of Figure 7-5 (point W2). Due to the action of the integrating network, this waveform is completely absent of any horizontal sync pulses. The actual vertical sync pulse is visible as a slight positive pip on the leading edge of the waveform. This sync pip is the controlling pulse of the synchronized oscillator. If it were not present, the image on the screen of the picture tube would roll either up or down, depending upon the setting of the vertical hold control. Again, a large portion of the waveform is due to the action of the synchronized oscillator.

In some receivers that have interchassis cabling, the integrating network is preceded by a single-stage differentiating network. This network is used to counteract the stray capacitance of the interchassis cabling which distorts the leading edge of the vertical sync signal.

Another method of filtering the vertical sync pulse that is being employed in some receivers is shown in Figure 7-7. By this method the sync signal is passed through a single-section low-pass filter and a vertical sync separator tube. The use of a sync separator tube is employed because the vertical sync pulses are attenuated by the circuit that is incorporated to improve horizontal sync stability under noise (C 55, R82). By the use of a low-pass filter in conjunction with a sync separator tube, the vertical sync-to-noise ratio is improved.

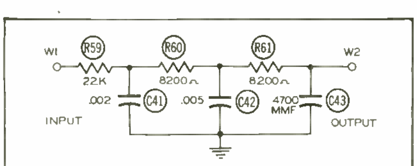


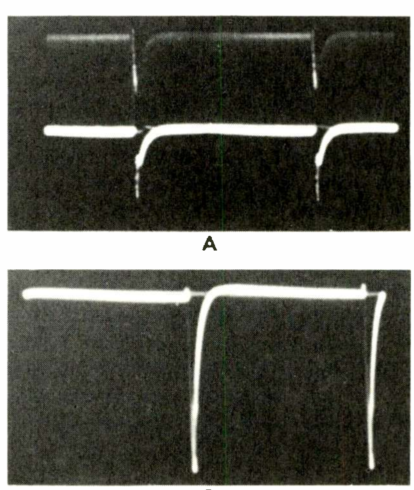
Figure 7-5. A Cascaded Integrating Network.

The combined sync pulses are fed into the single-section filter, consisting of R67 and C57, where the vertical sync pulse is partially filtered from the horizontal sync pulse. The vertical pulse then passes directly into the vertical sync separator tube where it is further filtered and amplified. Since the vertical sync separator stage is designed to pass only the vertical sync pulses, the output consists of a smoothly integrated sync pulse, which is used to trigger a multivibrator.

Vertical Oscillators -

After being properly filtered, the vertical pulse is then coupled to a blocking oscillator or a multivibrator. In this stage, the vertical pulse is used to keep the scanning beam of the receiver in step with that of the transmitter. Each circuit must be able to respond to rapid changes from conduction to nonconduction in periods of controlled duration. When cost of production is taken into consideration, the multivibrator is usually employed because the added expense of a feedback transformer is not needed.

The nonsynchronized frequency of the oscillator must always be



A

B

Figure 7-6. Waveforms of Figure 7-5. (A) Input at W1. (B) Output at W2.

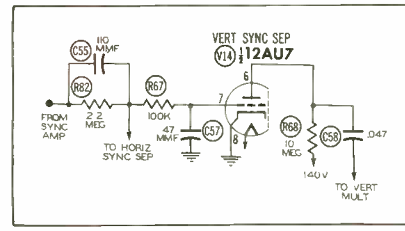


Figure 7-7. Vertical Sync Separation Circuit Which Employs the Use of a Single-Section Low-Pass Filter and a Vertical Sync Separator Tube.

lower than the frequency at which the oscillator is locked in by the sync pulses. In order to obtain proper lock-in, these two frequencies must be close together.

Blocking Oscillator: Figure 7-8 represents a typical blocking oscillator circuit employed in present day receivers. As is typical of all blocking oscillator circuits, the voltage feed-back is provided by the transformer, T2. The trace portion is formed when the tube connects.

This circuit employs the use of one-half of a 6SN7 operating with grid-leak bias. The operation of the circuit begins at the time power is applied to the plate of the tube. Upon the application of power, current begins to flow in the circuit because there is no bias, due to the action of the grid-leak arrangement. With the increase of plate current flowing through the primary of the feedback transformer, a voltage is induced across the secondary of the transformer which is applied to the grid circuit. The secondary of the transformer is poled so that the voltage induced by the current flowing through the primary drives the grid positive. The grid being driven positive increases the current through the tube, which, in turn, increases the current flowing through the primary of the transformer.

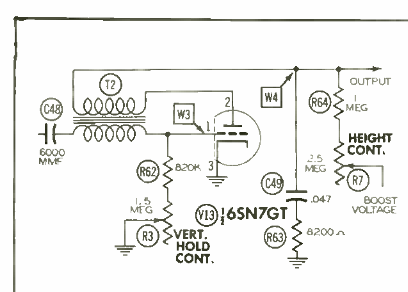


Figure 7-8. A Blocking Oscillator Employing One-Half of a 6SN7.

This drives the grid more positive until the tube reaches the saturation point. While the tube is reaching the saturation point, a negative charge is being placed on the grid side of capacitor, C48, due to grid current flow. The capacitor will hold that charge until after the point of saturation of the tube.

When the point of plate current saturation is reached, the magnetic field around the primary of T2 is no longer changing. Since the induction of voltage into the secondary depends upon the changing magnetic flux, there is no further increase in voltage at the grid. This tends to make the grid become less positive, reducing the plate current flow. This reduction in plate current flow causes the magnetic field to collapse, which will cause an instantaneous change of polarity across the secondary of the transformer. This reversal of polarity aids in the discharge of C48, which sends the grid further negative until the point of plate current cutoff is reached. From this point the grid potential follows an exponential curve of R-C discharge until the point of plate conduction is again reached. In actual operation, this action of reversal of grid voltage and cutoff of plate current is instantaneous.

The RC combination of the capacitor C48 and the resistors R62 and R3 controls the frequency of operation of the oscillator. The values of these components are chosen so that the free-running frequency is adjusted slightly lower than the controlling frequency of the vertical sync pulse. As a result, the oscillator is brought out of cutoff by the vertical pulse before C48 has dissipated all its charge. Therefore, the controlling factor of the oscillator is the vertical sync pulse. R3 is made variable so that the frequency of the oscillator can be manually changed for synchronization with the incoming vertical pulse. This resistor is the vertical hold control. The coupling capacitor, C48, can be placed in the circuit to the right of the secondary of the blocking oscillator transformer, instead of, to the left as is shown. It produces a similar operation in either position.

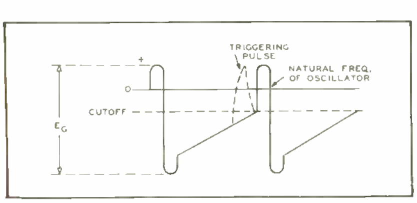


Figure 7-9. Grid Waveform of a Blocking Oscillator with Vertical Sync Pulse.

Figure 7-9 shows the waveform present at the grid of the blocking oscillator. The oscillator is operating at its natural frequency and will do so until the vertical pulse reaches the grid and triggers the oscillator. The dotted pulse shown in Figure 7-9 is the triggering pulse of the vertical sync. The photograph in Figure 7-10 is the waveform taken at point W3 of Figure 7-8. It shows the actual operation at the grid of the blocking oscillator, with the vertical sync pulse triggering the oscillator at the sync frequency.

The output of the oscillator is taken from the primary side of the feed-back transformer and is fed to the saw-tooth forming capacitor. In the circuit of Figure 7-8 the saw-tooth capacitor is C49. Across this capacitor the desirable saw-tooth, which is to be used for vertical sweep, is formed. Some circuits employ another tube in conjunction with the discharge capacitor but this is not always necessary. As is the case of the circuit in Figure 7-8, the blocking oscillator tube is also used as the discharge tube. The addition of a discharge tube is for greater stability. If good stability is obtained with the use of the blocking oscillator tube alone, the additional discharge tube is not necessary.

Since the saw-tooth capacitor is effectively connected between plate and cathode of the blocking oscillator, the charge and discharge of the capacitor will be controlled by the operation of the blocking oscillator tube. With the controlling frequency of the oscillator being 60 cps, the charge and discharge time of the capacitor will be the same.

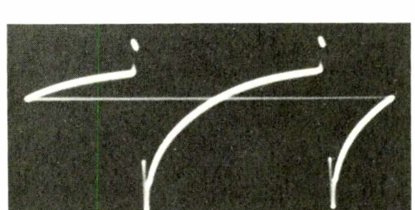


Figure 7-10. The Grid Waveform of the Blocking Oscillator of Figure 7-8, Taken at Point W3.

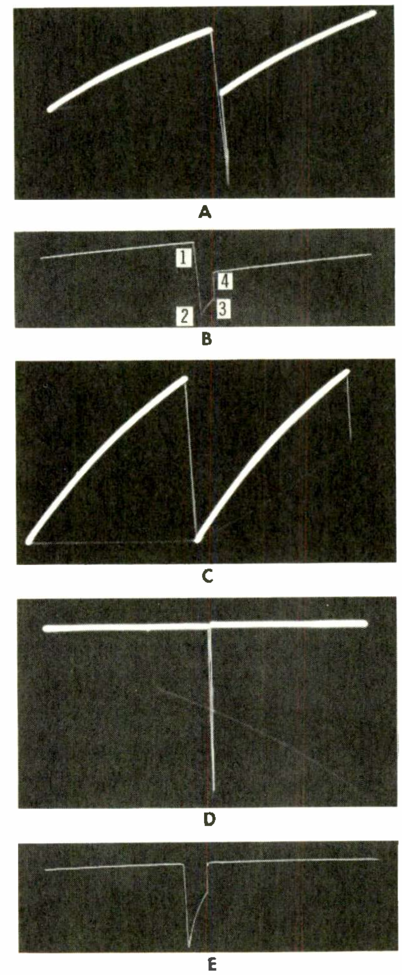


Figure 7-11. (A) Waveform Taken Across the Discharge Capacitor and Peaking Resistor of Figure 7-8. (B) An Expanded View of Photograph A. (C) Waveform Across The Discharge Capacitor. (D) Waveform Across the Peaking Resistor. (E) An Expanded View of Photograph D.

During the time the oscillator tube is cut off, the capacitor C49 is being charged and will continue to charge until the tube conducts. During the time of the short conduction of the tube, the capacitor has a relatively small resistive path through which it is able to discharge.

The purpose of R63 is to provide a peaking action to the discharge portion of the saw-tooth produced across C49 and R63. Since the deflection coil contains both resistance and inductance, the input voltage to the deflection coil must be a trapezoidal wave in order to provide a saw-tooth of current through

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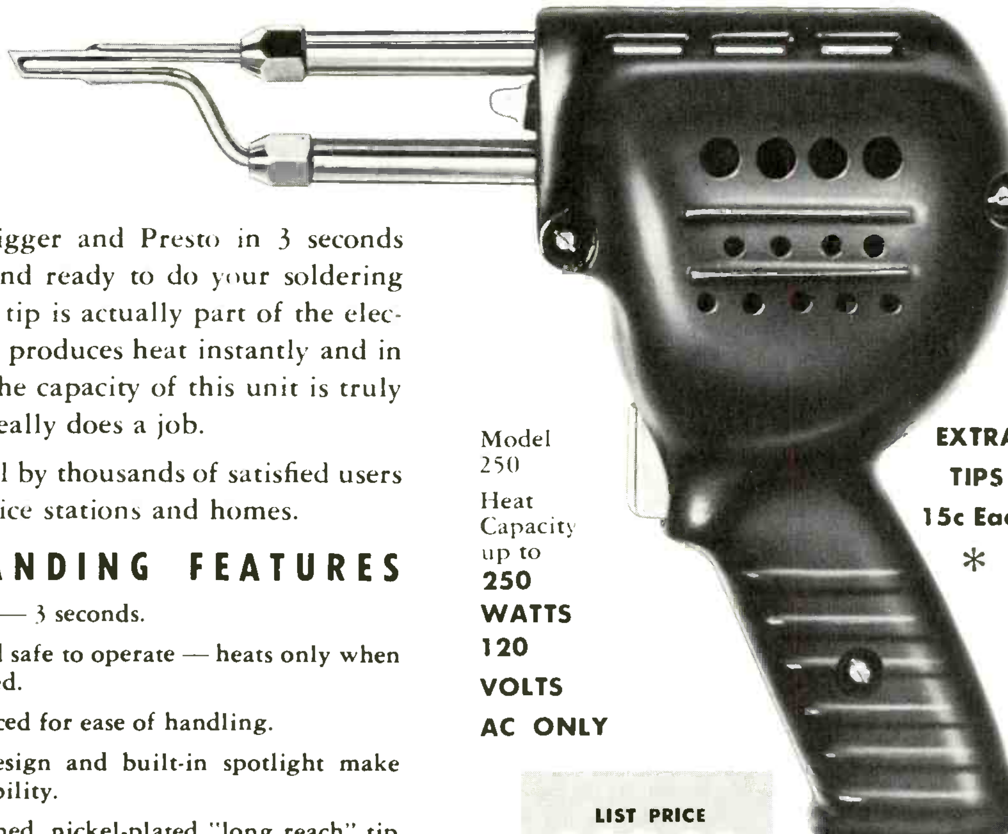

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the coil. This is accomplished through the use of R63 placed in the discharge path of the capacitor C49.

The effect of the resistor is shown by referring to Figure 7-11. Photograph (A) is the waveform taken between point W4 and ground of Figure 7-8. Photograph (B) is the same waveform as in photograph (A), except the horizontal sweep of the scope was expanded so that the discharge portion of the waveform could be viewed. Since the trace time of the waveform is so much greater than the retrace time, the trace portion in photograph (B) becomes flat as a result of greatly increasing the horizontal sweep of the scope.

At point 1, the charge portion of the waveform has been completed and the retrace portion is ready to begin. Between points 1 and 2 the voltage immediately drops to minimum because of the voltage drop developed across R63. At point 2 the discharge current starts to diminish at an exponential rate. The exponential discharge portion is shown between points 2 and 3. At point 3 the tube is cut off and the charge portion of the waveform begins. At the time the tube stops conducting, the plate voltage suddenly rises to point 4. The capacitor then charges through the plate load resistance until point 1 is again reached.

The waveform in Figure 7-11C is the voltage wave that is present across C49. The waveform that is present across the peaking resistor is shown in Figure 7-11D. It is the addition of these two waveforms that make up the output waveform shown in Figure 7-11A. In order to show the actual pattern of the waveform across the peaking resistor, an expanded view of the waveform in Figure 7-11D is shown in Figure 7-11E.

The main requirement of the saw-tooth waveform is good linearity. Since the charging of the capacitor is usually non-linear over the entire portion of the charging cycle, only a small portion of the cycle must be used for the best results. The degree of linearity can be improved by placing a large series resistance in the charging path of the capacitor. In the circuit of Figure 7-8 this resistance consists of R64 and R7. Since the frequency of the charging and discharging of the capacitor is controlled by the operation of the blocking oscillator, the amplitude to which the capacitor may charge can be controlled by making the charge resistance variable. In Figure 7-8 the variable resistor, R7 is the height control of the receiver. Increasing R7 increases the time constant of the charge path and decreases the amplitude to which the capacitor is able to charge before the blocking oscillator begins to conduct. Decreasing the resistance makes the time constant of the circuit on the charge portion shorter and increases the amplitude to which the capacitor is able to charge. Figure 7-12A shows the effect upon the capacitor when the value of the charging resistance is changed. With R1 being the lowest of the three resistances, the voltage across the capacitor reaches the highest peak.

A boost voltage is applied at the center tap of the height control in the circuit of Figure 7-8. The purpose of this boost voltage is to increase the amount of the charge across the capacitor, so that a more linear portion of the charge curve may be used. Figure 7-12B is representative of applying a boost voltage to the charging path of the capacitor. During the increment of time between T1 and T2 the portion of curve (B) is more linear than the portion of curve (A). Curve (B) is the result of boosting the voltage so that the curve will be more linear. The use of a boost voltage, in conjunction with the variable height resistor, aids in producing a linear saw-tooth voltage of the proper amplitude for driving the vertical output stage.

As was stated at the beginning of the discussion on the discharge circuit of the blocking oscillator, some receivers employ the use of a discharge tube in conjunction with the discharge capacitor. Whenever an increase of cost in production can be sacrificed for greater stability in the vertical sweep, the extra tube for the discharge circuit is used. Figure 7-13 is representative of a blocking oscillator circuit employing a discharge tube. The first half of the 6SN7 tube is used for the blocking oscillator and functions in the same manner as was described in the discussion of the blocking oscillator of Figure 7-8. The other half of the 6SN7 is used as the discharge tube in conjunction, with the discharge capacitor, C61.

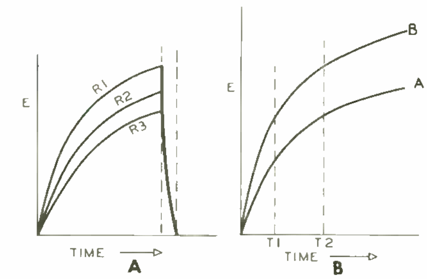

Figure 7-12. (A) The Effect on the Charge of the Sawtooth Forming Capacitor with Different Values of Charging Resistance. (B) The Effect on the Charge of the Capacitor With the Application of a Boost Voltage.

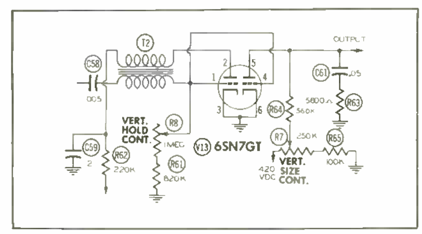

Figure 7-13. Blocking Oscillator and Discharge Circuit Employing One-half of a 6SN7 to Discharge The Saw-tooth Capacitor.

Since the two grids of the tube are tied directly together, the discharge tube operates through the same cycle as the blocking oscillator. Any variation at grid 1 is present at the same time on grid 2. Whenever grid 1 is at cutoff grid 2 will also be at cutoff and no plate current will flow in the discharge tube. As before, when the discharge capacitor was connected from the plate to the cathode of the blocking oscillator tube, the discharge capacitor, C61, will acquire its charge from the power supply through the resistance combination R7 and R64. When the blocking oscillator plate is drawing current, the plate of the discharge tube, also, will draw current, placing the tube into operation. During this time the discharge capacitor will discharge through the low resistive path of the discharge tube. There is less chance of the operation of the blocking oscillator being interrupted when the discharge path of the capacitor is through a section other than the blocking oscillator. This is the reason for greater stability when this type of circuit is employed.

C. P. OLIPHANT

Built-in UHF Tuning Units -

Eventually, when large numbers of UHF stations are in operation, it is expected that television sets in production will be factory equipped with UHF tuning provisions. Currently, several manufacturers are offering two versions of their television receivers; one for VHF reception only, while the other is equipped for both VHF and UHF reception.

Two types of built-in tuning systems are now in evidence. One is employed in receivers equipped with turret tuners containing tuning strips. UHF tuning strips may be substituted in place of any VHF strips in positions where VHF signals are not received. These UHF strips are supplied for any specified channel.

The second type of built-in UHF tuning system employs separate VHF and UHF tuners, with the UHF tuner output fed into the VHF tuner and then to the video IF circuits. If the VHF tuner is unmodified, the UHF tuner output is usually accepted on channel 5 or 6 position, whichever is not used in the receiving area. Switching antennas and B+ to the UHF tuner is usually accomplished by a linkage assembly operated automatically or manually. A separate UHF tuner control is provided in this application.

Some television receivers employing built-in UHF systems use a VHF tuner, modified so that it contains more than the usual 12 positions. One or two additional positions may be used on this type tuner. An advantage of the additional position on the VHF tuner is that a single conversion system is feasible. A block diagram is shown in Figure 4. The UHF signal may be converted in a single process to the frequency of the receiver IF stages and the VHF tuner then becomes a two stage IF amplifier. Switching to UHF position also diables the local oscillator in the VHF tuner since it is not required in the tuner's application as an IF amplifier.

UHF channel indication is an important factor when tuning in a UHF station. One method is to use a drum type dial on a shaft concentric with the VHF tuner shaft and a drum or pulley arrangement to control its operation. To minimize the number of operating controls, the VHF fine-tuning control is usually employed to tune the UHF system.

Connecting B+ and switching antennas in this type of built-in UHF

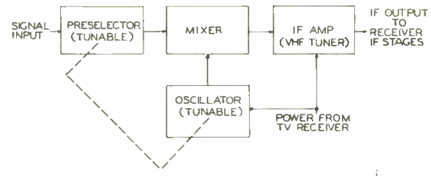

Figure 4. Block Diagram of Built-in UHF System, Employing VHF Tuner as IF Amplifier (Single Conversion).

system is effected by, either a switch operated by a cam arrangement on an extension of the VHF tuner shaft, or by switch controls in the modified VHF tuner.

Specific descriptions of a number of UHF tuner units are given in this, and previous issues, of the PF INDEX and Technicial Digest. However, a description of these circuits collectively should aid in formulating a better understanding of UHF tuning devices as a whole. A breakdown, circuit-wise, of UHF tuning devices shows that each utilizes the following circuitry provisions.

1. Preselector.
2. Oscillator.
3. Mixer.
4. IF Amplification.
5. Power Provisions.
6. VHF-UHF Switch.

Preselector -

A preselector contained in a UHF tuner is an RF tank circuit. It provides the required selectivity for efficient performance. Usually two preselectors are used to obtain the necessary bandwidth. UHF tuners of the preset variety and built-in continuously tunable units whose output is fixed, require a minimum bandwidth of 6 megacycles. 12 megacycles minimum bandwidth is required in the continuously tuned UHF converter units whose output frequency covers two channels of the VHF tuner.

Several types of preselectors are used. Some of these employ lumped constants (inductor and capacitor), while others use transmission-line tuning, or RF cavity tuning in the tank circuit.

Lumped constants are most generally used in lower frequency applications. As the higher frequencies are approached, the physical size of inductors and capacitors decrease to such an extent that efficient control of their operation over a wide band of frequencies becomes rather difficult. This has led to the use, in several converters, of sections of transmission lines in the RF circuit.

A transmission line cut to one fourth wave-length and shorted at one end acts as a parallel resonant circuit and may be efficiently employed in RF tuner applications. Variable tuning is achieved by lengthening or shortening the transmission line to provide resonance over a desired range of frequencies.

At the frequencies of UHF television channels, a one-fourth wave-length transmission line may be several inches in length. In order to tune the transmission line, its electrical length must be changed. This is done mechanically by means of a slider or shorting bar, or electrically by capacitance or inductance. Sometimes the configuration of the tuned line is in the form of a concentric-shaped element, to minimize space requirements, and to facilitate shorting action by sliding contacts attached to a radial arm.

UHF Oscillator -

To effect the superheterodyne action in a UHF tuner, a local oscillator operating at the fundamental, half or third-frequency is provided. The most popular tube for UHF oscillator applications is the 6AF4, designed specifically for this purpose. In those instances where one of the current high production type tubes is used as the oscillator, it is designed to function at half-frequency in the continuously tunable converter units or at one-half or one-third frequency in the preset types.

In UHF tuning systems employing double conversion, it is customary for the UHF local oscillator to function below the frequency of the incoming signal to present the correct relationship between the video and sound carriers at the receiver IF circuits.

In built-in UHF tuning systems of the single conversion type, the local oscillator operates above the frequency of the incoming signal in the same manner as the local oscillator in a VHF tuner.

A problem common to oscillator circuits in all receivers, is that of radiation. To maintain oscillator radiation at a minimum, all oscillator circuits in UHF tuners are completely shielded. Also, there is the problem of oscillator coupling back through the RF system to the antenna which could result in undesirable interference with other receivers. This difficulty is met in lower frequency tuning units by employing an RF stage of amplification between the mixer and antenna system which acts to block oscillator coupling to the antenna. Although RF amplification is not extensively employed in current UHF converter units, the problem of oscillator coupling to the antenna is minimized in another way. A crystal mixer is used, necessitating low oscillator injection voltages for correct mixing action. Thus, the comparatively weak signal applied to the mixer circuit, together with the shielding of the oscillator circuit, maintains radiation at a minimum.

UHF Mixer -

When the incoming UHF signal and the local oscillator signal are fed to the mixer circuit, the resultant heterodyne signal is the desired intermediate frequency. Crystal diodes have been used extensively in this application. Three popular crystals for this purpose are the CK-710, IN72, and IN82. Features of crystal diodes as UHF mixers are: low cost, simplicity, and low noise figure. The main disadvantage of a crystal diode employed as a mixer is that a conversion loss of about 8 or 9 db results. This is usually compensated for by one or more stages of intermediate frequency amplification ahead of the receiver's IF circuits.

Efficient mixing action by a crystal diode demands that the oscillator injection voltage be uniform throughout the range of the UHF band. Continuously tunable UHF units are designed with this mind. However, the preset UHF converters can be provided with sufficient means to establish this voltage at the designated value. Injection voltage to the crystal mixer is measured by connecting a milliameter to measure crystal current. By varying the coupling between the oscillator and mixer the desired crystal current may be read on the meter.

IF Amplification -

Amplification of the IF signal from the mixer circuit, essential for efficient UHF television reception, is provided to compensate for the lack of RF amplification and the use of a "losser" type mixer. As previously stated at the beginning of this article, the UHF converter unit, when employed with a television receiver, connects in series between the VHF tuner and the antenna system. One function of the VHF tuner is to amplify the converted signal from the UHF unit. If double conversion is employed, it has a dual function. It amplifies the applied signal, and converts it to the frequency of the video IF circuits in the receiver. For single conversion systems, the VHF tuner functions strictly as an IF amplifier at the frequency of the video IF stages in the receiver.

In addition to the amplification provided by the above described method, many units incorporate one or two stages of IF amplification prior to application of the signal to the VHF tuner. Usually, these amplifier stages will be included in the separate self-contained UHF converters.

Tubes frequently used as IF amplifiers in UHF converters are the dual-triode type 6BK7 or 6BQ7. They are usually employed in a cascode circuit, because of their inherent low noise characteristics. In some instances, one or two pentode type 6CB6 tubes are used.

Power Provisions -

Most of the externally connected UHF tuning devices are equipped with a built-in power supply. This feature facilitates the installation of the unit, since all inter-connections between the converter and receiver are external.

The power supply usually consists of a power transformer, rectifier (tube or selenium), and an RC filter network.

Built-in UHF tuners and some of the single channel preset converters receive power direct from the television receiver. The use of miniature type tubes and low power requirements of these units place only slight drain on the receiver power supply.

VHF - UHF Switch -

An important factor, contributing greatly to the ease with which VHF or UHF bands may be selected is the VHF-UHF switch. It is designed to select antennas, select the input to the VHF tuner, and switch B+ on or off to the UHF tuner. Additional switch positions are provided on separate, self contained converters to also turn power on and off to the television receiver. This last operation is made possible by plugging the television line cord into the AC receptacle at the back of the converter and plugging the converter line cord into a wall socket.

Typical operation of the function switch on most UHF converters is as follows:

1. Off Position - Power to both television receiver and converter is off.

2. VHF Position - Power is supplied to the television receiver. The VHF antenna is connected through the switch contacts to the antenna input terminals of the receiver, and power is supplied to the UHF converter tube filaments.

3. UHF Position - Power is supplied to the television receiver, and B+ and filament power is applied to the converter. The VHF antenna is disconnected (grounded in some instances) and the converter output is connected through the switch contacts to the antenna input terminals of the TV set.

Successful operation of the UHF converters will depend a great deal on the care taken during installation. The higher frequencies of the UHF band will require close attention to details and the little additional effort required will pay off in customer satisfaction. The interconnecting leads should not be excessively long and should be checked for good mechanical and electrical connection. Extra care should also be taken in the dressing of the connecting leads. After the installation is complete, the customer may also require instructions for the proper operation of the controls.


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1953 TV SET At year-end, a survey of tube type in TV receivers of 19 different manufacturers shows that certain tubes are favored for each stage. Results of this compilation, published in the first issue of the newly launched magazine Electronic Design, indicate that the typical 1953 TV receiver would use the following complement of tubes:

RF Amp.	6BK7
Osc. Conv.	6J6
Video IF	three 6CB6
Video Det.	6AL5
Video Amp.	12AT7 or 6CB6
Sync. Amp., Sep., Clipper	12AU7
Vert. Osc.	6SN7
Vert. Output	6S4
Horiz. AFC	6AL5
Horiz. Osc.	6SN7
Horiz. Output	6BQ6
Damper	6W4
H. V. Rect.	1B3
L. V. Rect.	5U4
Audio IF Amp., Limiter	6AU6
AF Det.	6AL5
AF Amp.	6AV6
Audio Output	6V6 or 6W6

Of course, it is unlikely that any one receiver will actually have the above tube complement. Greatest variation will be found in video output amplifiers, where 11 different tube types were found to be servicing this function in only 22 different sets. On the other hand, chances will be 17 out of 22 that the audio detector is a 6AL5. Models coming out early in 1953 may also affect the tube popularity picture.

SILENCER PAYS OFF: Somewhere out on Long Island, a night guard in a factory stood it as long as he could, then drew his trusty 45 and put a bullet through his TV screen to silence Abbott and Costello. In appreciation of his heroic act, or perhaps because it was just man-bites-dog news, CBS-TV put the guard on their Strike It Rich program a few days later, where he won $280 for a new TV set.

DEAD ON ARRIVAL. While testing a power amplifier of a television transmitter, an employee of a large TV-radio manufacturer took the discharge of a capacitor bank that had been charged to 3,000 volts. He was knocked unconscious, and was dead by the time he had been moved to a local hospital. The transmitter was turned off, but he had apparently neglected to use the grounding stick provided for discharging the capacitors, or had accidentally touched one of their terminals before putting the stick on them. This particular man had been with the company for 16 years, working chiefly on high-voltage equipment as a test man, so he knew better. Moral: With high voltage, your first mistake may be your last.

SIAMASE TV. Marconi television transmitting equipment has been ordered for installation at Chulalongknorn University, Bangkok, which is to have the first TV station in southeast Asia.

DOUGHNUTS DISAPPEAR. To get at the tube socket terminals of a GE clock radio in 1951, you had to untwist locking tabs on top-of-chassis metal doughnuts that protected prying fingers from exposed dip-soldered terminals. GE didn't like the idea either, because it took time and money to make and install those five individual covers. Everybody will therefore be happy about the new safety cover on 1952 dip-soldered models: it's a single molded plastic piece that goes around all the tube and even has cutouts for the two IF transformers located between tubes. Loosen two screws and the entire cover comes off, exposing all terminals at once for troubleshooting.

TV SCRAPPING RATE. The number of years required for a TV set to travel from the factory to the junk heap is as yet unknown since the sets have been around in quantity for only 6 years, but a TV Digest survey comes up with the prediction that it'll be 8-1/2 years. In more dignified technical language, this is known as the wearout and scrapping rate.

For radios, the accepted life-span figure is 7 years. This is a good comparison to bring up when TV service charges are questioned on elderly sets; scrapping before retirement age is like throwing away a half-smoked cigar. The same predicters say that the average retirement age of a picture tube is 5-1/2 years--a much higher figure than we've heard anywhere up to now. This too is good news for serviceman, as adding the price of a new picture tube onto legitimate labor charges for a TV service job almost invariably makes the customer unhappy.

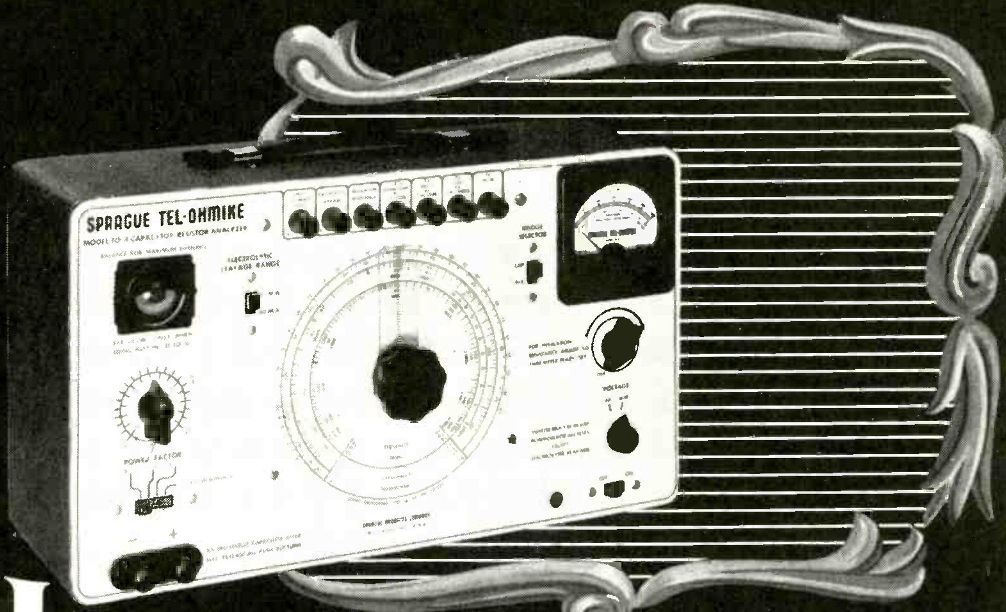
Wear in picture tubes comes mostly from electrical shock to the gun and phosphors due to turning the set on and off, so caution your customers to leave their set on in between desired programs if they want their picture tube to last longer. Continuous hours of use have little effect on the life of the tube, in comparison to the damage done by the on-off switch. The same applies to the fluorescent lamps in your shop; leave them on through lunch hour or while out on calls, and they'll stay brighter longer.

DOWN PAYMENT. Serviceman Jim Kirk requires a down payment on repair charges for old radios. This avoids the nuisance of having the sets on his shelves for months or even forever, taking up space, repair time and money, just because the customer later forgets about sentiment and decides the old set isn't worth the amount of the repair charges.

When asked for a down payment, most set owners have proved willing to pay all or almost all of the total charge willingly beforehand, and they then come for the set promptly. The set alone they may leave and forget, but set and down payment together--never! November 1952 Radio-Electronics was the source of this helpful business tip.

PIN-UP. Newest novelty hit is Motorola's pin-up clock radio, which can be hooked to a wall like a kitchen clock. Just the thing for dining room too, to bring morning news and weather to the breakfast-snatching commuter and time his bites so he'll just catch the last car of the 7:51 as it starts rolling onto the big city.

♦ ♦ Please turn to page 120 ♦ ♦



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INDEX TO PHOTOFACT

RADIO AND TELEVISION SERVICE DATA FOLDERS

No. 36

Covering Folder Sets Nos. 1 thru 194

HOW TO USE THIS INDEX

To find the PHOTOFACT Folder you need, first look for the name of the receiver (listed alphabetically below), and then find the required model number. Opposite the model, you will find the number of the PHOTOFACT Set in which the required Folder appears, and the number of that Folder. The PHOTOFACT Set number is shown in bold-face type; the Folder number is in the regular light-face type.

IMPORTANT—1. The letter "A" following a Set number in the Index listing, indicates a "Preliminary Data Folder." These Folders are designed to provide you *immediately* with preliminary basic data on TV receivers pending their complete coverage in the standard, uniform PHOTOFACT Folder Set presentation.

2. Models marked by an asterisk (*) have not yet been covered in a standard Folder. However, regular PHOTOFACT Subscribers may obtain Schematic, Alignment Data or other required information on these models without charge by supplying make, model or chassis number and serial number. (When requesting such data, mention the name of the Parts Distributor who supplies you with your PHOTOFACT Folder Sets.)

3. Production Change Bulletins contain data supplementary to certain models covered in previously issued PHOTOFACT Folders, and are listed in this Index immediately following the listing of the original coverage of the model or chassis. These Bulletins should be filed with the Folders covering the models to which the changes apply.

IMPORTANT PHOTOFACT INFORMATION

We want you to receive maximum benefits through your use of this Index and of PHOTOFACT Folders. To keep you fully informed about PHOTOFACT, we have prepared the table of informative subjects listed below. Be sure to read each item carefully.

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AIRLINE—Cont.

AIRLINE—Cont.

AIRLINE—Cont.

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ALGENE

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AMPLIPHONE

AMPRO (See Recorder Listing)

ANDREA

ANSLEY

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IMPORTANT

How to obtain a sample PHOTOFACT Folder

Service Technicians who have not yet enjoyed the advantages of the world's finest Radio-TV service data, may obtain a Free Sample PHOTOFACT Folder and see for themselves how they can save time and earn more. To get your free sample, simply state the PHOTOFACT Set Number and the Folder Number (not applicable to listings bearing suffix letter "A" or an asterisk *). Mail your request on your business letterhead (or enclose your business card) to:

HOWARD W. SAMS & CO., INC
Department P
2201 East 46th Street
Indianapolis, Indiana

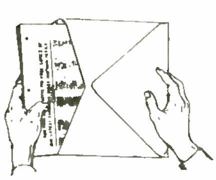
This offer is limited to one sample Folder. (PHOTOFACT Distributors do not stock sample Folders.)

IMPORTANT

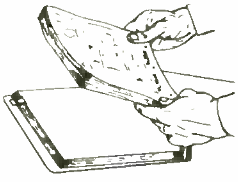
Quick, Easy PHOTOFACT Filing Method

The preferred 30-Second method for filing PHOTOFACT Folders

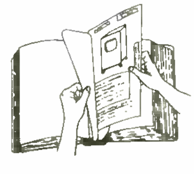
Your PHOTOFACT Folder Sets come to you in convenient envelopes. When you remove a Set from its envelope, you will find the Folders already arranged in proper filing order, and preceded by an Index Separator. This Separator lists each receiver covered in the Set, and has an index tab showing the Set number. To file, here's all you do:



1. Remove the Index Separator and the Folders from the envelope. The Folders and manila TV Jackets are already arranged in proper numerical filing order except the TV folders, which are placed last in the Set.



2. Open your binder and place the entire contents, taken from the envelope, behind the preceding Set of folders, laying aside the TV folders.



3. Now, insert the TV folders in their respective manila jackets and your filing is complete.

To locate the folder you want, refer to instructions on the first page of this index listing.

ALWAYS REFER TO THE PHOTOFACT INDEX

IMPORTANT

How to obtain PHOTOFACT Volume Labels

A certificate redeemable for a complete set of Volume Labels for PHOTOFACT *Volumes 1 through 10,* is included in PHOTOFACT *Set No. 62.* A certificate redeemable for a complete set of Volume Labels for *Volumes 11 through 20,* is included in PHOTOFACT *Set No. 102.*

Simply mail these certificates to Howard W. Sams & Co., Inc., for your free Sets of Labels.

IMPORTANT

How to obtain Service Data on Pre-War Models

Photo copies of schematics covering pre-war (prior to 1946) receivers can be obtained by regular PHOTOFACT subscribers at 50¢ each (our cost). Additional data can be supplied at a nominal cost per page. When requesting pre-war data, please mention the name of the Parts Distributor who supplies you with your PHOTOFACT Folder Sets.

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RECORDERS

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From time to time, PHOTOFACT Folder Sets include valuable "bonus" aids, as well as useful data of a special nature. The following materials are extra benefits incorporated in the PHOTOFACT Folder Sets indicated, at no additional cost.

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2—TRADE DIRECTORY— Parts Manufacturers	**12**
3—National Electrical Code on Antennas	**88**
4—Record Changer Cross Reference by Manufacturer and Model	**118**
5—Mica Capacitor Color Codes	**48**
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7—"Let's Look at the Sync Pulses"	**64**
8—Replacement of Disc & Plate Type Ceramic Capacitors	**68**
9—Certificate entitling subscriber to PHOTOFACT Volume Labels for Vols. 1-10	**62**
10—Certificate entitling subscriber to PHOTOFACT Volume Labels for Vols. 11-20	**102**
11—Certificate entitling subscriber to 100 Door Knob Hangers	**80**
12—Photofact Television Course appearing serially in	**38-51, 54**
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17—Proposed Television channel allocation	**132**
18—General Electric Clock Data	**160**

"SHOP TALK"(cont'd from Page7)

source of trouble. Generally, a defective crystal shows up by producing an excessively snowy picture or, in the case of a complete breakdown, no picture at all.

A good many converters make provision for measuring the crystal current in the absence of a signal. The value of current obtained is a measure of two things; the condition of the mixer crystal and the strength of the oscillator output. In the high frequencies of the UHF band, it is quite possible for the oscillator output to fall below normal or for it to develop "blind spots" at various points within the UHF region. If the crystal is good (perhaps as determined by substitution (then a normal crystal circuit current will indicate that the oscillator injection voltage is likewise normal. Generally, manufacturers specify a minimum current above which it is safe to assume the oscillator is functioning as it should.

If any defect other than those specified above is encountered, it will usually be found by voltage and/or resistance checks in the usual manner. Be particularly careful not to disturb the positioning of circuit components because, in the UHF band, a slight displacement can have a decided effect on tuner operation or alignment. Select replacement parts carefully and always air-check a unit before returning it to its owner.

REVIEW. In brief, the review article describes a method for determining quite accurately whether the transmission line is matched to the antenna at one end, and to the receiver at the other. In weak signal areas, both at VHF and UHF, information of this type can be especially valuable. The article concerned is as follows:

"Sweep Generator Adjustment of Transmission Lines and Antennas"
by John A. Cornell
Radio & Television News,
September, 1949

Published by
Ziff-Davis Publishing Co.
366 Madison Ave.,
New York 17, N. Y.

Subscription Price $4.00 per year. Direct all communications converning subscriptions to; Circulation Dept., 64 East Lake St., Chicago 1, Illinois.

* * *

Well known by now is the fact that to obtain the maximum signal from an antenna, it is absolutely necessary that the complete system (down to the receiver) be matched as far as possible. If there are any impedance transformers within this system (either at the set or at the antenna), they must be matched, too.

Now, it is one thing to make such statements and quite another to carry them out. Ask the average service man how he would determine whether a line is matched and his answer is likely to be vague. Very few technicians take the trouble to check the mismatch on an installation. But with the advent of UHF, matching will become more and more important because it will frequently mean the difference between a usable picture and one that is poor and unsatisfactory.

A method for checking the match or mismatch of a line requires a sweep generator, an oscilloscope, a crystal diode, and several resistors and capacitors. The circuit is shown in Figure 4. First, the sweep generator output is matched to the transmission line by connecting two 120-ohm resistors and a 50-ohm resistor as shown. (We are assuming here a 300-ohm transmission line and a 50-ohm generator output impedance.) Next, a crystal diode detector network is placed to the line. The other end of this detector attaches to the vertical input terminal of the scope. Connection is also made to the "GND" terminal on the scope. Finally, there is a wire which goes from the sweep generator to the horizontal input terminal of the scope (not shown in Figure 4). This is for the purpose of driving the scope beam at the same rate (and in the same manner) as the sweep generator output. Usually this is a 60-cycle voltage.

The equipment is now turned on. The sweep generator is set to sweep over a 6-mc range at the frequency of one of the local channels, say No. 3 (60-66 mc). The oscilloscope is adjusted to provide a trace across its screen. At the start the vertical gain control is turned to mid-position. If the other end of the transmission line is properly terminated--say in a folded dipole--then the pattern on the screen should be a fairly straight line.

Suppose, however, that the other end of the line is open; i.e., it has nothing attached to it. Then what you will see on the scope is a pattern similar to that shown in Figure 5A. If the other end of the line is short-circuited, the same type of pattern (reversed 180°) will appear.

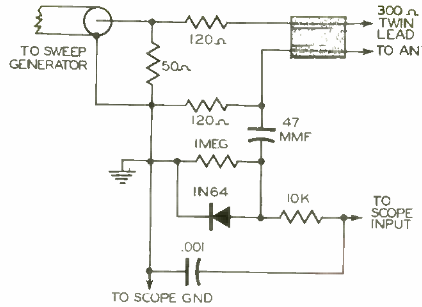

Figure 4. Circuit for Measuring Antenna System Mismatch.

But if the impedance across the other end of the line is gradually made to approach 300 ohms, then the peaks and valleys in the wave will slowly come closer together. See Figure 5B. And when the impedance reaches 300 ohms, a straight line will again be obtained.

The straight line indicates a perfect match. On the other hand, waviness in the pattern indicates mismatch, and the greater the separation of the peaks and valleys, the greater the mismatch.

To understand the reason for this behavior, let us consider briefly the operation of a transmission line. When one end of the line is matched by an impedance equal to the line impedance, then the impedance "seen" at the other end is equal to the line impedance. Thus, suppose a line has a characteristic impedance of 300 ohms and one end is terminated in a 300-ohm resistor. Any circuit connected to the other end of the line will then "see" 300 ohms and this would be true for all frequencies fed into the line.

If the far end of the line is left open instead of having a 300-ohm resistor connected across it, then the impedance "seen" or presented across the other end will depend upon the length of the line and the frequency of the signal fed into it. For example, a frequency which would make the line an even number of quarter-waves long would cause

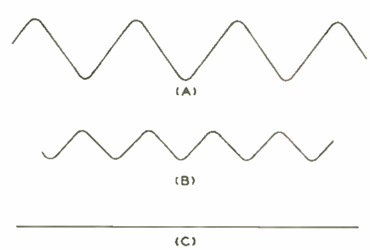

Figure 5.

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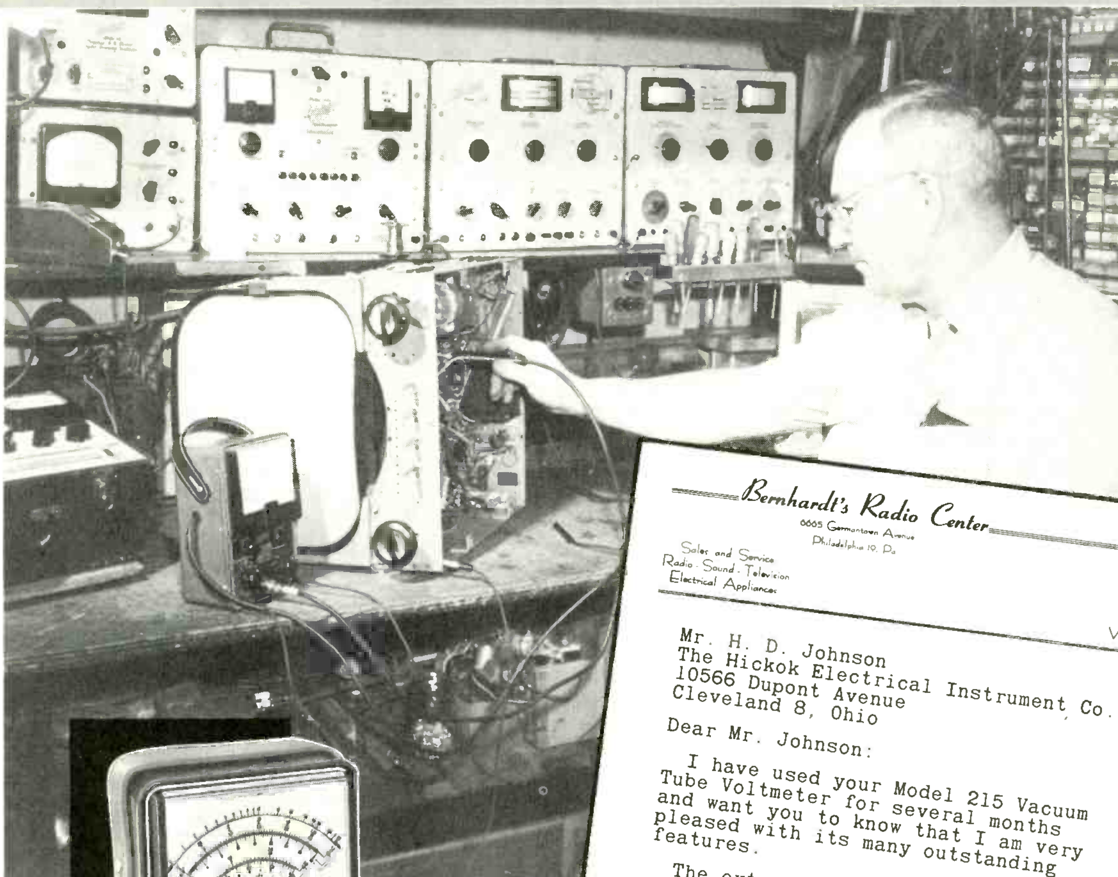
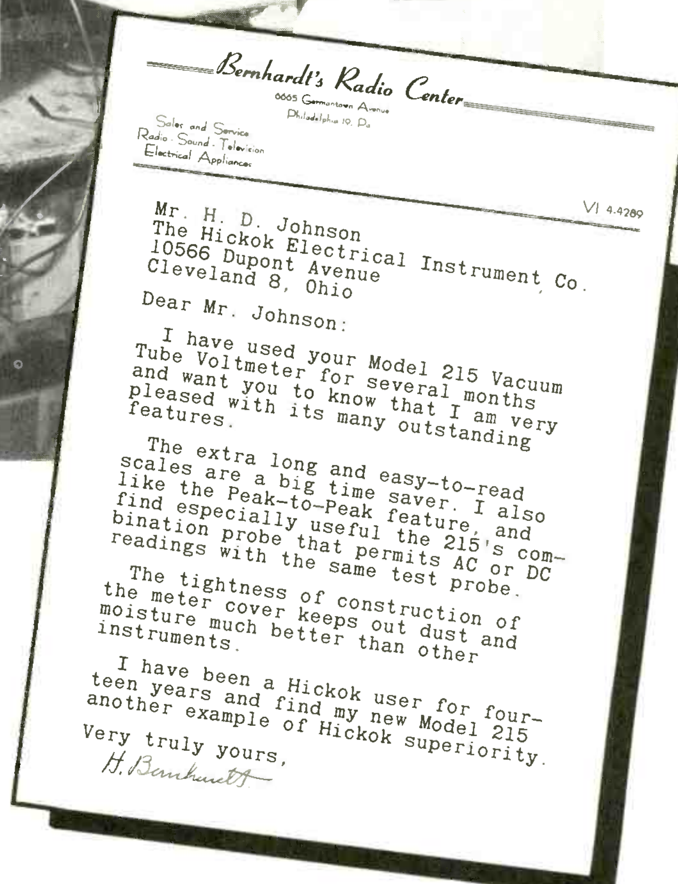


MODEL 215



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the impedance at the sending end to be very high (actually infinite on a line with no losses). By the same token, a line which was short-circuited at one end would present zero impedance (or a very low impedance) at the other end when the frequency made the line an odd-number of quarter-waves long. Intermediate frequencies would cause intermediate impedance values to appear at the sending end.

When a sweep generator is connected to the line, as in Figure 4, and it sweeps over a range of frequencies, then the impedance it "sees" at its end (called the sending end) will depend on what is connected across the other end of the line. If the line is properly terminated, i.e., matched, then the impedance at the generator end of the line will remain steady. But, if the opposite end is mismatched, then the impedance presented to the sweep generator will vary with each frequency in the sweep range. Now, if the generator output voltage is reasonably flat over the swept band, the RF voltage at the sending end of the line will vary in the same way that the line impedance varies. By connecting an RF detector across this point of the line, the variations can be detected and displayed on the scope screen. The result, for an open-ended line, is shown in Figure 5A. Of course, if the line is matched, the impedance presented at the sending end will not vary, and the RF voltage will likewise remain steady. On the screen this will produce a straight line. Between these two extremes will be found patterns in which there are peaks and valleys and the distance between the peak and valley will be an indication of the extent of the mismatch. Your job will be to make this difference as small as possible.

In presenting the standing wave pattern on the scope screen, it is possible to show it as indicated in Figure 5 or to display it with a base or reference line. See Figure 6. For the latter case it is necessary that the sweep generator possess a blanking switch or control which will cut off the generator output on the return trace of the beam. In other words, the frequency is swept once across the band and then the sweep oscillator is cut-off during the remaining half cycle of the driving voltage. In the oscilloscope the beam is active throughout the entire cycle. Hence, when the sweep generator is cut off, the beam forms the base line. This type of presentation is more effective than that

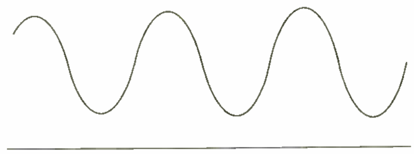

Figure 6

shown in Figure 5, but it does require a sweep generator with a blanking circuit.

It might be pointed out in passing that when any one of the patterns of Figure 5 is developed on the screen, the phasing control on the sweep generator should be adjusted until a single trace is obtained. Failure to do this will generally result in a double pattern and lead to confusion.

The first step in applying this method is to determine if the voltage output of the sweep generator is flat (or reasonably so) over the range it is to be used. Note that this does not mean it must be flat from one end of its dial to the other. Few generators are. All that is required is that the output be steady over the small region to be swept. Generally this is 6 mc.

The set-up to use is the same as shown in Figure 4 except that the transmission line is disconnected. The generator output voltage now feeds directly into the detector. Set the generator to the range desired and adjust its sweep for 6 mc. If straight line is obtained on the scope screen, the generator output voltage is steady over the sweep range. Check the generator output at all frequencies at which the transmission line is to be checked.

The next step is to check an actual system. Suppose we have the transmission line hooked up to a suitable antenna and we wish to determine whether the two match. At the receiver end of the line we would connect our equipment as shown in Figure 4. (The receiver is not attached to the line). The equipment is turned on and the generator is set to sweep over the desired channel. From the resultant pattern on the screen you can tell at a glance how well the antenna and the transmission line go with each other. It may be that you will find the mismatch considerable in which case you may want to change the line, the antennas, or the spacing of the antenna bars. Whatever you do, the result will be instantaneously visible on the screen.

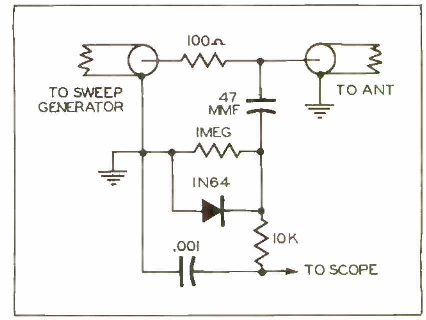

Figure 7. Circuit of Figure 4 Adapted to a Coaxial Lead-in Line.

The same equipment can be used to determine if the transmission line is matched to the receiver. To proceed, connect the line to the receiver and then place the equipment at the other end of the line (with the antenna disconnected). If it is not practical to follow this procedure, then take a 50-foot section (or more) of the line, connect one end to the receiver and the other end to the sweep generator and crystal detector. If the line is twin lead or otherwise unshielded, do not roll it up. However, if the line is shielded (such as coax), it is permissable to roll the line up.

Incidentally, the instrument set-up for coaxial line is just as simple as it is for twin lead. Figure 7 illustrates how the connections are made.

One final application of this method is the testing of impedance transformers. The most common type of impedance transformer is one that matches a 72-ohm unbalanced line to a 300-ohm balanced line. To determine how well a unit performs this function, take a 50-foot (or longer) section of coaxial cable and connect the sweep generator and crystal diode to one end, as in Figure 8. To the other end of the cable attach the transformer. The 72-ohm side of the unit connects to the coaxial cable while a 300-ohm resistor is placed across the other terminals on the transformer in order to terminate it properly. Now turn the test equipment on and observe whether any standing waves are produced over the channels for which this system is to be employed. A simple test like this, of a number of impedance transformers, will soon reveal how poorly designed many are.

♦ ♦ Please turn to Page 122 ♦ ♦

"TEST EQUIP.(cont'd from Page23)

suggested that the frequencies which need be used as a center frequency of the sweep generator be enclosed in a box using a red pencil. The same can be done for the marker generator frequencies by using a blue pencil, since in some cases a different column of frequencies may be required, even though the sweep generator and marker generator are combined into a single unit. This is brought about by the fact that the two generators may not cover exactly the same range. Note that the lowest frequencies shown in the column D are above the upper limit of channel 6. Thus, no channel 5 or 6 interference from the marker should be encountered when using an instrument set at these frequencies. There is a possibility, however, of getting interference on channel 10 when the marker is set between 95 and 100 megacycles. When set within this range, the second harmonic falls on channel 10, and should a converter having a channel 10 output be used, interference will be encountered.

Getting back to our original test set-up, and referring to column D of the chart, we find that a frequency of 109.6 megacycles will produce a 548 megacycle harmonic. Also that a 110.8 megacycle signal will produce a harmonic at 554 megacycles. A frequency of 109.85 megacycles produces a harmonic at 549.25 megacycles, which is the video carrier of channel 27. Also we can determine from the chart that a frequency of 110.74 megacycles produces a harmonic at 553.75 megacycles, which is the sound carrier of channel 27. Thus, by setting the marker generator to 109.85 megacycles, a marker will be produced which is equivalent to the video carrier of channel 27. The oscillator should then be adjusted to place the marker at the 50% point on the response curve. Be sure to make the three checks to determine whether the marker being viewed is the correct one. After the oscillator is properly set, the preselector units can then be adjusted for maximum amplitude.

The single channel type converter or tuner is the easiest to align of all converters, since there is no tracking problem. There is one precaution, however, which must be taken, and that is to be sure that the oscillator is set on the low side of the incoming signal. Should the oscillator be set on the high side of the incoming signal, an inversion of the television signal will result. At the transmitter, the sound carrier is at the higher end of the television channel and the video carrier is at the lower end of the channel. Should the oscillator be set above the incoming signal the relationship of these two signals will be inverted. This is the reason for checking whether the high frequency end of the band was at the right or left edge of the scope tube prior to starting the UHF alignment. Of course, once this is determined with any specific piece of test equipment, a check need not be made before each alignment. When the oscillator is properly set on the low side of the incoming signal, the response curve as viewed on the scope will be in the same position as it was when the channel 5 or 6 frequency was injected at the antenna terminals.

A different procedure is used when checking alignment of continuously tuned UHF tuners or converters. Normally a low and high limit check point is given, as well as one or two check points somewhere in the frequency spectrum. Let us assume that the alignment instructions for a continuously variable tuner calls for a check at 470 megacycles, 890 megacycles, and at 630 megacycles. The procedure would be, to inject a sweep frequency that will provide a harmonic falling in the region of channel 14, and by tuning the UHF tuning knob or control, it should be possible to place the channel 14 video carrier marker at the 50% point on the response curve. If it cannot be placed at this point, the oscillator is not properly adjusted, since it does not give proper tuning range. A similar test is made at the high frequency end by injecting sweep and marker frequencies whose harmonics produce a signal at channel 83. By tuning the UHF tuning control it should be possible to place the channel 83 marker at the 50% point on the curve, indicating adequate tuning range. If this cannot be done, adjustment of the oscillator is necessary. The check point at 630 megacycles is made by injecting sweep and marker signals whose harmonics provide a 630 megacycle signal. The converter is then tuned so that this signal is accepted and a check is made of the amplitude and wave shape at that point. The maximum allowable variations of amplitude and calibration on the dial will usually be stated in the alignment instructions.

Another system which can be employed in checking a variable UHF tuner or converter is to start at one end of the band, and by tuning the generator sweep frequency dial as well as the UHF tuning dial, the response curve can be viewed throughout the entire range. Whenever injecting a marker to check the calibration points along the dial, be sure to make the three checks to determine whether or not the correct marker is being used. Since this type of tuner covers the entire range there is a much greater possibility of obtaining an improper marker than in the case of the single channel unit. As would be expected, the tracking of a tuning device of this type is very critical. It is not uncommon, however, to find a few spots throughout the tuning range where a noticeable dip will be seen in the response curve. Do not condemn the alignment of the converter should these conditions occur. If, however, there is a completely dead spot throughout a portion of the tuning range, there probably is a defect in the tuning unit.

Usually it will be found that the attenuators on the sweep generator can be set so that a minimum signal is being put out by the unit. Conversely, it may be necessary in those cased where a built-in marker is being used, to set the marker output to provide maximum output to produce a visable marker pip. A little experience in setting these attenuators will aid in eliminating any problems in this respect.

When using an external marker generator, usually all that is necessary to do is to place the output cable near the input of the converter to obtain marker injection. If sufficient signal cannot be obtained in this manner, the output cable of the marker generator may be directly connected to the input point on the converter, while noting if an appreciable change in the wave shape results. Usually all that will happen, will be a slight decrease in amplitude of the waveform. If the amplitude of the marker signal is too great, the waveform may be distorted. This is illustrated in Figure 11A, which is a result of too much marker injection. Should this occur, the output from the marker generator should be decreased or more loosely coupled. A waveform as shown in Figure 11B should then be obtained.

The condition shown in Figure 12 is caused by unsufficient bias on the IF stages, resulting in overload. Note the similarity of this waveform with that of Figure 11A. A portion at the left side of Figure 12, however, is free of noise or "grain" indicating an overload condition. The bias on the stages should be increased, or the output of the generator should

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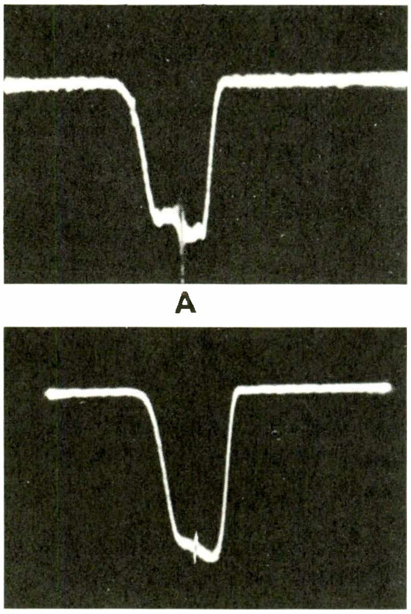


A

B

Figure 11. Waveform Showing Results of Excessive Marker Injection (A) and Normal Curve After Marker Signal Level is Reduced (B).

be decreased. Whenever possible, the latter should be employed to correct this condition.

Another thing which is helpful in making the marker more distinct on the waveform, is the placement of a capacitor across the input terminals to the vertical amplifier in the scope. This tends to by-pass the higher frequencies associated with the beat between the sweep frequency and the marker generator frequency. At any time, should the marker not be clearly visible, a capacitor could be connected to see if it aids in making the marker more pronounced. The effect of this capacitor is shown in Figure 13. Figure 13A shows the waveform without the capacitor, and 13B with the capacitor. A value of from 1,000 to 10,000 mmf is a nominal value for this application. This is not always helpful, however, since sometimes it may even decrease the amplitude of the marker.

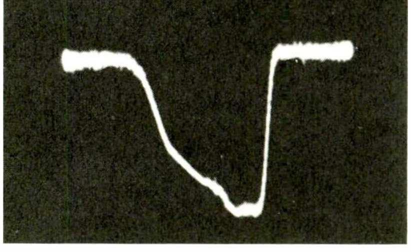
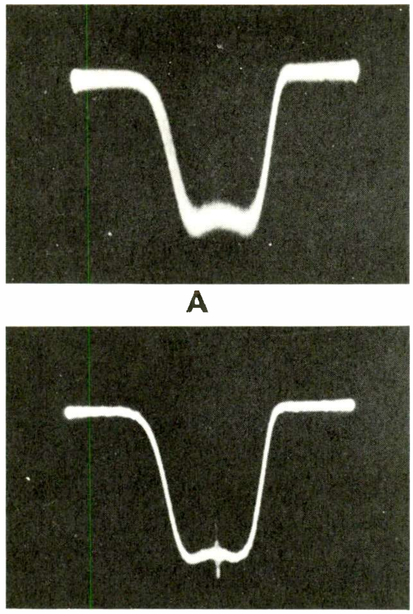


Figure 12. Waveform Showing Effects of Overload.



A

B

Figure 13. Illustrating the Effect of The Addition of a Capacitor at Vertical Input Terminals of Scope. (A) Capacitor Removed. (B) Capacitor Connected.

It should be kept in mind that the alignment procedure using VHF equipment outlined in this article is intended to be used as a stop-gap measure until suitable UHF signal generating equipment is made available to the service industry. If proper precautions are taken, however, satisfactory servicing can be accomplished with existing equipment.

SWEEP GENERATORS

Following is a list of several sweep generators which are suitable for UHF alignment. A discussion is given for each instrument showing which columns of the Sweep and Marker Generator Chart need be used to cover all 70 UHF channels. Also a general discussion on output cable termination is given, as well as pointing out the proper setting of the band selector for each instrument.

HICKOK 610, 610A

Channels	Column	Range Selector
14-30	D	75-115 mc
31-34	C	150-230 mc
35-49	D	75-115 mc
50-51	C	75-115 mc
52-54	B	75-115 mc
55-69	D	75-115 mc
70-74	A	75-115 mc
75-83	D	75-115 mc

Figure 14. Hickok 610A Sweep Generator.

(If the Hickok 610 or 610-A is to be used for UHF alignment, it is suggested that the columns shown be boxed-in on the Frequency Chart.)

The output cable should be terminated with the Type 75 Hickok Terminating Pad, or a 100 ohn carbon resistor can be used if an unbalanced output is required. A balanced output can be obtained from the Type 75 Pad by reversing the plug in the pad.

The fundamental frequency of operation of all oscillator settings specified are above channel 6. Thus no channel 5 or 6 interference should be experienced.

When aligning a converter whose output is on channel 10 however, interference may be experienced on and near the following channels when using the frequencies specified above: 14 to 18, 31 to 35 and 50 to 52. This interference is caused by the second harmonic of the FM oscillator of the signal generator producing a channel 10 signal. Should this condition exist, column B of the chart should be used for channels 14 to 18; the frequencies between 82 and 86 mc (7th harmonic) can be used for channels 31 to 35; and the frequencies between 85.7 to 88 mc (8th harmonic) can be used for channels 50 to 52. The use of these settings should eliminate channel 10 interference.

BUILT-IN MARKER

The high order of harmonics required to produce the desired UHF signals from the built-in marker generator in the Hickok 610 or 610A are of low amplitude and are not practical for use in the UHF range. An auxiliary generator may be used, however, to provide the desired markers. Several generators suitable for this purpose are listed under the Marker Generator Section

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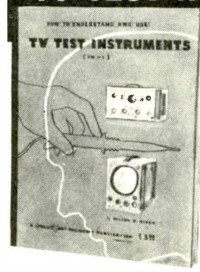

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which follows. The Hickok Models 292X and 680 are included in this listing.

JACKSON TVG-1, TVG-2

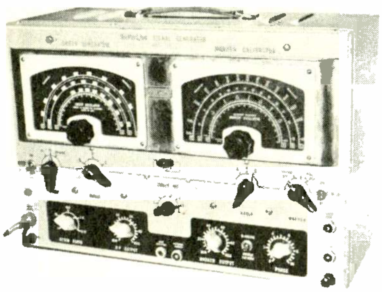

Figure 15. Jackson TVG-2 Sweep Generator.

Channels	Column	Sweep Range
14-22	C	A
23-42	C	B
43-51	C	A
52-83	C	B

(If the Jackson TVG-1 or TVG-2 generator is to be used for UHF alignment, it is suggested that the column shown above be boxed-in on the Frequency Chart.) The proper sweep ranges can also be noted on the chart, to facilitate the use of the chart with this particular instrument.

The output cable should be terminated with a 75 ohm carbon resistor. If a balanced output is required, a pad should be constructed as outlined in the text (use 75 ohm for the value of Rz).

When using the frequency settings in column C, no channel 5 or 6 interference should be experienced. However, interference on and near channels 30, 49 and 68 may be encountered. This interference is caused by the 5th, 6th and 7th harmonics, respectively, of the fixed center frequency FM oscillator (114 mc). (See text.)

When aligning a converter whose output is on channel 10, interference may be experienced on and near the following channels when using the frequencies specified above: 14 to 18, 31 to 35, 47 to 51 and 63 to 68. By tuning the sweep generator to a lower frequency and using a higher harmonic, this interference can usually be avoided.

BUILT-IN MARKER

The high order of harmonics required to produce the desired UHF signals from the built-in marker generator in the Jackson TVG-1 or TVG-2 are of low amplitude and are not practical for use in the UHF range. An auxiliary generator may be used, however, to provide the desired markers. Several generators suitable for this purpose are listed under the Marker Generator Section which follows. The Jackson 641 and 641-A are included in this listing.

SIMPSON 479, 480

Figure 16. Simpson 480 Genescope.

Channels	Column	FM Range
14-21	A	B
22-49	B	B
50-64	A	B
65-83	B	B

(If the Simpson 479 or 480 generator is to be used for UHF alignment, it is suggested that the columns shown above be boxed-in on the Frequency Chart. The proper FM Range can also be noted on the chart to facilitate the use of the chart with this particular instrument.)

The output cable of these generators are equipped with a terminating box. By connecting jumpers between the proper terminals, as outlined in the operator's manual, a balanced or unbalanced output can be obtained. To insure proper results, make sure the cable is properly terminated throughout the alignment.

All frequencies specified in the chart are above channel 5 and 6, thus no interference from this should be experienced. When aligning converters having an output on channel 10, interference may be experienced on and near the following channels; 30 to 35 and 65 to 68. By tuning the sweep generator to a lower frequency and using a higher harmonic, this interference can usually be avoided

BUILT-IN MARKER

Channels	Column	AM Range
14-83	D	C

(If the Simpson generator is to be used for UHF alignment, it is suggested that the column shown above be boxed-in on the Frequency Chart. The AM Range could also be noted on the chart to facilitate the use of the chart with this particular instrument.)

Separate attenuators for the AM and Sweep generators are incorporated in this instrument. The sweep attenuator should be set so that just enough sweep signal is generated to obtain sufficient deflection. (Keep scope gain at maximum allowable setting.) Set the AM attenuators so that the marker is just visible. Excessive marker signal may swamp the response pattern.

When aligning converters having the output on channel 10, interference may be experienced when the marker is tuned between 95 and 100 mc. If this occurs tune to a lower frequency and use the next higher harmonic.

The marker amplitude is quite low when using the 5th and 8th harmonics, particularly above 800 mc. The setting of both attenuators at the upper channels is much more critical than at the lower channels. If after careful setting of the attenuators, the marker cannot be seen on the higher channels, an auxiliary marker generator can be used.

An alternate method for setting the end limit at the high end of the band, which does not require the direct use of a marker, can be used very successfully with these generators. If the upper end limit is specified as 920 mc, for instance, it may be found that the marker cannot be seen at this frequency. Since the 4th harmonic of the FM oscillator is being used, by checking the accuracy of the setting at the 3rd harmonic (the marker can be seen at this point), we can also be assured of the accuracy at the 4th harmonic. By dividing 920 by four we find that the fundamental frequency of the FM oscillator is 230 mc. The 3rd harmonic of this frequency is 690 mc. Tune the converter so that the marker is centered on the waveform as shown in Figure 5B in the text. Now adjust the sweep generator dial setting so that the waveform is exactly centered on the scope. The sweep width (frequency deviation on sweep generator) should

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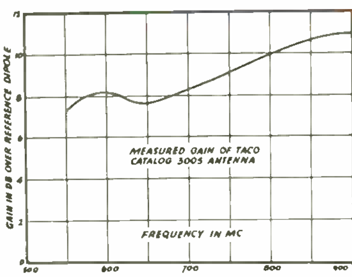

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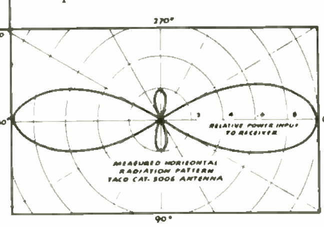

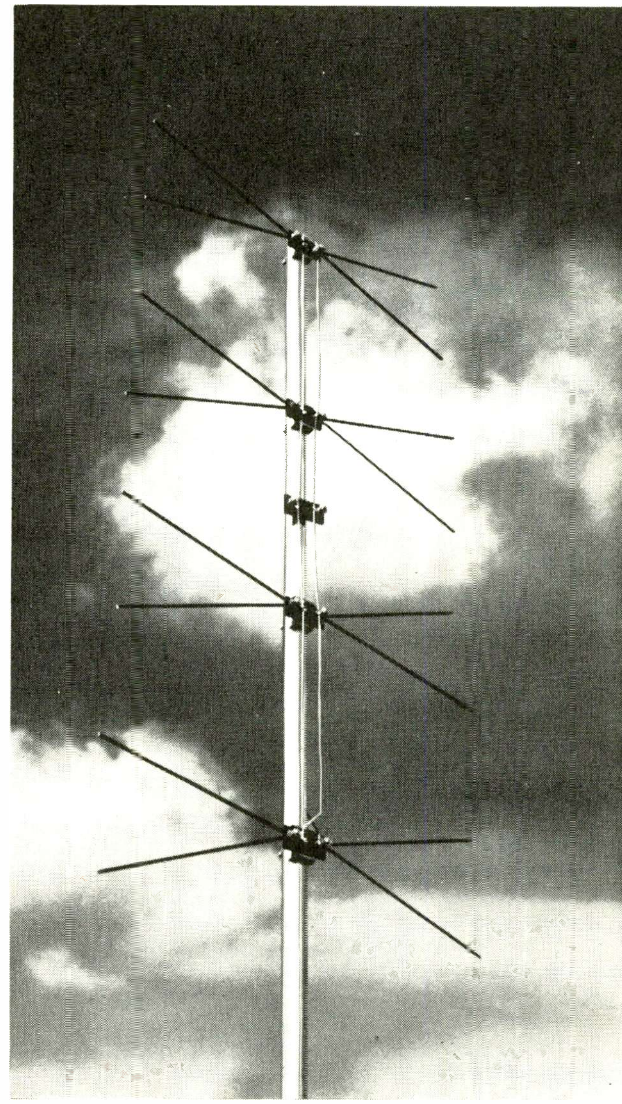

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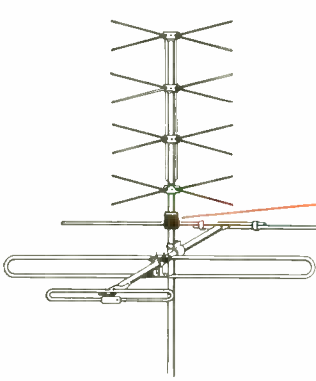

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be decreased so that the response curve itself occupies the complete sweep trace on the scope. This allows greater accuracy in centering the response curve. With these conditions fulfilled, the center of the trace represents 690 mc and 920 mc.

Leave the sweep generator at this setting and tune the converter to the upper end limit. The converter oscillator is properly set when the response curve is centered on the scope.

This procedure can also be used for presetting the oscillator on single channel converters when the marker is not visible on the upper channels. An additional all-channel converter will be required, however, to check the setting at the 3rd harmonic.

Actually, the sweep generator itself, can be calibrated with the aid of the built-in logging scale. After the correct settings are known, the above procedure can be used to quick check the converter at the end limit, or at any calibration point by setting the sweep generator frequency so that the response curve is centered on the scope. The fundamental frequency can then be used on the dial and the harmonic frequency can be calulated.

SYLVANIA 500

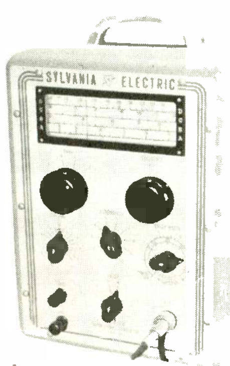

Figure 17. Sylvania 500 Sweep Generator.

Channels	Column	Band
14-51	B	D
52-54	C	D
55-83	B	D

(If the Sylvania 500 generator is to be used for UHF alignment, it is suggested that the columns shown above be boxed-in on the Frequency Chart. The proper band can also be noted on the chart to facilitate the use of the chart with this particular instrument.)

The output cable provides an unbalanced output and should be terminated with a 75 ohm carbon resistor. If a balanced output is required, construct a pad as outlined in the text (use 75 ohm for the value of Rz.)

No channel 5 or 6 interference should be experienced when using the above specified frequencies. When aligning a converter whose output is in channel 10, however, interference may be experienced on and near the following channels; 30 to 35 and 63 to 67. If this occurs, tune the sweep generator to a lower frequency and use a higher order harmonic, thus avoiding the interference.

This instrument employs a fixed center frequency FM oscillator, harmonics of which will cause interference near channels 22, 43 and 65. This difficulty is also experienced when aligning UHF tuners having a 127 mc IF. The text outlines a procedure whereby this harmonic can actually be used for alignment purposes.

MARKER

The Sylvania 500 does not incorporate a built-in marker generator. An auxiliary generator should be used to provide the desired marker. Several generators suitable for this purpose are listed under the Marker Generator Section which follows. The Sylvania 501 is included in this listing.

TRIPLETT 3434, 3434A 3435

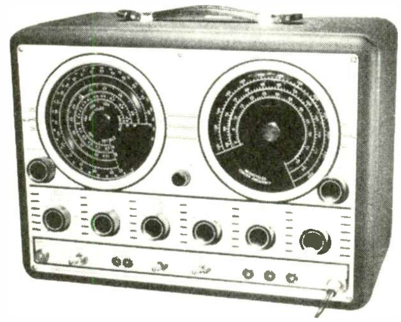

Figure 18. Triplett 3434A Sweep Generator.

Channels	Column	Sweep Band
14-83	D	B

(If one of the above listed Triplett generators is to be used for UHF alignment, it is suggested that the columns shown above be boxed-in on the Frequency Chart. The proper band can also be noted on the chart to facilitate the use of the chart with this particular instrument.)

Two output cables are supplied with these instruments, one with balanced output and the other unbalanced. The balanced cable is properly terminated while the unbalanced cable requires the addition of a carbon resistor (50 to 75 ohms) for proper termination.

All frequencies specified are above channel 6, thus no channel 5 or 6 interference should be experienced. When aligning converters having the output on channel 10, interference may be encountered on all dial settings between 95 and 100 mc. Should this occur, tune the sweep generator to a lower frequency and use the next higher harmonic. This should make it possible to avoid this type of interference.

BUILT-IN MARKER

The high order of harmonics required to produce the desired UHF signals from the built-in marker generator in the Triplett Models 3434 and 3434A are of low amplitude and are not practical for use in the UHF range. An auxiliary generator should be used with these instruments, as well as the Model 3435, to provide the desired markers. Several generators suitable for this purpose are listed under the Marker Generator Section which follows. The Triplett 3433 is included in this listing.

MARKER GENERATORS

AM signal generators which operate on the fundamental at 94 to 120 mc can be used as an auxiliary generator for the purpose of supplying markers during UHF alignment. Column D of the Sweep and Marker Frequency Chart shows the fundamental frequencies within this range whose harmonics produce the desired UHF signals.

Needless to say, the accuracy of the signal generator is of extreme importance in this operation. Any error in calibration at the fundamental frequency is multiplied by the order of harmonics which is being used. A good source of a frequency standard for checking the generator within this range is an FM station. Tune an FM receiver to a station of known frequency. Loosely couple the signal generator to the receiver and tune the generator for a zero beat. The calibration of the instrument can then be checked.

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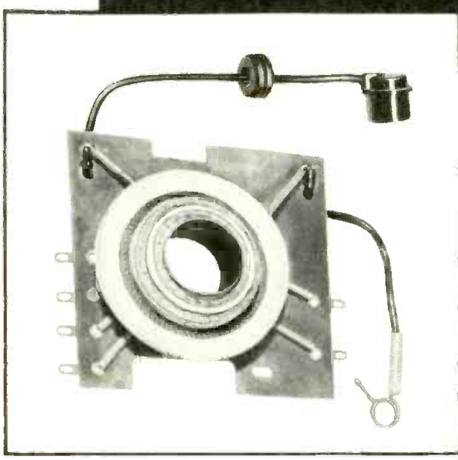

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Several signal generators which are suitable for marker use are included in the following listing. Instructions for use of each generator in connection with the chart is given.

In most cases sufficient coupling can be obtained by merely placing the marker generator lead near the sweep generator lead. If more coupling is required, use a very small value capacitor (approximately 10 mmf.) for coupling. At times it may be necessary to make a direct connection to the sweep generator lead. If any direct connection is made, observe the waveforms to be sure that its shape is not affected.

Always allow the marker generator to warm up for ten to fifteen minutes before using. This will provide a more accurate and stable signal.

HICKOK 292X

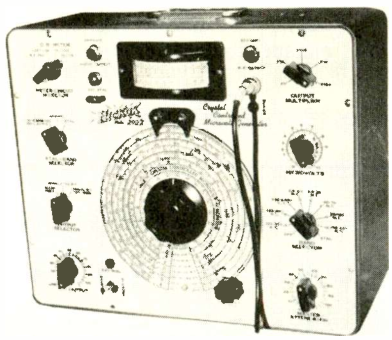

Figure 19. Hickok 292X Signal Generator.

Channels	Column	Band
14-44	B	H
45-49	D	G
50-51	B	H
52-78	C	H
79-81	B	H
82-83	C	H

The above recommended frequencies allow the use of frequencies up to 220 mc which this instrument is capable of producing. Thus a low order of harmonics is required to cover the UHF band.

An alternate method is the use of column D as specified below. This allows the use of only one column in the chart, but requires higher harmonics for UHF coverage.

ALTERNATE FREQUENCIES

Channels	Column	Band
14-83	D	G

(If this generator is to be used as a marker generator, it is suggested that the columns be boxed-in on the Frequency Chart. The proper band can also be noted on the chart to facilitate the use of the chart with this particular instrument.

When aligning a converter having the output on channel 10, interference may be experienced on and near channels 31 to 35 and 63 to 67. If this is the case, use a lower frequency and a higher order harmonic for these channels.

HICKOK 680

Figure 20. Hickok 680 Marker Generator.

Channels	Column	Range
14-22	(See Chart Below)	
23-43	B	High (Red)
44-51	Use 1/10 of Freq.	Low (Black)
52-78	C	High (Red)
79-83	A	High (Red)

(Note: The UHF frequencies up to 868 mc are calibrated directly on the dial of this instrument. The use of the specified frequencies on the chart, however, removes the need of interpolating the video and sound carrier frequencies.)

Channel	Frequency
14	58.75 (8)
	58.91 (8)
	59.47 (8)
	59.5 (8)
15	59.5 (8)
	59.66 (8)
	60.22 (8)
	60.25 (8)
16	60.25 (8)
	60.41 (8)
	60.97 (8)
	61
17	61 (8)
	61.16 (8)
	61.72 (8)
	61.75 (8)
18	61.75 (8)
	61.91 (8)
	62.47 (8)
	62.5 (8)
19	62.5 (8)
	62.66 (8)
	63.22 (8)
	63.25 (8)
20	63.25 (8)
	63.41 (8)
	63.97 (8)
	64 (8)
21	64 (8)
	64.16 (8)
	64.72 (8)
	64.75 (8)
22	64.75 (8)
	64.91 (8)
	65.47 (8)
	65.5 (8)

(If this generator is to be used for UHF alignment, it is suggested that the columns specified be boxed-in on the Frequency Chart. The frequencies listed for channels 14 to 22 should also be added between columns to facilitate the use of this generator with the chart.)

This generator incorporates a crystal oscillator which permits checking of the calibration at each 2.5 mc point. This should be done regularly to insure accurate UHF markers.

JACKSON 641, 641A

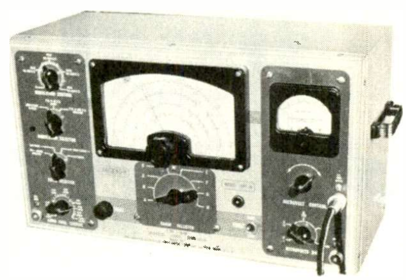

Figure 21. Jackson 641A Signal Generator.

Channels	Column	Band
14-83	D	A

(If this generator is to be used for UHF alignment, it is suggested that column D be boxed-in on the Frequency Chart. The range can also be noted on the chart to facilitate the use of this instrument with the chart.)

Channel 10 interference may be encountered on and near channels 15 to 17 when aligning a converter having the output on channel 10. If this occurs, use a lower fundamental frequency and a higher harmonic.

SYLVANIA 501

Figure 22. Sylvania 501 Marker Generator.

Channels	Column	Band
14-83	D	C

(If this generator is to be used for UHF alignment, it is suggested that column D be boxed-in on the chart. The range can also be noted on the chart to facilitate the use of the chart with this instrument.)

When aligning a converter having the output on channel 10, interference may be encountered on and near channels 15 to 17. Should this occur, use a lower frequency and the next higher harmonic.

TRIPLETT 3433

Figure 23. Triplett 3433 Signal Generator.

Channels	Column	Band
14-83	D	J

(If this generator is to be used for UHF alignment, it is suggested that column D be boxed-in on the chart. The range can also be noted on the chart to facilitate the use of the chart with this instrument.)

When aligning a converter having the output on channel 10, interference may be encountered on and near channels 15 to 17. If this occurs, use a lower frequency and the next higher harmonic.

We wish to acknowledge the cooperation of the following test equipment manufacturers in providing us with the equipment that was used in the preparation of this article:

The Hickok Electrical Instrument Co.
The Jackson Electrical Instrument Co.
The Simpson Electric Co.
Sylvania Electric Products, Inc.
The Triplett Electrical Instrument Co.

W. WILLIAM HENSLER

"UHF" (cont'd from Page 44)

preselector circuits, and by a combination of capacitive and inductive tuning in the oscillator circuit. The tuning mechanism consists of brass cores attached to nylon rods which in turn are fastened to the adjustment plate. The tuning shaft is threaded so that rotation of the shaft moves the brass cores in or out of the tuned elements of the preselector and oscillator circuits.

An examination of the brass cores shows that they are tapered. The dual purpose of the taper is to achieve tracking and, more specifically to effect bandspread at the upper half of the UHF band.

The preselector circuits are located on top of the chassis and are shown in Figure 15. The UHF signal is applied to the converter at the 72-ohm coaxial input and fed to a tap on the first preselector circuit. Coupling between the first and second preselectors is provided by a strip of metal formed into a rectangle shape and rivited in a position between the two circuits to provide loop coupling. Note the small slot in the top of the coupling loop. This accommodates an alignment screwdriver blade for rotating the loop to adjust the bandpass of the preselectors.

A crystal mixer is tapped into the second preselector circuit and its output fed to the IF amplifiers.

The Model U70 oscillator section is contained in a compartment under the chassis and shown in Figure 16. Tapered brass cores, one for varying capacitance and the other for varying inductance, are used in the oscillator circuit. When low frequency UHF channels are tuned, the brass core is completely out of the inductance and only the brass core for the capacitance is effective in changing oscillator frequency. As mid-positions are approached, the brass core begins to enter the inductance, thus decreasing the inductance, and the tapered portion of the capacitor core is employed for decreasing the capacitance. L7 and C9 form the variable capacitance and inductance in the oscillator circuit.

An intermediate frequency results when the oscillator signal and the incoming UHF signal are beat together at the crystal mixer. The schematic diagram of the Model U70 is shown in Figure 17.

Two stages of IF amplification are used in the Model U70. Both stages employ type 6CB6 pentode tubes. However, in the first stage, the 6CB6 is connected to operate as a grounded-grid triode while the second tube is connected in the conventional fashion.

Twelve megacycle bandwidth is maintained in the IF amplifier stages to provide an output signal at the frequencies of either channel 5 or 6. Bandwidth adjustment is accomplished by two capacitors, C11 and C21. They consist of a piece of wire soldered to one terminal of each IF transformer and the free end inserted into a ceramic tube capacitor. Adjusting is done by pushing or pulling the free end further in or out of the ceramic tube capacitor.

Installation of the converter to a television receiver may be readily accomplished. The required antenna systems are connected to the appropriate terminals on the back of the converter and the converter output is fed to the VHF receiver antenna input terminals with a short length of 300-ohm line. Plugging the TV receiver line cord into the receptacle at the back of the converter and plugging the converter into the AC wall socket completes the installation.

Initially both converter and VHF receiver are turned on indiv-

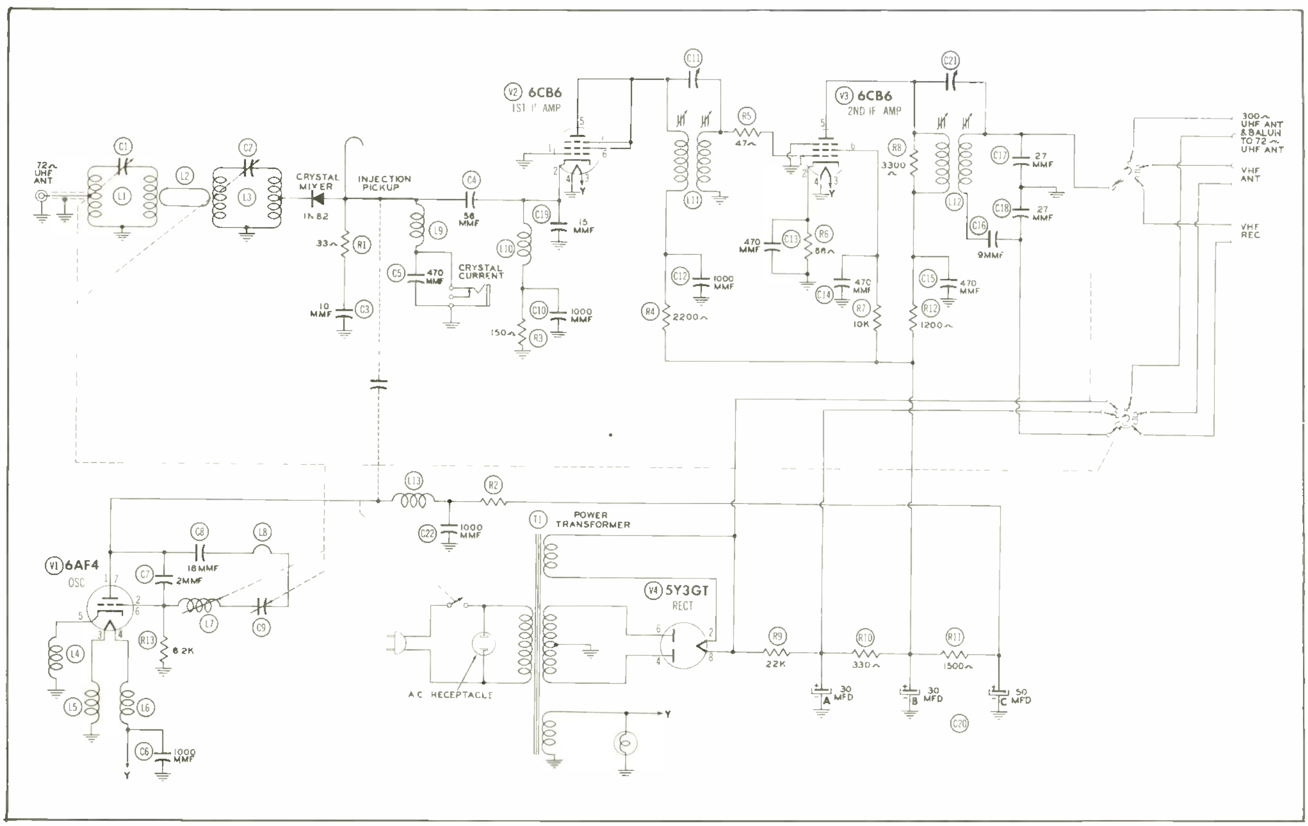

Figure 17. Schematic of RCA Model U70.

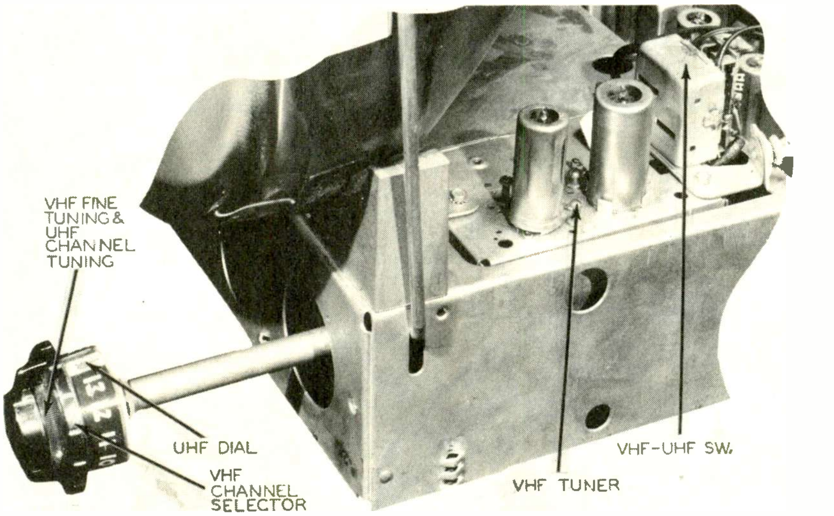

Figure 18. Top Chassis Photo Showing 13 Position Tuner Employed In Sylvania Chassis 1-508-2.

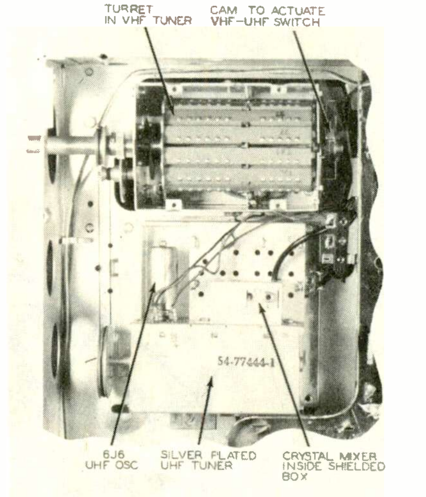

Figure 19. Bottom Chassis View Showing VHF and UHF Tuning Units.

idually. Subsequent operation is facilitated by leaving the TV receiver ON-OFF switch in "ON" position and controlling power to both units with the function switch on the converter.

The operation of the function switch is as follows:

1. OFF position. Power to both receiver and converter is off.

2. VHF position. Power is supplied to converter filaments and to the TV receiver, and the VHF antenna is connected through the switch to the TV receiver. In this position, the TV receiver functions in the usual manner to receive VHF stations.

3. UHF position. B+ power is applied to converter tubes, and the converter output is connected to the VHF receiver antenna input terminals. With the TV receiver set to receive either channel 5 or 6, UHF stations tuned by the converter are accepted by the television receiver.

When tuning in UHF stations, tune for best picture and sound. However, if interference is noted, turn the VHF receiver fine tuning control until the interference disappears and retune the converter tuning knob for best picture and sound.

The Model U70 may be checked by tuning to a weak UHF signal. If snow is excessive, the crystal may be defective and should be replaced. If this procedure is followed and a new crystal does not effect a reduction in snow, it is probable that the RF circuits need readjustment to compensate for the new crystal.

SYLVANIA BUILT-IN VHF-UHF TUNING SYSTEM

Sylvania has incorporated in some of their current runs of television receivers a built-in, all-channel, tuning system. Chassis 1-508-2 employs such a system. A partial top view of the 1-508-2 chassis (Figure 18) shows the VHF tuner. The UHF unit is mounted beneath the chassis, and is shown in Figure 19.

Essentially, this tuning system utilizes a 13-position VHF turret tuner and a UHF tuner which is coupled by a dial-cord arrangement to the fine tuning control of the turret tuner. Twelve positions of the turret tuner are used for reception of VHF signals in the accustomed manner, while the thirteenth position of the turret establishes the setting to tune in UHF stations. Simultaneously, when the turret is rotated to the thirteenth, or UHF position, a cam arrangement on an extension of the turret shaft actuates a VHF-UHF switch. This switch performs the following functions:

VHF POSITION: The VHF antenna is connected through the switch contacts to the input of the turret tuner. B+ is removed from the UHF unit, and the UHF output connection is opened.

UHF POSITION: The VHF antenna is grounded. B+ is applied to the UHF tuner, and the UHF output is applied to the turret tuner input.

The tuning system is designed for a single conversion process in both VHF and UHF positions. Thus, in both instances, the tuner outputs are at a frequency in the 40 megacycle range.

The output of the UHF unit is fed through the turret tuner. The turret tuning strip for this position is designed to accept 40 megacycle signals. B+ is removed from the local oscillator when the turret-tuner is turned to UHF position. Thus, the turret tuner, in UHF position, functions as a two-stage amplifier. Signals applied to the video IF strip in the receiver are therefore essentially alike for both VHF or UHF reception.

Figure 20 is an illustration of the tuning knobs employed on the Sylvania 1-508-2 chassis. Note that the turret selector knob is marked with VHF channel numbers and has a window opening between positions 2 and 13. As previously stated, this position switches the circuits to accept the output from the UHF tuner. UHF channel markings are then visible through the window, and UHF channels may be tuned in by turning the VHF fine tuning knob. As the fine tuning control is rotated, a gear and pulley arrangement tunes the UHF unit.

The UHF tuner employs double-tuned preselector circuits, a local oscillator, and an oscillator-doubler circuit. RF tuned circuits are of the transmission-line type. They consist of quarter-wave, end-tuned, coaxial lines. For high

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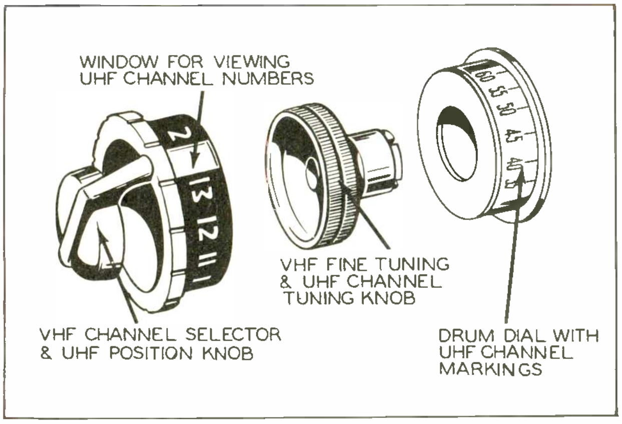

Figure 20. Concentric Shaft VHF-UHF Tuning System.

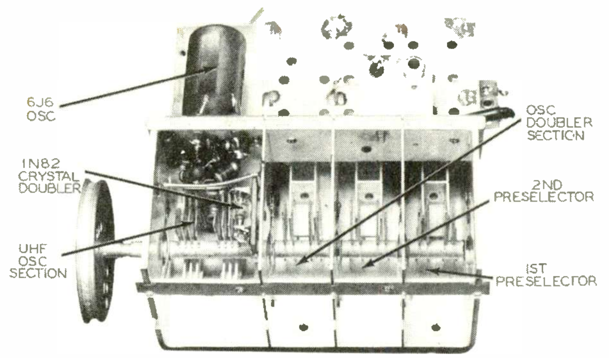

Figure 21. Silver Plated UHF Tuner Used In Sylvania Chassis.

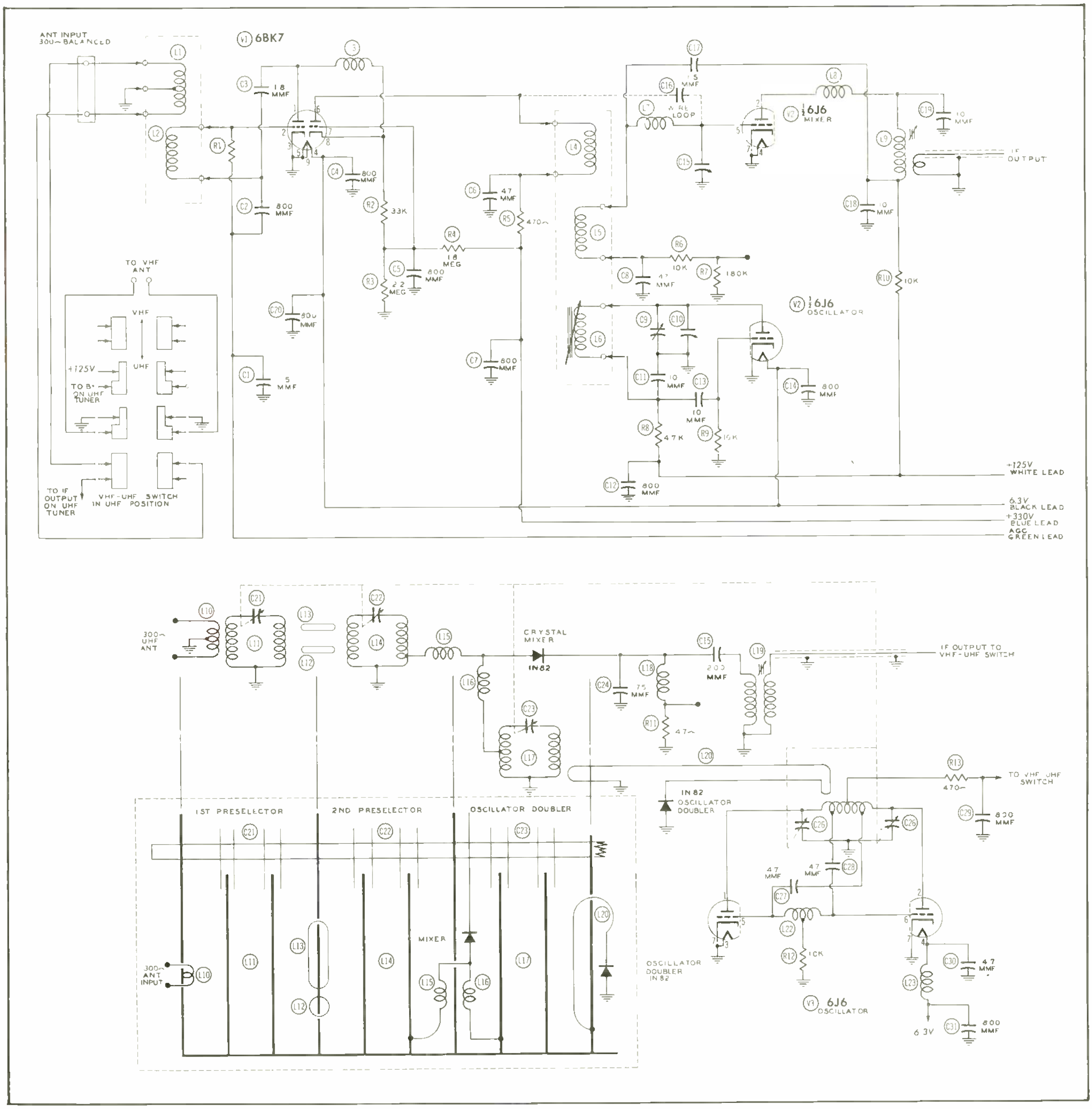

Figure 22. Schematic of Sylvania Chassis 1-508-2 VHF and UHF Tuning Units.

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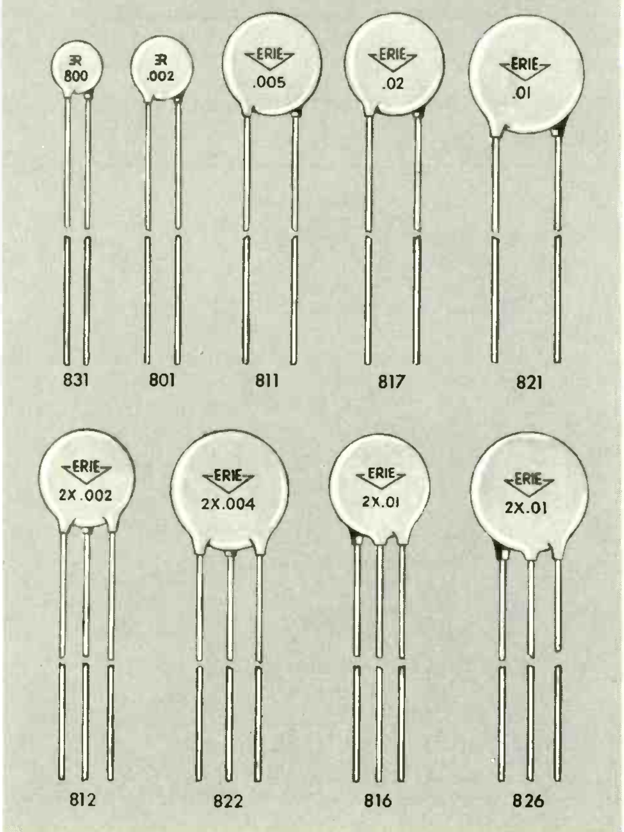

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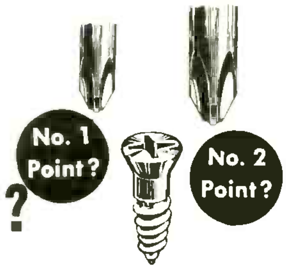

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efficiency, the entire UHF unit is silver-plated.

To electrically lengthen the tuned lines to effect a resonant condition at any frequency within the UHF band, capacitive tuning is employed at the open end of the line. The variable ganged capacitor used in this application (see Figure 21) is of a type similar to those used in conventional low frequency applications. Each line is tuned by four rotor plates. The two outer plates for each line are slotted to permit point-by-point corrections of passband characteristics, while the inner two plates are solid. The solid rotor plates may be used to compensate for general overall trends in tuning characteristics. Trimmers are provided to set the high-frequency end in the RF sections.

Figure 22 is a schematic of the VHF and UHF tuners used in this chassis. The section enclosed in dotted lines at the lower left of the UHF schematic is a pictoral drawing of the tuned lines in the tuner. The item numbers of the components in this pictoral drawing correspond to the item numbers of the electrical symbols in the schematic. Since the push-pull oscillator tuning section is comprised of a conventional split-stator capacitor, it is not included in the pictoral drawing.

The UHF local oscillator employs a twin-triode 6J6 tube in a push-pull circuit. This circuit is also tuned by rotor plates on the ganged tuning element. The half-frequency signal from the local oscillator circuit is loop-coupled to the oscillator doubler. Note in schematic Figure 22 that a crystal diode is employed in series with the coupling loop to provide rectification of the oscillator signal and thus effect more efficient doubling action.

The input of the UHF tuner is designed to match a 300-ohm lead. Interstage coupling in the RF circuits is by means of two loops which are used in this application to provide sufficient bandwidth over the tuning range.

A 40-megacycle intermediate-frequency signal is obtained by feeding the incoming and oscillator signals to the crystal mixer, type 1N82. This crystal is contained in a shielded compartment on the tuner, and may be reached by removing two screws holding the shield in place.

The entire UHF unit is provided with shields to minimize radiation. Also, to maintain uniform characteristics, the UHF unit is initially assembled on a metal base plate which in turn is mounted on the television receiver chassis. This provision minimizes any tendency to strain, or distort positioning of the tuned elements in the tuner when screwing the base plate to the television receiver chassis.

SUTCO COMBINATION BOOSTER AND UHF CONVERTER

Sutton Electronic Company, Inc., has developed a combination Booster and UHF Converter designated as Sutco Model 21A. It provides in a single, compact cabinet all the advantages of a booster for VHF operation, plus the additional feature of a UHF converter continuously tunable over the entire UHF band.

Three knobs on the front of the cabinet (Figure 23) control the operation of the Model 21A. The knob on the left is the booster tuning control, tuning VHF channels from 2 through 13. The knob at the lower center operates the selector switch, whose positions are indicated as follows:

1. OFF
2. VHF 2-6
3. VHF 7-13
4. UHF

On the right is the UHF tuning control knob.

The booster section of the unit employs a 6J6 tube in a push-pull wide-band amplifier circuit, designed to amplify television signals on channels 2 through 13. Either 300-ohm balanced line or 75-ohm coaxial line may be employed at both input and output terminals of the booster section. In positions 2 and 3 of the selector switch the unit functions as a booster on the VHF channels. The operation is the same as if the UHF section were not contained as part of the unit.

The UHF converter section employs a three-gang tuned element consisting of concentric resonant lines. It is continuously tunable over the full UHF TV band. A single tube, type 6AF4, is used in this section, and functions as the UHF local oscillator.

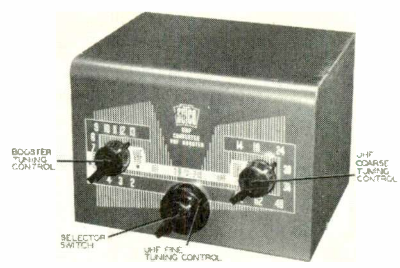


Figure 23. Sutco Model 21A.

With the selector switch in UHF position the booster section operates as an IF amplifier stage between the UHF converter output and the input to the television receiver.

A better understanding as to the operation of the Sutco Model 21A is obtained by observing the block diagrams in Figure 24. These diagrams illustrate the functioning of the booster and UHF converter for each position of the selector switch. Note in position 1, or "OFF" position (Figure 24A), that both the UHF and booster sections are inoperative and that the VHF antenna connects to the television receiver for VHF reception. Figure 24B illustrates the operation in positions 2 and 3, or positions marked "VHF 2-6" and "VHF 7-13", of the selector switch. In these positions the booster is connected between the VHF antenna and the television receiver to provide additional signal gain on channels 2 through 13. In position 4, or "UHF" position, of the selector switch, the booster remains connected to the television receiver and the UHF converter output is applied to the booster input. The converter output, designed to fall on the frequency of channel 5 or 6, is accepted by the booster section which is adjusted to channel 5 or 6. In

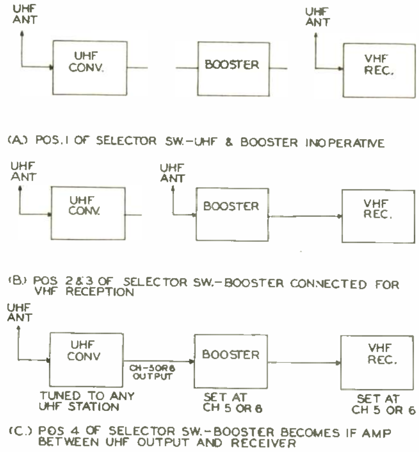
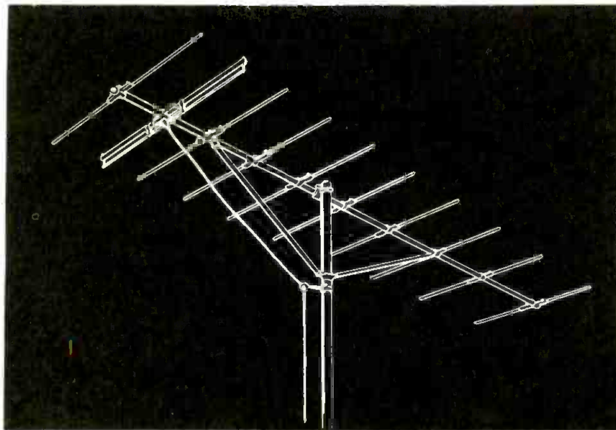
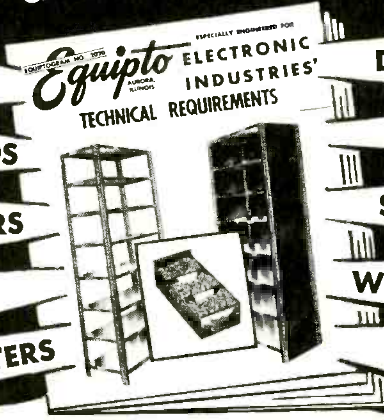


Figure 24. Block Diagram Illustrating Function of Selector Switch.

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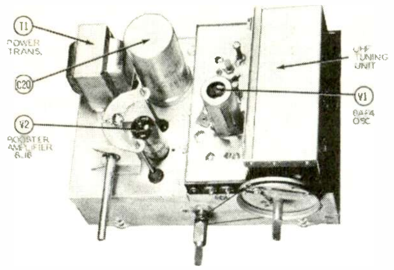

Figure 25. Top Chassis View of Sutco Model 21A.

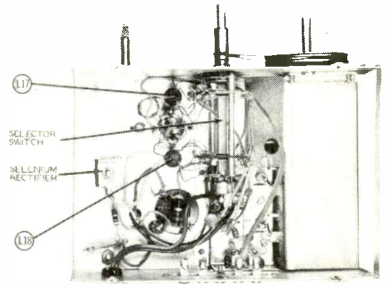

Figure 26. Bottom Chassis View of Sutco Model 21A.

turn, the television receiver tuner is set at channel 5 or 6 position to receive the booster output.

Top and bottom chassis photos of the Sutco Model 21A are shown in Figures 25 and 26 respectively to illustrate the layout of the unit.

A schematic of the Model 21A is shown in Figure 27. L1, L2, and L3 form the three-gang concentric resonant lines for tuning the UHF TV band. L1 and L2 are employed in the double-tuned preselector circuits. The preselector output is fed to the crystal mixer, type CK-710.

L3, the third section of the three-gang tuning element, is employed in the oscillator circuit. The oscillator frequency is maintained at 76 to 88 megacycles below that of the incoming signal to establish the desired intermediate frequency out of the crystal mixer at channel 5 or 6 frequencies (76-88 megacycles).

The 1,000 mmf. capacitor and 470-ohm resistor (shown dotted) in the crystal mixer output circuit are for alignment purposes only. If alignment is required, these two components may be added temporarily.

The crystal mixer output is transformer-coupled by L10 to terminals on the selector switch. With the switch in "UHF" position as shown on the schematic, the intermediate frequency signal from the crystal mixer is applied to the booster input coil L17. This signal is amplified by the 6J6 tube in a push-pull amplifier circuit, and applied through additional switch positions to the output terminals 4 and 5 on the terminal strip, located on the back of the unit. To accept the intermediate frequency signal by the booster circuits, the booster tuning knob should be set at channel 5 or 6 position.

Another function of the selector switch in "UHF" position is to apply B+ to the UHF oscillator tube. This is provided by a shoe on the switch wafer SW1B, rear. Note also that the VHF antenna is disconnected at switch wafers SW1A, front, and rear, in "UHF" position.

Turning the selector switch one position in the direction of the arrows removes B+ from the UHF tuner section, disconnects the crystal mixer output from the booster, and connects the VHF antenna to the booster input. This position of the switch provides booster action on the high VHF channels (7-13). A portion of both L17, input coil for the booster, and L18, output coil,

♦ ♦ Please turn to Page 123 ♦ ♦

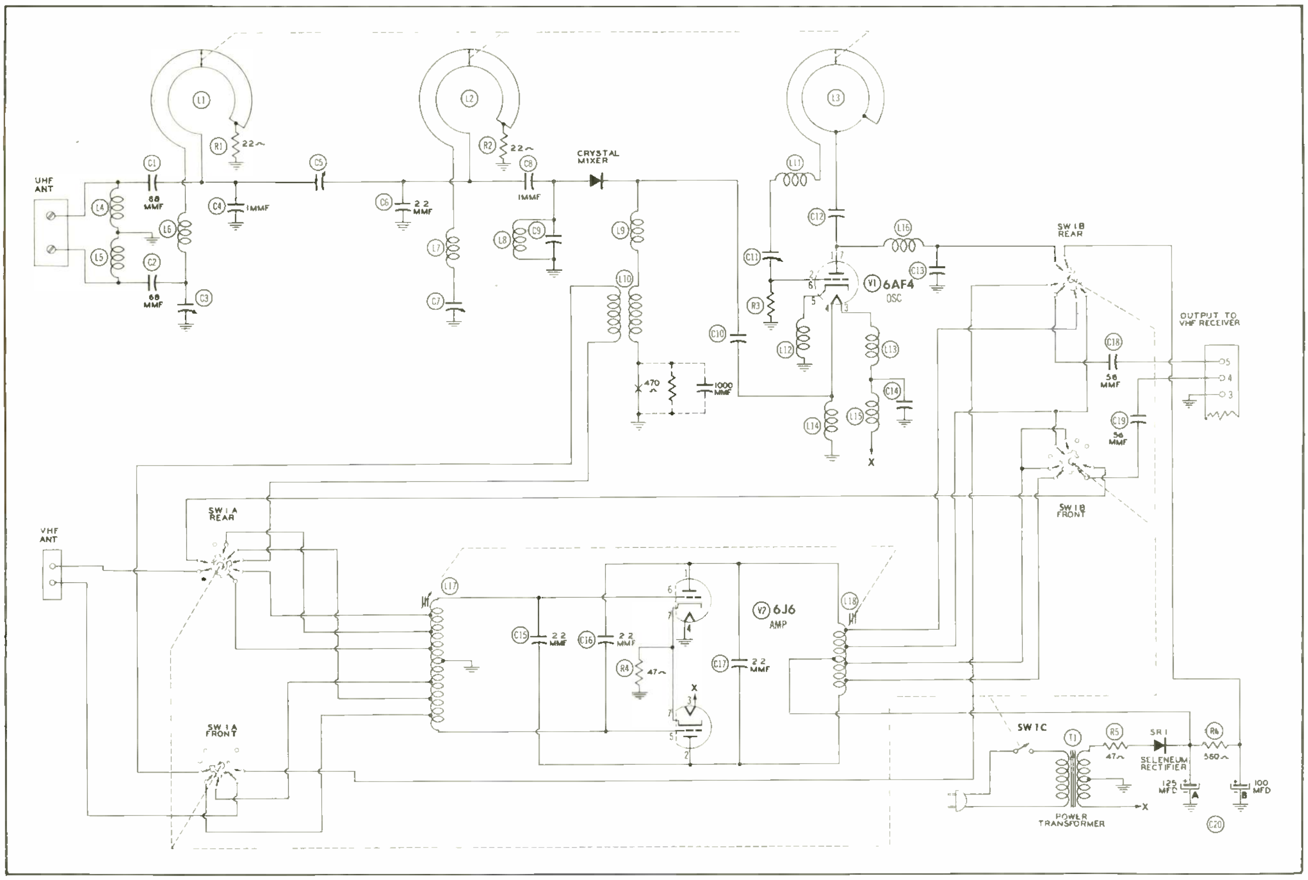

Figure 27. Schematic of Sutco Model 21A.

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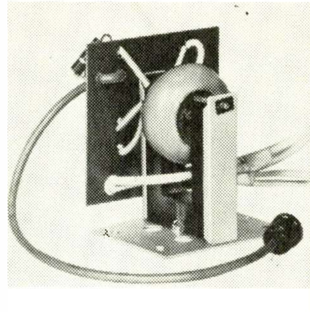

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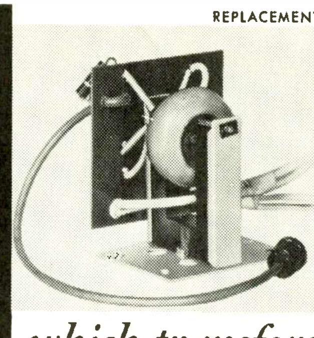

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GLOSSARY OF UHF TV TERMS
(Continued from page 45)

lator frequency plus the intermediate frequency in a superheterodyne receiver having the oscillator operating above the desired signal. In a receiver having the oscillator operating below the incoming signal, the image frequency is equal to the local oscillator frequency minus the intermediate frequency. In either case, an undesirable signal will be received at the image frequency unless it is rejected in pre-selector circuits ahead of the mixer.

IMPEDANCE MATCH: A condition whereby the impedance of the load is equal to the impedance of the source.

INCREMENTAL TUNING: The addition of small inductors or capacitors to an RF circuit to change its resonant frequency. Used frequently in switch type tuning systems.

INFINITE IMPEDANCE: A condition equivalent to an open circuit. Theoretically, a parallel resonant circuit without any resistance exhibits the properties of an infinite impedance or open circuit.

IMAGE REJECTION: A term pertaining to the attenuation of the image signal. The use of preselector circuits is instrumental in providing image rejection.

INSERTION LOSS: Effectively all losses in a UHF tuning unit lie in the crystal mixer circuit. Only a fraction of the power supplied by the incoming signal is obtained as an intermediate frequency signal in the mixer output. This loss is usually expressed in decibels, as a ratio of the power applied to the mixer to the power obtained in the output.

LECHER WIRE: A modified transmission line, usually provided with a shorting bar, which is used either as an RF tank circuit in receiving devices, or adapted in such a manner that accurate frequency measurement may be performed by measuring the distance between the loops of standing waves along the wire.

LINE IMPEDANCE: See "CHARACTERISTIC IMPEDANCE".

LOOPS: Points along a transmission line having standing waves where maximum potentials exist.

LOSSER: A circuit having less power in the output as compared to the power applied to the input is considered a losser. This term is particularly applicable to mixers. A crystal mixer is a losser.

LUMPED CONSTANTS: The resistance, capacitance or inductance which is provided by the addition of an individual component, such as a resistor, capacitor or inductor, is considered a lumped constant. In UHF work, lumped constants are employed to augment the distributed constants in the circuits.

SINGLE CONVERSION: Converting the frequency of an incoming signal to an intermediate frequency in a single step process constitutes a single conversion. The process is frequently employed in the built-in type UHF tuning devices.

STANDING WAVE: Standing waves result from a condition where an impedance mismatch between the source, line or load results in energy being reflected from the load back into the transmission line to form stationary loops.

STANDING WAVE RATIO: The ratio of the maximum voltage (or current) to the minimum voltage (or current) along a line is the standing wave ratio.

SURGE IMPEDANGE: See "CHARACTERISTIC IMPEDANCE".

SLOTTED ANTENNA: A type of transmitting antenna having slots approximately one-half wavelength long which act as radiators of the signal.

SPURIOUS FREQUENCIES: Any undesired signals, such as images, cross-modulation, parasitic oscillations and harmonic interference may be considered spurious frequencies. When these signals fall within the passband of the tuned circuits, and are of sufficient amplitude, they appear in the output along with the desired signal.

SPURIOUS RESPONSE: A condition in a receiving device whereby the circuits are resonant to frequencies other than those for which it is designed.

SUCKOUTS: A hole in the response pattern of a tuned circuit due to self resonances of components at certain frequencies.

TEMPERATURE NOISE: A condition in a crystal mixer or vacuum tube diode, whereby noise effects are introduced into succeeding stages. It is defined as the temperature that would be assigned to a resistance equal to the impedance of the crystal mixer output, that would produce the same amount of noise.

TRANSIT TIME: As applied to a vacuum tube, transit time is the time required for an electron to go from one element to another.

TUBE NOISE: Noise of random nature generated within a vacuum tube and covering a wide range of frequencies. It limits the possible amplification obtainable in the input circuits of a receiving device.

TWIN-LEAD, RIBBON: A type of transmission line of flat construction consisting of two parallel conductors imbedded in a phenolic base.

TWIN-LEAD, TUBULAR: A type of transmission line employing two parallel conductors separated by a tubular material. The hollow construction of this transmission line adapts it for use in damp climates. The presence of moisture has but slight effect on its characteristics.

UNBALANCED LINE: A transmission line having the conductors operating at a different level of potential above ground.

UNBALANCED OUTPUT: The output of a tuning device designed to connect to an unbalanced line.

UHF: Means Ultra-High-Frequency. The entire UHF spectrum extends 300 megacycles to 3000 megacycles. The UHF TV band occupies a portion of this spectrum (470 to 890 megacycles).

V ANTENNA: An antenna composed of elements in the shape of a V. The transmission line couples to the apex of the V, and the directivity is toward the open end of the V.

VARIABLE IF: The condition whereby the output of a mixer in a superheterodyne circuit can be selected over a desired range. A separate UHF converter whose output can be made to fall at either channel 5 or 6 is a form of variable IF system.

WAVEGUIDE: A modified, hollow transmission line designed to carry Ultra-High-Frequency signals to the antenna, or to propogate the energy into space at the end of the line. Waveguides are usually rectangular, and are so constructed to be resonant at the frequency which they are to operate.

WAVELENGTH: The distance traveled by an alternating type of electrical energy in the time of one cycle.

"TRAN. LINES"(cont'd from Page33

In this manner the separation of the wires themselves is kept constant and accurate. The brown polyethylene jacket protects the line against the weather and abrasive damage. The characteristic impedance of the line is 270 ohms and its attenuation per 100 feet of length is 3.6 db at 500 mc and 5.1 db at 900 mc. Best installation practice calls for sealing the ends of this line in much the same manner as mentioned before with 300 ohm tubular line.

That is the story on a few of the different types of transmission lines and how they fit into the new UHF field. In summation it can be siad that the choice of a low loss, weather-resistant line from antenna to receiver is of special importance for the satisfactory reception of UHF television signals.

A number of accessories are on the market for use with these transmission lines. Their suitability in installations for UHF reception is yet to be fully proven in many cases. However, from the experience of installers in the Portland area, it would seem, for one thing, that stand-off insulators should be of the 7 inch variety or longer. This is due to the desireability of keeping the transmission line as far away from surrounding surfaces as possible.

Lightning arrestors may also be had to fit each style of transmission line. There have been some reports that most lightning arrestors seriously impair the reception of UHF signals; for this reason, until further tests have been made in UHF areas, the subject of lightning arrestors will be bypassed.

The material in this article has been gathered from reports out of Portland, Oregon, and from manufacturer's literature on the equipment mentioned. We expect to have additional field reports in the near future, and at that time more detailed information on UHF antenna installations can be published.

GLEN E. SLUTZ

TV SUPPLEMENTARY SHEET NO. 1

MODEL & CHASSIS	PART '	CATALOG '	FUNCTION	DESCRIPTION	LIST PRICE
ADMIRAL					
22A2,A 22M1 22Y1	75B1-50	AG-83-S KSS-3	Tone	2 Meg. Ω carbon	$1.25
	75B11-20	RTV-327	Contrast/ Vol./Sw.	1500/1 Meg. Tap 500K Ω Conc. Dual carbon--SPST	$4.30
	75B13-3	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	75B13-7	AG-15-S FKS-1/4	Vert. Lin.	3000 Ω carbon	$1.25
	75B13-12	AG-49-S KSS-3	Bright.	100K Ω carbon	$1.25
	75B13-13	AG-40-S KSS-3	Hor. Hold	25K Ω carbon	$1.25
	75B13-14	AG-61-S KSS-3	Vert. Hold	1 Meg. Ω carbon	$1.25
	75B13-16	A43-750 KSS-3	Focus	750 Ω 2W-W.W.	$1.25
AMBASSADOR					
C1720 C2020 C2420 CD2020 T1720 T2020	131-0001	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	131-0002	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	131-0003	RTV-1	Contrast Vol./Sw.	10K/1Meg. Tap 200K Ω Conc. Dual carbon--SPST	$3.70
	131-0012	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25
	131-0012	AG-44-S KSS-3	Bright.	50K Ω carbon	$1.25
	131-0013	AG-61-S KSS-3	Vert. Hold	1 Meg. Ω carbon	$1.25
	131-0014	RTV-10	Focus	5000 Ω 4W-W.W.	$1.85
14MT,MTS 16MT,MTS 17MC,MCS, MT,MTS 20MC,MCSMT, MTS	VC-12120B	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	VC-12121C	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	VC-12127B	RTV-297	Contrast. Vol./Sw.	750 Tap 500/250K Ω Conc. Dual--SPST	$4.30
	VC-12130	AG-49-S KSS-3	Bright.	100K Ω carbon	$1.25
	VC-12131	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25
	VC-12132B	AG-83-S KSS-3	Vert. Hold	1.3 Meg. Ω carbon	$1.25
AM-17C, CB,CIM ET,TIM	PT-1002	RTV-252	Contrast Vol./Sw.	750 Tap 250/250K 2W-W.W./carbon Conc. Dual--SPST	$4.30
AM-20C,T PL-17CB,CG, PG,TM 20C 23P	PT-1004	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	PT-1005	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	PT-1007	AG-49-S KSS-3	Bright	100K Ω carbon	$1.25
	PT-1008	AG-61-S KSS-3	Vert. Hold	1 Meg. Ω carbon	$1.25
	PT-1009	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25
20PC 20PCS 20PCS2	VC-12120B	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25

MODEL & CHASSIS	PART '	CATALOG '	FUNCTION	DESCRIPTION	LIST PRICE
AMBASSADOR					
	VC-12121C	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.24
	VC-12127B	RTV-297	Contrast/ Vol./Sw.	750 Tap 500/250K Ω Conc. Dual carbon SPST	$4.30
	VC-12131C	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25
	VC-12132C	AG-83-S KSS-3	Vert. Hold	1.3 Meg. Ω carbon	$1.25
	VC-12135	AG-49-S FKS-1/4	Bright	100K Ω carbon	$1.25
ANDREA 2C-VL20	GRV-812-I	AG-83-S FKS-1/4	Height	2 Meg. Ω carbon	$1.25
	GRV-824	A43-2000 FKS-1/4	Vert. Lin.	2000 Ω 2W-W.W.	$1.25
	GRV-830	AG-60-Z FS-3/SWB	Vol./Sw.	500K Ω carbon--SPST	$1.25 .60
CHASSIS VL-20	GRV-831	RTV-75	Hor./Vert Hold	50K/2 Meg. Conc. Dual carbon	$3.10
	GRV-834	RTV-300	Bright./ Contrast	20K/5000Ω 4W-W.W./ carbon Conc. Dual	$4.05
ARTONE AR14L AR17L 17CD 17CRR 17ROG 20CD 203D 1000 1001 2nd Run	P-2	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	P-5	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	P-7	AG-60-Z FS-3/SWB	Vol./Sw.	500K Ω carbon SPST	$1.25 .60
	P-12	AG-8-S FKS-1/4	AM-Rejection	1000 Ω carbon	$1.25
	PD-5	RTV-146	Vert./Hor. Hold	1 Meg./50K Ω Conc. Dual carbon	$3.10
	PD-6	RTV-253	Contrast/ Bright.	2000/100K Ω Conc. Dual carbon	$3.10
MST-12 MST 14 14TR 16TR 17CD 17CRR 17ROG 20CD 20TR 112X 203D 312 819 3163CR 8163CR 8193CM 1st Run	P-2	AG-19-S FKS-1/4	Vert. Lin.	5000 Ω carbon	$1.25
	P-5	AG-84-S FKS-1/4	Height	2.5 Meg. Ω carbon	$1.25
	P-6	A10-1500 FKS-1/4	Focus	1500 Ω 4W-W.W.	$1.85
	P-7	AG-60-Z FS-3/SWB	Vol./Sw.	500K Ω carbon SPST	$1.25 .60
	PD-4	RTV-145	Contrast/ Bright.	750 Tap 250/100K Ω 2W-W.W./carbon Conc. Dual	$3.70
	PD-5	RTV-146	Vert./Hor. Hold	1 Meg./50K Ω Conc. Dual carbon	$3.10
ARVIN 5175 5176	E22464-17	RTV-258	Contrast/ Vol./Sw.	25K/3 Meg. Tap 1 Meg. Conc. Dual carbon--SPST	$4.30
	E22464-20	RTV-259	Vert. Lin./ Height	3000/2.5 Meg. 2W-W.W./carbon Conc. Dual	$3.10
CHASSIS TE320	E22464-34	AG-49-S KSS-3	Bright.	100K Ω carbon	$1.25
	E22464-35	Order from MFR.	Tone/ Phono Sw.		
	E22464-36	AG-83-S KSS-3	Vert. Hold	1.5 Meg. Ω carbon	$1.25
	E22464-37	AG-44-S KSS-3	Hor. Hold	50K Ω carbon	$1.25

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Dollar and Sense
(Continued From Page 63)

BUSINESS OUTLOOK. Today things are good at practically all levels of business, and there's enough steam in the boiler to carry this boom well into next year, according to Business Week publisher Elliott V. Bell. But there are definite signs of a recession, due either in 1953 or 1954. Production, income and employment are all at historic peaks; profit margins have been narrowing for over a year; inventories are high (except TV sets); houses are being built faster than young people are getting married; the peak of armament spending is only about six months ahead; new autos no longer sell themselves; finally, for the first time since 1929 we have a boom in industry along with world-wide weakness in commodity prices.

For a servicing business, this means it will be wise to look farther ahead than tomorrow. Avoid over-confidence. Get on safe financial ground for weathering a recession. If it doesn't come so soon, you've lost nothing; if it does come, you may have saved your business by looking ahead now. In General Eisenhower's own words, now is the time to restore "frugality, thrift, and efficiency", in business as well as in government.

COMMUNITY TV NEWS. In Minot, North Dakota, an A-M radio station has a community TV system which it feeds with programs from its own studio instead of taking them off the air, as no station signals are available. Remote pickups include local baseball, basketball and football games. If nothing else is available, they'll even televise their radio announcer playing records for 3 hours a day. Plans call for building a TV station eventually, to capitalize on programming experience obtained.

In other small localities, radio stations are beginning to think seriously about community TV systems of their own also, but for use in place of transmitters. Such wired systems are cheaper than construction and operation of a regular transmitter, and give listeners a choice of several good signals.

UMPIRE. A special industrial TV setup known as the TV Automatic Umpire is announced by Radio Receptor Co. of Brooklyn. The camera scans the path of each ball thrown, and associated equipment interprets the resulting signal as a strike or ball. Plans call for demonstrations to major league ball clubs during the next spring training season.

PREDICTION. Enthusiastic DuMont sales manager Dan Halpin sees in his crystal ball three TV sets per family--one for the parents, one for the children, and one for the mother-in-law.

ROUNDS GO OUT. Less than half of 1 percent of all picture tubes sold to set manufactures are round-screen tubes today. The rest are rectangular, with the industry standardizing for 1953 on 17, 21, 24 and 27-inch sizes.

BEST PAPER. For reasons unknown, people are more prompt with payments for TV sets than for auto, furniture, refrigerator or stove payments. Banks and finance companies therefore consider as "the very best" the "paper" which they hold on TV sets sold on time payments.

Estimates indicate that 2 out of 3 TV sets are sold on an installment basis, at an average debt of about $275 per set. Putting it all together, this country still owes some $750,000,000 on the TV sets at which it is looking today.

WHAT'S MY LINE? If I work with female patch jumpers, baby scoops, four-way barn doors and lazy boys, what would be my job? Here's a tip--they're all listed in DuMont's new Television Equipment Components booklet. The female costs $9.50, the scoop $32.45, the door $15 and the boy $40. The last three have something to do with studio lighting, but we couldn't figure out what the female patch jumper was good for.

PREVIEW TV. Now they announce a patented gadget that tantalizingly turns on a TV set for four minutes at the beginning of each half-hour program, then turns it off and lights up a sign announcing how much (usually 25¢) has gotta be put in the coin slot in order to see the rest of that program. During this free-sample time the patron can see what's on other channels too. A number of motels are reported to have signed up for installation of sets having this business-getter, on claims that it'll increase the coin take six-fold over ordinary coin-operated TV sets.

JOHN MARKUS

"ANTENNAS"(cont'd from Page31)

ing to the manufacturer, is used to eliminate interaction between the two sections of the antenna and to enable the use of a single transmission line to the TV receiver.

Channel Master's Ultra Bow with Screen Reflector (Model 403) features a bow-tie with a flat screen reflector. This antenna is pictured in Figure 14. A pair of these fan dipoles may be stacked one above the other for increased gain.

Telrex, Inc., has announced a "UHF Corner Reflector" (Model 600) which, it is claimed, has an average gain of 14.7 db over the UHF range. The antenna has an effective range of from 10 to 60 miles according to the manufacturer's literature.

Unclassified Types of UHF Antennas -

In addition to the antennas already described, there are a few which should be added to the general group of UHF antennas. LaPointe-Plascomold Corp. (Vee-D-X) has announced a UHF Colinear which, though much like a Yagi in performance, has a different physical construction. The Colinear will be used principally in fringe areas where gain is a primary consideration. The manufacturer states that this antenna will deliver a maximum gain of 16 db. He also states that although the Colinear is a "cut to frequency" antenna, it will cover 20 UHF channels with only a slight loss of gain. The UHF Colinear has four bays, each consisting of a full wave radiator and reflector. The spacing is adjusted at the factory for optimum gain at the desired channel.

Radio Merchandise Sales (RMS) has announced their Model COR which consists of a folded dipole and a corner array reflector. This antenna may be obtained cut to a specific channel or for a group of channels.

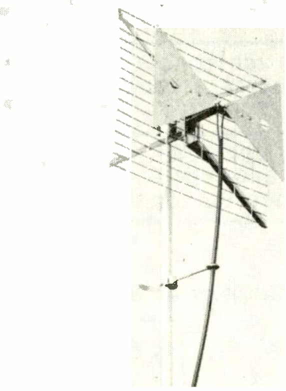


Figure 14. Channel Master Ultra Bow With Screen Rejector, Model 403. (Sample Courtesy of Channel Master Corp.)

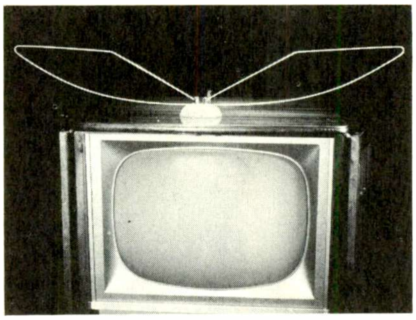


Figure 15. Telrex Bat Wing, Model BW-1. (Sample Courtesy of Telrex, Inc.)

Telrex, Inc., has an indoor antenna of special design which they designate as their Bat Wing, Model BW-1 (See Figure 15), for UHF and VHF reception at distances of from 5 to 10 miles. Another of their models is the "UHF Clover-V-Beam" (Model 100) which resembles a pair of figure 8's on their sides, one above the other. A photograph of the array appears in Figure 16. All-channel reception in both UHF and VHF spectrums is claimed for this antenna, which includes some of the features of both the V dipole and the conical in its design and construction.

This completes the list of UHF antennas which have been or are now appearing on the market. The whole field of UHF antenna development is still in a state of flux and new designs are being brought forth regularly so that this listing is complete only to the extent of the data available at the time of writing.

GLEN E. SLUTZ

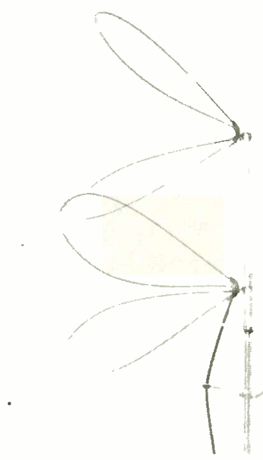


Figure 16. Telrex UHF Clover-V-Beam, Model 100. (Sample Courtesy of Telrex, Inc.)

"SHOP TALK" (Cont'd. from Page 96)

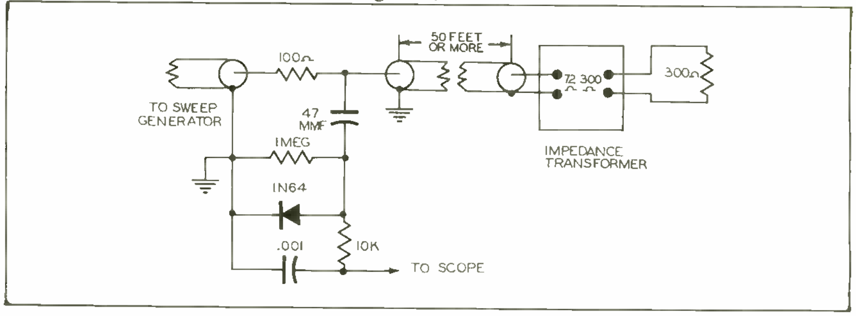


Figure 8. A Test Set-Up For Impedance Transformers.

Undoubtedly the reader will recognize that the transformer could also be tested by using a 300-ohm line and terminating the unbalanced end of the transformer with a 72-ohm resistor. Use the method most convenient to your facilities.

MILTON S. KIVER

"UHF" (cont'd from Page 115)

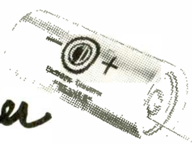
are shorted to provide tuning at the frequencies of the high VHF channels.

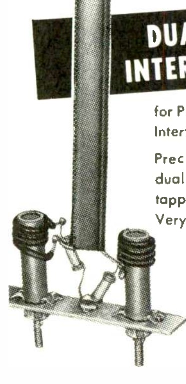
With the selector switch in Position 2, the booster connects as an amplifier for VHF channels 2-6. The short is removed from L17 and L18 for the lower-frequency operation. The circuit shows that the booster operates the same in Positions 2 and 4, except that the VHF antenna connects to the booster input instead of the crystal mixer output.

Position 1 (Off) turns power off for both the UHF and booster selection, and routes the VHF antenna directly to the receiver input; thus, when tuning VHF stations from which strong signals are available, the booster is out of the circuit and cannot overload receiver circuits.

One main feature of the Sutco Model 21A is the combining of a VHF booster and a UHF converter. The input can, therefore, help out on VHF fringe work in addition to making possible UHF reception on conventional VHF receivers.

MERLE E. CHANEY





"TUBES" (cont'd from Page47)

7 pin miniature construction. By closely examining the inside of a 6AF4 tube, it is observed that the element structure occupies only the lower half of the tube envelope and the upper half is vacant. (See Figure 1). The reason for this, is that it was necessary to position the elements in the tube so as to maintain lead length at a bare minimum for efficient operation at UHF frequencies.

One requirement must be met for the use of a 6AF4 tube as an oscillator, and that is, the tube socket must firmly secure the tube in position and provide good connection to the pins. If the tube is not securely held, the resultant oscillator frequency may vary as much as 10 megacycles. It is recommended, therefore, that a suitable tube shield and clamping arrangement be employed on the 6AF4 tube when used in UHF applications.

Another tube recently brought on the scene is the type 6AN4. It is a triode, designed for service as a UHF mixer or amplifier. One problem in the design of UHF tuning devices has been that no RF amplification could be provided, chiefly due to the lack of a suitable tube. Preselection provided the required selectivity, and crystals provided the first detector action. However, up to this point there was an appreciable loss in signal, which was usually compensated for by the use of intermediate frequency amplifiers prior to application of the signal to the receiver's video IF stages. The 6AN4 is designed to function in the UHF tuner to provide a signal gain in the RF and/or mixer circuits instead of a loss. Therefore, when a 6AN4 tube is employed in UHF tuners, it may be found that intermediate frequency amplification is not employed in the tuner. In these instances, the signal from the crystal mixer may be fed directly to the video IF circuits in the receiver. It is observed, however, that in one application of a 6AN4 tube in a UHF tuner, that a single conversion process is incorporated. In this particular unit, the UHF tuner output is fed to the VHF tuner which, in UHF position, becomes a 2 stage IF amplifier ahead of the existing video IF stages in the receiver.

Any number of combinations may be incorporated in a receiver employing a UHF tuner with a 6AN4 tube as a mixer or RF amplifier. It will depend upon the design required for the specific application.

Charts 1 and 2 show physical and operational specifications of the 6AF4 and 6AN4 type tubes. These tubes are comparatively new and their specifications do not appear in many tube manuals. They are reproduced here for your use through the courtesy of Sylvania Electric Products, Inc.

The previously described tubes are those which have been especially designed for UHF tuner applications. However, an examination of current UHF receiving devices shows that in some instances VHF receiving tubes are employed. An illustration of this is the use of a 6J6 twin triode as the local oscillator in a UHF tuner. In this application, the 6J6 operates as a push-pull, half-frequency oscillator.

Another illustration of the use of VHF type tubes in UHF application is the use of a dual triode tube, type 6BQ7, as twin local oscillators in a UHF tuner. This tuner is the preset switch type providing service on any two previously chosen UHF channels. Each triode section of the 6BQ7 functions as a separate oscillator. The fundamental frequency of either triode could be established anywhere between 200 and 300 megacycles. A harmonic tank coil, positioned closely to the fundamental tank coil, is adjusted to the second harmonic to provide the required signal to the crystal mixer for reception of UHF channels occupying the lower half of the UHF band. For signals available at the upper half of the UHF band, the harmonic tank coil is adjusted to the third harmonic of the fundamental. Thus, a tube designed primarily for lower frequency service was utilized to provide efficient performance in a UHF tuning device.

The ultimate in television receiver design will be achieved when the same tubes are used in a tuner for both VHF and UHF reception. The great strides which have been taken in tube design in recent years seem to indicate that such will be forthcoming.

MERLE E. CHANEY

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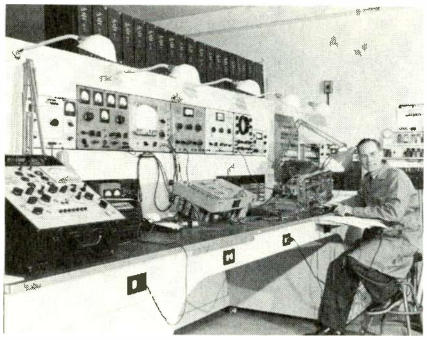
January-February 1953 Issue

+ More or Less –



It has been our usual practice to identify and describe the service activities, pictured on the cover of each issue of the PF INDEX and Technical Digest, on the following right-hand, or title, page. Because of the interest evidenced in shop layouts pictured previously, and also in view of several features apparent in the cover photograph, we are including the complete letter which accompanied the illustration.

We are indebted to Mr. Rod Harley, who operates the Rod Harley Personalized Radio & Television Service & Sales, 220 Seabright Avenue, Santa Cruz, California, for supplying us several illustrations of his shop. We selected one which we felt most representative (reproduced above) for cover use.

Mr. Harley's letter, detailing features of the shop layout, follows:

"I have been in the radio service business since 1932. When you brought out the PHOTOFACT service, I immediately subscribed to it and have been receiving every issue ever since, as the enclosed photograph will testify.

"We really needed your service. I have been watching, with great pleasure, the pictures of servicemen's benches on the front cover of your PF INDEX. In the past, I have seen many service benches which appeared small or crowded and poorly lighted. Having been in the same predicament up to a few weeks ago, I decided on a new bench, and the enclosed pictures will show what I came up with.

"A few of the interesting points about the bench are:

1. There is bronze screening directly underneath the Masonite top, which extends to the rear up the back and then underneath all of the instruments.

2. Two bread boards underneath the top on which sets can be checked when the bench is loaded; or they are handy for holding PHOTOFACT manuals during the service operation.

3. The placement of lights with the two Flex lamps at each end. These lamps can be moved to any position on the panel.

4. The entire bench is mounted on castors for various placements in the shop.

5. Heavy construction employing 4 x 4's and 2 x 6's. The long spans of 13' allow for additional instruments . . just cut the required hole in the front panel and set it alongside those already there.

6. The two openings underneath the instruments to hold odds and ends in order that the bench top will be free.

7. Plenty of drawer space.

8. Large mirror at the right end for viewing television sets at the rear of the chassis.

9. Last, but not least, plenty of reserve space for additional Sams PHOTOFACT manuals.

"Hoping you like this layout as well as I do, I am

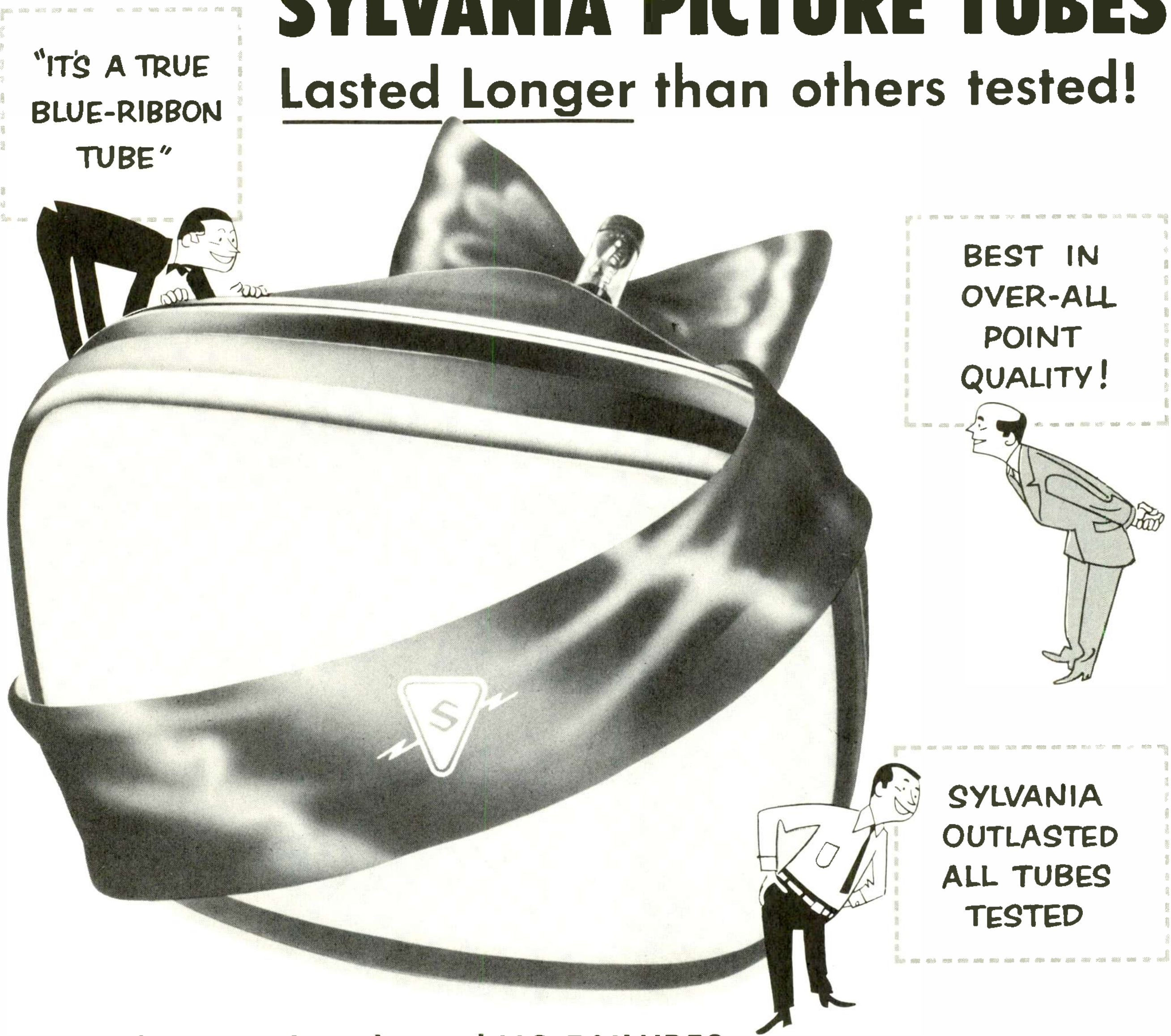
Sincerely yours,
Rod Harley"

We do like it . . . we found it of extreme interest and felt that others may also want to study it.

J.R.R.

SYLVANIA PICTURE TUBES

Lasted Longer than others tested!

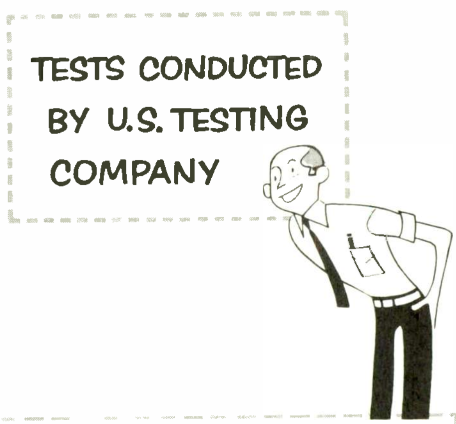


Only Sylvania tubes showed NO FAILURES after 1400 hours . . . *at accelerated voltages*

Exhaustive tests conducted under the supervision of an outside impartial laboratory, the United States Testing Company, showed Sylvania Picture Tubes lasted longer than any others tested.

These tests included the picture tubes of nine leading manufacturers. All tubes were placed in identical test racks and tested under identical accelerated voltages. At the end of 1400 hours, only the Sylvania Picture Tubes showed *no failures.*

These tests definitely establish the outstanding dependability of Sylvania Picture Tubes. They prove that these tubes will best uphold your reputation for fine performance in the sets you manufacture, sell or service. Send today for complete details about Sylvania Picture Tubes. Sylvania Electric Products Inc., Dept. 3R-1601, 1740 Broadway, New York 19, New York.



SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

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From: