New Stereo Pickups and Arms

SPECIAL REPORT – SEPTEMBER

Radio-Electronics
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Why are more Service-Dealers Switching to JFD Exact Replacement TV Antennas?

because 50 per cent of all TV sets made in the last 4 years are portables—sending more antenna replacement business to service-dealers every day.

because as JFD Exact Replacement Specialists, service-dealers can get out of the unprofitable “rabbit-ear” business—earn a profit on the antenna sale (at full mark-up) and on the installation.

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because with JFD guides, streamers, and sales helps, service-dealers get the merchandising know-how that nets them a bigger slice of the $3,500,000 dollar portable antenna replacement market.

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The swing-back and lock-in chassis units on this piece of radar apparatus installed at Newark (N.J.) Airport prove that electronic equipment can indeed be so designed that it is easy to service.

Color original by Habershaw Studios

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National Technical Schools
1910 Figueroa St., Los Angeles, Calif.

SEPTEMBER, 1960

www.americanradiohistory.com
Flattest Speaker?
A new speaker-microphone considerably flatter than conventional speakers has been announced by Emerson Radio & Phonograph Corp. A unit demonstrated by Benjamin Abrams, president of Emerson, was 16 inches in diameter and only ½ inch thick.

The speaker is made up of two perforated metal plates. Between them lies what is believed to be a diaphragm with a printed-circuit voice coil. It can be made as small as a button for use as a hearing-aid speaker or microphone or almost any other size and shape.

The device was developed at the Weizmann Institute in Israel under a research and development program performed jointly by Emerson and a French company. Emerson has exclusive rights to the invention in the Western Hemisphere, according to Mr. Abrams.

Three Tubes in One Envelope
A new group of electron instrumentalities made by G-E combine the functions of up to three separate tubes in a single 12-pin envelope. These Compactrons will make possible size and price reductions in radios, TV’s, hi-fi sets and many other types of electronic equipment. For an example of Compactron savings see the photo. The two units on the right replace the five standard radio tubes on the left, and represent a saving in cost, size and operating power.

Development engineers at G-E also said that other circuit elements could be included in evacuated Compactrons, giving a hint of a receiver where all smaller components (resistors and capacitors) would be combined with tubes in plug-in packages.

Accurate Missile Tracking
A missile tracking system, so accurate that its most serious errors are due to our not knowing the exact speed of light, will be built near Cape Canaveral by General Electric. The MISTRAM system (Missile TRAjectory Measurement system) is designed to determine, with extreme accuracy, the guidance performance of missiles fired from the Cape.

The basic system, which should be completed and in operation by January, 1962, will consist of a group of five receiving stations arranged in an L (see diagram). Antennas at the five stations (one central station and four remotes) will follow the flight of a missile and receive signals from a radio beacon in the missile. Measurements will be made on a CW carrier to get an exact indication of phase difference of extremely high-modulation frequencies.

The range measured by the central station using these signals, and that from each remote is used to determine the position of the missile.

The unusual part of the MIS-TRAM system is that it does not require huge tracking antennas since azimuth and elevation data can be derived by computers from the range and range-difference information.

UHF Tests
Experiments that may change the whole face of our TV allocations system will commence as two UHF test stations go into operation about July 1, 1961. Congress approved the FCC project when it appropriated $2 million for the stations. One of the stations will be in the heart of New York City—the other about 10 miles away.

With the VHF channels (2 to 13) getting scarce, the FCC intends to (Continued on page 10)
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Laser—a Light Amplifier

The first device actually to amplify visible light was announced by Dr. Theodore H. Maiman of Hughes Aircraft. He developed the laser (light amplification by stimulated emission of radiation) that does the amplifying. The device could be used as a light radar that would use light waves (up to 500,000 billion cycles) in place of microwaves. Another possible application is in TV and voice communications where the needle-sharp beam (if projected from the earth to the moon the beam would spread to only 10 miles in diameter) offers a static-free line that resists jamming. The high resolution due to its sharp beams permits detailed pictures of any area—

Teeners and Radios

The great majority of teen-age girls have their own radios, according to a survey taken by Seventeen magazine.

The survey shows that 93.5% (4,500,000) of the magazine’s readers (under 20) personally own a radio; 90.8% listen to the radio during the average day (76.2% at night); 76% report disc-jockey shows as their favorites and 715,000 expect to get a new radio within the next 12 months.

NEWS BRIEFS (Continued from page 6)

find out if uhf (channels 14 through 82) is practicable in difficult reception areas such as a skyscraped city.

Uhf signals are supposed not to travel as far as those of vhf. Ghosts caused by reflections off buildings are considered more troublesome with uhf.

Some of the points to be covered are uhf signal strength as compared with vhf signal strength at the same location and the most practical tuner design.
How to Get a Commercial FCC License

do you know what an FCC license really can do for you in Electronics?

1. More income for you every week
2. A more interesting job in electronics

The chances are good that if you are reading this magazine you can qualify for the really good jobs in electronics like those shown in the pictures at the left . . . and it won't take long to do it. Your past training and experience in basic electronics (such as radio and TV repair, armed forces electronics, ham operators, etc.) can be the foundation for a profitable career as an "across-the-board" electronics technician. The Career Information Material shown below will show how you can qualify for a government certificate of competency . . . a commercial FCC License . . . and get a really fine technical education. Find out how your success with the FCC examination is guaranteed . . . or your money back. You will also find out which jobs require the FCC License . . . where technicians are needed . . . what a technician needs to know about electronics. It will cost the price of a postage stamp to get the facts. If you are in any type of electronics work . . . or if you have had previous training or experience in electronics . . . you owe it to yourself to ask us to send you information on profitable careers in electronics.

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2. To solve the problems that will stump your fellow technicians
3. Training is Job Insurance when employment is tough to find . . . and more money for you when times are good

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NEW Two-Color TV for Japan

A Japanese TV manufacturer is planning to put a two-color-system color set on the market in Japan. Mr. Saburo Soda, president of the Chuo Musen Co., Tokyo, claims that the cost of the set will be about one-third that of a standard three-color set.

The set converts the ordinary three-color signal to a two-color signal. It is then fed to a black-and-white picture tube. To get color effects, a two-color wheel (red and green) is spun in front of the tube face. The reproduced colors are said to be not as natural as those obtained on a standard receiver, but they are "at least serviceable." Adjustments and maintenance are said to be easier.

While two-color TV systems have been demonstrated in the past, Mr. Soda made it clear that his is an independent system, developed on a theory put forward by a Tokyo engineer on the basis of the two-color theory announced last year by Dr. Edwin Land of the Polaroid Corp.

Acoustic Thermometer

An acoustic thermometer to measure high-altitude air temperature has been used by Soviet scientists at a height of 16 miles, according to Tass, the Soviet press agency.

The device consists of two parts. One is a radiator and two microphones; the other is a generator and electronic "device for measuring the time of sound propagation."

According to Tass: "Once the time sound takes to travel from the radiator to the microphone is known, the exact temperature of the air can be computed."

The thermometer depends on the principle that the speed of sound through air increases as the air temperature rises. It was developed at the Radio Physics Laboratory of the Soviet Academy of Sciences' Institute of Physics of the Stratosphere.

Asks 50 Satellites

A plan calling for placing about 50 communications satellites in orbit has been presented to the FCC by the Bell Telephone System. The (Continued on page 18)
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This correspondence course is directed toward two major objectives—(1) to teach you a great deal about electronics, and (2) to prepare you to pass all of the F.C.C. examinations required for a first class commercial operator’s license. We teach you step by step and have you practice with FCC-type tests which you send to the School for grading and comment. You prepare for your F.C.C. examinations under the watchful direction of an instructor who is especially qualified in this field.

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Get details concerning how we can prepare you for your F.C.C. license and how that license can help you advance in electronics. Mail the coupon below to the home office of Grantham School of Electronics in Hollywood, Calif., and our free catalog will be sent to you promptly.

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satellites, spaced about 3,000 miles apart, would provide communication facilities between the US and all other world areas. In most instances, a direct hookup could be made with no intermediate stations in any other country. The proposal indicated that the Bell system would expect to share in the cost of the program.

The best frequencies for space use would be between 1,000 and 20,000 mc. “Our future in world communications and our future in the exploration and exploitation of space depend on the wise use of the very limited range of frequencies in the electromagnetic spectrum which is suitable for satellite communication and for other space purposes,” Mr. James B. Fisk, president of Bell Telephone Laboratories, said.

### Calendar of Events—September 1960

- **Conference on Communications**, Sept. 9-10, Roosevelt Hotel, Cedar Rapids, Iowa.
- **EIA Fall Conference**, Sept. 13-14, French Lick, Ind.
- **Upper Midwest Electronic Trade Conference**, Sept. 15-17, Minneapolis Auditorium, Minneapolis, Minn.
- **New England High Fidelity Show**, Sept. 16-18, Boston, Mass.
- **ERA Business Management Institute**, Sept. 18-23, Urbana, III.
- **National Symposium on Space Electronics and Telemetry**, Sept. 19-22, Shoreham Hotel, Washington, D.C.
- **Industrial Electronics Symposium**, Sept. 21-22, Manager, Cleveland, Ohio.
- **High Fidelity Show**, Sept. 23-25, Palmer House, Chicago, Ill.
- **National Communications Symposium**, Oct. 3-5, Hotel Utica and Utica Municipal Auditorium, Utica, N.Y.
- **Conference on Radio-Interference Reduction**, Oct. 5-6, Chicago, Ill.
- **EIA Conference on Value Engineering**, Oct. 5-6, Disneyland Hotel, Anaheim, Calif.
- **Symposium on Adaptive Control Systems**, Oct. 17-19, Garden City Hotel, Garden City, N.Y.
- **Symposium on Space Navigation**, Oct. 19-21, Drake-Hilton Hotel, Columbus, Ohio.
- **International Congress & Exhibition for Instrumentation and Automation**, Oct. 19-26, Dusseldorf, Germany.
- **East Coast Aeronautical and Navigational Electronics Conference**, Oct. 24-26, Lord Baltimore Hotel, Baltimore, Md.
- **Conference on Electronic Techniques in Medicine and Biology**, Oct. 31-Nov. 2, Sheraton Park Hotel, Washington, D.C.
- **IRE-EIA Radio Fall Meeting**, Oct. 31-Nov. 2, Syracuse Hotel, Syracuse, N.Y.

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NATIONAL RADIO INSTITUTE, Washington 16, D.C.
MIDDLETON-MACK FEUD

Dear Editor:

Regarding the Mr. Mack-Bob Middleton feud:

There are not six readers of the magazine who know what Mr. Middleton was talking about, much less what Mr. Mack yucks about. The only one who knows what Mr. Mack was talking about is Mr. Mack. Mr. Mack is sticking his nose into a business that does not appreciate his comments.

If Mr. Middleton thinks no one reads and appreciates his general run of articles, he is mistaken. I recently heard a technician say that he swears by Bob's articles.

However, I will agree with Mr. Mack on one point—Mr. Middleton shouldn't have started this particular issue in the first place. At least, not in a publication catering to technicians and experimenters. The further a technician stays away from this line of thinking, the better. It only adds to the existing confusion.

HAROLD DAVIS
Jackson, Miss.

[The article on "Characteristic Impedance" by Mr. Middleton in which "Eggy" was attacked appeared in the March, 1960, issue. Mr. Mack's letter defending "Eggy" appeared in the June issue. Mr. Middleton answered Mr. Mack in the July issue of RADIO-ELECTRONICS.—Editor]

METAL DETECTORS

Dear Editor:

Your "Underwater Metal Detector" article, by Kenneth Richardson (July, page 30) shows once again how simultaneous invention can occur in widely separated places and minds.

Since my "retirement" here in sunk-on-treasure-rich Florida, I've been fooling around with a number of metal-detector principles, including the very one described by Mr. Richardson. To make test work easier, I used a plastic water pail with a salt solution on my desk top.

One trouble with such bridge circuits is that they indicate any change in resistance between the probe (single or multiple) and the larger area plate. Such changes are caused by variations of salinity, polarization of electrodes, galvanic voltages, etc. I also found that the bridge circuit can be eliminated by using a 1.5-volt flashlight cell, a 5-ma. meter, a very-minute-area probe electrode and another larger electrode of.

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CORRESPONDENCE (Continued)

the same metal (the probe electrode should be positive). If this probe has an area of only 1/64 square inch or less, the normal current in the milliammeter will be practically zero, due to a layer of gas which quickly forms on it (the probe). But when it contacts a piece of metal of larger area, the current increases. The head of a pin is easily detected and larger metal objects cause strong or off-scale indications. The multiprobe rake scheme was found to be excellent for probing larger ground areas.

I also tried another scheme using no battery, one small area probe electrode, another large-area electrode (both of zinc) and a 6- to 10-ma meter, using salt (sea) water as the electrolyte. This develops no voltage unless the probe electrode contacts another and different metal object.

The meter reading varies with the kind of metal object contacted. Some typical values are: aluminum—0.2 ma, steel or iron—18 ma, brass—8 ma, copper—4.5 ma, lead—14.7 ma, carbon—1 ma and nickel—8 ma.

Of course, any detection device which requires direct, conductive contact with the sought-for metal object is beset with the difficulty of obtaining such contact in many underwater locations, especially after prolonged submergence. Calcerous deposits of coral, etc. soon enclose all objects in a hard coating. For this reason inductive devices are preferable. These also operate through sand and other covering material such as mud, coral, etc.

Using the Hughes induction-bridge circuit with a foot-diameter air-core coil, a 6-volt battery and buzzer and headphone indicator, a half-dollar coin can be detected at about 2 inches, a silver spoon somewhat farther and still larger metal objects at greater distances.

A radio-frequency heterodyne system (a fixed-frequency oscillator beating against another oscillator whose frequency is modulated by the presence of a metallic object in the field of an air-core search coil) can be made much more sensitive and is less affected by submergence even in salt (sea) water. This type is necessarily more complicated and it is more difficult to maintain a normal zero-beat. The sensitivity and criticalness of adjustment increase with the oscillator frequencies.

I am working on still another and more effective principle but cannot disclose it now.

Benjamin F. Meissner
Miami Shores, Fla.

ON STATIC CONTROLS

Dear Editor:

The article "Static Controls In Industry" on page 63 of the April (1960) issue was very interesting. However, it should be brought out that the magnetic amplifier system of the Westinghouse CYPACK is not the latest in static control. While CYPACK has many advantages over electromechanical devices such as relays and timers, it leaves a
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CORRESPONDENCE (Continued)

lot to be desired when compared with transistorized static units such as the Square D Co. NORPAK.

The NORPAK system is smaller and lighter than an equivalent CYPAK system. Another advantage of the NORPAK is its response speed, up to 25,000 times per second.

The logic functions and, or or not can be accomplished by combinations of one unit, the nor unit. A number of nor circuits are encapsulated into a module and (with a power supply and signal converter) marketed for user assembly into his own control system. Almost any configuration can be used in grouping these modules; they can even be laid out on a piece of plywood.

I think you will find that the NORPAK is the best answer to the static-control problem on the market at this time.

W. K. PENHALLEGON
Field Engineer, Square D Co.
Lutherville, Md.

[Mr. Jaski's article was only the first of a three-article series. The section that deals with transistors in industry appeared in the July issue, page 43. —Editor]

CHECK VOLTAGE

Dear Editor:
The dear public and others have been led to expect a reasonably accurate 1.34 volts from the Mallory mercury cell. I have just seen a memo from Mallory in which they mention two batches, one 1.34 volts and the other 1.4 volts. Tell the boys to be sure of the voltage of the ones they use.

ED W. LOGAN, JR.
Memphis 18, Tenn.

["Transfer Standard Calibrates Voltmeters," page 100, June, 1960, refers to the type RM cell as having a voltage of 1.365. —Editor]

SETS WANTED

Dear Editor:
As part of a program of community service, I teach (and financially help) youngsters, within the territorial limits of my club, radio and TV theory and repair.

Most of the students come from poor parents and are willing to learn something that may someday help them. In my home, I have test equipment (meters, generators, vtm's and scopes) for their use. We have a couple of electronic service shops here whose profits are used to buy surplus parts that the students need to learn their trade.

I would appreciate it very much if you could help us contact technicians, hams, etc., in the Philippine area, who would like to help us out in this venture. If they have old unserviceable radios, TV sets or the like, let us know. I am willing to pay the postage.

AUGUSTO (GUS) SALVA
President, Batangas Rotary Club
Bauan, Batangas,
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HAROLD R. STANLAKE
Perry, Michigan

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- **HF90 70-Watt Stereo Power Amplifier:** Designed to play voices of the stereo HF99, differing only in rating of the output transformer. IM distortion 1% at 70W; harmonic distortion less than 1% from 20-20,000 cps within 1 db of 70W. Kit $74.95. Wired $114.95.

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- **New HF95 5-Way Speaker System Semi-Kit:** Complete with factory-built 3/4" veneered plywood (4 sides) cabinet. Bellows-suspension, full-inch excursion, 8" woofer (45 c.s.r.) & 3½" cone tweeter, 1¼" cu. ft. ducted-port enclosure. System Q of 0.2: for smoothest response, best transient response 45:14,000 cps clean, useful response 16 ohms, HWD: 24½" x 10½" x 16½". Unfinished birch. Kit $47.95. Wired $56.95. Walnut or mahogany. Kit $55.90. Wired $64.95.

- **HF51 Bookshelf Speaker System** complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression driver exponential horn tweeter. Smooth clean bass; crisp extended highs; 70-12,000 cps range, 8 ohms. HWD: 23½" x 11½" x 9½". Kit $39.95. Wired $47.95.

- **HF52 Omni-Directional Speaker System (not illustrated)**. HWD: 36". 15¾". 11½". "Fine for stereo" - MODERN Hi-Fi. Completely factory-built. Mahogany or walnut $139.95. Blond $146.95.

- **New Stereo Automatic Changer/Player:** Jam-proof 4-speed, all record sizes, automatic changer and auto/manual player. New extremely smooth, low distortion moisture-proof stereo crystal cartridge designed ideally with tonearm to eliminate midrange resonances. Constant 4½ gram stylus force is optimum to prevent groove flutter distortion. No hum, turntable conversions, automatic feedback, center-hole enlargement. Only 10½" x 13½" Model 10070; 0.7 mil diamond; 3 mil sapphire dual styli, $59.75. 10075: 0.7 mil, 3 mil sapphire, $74.75. Incl. FET.


- **AM Tuner HF46:** Selects HF50. Selects "hi-fi" wide (20-9000 cps) or weak-station narrow (20-5000 cps) audio bands. Tuned RF stage for high selectivity & sensitivity, Precision eye-triacton tuning. "One of the best available." - HF SYSTEMS. Kit $39.95. Wired $65.95. Incl. cover & F.E.T.

- **New FM/AM Tuner HF79:** Combines renowned EICO HF790 FM Tuner with excellent AM tuning facilities. Kit $59.95. Wired $84.95. Incl. cover & F.E.T.

- **New AF-4 Economy Stereo Integrated Amplifier** provides clean 4W per channel or 8W total output. Kit $38.95. Wired $54.95. Incl. cover & F.E.T.

- **HF12 Mono Integrated Amplifier** (not illustrated.) Complete "front end" facilities & 3-way performance, 120W continuous, 25W peak. Kit $34.95. Wired $57.95. Incl. cover.

- **New HF35 1-Watt Stereo Power Amplifier** with superlative 35W mono power amplifiers. 200W peak output. Uses superlative ultra-linear connected output transistors for undistorted response across the entire audio range at full power, assuring almost clarity on full orchestra & all borders. Internal channel separation. IM distortion 0.5% at 100W. harmonic distortion less than 1% from 20-20,000 cps within 1 db of 100W. Kit $99.95. Wired $139.95.
INTERSTELLAR COMMUNICATION

...The Riddle of Life Among the Stars Will Be Solved...

SLOWLY, many of our most responsible astrophysicists and other scientists have come to the inevitable conclusion: that the headlines of science-fiction fans have reached decades ago: Man, inhabiting a very minor planet, is not alone as an intelligent-intellectual creature.

Indeed, such scientists as Prof. Donald H. Menzel, director of the Harvard Observatory and one of the world’s leading astrophysicists; Prof. Giuseppe Cocconi, and Prof. Philip Morrison of Cornell University, to name only a few, are certain that among the hundreds of billions of stars flung throughout the vastness of space are hundreds of millions of planets similar to our own earth which orbit around stars like our own sun. The inevitable conclusion, therefore, must be that evolution on one planet under parallel conditions must in time produce intelligent-intellectual creatures. That such creatures may not be manlike at all seems certain, but their shape and appearance need not worry us for the present. Such creatures may be on a lower or on a much higher plane than man among the far-flung myriads of inhabitable planets at this very moment.

Evolution of suns and their planets, when compared to man’s time scale, is an unimaginably long process—it may be from 10 to 20 billion years, depending upon the dimension of each particular sun. Nor do we as yet know even vaguely what the exact development time of the various types and sizes of different suns is.

But we do know that not all suns and their planets evolve alike. Hence, evolution on some planets in various universes must be far behind our own, in others far ahead.

On the other hand, scientists have incontrovertible proof that suns are born and die; in time their nuclear energy runs down. Then such a sun stops giving off light and other radiation—it becomes a cold burned-out cinder. Its planets, deprived of light and radiant energy, die soon, too, as nothing can grow any longer on their icy surfaces. Unless, of course, their intelligent populations—if there are any—withdraws into the planets’ interiors, there to sustain in an artificial, nuclear-heated core world such an underground civilization cannot last forever either—atomic and hydrogen energy will give out, too, because in a calculable time, the available fuel—the planet itself—will be consumed.

Many ages before that, the intelligent inhabitants will have taken measures to emigrate to another neighboring sun-like world, if they can. But this—anywhere in any universe—is a formidable undertaking. Suns are inevitably far apart on a planetary distance scale. Our own nearest neighbor sun, Alpha Centauri, is four and one-thousand light years away, i.e., the time it takes light constantly traveling at 186,000 miles a second to reach us, or a distance of 25½ trillion miles. And the nearest star may not be suitable for emigration purposes—it may be too hot, too large, or it may have no planets. Thus our marooned-world people may have to select a star 1,000 light years away—6 quadrillion miles distant! Naturally they would first wish to explore the distant sun’s planets to ascertain if one or some of them were suitable or inhabitable for their race. So they would try to communicate by radio with such a distant planet, even if it took a message 1,000 years to go to its destination and another 1,000 years to come back. Does that make the project impossible? No. In a few thousand years they would have their answer. It might even come from a much nearer world, if they kept signaling long enough. Some inhabited world, sooner or later, would be bound to intercept the steady, powerful stream of messages.

Does this sound like romantic science-fiction? It does—indeed. The present writer published dozens of stories of this genre, beginning with World War I, in his former publications, Science and Invention, Amazing Stories, Wonder Stories and others.

Nor is the idea of communication with alien worlds a novelty. Fifty-one years ago, the writer authored a serious article, "Signaling to Mars." It appeared in his magazine Modern Electrics for May, 1909.* This was before radio.

We calculated that it would take 70,000 kilowatts to span the 35 million miles to the planet Mars! A lot of energy, but this was in the crude wireless days when Dr. de Forest’s vacuum tube was still in the laboratory.

Since then our scientists have successfully bounced radio signals against the moon (1946), the planet Venus (1958) and lately (1959) even against the sun, 92 million miles distant, and in the latter case have received the signals back in a little over 16½ minutes.

Thus we can no longer be too surprised that serious scientists are now actually beginning to listen for interstellar communications.

As this is written, the new National Radio Astronomy Observatory at Green Bank, W. Va., has already gone into operation. The observatory’s 86-foot parabolic reflector antenna will be directed at the stars Tau Ceti and Epsilon Eridani, somewhat less than 12 light years away from the earth. Specially designed super-sensitive receivers will filter artificial signals from the natural confusion of background radio noises, it is hoped. Dr. Otto Struve, director of the observatory, and Dr. Frank D. Drake, radio astronomer, know that this is a long-time project that may require many years before positive results can be obtained. Thousands of stars may have to be investigated before the anticipated interstellar intelligence can be successfully intercepted and recorded. Even if the results are negative over a period of many years, we cannot despair and stop our efforts. There is always the immensity of time and distance to be considered and the immensity of bandwidth to be studied. If a planet is 500 light years away and has managed to transmit before we may listen in its direction for 499 years and never get a message, then receive it in the 500th year! And that is only one message from one planet. There may be millions of others hidden in time, space and direction.

Soon, in the writer’s opinion, the world’s radio observatories, geared to receive interstellar news, will not be on the earth at all but on the moon. Here the conditions for reception of transgalactic intelligence are almost ideal. The curse of radio astronomy today is the earth’s atmosphere with its bedlam of every imaginable type of noise. In addition, there are the hundreds of man-made types of electric noise generators that constantly increase in intensity as time goes on.

A very large percentage of these noises will be absent on the side of the moon turned constantly away from the earth, since the entire body of the moon will be interposed between its far side and the earth. It is here that the great radio observatories will be located, many of them entirely automated and unmanned, permanently recording all intelligence for transmission to earth.

What about the earthlings’ answer to the distant broadcasting “Planet X”? This problem, pregnant with many socio-political questions, has already been investigated by a score of scientists and philosophers. There seems to be no agreement so far as to the most advisable course. It probably had best be left to future and wiser generations.

-H.G.

*See also “Can We Radio the Planets?” by H. Gernsback, Radio News, February, 1927
A NUMBER of new designs have appeared since our last survey of stereo cartridges (Radio-Electronics, March, 1959), and many of the older ones have been refined and improved.

Certain definite trends in cartridge design can now be seen. Perhaps most noteworthy has been the advance of the moving-magnet pickup into the dominant position among magnetic cartridges. A few years ago the Shure Studio Dynetic introduced the moving-magnet design to the high-fidelity market. Today, half of the new stereo cartridges described in this series employ a moving magnet as their generating element.

The moving-magnet design is not inherently superior to any other. It does offer certain advantages in a stereo pickup. By proper design, the moving mass may be kept very low, yet modern magnetic materials make it possible to develop a relatively large output voltage from the minute stereo record groove modulation. The stylus-structure design of most moving magnet cartridges is such that they are quite rugged and yet easily replaced by the user.

But do not assume that other kinds of cartridges have been eclipsed by the moving-magnet types. Both the moving coil and variable-reluctance designs have their adherents, with outstanding performers in both camps.

Ceramic cartridges have continued to capture the lion’s share of the mass market. A few ceramics have been aimed at the quality trade. These compete directly with magnetic cartridges, both in performance and price.

The integrated pickup design in which the cartridge and arm are designed as a unit (and must be used together) is becoming increasingly popular. This approach eliminates some of the consumer's freedom of choice in component selection. But it also eliminates many pitfalls involved in joining cartridges and arms of different makes (and usually results in a higher overall performance level for a given expenditure).

CBS Professional 55
This is a high-performance ceramic cartridge with relatively high stylus compliance and therefore able to track at low stylus forces.

It is housed in a transparent plastic body which affords an excellent view of its internal structure (each of its internal parts has its own distinctive color). The two ceramic elements are coupled to the stylus by the lever system shown in Fig. 1. Both elements are normally deflected slightly by the armature lever tips. Lateral stylus motion moves one element tip backward (and allows the other to come forward) while vertical motion causes both elements to move in the same direction. The 45° Connoisseur CS-1 arm and pickup.

Confused about the new crop of stereo cartridges and arms? Here's the first in a 3-part series that will give you the answers you have been looking for. Part I discusses ceramic units.

By JULIAN D. HIRSCH
modulation of the stereo record groove is equivalent to a composite vertical and lateral signal, and each channel of the cartridge delivers an output voltage corresponding to the recorded amplitude of one of the channels of the stereo disc.

The design of the stylus lever arm provides high compliance (low mechanical impedance, desirable for low record wear) at the stylus point. It requires only one-fourth as much force at the stylus for a given element deflection as it would if the stylus drove the elements through a direct linkage.

The moving system of the CBS Professional 55 is heavily damped to reduce mechanical resonance effects. The ceramic elements are surrounded by a viscous material, and a bar of damping material extends from the tip of the stylus bar to the cartridge body.

The Professional 55 may be mounted in any standard arm with ½- or 7/16-inch mounting centers. It has three output terminals with a common ground.

A special feature of the 55 is the two sets of plug-in equalizing networks supplied with each cartridge. A ceramic cartridge normally delivers an output proportional to the amplitude of the record groove modulation. Although an amplitude-responding cartridge provides an approximate equalization for the RIAA recording characteristic, some additional equalization is still required. The equalizing networks (visible in the photograph at the bottom of the next page) plug into the preamplifier input. The leads from the tone arm, in turn, plug into the other end of each network (one per channel). When they are connected to the high-level input of a preamplifier, the output of the pickup system is accurately equalized for the RIAA characteristic and no further equalization is required from the preamplifier.

If it is desired to use a low-level (magnetic) input, the other pair of plug-in networks is used. In this case the cartridge output is converted to a velocity-responding basis, similar to the output of a magnetic cartridge, and the preamplifier provides the equalization.

The rated frequency response of the CBS 55 is 20 to 15,000 cycles ±3 db. The stylus is a 0.5-mil diamond, with lateral and vertical compliance of 3 x 10⁻⁴ cm/dyne. Depending on the arm in which it is installed, the tracking force is between 1.5 and 4 grams. The output —using the constant-velocity equalizers—is about 20 mv at 5-cm/sec stylus velocity, and with the RIAA network is 0.4 volt. The stylus assembly is replaceable by the user.

The CBS Professional 55 sells for $28.95 complete with two sets of plug-in equalizing networks in a fitted case.

**Electro-Voice 31MD7**

The Magnaromic model 31MD7 is a ceramic stereo cartridge featuring a built-in printed-circuit equalizing network which converts its constant-amplitude response to constant velocity. It is intended to be connected directly to the magnetic input terminals of a preamplifier.

Fig. 2 shows the two ceramic elements and the manner in which they are coupled to the stylus. The stylus tube rests in a plastic yoke which is fastened to the ends of the two ceramic elements. Since the elements are angled at 90° (each one 45° from the vertical), each of the stereo channels in the record groove will cause only its corresponding element to be deflected and generate a voltage. Yoke compliance minimizes the deflection of the other element, thus maintaining channel separation.

The cartridge has standard ½- to 7/16-inch mounting centers and four output terminals. The terminals are in line, with the left and right channels on the outside and their grounds in the center.

The frequency response is rated at 20 to 15,000 cycles ±5 db. The output is 14 mv per channel at 5-cm/sec stylus velocity.

The stylus assembly is easily replaced by the user. The metal plate surrounding the stylus bar, which serves as a mounting for the bar, slides off the cartridge body, carrying the stylus with it. The stylus itself is a 0.7-mil diamond. The moving-system compliance is rated at 3.5 x 10⁻⁴ cm/dyne. The recommended tracking force is 2 to 4 grams in a transcription arm and 4 to 6 grams in record-changer arms.

The price of the Electro-Voice 31MD7 is $24.

**Sonotone 8TA**

The 8TA is an improved version of the original 8T stereo cartridge (September, 1958, page 9). Its appearance is nearly identical to the 8T, but a number of significant design changes have been made to improve its performance.

The chief change has been the replacement of the solid monel stylus shaft with a hollow aluminum tube one-third as heavy and 80% stiffer. The stylus jewels themselves have been reduced in size (and mass) to 40% of the original values. The 3-mil jewel on the turnover stylus bar is now mounted behind the 0.7-mil jewel instead of directly opposite it, to reduce further the effective mass of the moving system.

The original 8T had a relatively large open space around the nylon yoke that coupled the stylus bar to the ceramic elements. Dust could become trapped in this space and stick to the viscous damping grease within the cartridge. The resultant buildup of dust and lint could interfere with stylus motion. On the 8TA, a gold-plated metal cover protects the interior of the cartridge from dust buildup and keeps the stylus jewels from becoming clogged.

The reduction in stylus mass raises its resonant frequency from about 9,000 to 12,000 cycles. This resonance is well damped, resulting in an extension of
the upper frequency response of the 8TA to 15,000 cycles ±3 db. The upper limit of the original 8T was 12,000 cycles. The channel separation has also been improved in the range above 2,000 cycles. The compliance of the new stylus assembly is $3 \times 10^{-4}$ cm/dyne, about 25% greater than that of the older unit.

The output of the Sonotone 8TA is about 0.3 volt per channel. It must be terminated in a resistance of at least 2 megohms for proper bass response, unless the recommended R-C equalizing network is used to convert its output to constant velocity. When so operated, its output is relatively high—about 35 mv.

The recommended tracking force is 3 to 5 grams in transcription arms and 4 to 6 grams in record changers.

The 8TA, like its predecessors, has a turnover stylus assembly containing both 3- and 0.7-mil jewels. Various combinations of sapphire and diamond styli are available. The stylus assembly is easily replaced without tools.

The Sonotone 8TA sells for $14.50 with two sapphires, or $19.50 with a 3-mil sapphire and a 0.7-mil diamond.

Connoisseur stereo pickup

The Connoisseur CS-1 is a unique integrated stereo pickup manufactured in England by Sugden and imported by Ercona Corp.

The cartridge is a ceramic type similar in principle to most ceramic cartridges we have described, but with somewhat more refined construction.

The two ceramic elements, making the usual 90° angle to each other, are very small and are immersed almost completely in a viscous damping material (Fig. 3). A Y-shaped yoke, which appears to be made of nylon, couples the ends of the elements to the stylus tube, which is firmly clamped in a slot in the end of the Y. The stylus assembly of the Connoisseur pickup does not appear to be replaceable by the user. The stylus arm is a short, light, hollow aluminum tube whose mass is obviously much less than that of any of the replaceable styli used on domestic ceramic cartridges. According to the manufacturer, it is 2 milligrams.

The CBS Professional 55 comes with two sets of equalizing networks.
The Sonotone 8TA is identical in appearance to the 8T shown above.

Electro-Voice 31MD7.

The stylus jewel is a diamond with a 0.5-mil radius. The compliance of the stylus is $3.5 \times 10^{-6}$ cm/dyne in both lateral and vertical planes. The frequency response is rated at 20 to 20,000 cycles ± 2 db.

The Connoisseur CS-1 pickup is designed to work into a resistive load of approximately 50,000 ohms such as the input circuit of most preamplifiers. When loaded in this manner, it is velocity-responsive, similar to a magnetic cartridge, but with a much higher output (about 40 mv at 5-cm/sec stylus velocity).

The cartridge can be used only in its companion arm, which forms a part of the CS-1 pickup. The arm has a unique method of raising or lowering it to the record surface, without danger of dropping or scrapping the stylus against the record surface.

Fig. 4 illustrates the operation principle of the Connoisseur arm. In an actual arm, most of the operating portions are enclosed by the arm itself, which extends to the rear of the elevating knob to form a counterweight.

The yoke which holds the elevating knob and screw is fastened to the arm mounting post and does not move with the arm. The horizontal pivot is on the mounting post and the vertical pivot is about an inch forward of the mounting post. An internal projection extends rearward under the elevating screw. When the knob is turned clockwise, the rear of the arm is depressed, raising the cartridge from the record (Fig. 4). The arm may be positioned freely in the lateral plane, either to the magnetic arm rest or to any point of the record. Turning the knob counterclockwise lowers the pickup gently and smoothly to the record surface, after which another turn or two provides sufficient clearance between screw and the arm to allow for normally warped records.

The elevating mechanism has no effect on the lateral position of the arm, which may be raised at any point and lowered again into the same groove.

The maximum tracking error is less than 2°. The tracking force (fixed at the factory) is 3 or 4 grams. Although two shielded-wire pairs are brought out of the arm, the cartridge has only three terminals. Therefore, there is a common ground between the two channels at the cartridge. In certain installations, notably those with separate amplifiers rather than an integrated stereo amplifier, this type of grounding may cause hum problems. On the other hand, the Connoisseur cartridge is totally immune to induced hum, and its very high output minimizes the likelihood of hum problems in the playback system.

The price of the Connoisseur CS-1 is $59.50.

Parts II and III of this series will cover variable-reluctance, moving-coil and moving-magnet cartridges.

TO BE CONTINUED
ANSWERING the door without having to rush to open it would be the answer to the busy housewife’s prayer. The Automatic Doorbell Intercom makes it possible to talk to a salesman without even leaving the kitchen. When someone rings the doorbell, the intercom goes on, operates 3 minutes and then shuts itself off. This is more than enough time to find out who the caller is and what he wants.

By turning itself off when not in use, the intercom saves power. The control circuit can be added to existing intercoms or the transistor amplifier described can be used as the center of the installation.

Switching circuit

The switching circuit is shown in Fig. 1. It does not require any changes in the existing doorbell, pushbutton and transformer setup. When a caller touches the pushbutton, the doorbell rings and relay RY1 is energized momentarily. RY2 (and the heater coil in RY3) is energized through RY3’s contacts, which are normally closed. RY2 will stay energized until RY3’s contacts open after a 3-minute delay. When this happens, the circuit goes back to its original state (after a short delay to allow RY3 to cool) to await the next caller.

The circuit to be controlled is connected across RY2’s (the hold relay) coil. Switch S2 was added to allow the intercom to be turned on or off manually. It is not needed if only automatic operation is desired.

One speaker is located near the doorbell, the other is in the kitchen along with TALK-LISTEN switch S1. The amplifier and switching chassis may be located almost anywhere (the basement, near the fusebox, is a suggested location). S1 is a dpdt spring-return toggle switch which can connect either speaker as a microphone.

The heart of the switching chassis is a small thermal time-delay relay. It has a temperature-sensitive bi-metallic strip which operates like a thermostat. When heated, it bends because one side of it expands more than the other. The strip is enclosed in a glass envelope (about the same size as a 6SN7-GT tube) along with a heater coil. When a voltage is applied to this resistance-wire coil, it heats the bi-metallic strip. After a given amount of time (depending on relay design), in this case 3 minutes, the contacts open (or close, again depending on relay design).

Nearly any intercom amplifier is suitable as long as it uses transistors or battery type tubes (to cut warmup time to a minimum). A tube amplifier (shown in one of the photographs) and a transistor unit were used in the author’s installation, with equal success.

Transistor amplifier

A good transistor amplifier is shown in Fig. 2. Three common-emitter stages are used. They give ample gain to drive the speaker with over ½ watt of power. A normal, conversational voice more than a foot from the microphone is readily understood at the other end of the intercom system. A low-noise transistor, the 2N105, is used at the input stage to reduce hiss. It is biased with a low collector voltage (and current) to help reduce noise.

The second stage or driver is more heavily biased. Collector dissipation is about 75 mw and it can easily supply the 25 mw of drive required for full power by the output stage. The second stage also has the volume control. As the resistance of this control, R4, is decreased, more and more negative feedback current flows into V2’s base from the collector, thereby reducing the gain of the circuit. The power amplifier is operated class-A with a zero-signal collector current of 150 ma. The power transistor (made by Sylvania) is either a 2N68 or 2N101, since they have identical characteristics. It requires a thermal connection to the chassis to help get rid of heat. However, the collector lead is internally connected to the body of the transistor and therefore the transistor must be electrically isolated from the chassis (Fig. 2). The mica washer can be obtained by tearing apart an old compression type mica paddler capacitor. The shoulder insulating washer can be found on an old binding post.

R1, R3 and R5 determine the operating points of the transistors and each may have to be adjusted to the particular transistor. R5 should be adjusted first to give a collector current of 150 ma in V3. If V3’s collector voltage is 12 ± 2, it is close enough. R3 is adjusted until the collector voltage of V2 is 17 ± 2. R1 is adjusted for a collector voltage at V1 of 1.5 ± 0.5. Extreme care must be taken not to damage the transistors when soldering them into the circuit. Firmly grasp the lead being soldered with a pair of long-nose pliers. The heat of the soldering iron (and lead) is absorbed by the pliers before it can get to the transistor. The pliers can be taken away after the point has cooled. Take the same precaution with the diode, D. Keep the power transformer, T5, well away from T1 and 2, to minimize hum.

This handy control circuit turns an intercom on when the doorbell rings and off 3 minutes later

By HENRY A. KAMPF

www.americanradiohistory.com
Fig. 1—Circuit of the switching chassis. Talk—listen switch, S1, may be located on or off switching chassis.

Rear view of switching chassis.

Switching chassis (panel in lower part of photo) and amplifier mounted near house master switch (see above).

Fig. 2—Transistor intercom-amplifier schematic.

SEPTEMBER, 1960

**AUDIO—HIGH FIDELITY**

R—10 ohms, 20 watts
S1—dpdt, spring-return switch
S2—single-pole, triple-throw switch
RY1—spst relay, 6-volt ac coil (Potter & Brumfield KASAT or equivalent)
RY2—ipsr relay, 117-volt ac coil (Potter & Brumfield KASAT or equivalent)
RY3—time-delay relay (Amperite 115C180 or equivalent)
F—1-amp fuse and holder
Octal socket for RY3
Chassis (or wall-mounted panel)
Speakers or intercom stations

Miscellaneous hardware

Switching chassis (panel in lower part of photo) and amplifier mounted near house master switch (see above).
The unit described here combines the functions of a small public-address amplifier, a remote line amplifier and a recording amplifier whose output level matches the bridge input of the Magnecorder PT6-JA tape recorder. It has three low-impedance microphone inputs, a phono input and a recorder input. The speaker output circuit has bass and treble attenuation controls and a bass-boost circuit.

Response curves are shown in Figs. 1-5. Fig. 1 shows the response from MIKE 1 input to the speaker output, with four settings of the tone controls. Curves A and B provide excellent response throughout the audio range and beyond on the high-frequency side. Fig. 2 shows the speaker output with the input to the phono circuit (J5). Curves A and B are even better here than in Fig. 1 because the signal does not have to go through an input transformer and there is one less coupling capacitor. Note that the response is better at both the low and extremely high frequencies. Fig. 3 shows the remote line output with input from each of the three sources. Here again the phono input (B) has the best bass response, but the recorder input (C) seems to have slightly better high-frequency response. Fig. 4 shows the recording output response with microphone and phono inputs. Fig. 5 shows speaker and line outputs with input to the recording jack (J4).

Input circuits
The three microphone circuits are

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By JAMES E. DALLEY

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**Fig. 1**—Frequency response curves with signal input to J1. Output taken from the 16-ohm speaker terminals: Curve A shows response with bass and treble controls set at maximum with the bass boost circuit operating. Curve B is the same as curve A, except that the bass boost circuit is switched out. In curve C, tone controls are set at half scale, and in curve D, in minimum position.
identical except for the RECORD-PLAYBACK switch (S3) in the MIKE 3 circuit. Each feed into the primary of a Newcomb TR-91 plug-in type microphone transformer. These transformers can be connected for either 50 or 200 ohms input impedance. The response curves are based on the 200-ohm connection. The 470,000-ohm resistor across the secondary of the input transformer loads the secondary slightly, flattening the rise in response around 20 kc and reducing any tendency to oscillate. The cathode, screen and plate circuits are conventional for resistance-coupled pentodes. Individual volume controls are at the grids of the mixing circuit for the three microphones and the phone input. This provides complete isolation and keeps volume changes in one circuit from affecting any other circuit.

The phono input goes directly from J5 to the volume control in the grid of the mixer V5-b. It has sufficient gain to overdrive the speaker output circuit with a crystal pickup or with the G-E reluctance pickup and the G-E preamplifier that I use with this installation. A crystal pickup sounds best with the bass boost in. However, the G-E preamp has 18 db of bass at 30 cycles and the very low tones are greatly overemphasized and usually drive the amplifier to distortion if the bass boost is left in with the G-E cartridge and preamplifier. A G-E A1-901 record filter is used between the pickup cartridge and the preamplifier to provide proper playback curves for all types of recordings.

For playing tape recordings switch S3 is thrown to the PLAYBACK position. This takes the signal from the bridge connection of the tape recorder through J4 and through the voltage divider to V5’s grid. The signal from the tape recorder is insufficient to drive the amplifier to full output when it is injected into the phono input and it drives the input circuits to distortion when fed directly into the microphone input, so an attenuation of approximately 18 db is inserted by the voltage divider. The amount of attenuation can easily be changed to match any recorder by varying the size of the 22,000-ohm resistor (R47) from the switch to ground. A larger value should be used if a higher input signal is needed. When S3 is in the PLAYBACK position, volume is controlled by the MIKE 3 volume control.

**Mixing and output circuits**

The mixing circuit consists of two 12A7 double triodes (V4, V5). The grids feed from the individual input volume controls previously mentioned. The cathodes of each tube are paralleled and the common bias resistor is bypassed to ground. At first all four plates were paralleled, but I found that this caused a loading effect on any one triode and produced considerable distortion. The 10,000-ohm isolation resistors eliminated the distortion, but also reduced gain so that an additional stage (V6-a) for the speaker output circuit was needed.

Output to the tape recorder feeds through a frequency-correction network to S3, which must be thrown to the RECORD position, and out of J4. The recorder output curves of Fig. 3 were made with the recorder connected to J4.

The line output circuit feeds through the LINE volume control directly from the output of the mixer. V6-b acts as the line output tube. It uses a Triad A-55L line output transformer having output impedance of 600, 250 and 50 ohms. A Triplet 327T decibel meter is connected directly across the 600-ohm line. This meter is actually calibrated for a 500-ohm line and, if accurate decibel readings are necessary, it should be replaced with a meter calibrated for a 600-ohm line. The line output is terminated in a pair of screw terminals and to two of the terminals of the output–input socket (J6—a Cinch-Jones S-315-AB socket). The three microphone inputs and the 8-ohm speaker output are also available at this socket. The plate circuit of the line output tube is shunt fed through a 15,000-ohm load resistor (R28) to prevent the direct current from passing through the primary of the small output transformer.

The speaker output circuit starts with V6-a which is fed from the mixers’ output. Its plate circuit includes the tone control and compensation circuits.

The plate load resistor consists of a 1,000-ohm resistor (R33) in series with a 15,000-ohm resistor (R32). A 0.5-µf capacitor (C16) is permanently connected to their junction and provides the bass-boost circuit. An 8-µf electrolytic (C31) is connected through S2 to the junction at all times except when the bass control is turned to the extreme counterclockwise position, opening S2. Some bass boost is provided even when S2 is closed and the 8-µf capacitor is in the circuit. The bass control places C23 in parallel with C24 in its maximum bass position (counterclockwise) and gradually reduces the effect of C23 in the circuit as the bass is reduced (R34 in its maximum resistance or clockwise position). The treble control is a simple attenuation control consisting of C22 in series with R44. This shunts the high frequencies to ground as R44 is reduced (clockwise position). The on–off switch (S1) is on the treble control.

The phase inverter and driver consists of a 12A7U7 double triode (V7). The cathodes are tied together and grounded through a 1,100-ohm biasing resistor (two parallel 2,200-ohm units). No bypass capacitor is necessary because signal currents in the two sections are equal and 180° out of phase, so they cancel in the cathode resistor. The grid of V7-a feeds from the speaker volume control and the grid of the phase inverter (V7-b) is fed by the signal developed across R38, which is connected to the junction of the grid resistors (R42 and R43) in the output stage. All three of these resistors are the same size (100,000 ohms) and provide a balancing effect on the drive to the

**Audio—High Fidelity**

![Fig. 4—Response of the recorder output: curve A, input to J1; curve B, input to J5.](image)

![Fig. 3—Frequency response of the 600-ohm line output: curve A, input fed to J1; curve B, input fed to J5; curve C, line output with recorder input.](image)

![Fig. 2—Same as Fig. 1, except signal is fed to the phono input (J5).](image)

![Fig. 5—Frequency response at the speaker and line output circuits with input to J4: curve A shows speaker output with bass boost; curve B shows speaker output without bass boost; curve C is for the 600-ohm line output.](image)
Fig. 6—Circuit of the unusual 10-tube unit.
phase-inverter circuit. R42 and R43 must be properly balanced to provide the correct drive to the second section of the phase inverter so that the grids of the output stage will be driven equally. This was done by feeding a signal in ahead of the phase-inverter stage and measuring the drive at the grids of the 6V6’s. The values of R42 and R43 are then adjusted slightly until a perfect balance is obtained. A 1-megohm resistor (R39) shunted across R43 provided the proper resistance in this case, but may not be the proper value for another set of parts. The output cathodes are bypassed because there is a variation of plate current in the push-pull stage when the signal changes in intensity. The output stage is operated class AB1 with 285 volts on the plates and 19 volts bias. The output transformer used is a Triad S-31A. It provides the proper primary impedance of 8,000 ohms and output impedance of 4, 8 and 16 ohms. This circuit is supposed to provide 15 watts of output power; however, there is noticeable distortion at 15 watts and tests indicate that 12 watts is about the maximum undistorted power. An inverse feedback circuit was originally used but, as greater undistorted power was obtained without it, it was removed.

Power supply

The power supply uses a Triad R-16A power transformer and a Triad C-12X filter choke, rated at 160 ma. The measured current at no signal input is 150 ma, so these ratings should not be reduced. R20 is primarily a voltage-drop resistor to reduce the plate voltage of the output tubes to about 285 (plate to cathode). The three filter capacitors (C19, C20 and C21) had to be doubled to reduce the hum when the bass boost is used. The hum is just noticeable with the speaker volume turned full and the input volume controls turned down. J7 is a power receptacle for the phono preamp. It is connected after the fuse and line switch to provide protection and to eliminate the necessity of separate switching for the preamplifier. It was added after the photographs were taken and therefore does not show up.

The amplifier was built on a 8 x 14 x 3-inch chassis. The cabinet is 15 x 9 x 11 inches. A slightly larger chassis and cabinet are recommended if space permits, because of crowding under the chassis and the heat dissipation problem.

All ground connections were made to a common bus of No. 12 copper wire grounded at both ends. All signal leads of any length were shielded in circuits up to the phase inverter. The shields should be kept on the microphone preamplifier tubes, but it makes little difference whether they are on or off the other tubes.

It seems presumptuous to call an amplifier using such common tubes and circuits high fidelity, but it closely approaches the performance of a strictly hi-fi unit using the same turntable and speaker.

TAPE recording can make the amateur or professional sound technician tear his hair if the tape tangles or snaps at the wrong time, as it usually does. To prevent this, never put too much tape on the reel. Use 600 feet of tape on 7-inch reels, and you’ll seldom be troubled with tangling or tape breakage. Such trouble is invariably encountered at the end of the tape when it is being rapidly rewound. The extra flange width keeps the tape from climbing out of the reel to backlash and break.

To mark a place on a reel of tape when you’re working in a darkened corner, drop a slip of paper, match stub or toothpick into the reel as you start recording. When the session is finished and you want a playback, rewind the tape until your marker falls out and you’re ready for business without a hitch.

Feedback and poor sound reproduction are usually problems when using nondirectional crystal mikes. A soft, thick cloth—even several layers of a handkerchief—wrapped around such a mike will often help when trouble of this kind is encountered. It’s a good thing to remember when you have to record “brassy” music at close range.

There’s probably nothing more annoying to the tape-recording enthusiast than to have recording tape spill when a reel is being handled. I keep this from happening by slipping a rubber band over the reel of tape as shown in the photograph. Even if the reel is accidentally dropped, the tape doesn’t usually spill off. For even greater safety, notch the rim for the rubber band.—Glen F. Stiltwell and John A. Comstock
The tunnel diode promises to be the most important achievement of the semiconductor industry since the transistor was invented. Circuits using tunnel diodes are already showing themselves superior to those using transistors and vacuum tubes, in several applications.

Let us connect a conventional p-n junction diode (such as the 1N34) in the circuit of Fig. 1. The center-tapped potentiometer allows us to either forward- or reverse-bias the diode. If we vary the potentiometer setting and plot the change of current as the voltage is varied, we get the typical p-n junction-diode curve (Fig. 2).

The curve shows that the diode has a low internal resistance when forward-biased (region A to B in Fig. 2) and a high resistance when back-biased. This is the area from A to D. Increasing either the forward or back bias of the diode increases the current (though the increase is very small in the reverse direction). We can say that the diode has a positive resistance when either forward- or back-biased.

### Tunnel-diode curve

Now suppose we insert an Esaki tunnel diode (General Electric Co. No. ZJ-56A) in the same circuit and plot the current as the voltage is varied. The curve is shown in Fig. 3. The current change is vastly different from that of the 1N34. As forward bias is increased, the current rises rather quickly to a peak (point B). As forward bias is further increased the current decreases abruptly to point C, then starts rising again. The current through the tunnel diode increases with an increase in voltage in the region from A to B. This means that it has a positive resistance in this range. From B to C in Fig. 3, there is a decrease in current for an increase in voltage, or a negative resistance. We can say that this tunnel diode has a negative resistance characteristic when it is forward-biased at any voltage between B and C.

If we draw a line tangent to the curve at point X in Fig. 4, we can see that the tangent or slope (e) of the curve is negative. (A negative curve, in mathematics, is one whose vertical value, or distance from the base line, decreases as its horizontal distance to the right from the origin increases. This is analogous to the electrical decrease in current with increase in voltage.) The value of the tangent is the current divided by the voltage at the tangent point. This equals the diode’s negative resistance.

### Bias

We want to bias the tunnel diode in the negative-resistance portion of its characteristic (Fig. 4, point X). When so biased it can oscillate or amplify.

A typical tunnel diode has a negative resistance of approximately -100 ohms when biased in its negative resistance region. Approximately 125 millivolts are required to bias the diode. The cur-
Oscillator, audio to rf ranges
Active element—a tunnel diode
Power source—penlight cell
Values given for four frequencies, others may be built as desired.

By adjusting circuit losses, it is possible to use the same diode for oscillation and amplification at different frequencies. This action is like that of vacuum tubes or transistors in reflex circuits, now becoming common in experimenters’ 1- or 2-transistor “shirt-pocket” radios.

Transistors and vacuum tubes depend on the control of charge carriers (electrons or holes) by a third element (a grid or base). This process takes finite time and is inherently noisy. These factors limit the frequency at which conventional devices can operate. The tunnel diode operates on a unique “quantum-mechanical” tunneling of charge carriers through the diode junction. This effect apparently takes place at close to the speed of light. Thus the tunnel diode’s theoretical upper frequency limit is extremely high.

Resonant circuits
Now that some of the mystery surrounding the tunnel diode has been clarified, we will attempt to create a circuit that will take advantage of its negative resistance. Fig. 6 shows a parallel-resonant circuit consisting of an inductance L and capacitor C.

If the capacitor is placed across the battery (and allowed to charge) and then reconnected to L, it will discharge through the inductance. Current flowing in L will cause a magnetic field to be built up around the coil until the capacitor has discharged. The field will then collapse (since the magnetic field can be maintained only while current is flowing). The collapsing field will induce a voltage in L which will cause the current to flow back into C (recharging it). This process would repeat itself again and again if there were no losses in the circuit) at a rate called the resonant frequency. In practice, however, no capacitors or coils are loss-free. These losses appear in the circuit in the form of resistance and consume power. To make this charge and discharge...
process continuous, power must be supplied to the circuit in amounts equal to the power consumed by R (the loss resistance). When this is done, the circuit oscillates. In practical vacuum-tube oscillators, enough of the output is fed back into the input circuit to overcome the resistive losses of the resonant circuit. This can be expressed by stating that the energy fed back overcomes the positive resistive losses. Thus the feedback energy can be called -R.

**Practical oscillator**

The tunnel diode has a negative resistance, or -R, characteristic. If the negative resistance is greater than the positive resistance of the circuit, we have a diode oscillator. Fig. 7 shows the circuit of such an oscillator.

The battery supplies the necessary bias voltage to set the operating conditions of the diode. R1, 2, and 3 are equivalent to R1 and 2 of Fig. 5. The diode is connected across the resonant circuit. Since the negative resistance of the diode is greater than the sum of R3 and the losses of the tuned circuit, the circuit will oscillate.

The table shows values of L and C that will enable the circuit to oscillate over a wide range of frequencies.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>L (µh)</th>
<th>C (µF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 cycles</td>
<td>0.15</td>
<td>1 h</td>
</tr>
<tr>
<td>5 kc</td>
<td>0.1</td>
<td>10 µh</td>
</tr>
<tr>
<td>10 mc</td>
<td>0.1</td>
<td>40 µh</td>
</tr>
<tr>
<td>100 mc</td>
<td>0.1</td>
<td>470 µh</td>
</tr>
</tbody>
</table>

If C is a variable capacitor, it is possible to tune the oscillator to various frequencies. This circuit will oscillate at a very high frequency whose limit is dependent on the value of L and C. The diode used, No. ZJ-56A, has the positive element connected to pins 1 and 2 and the negative element is pin 3. Two leads are used for the anode to minimize lead inductance. If this inductance is too large, it restricts the upper frequency at which the diode will oscillate.

**Adjustments**

Adjusting R2 is all that is required to establish proper bias for the diode. The oscillation can be detected by connecting an oscilloscope across the tuned circuit. If a scope is not available, tune a receiver to the approximate frequency and adjust R2 while searching for the signal.

**Construction**

The oscillator is constructed on a piece of phenolic board. A transistor socket is used for the diode (in case the builder wishes to use the same diode for other applications). Power is supplied by a single penlight cell mounted in a fuse clip. An on-off switch (mounted on the 100-ohm pot) is used to prolong battery life (which should be in excess of 50 hours).

The tuned circuit (a capacitor-coil combination selected from the above table) is plugged into the two pin jacks. This arrangement allows quick frequency shifting when desired.

The frequency stability of the oscillator is excellent and is limited primarily by the stability of the coil and capacitor.
There is strong evidence that life (human and otherwise) may be able to detect (or be affected by) radio waves.

By TOM JASKI

In a recent editorial (August, 1960), Hugo Gernsback called for a serious reappraisal of the effects of radio waves on human and animal physiology. In view of the almost casual use of high-power radar and industrial rf heating equipment, this is certainly a timely word of warning.

It is not surprising then that the Air Force is already keenly aware of these problems, and has a number of projects under way to discover the exact effects of high-intensity radar pulses and microwaves on human and animal tissue. These projects are being carried out at our major universities, each specializing in one particular frequency. For example, the project at the University of California, under the direction of Prof. Charles Süsskind, is primarily investigating the effects of 3-cm radar energy. Test subjects are mice, ants, and yeast cells.

Thermal effects

Of great importance, and therefore under intensive investigation, are the thermal effects of such waves, and these have been measured rather precisely under a variety of conditions.

Using mice as subjects, it was found that near-lethal doses of radiation do not seem to cause any pathological changes in them, and that the lethal effect is primarily an overtaxing of the mice's temperature-balancing system. It was found that the major heating effect took place immediately under the skin, but of course heat generated there is rapidly distributed through the body. The temperature of the mice was monitored continuously. The photograph shows zoologist Susan Prausnitz monitoring the temperature of a mouse suspended in the wire cage right in front of the waveguide just visible on the left. The mouse is slowly rotated to insure even radiation over the entire body. Death occurred in 50% of the mice when a critical temperature of 44.1°C was reached.

Other interesting findings include the fact that radar waves appear to have no significant effect on the fertility of the male mice. The effects of radar waves on the longevity of the mice are currently being investigated.

An intensive series of experiments was carried out on cellular organisms, such as yeast cells, but, other than showing thermal effects, the experiments were inconclusive. Similar experiments with insects such as ants delivered relatively minor data. But one interesting item which emerged was that the ants, normally moving every which way, in a Petri dish, will all line up in a 3-cm field, aligning their antennae parallel to the field, apparently to minimize the effects.

The project is continuing, and more research on mice, ants and other animals is contemplated. Psychological effects will be looked into. One promising item in the ant experiments was that the ants which were exposed to 3-cm waves apparently lost the ability, at least temporarily, to communicate the source of food to their fellows, as ants usually do. It may be significant that the large ants used have antennas which measure very nearly one-fourth the wavelength of the 3-cm radiation.

Incidentally, mice are so frequently used for this kind of experiment because they are easily handled, easily obtained and relatively inexpensive, while their physiology and metabolism bear a useful resemblance to human counterparts in some ways. The life span of a mouse is limited, permitting experimenters to evaluate genetic effects over several generations.

Meanwhile other service branches are carrying out research programs concerned with the effects of radio waves on animal life, not necessarily limited to radar frequencies. A public announcement by scientists at the National Institute for Neurological Diseases concerning the lethal effects of 388-mc radio waves on monkeys also shows there is great interest in other frequencies and effects besides thermal.

Some early reports

As long ago as 1930, Nrunori claims...
to have seen evidence that the human organism "radiates" and "reacts to" radio waves of 2.33 meters and its harmonics—in other words: 129, 258, 387 and 596 mc.

This brings to mind the work of a man who started publishing articles on this kind of subject more than 35 years ago. An Italian university professor named Cazzamalli placed human subjects in a shielded room, subjected them to high-frequency radio waves, and claimed to be able to record a "beat" which he received on a simple untuned receiver consisting of a galena crystal, a small capacitor, antenna and sensitive galvanometer. Cazzamalli’s equipment, as well as it can be determined from his early articles, is shown in Fig. 1. The one item which he never mentions, perhaps because he could not accurately determine it, is the power of his transmitter. He published oscillograms purportedly showing variations of the "beats" when his subjects were emotionally aroused or engaged in creative efforts. Later experiments delivered much more startling results: he found that some of his subjects would hallucinate under the influence of high-frequency radio waves, which by then ranged all the way up to 300 mc.

The Cazzamalli experiments were carefully duplicated with modern equipment, of much greater sensitivity than his. His "oscillatori telegrafico" (presumably a transmitter as used for wireless telegraphy) was replaced with a very modest low-power oscillator. The reason for this was twofold. In the first place, university authorities take a very dim view of experiments on human beings, even if these subjects are the scientists themselves, volunteering for the part. Second, a previous experiment had indicated in a rather startling way that power was not required to evoke effects in the human nervous system. In fact, there seemed to be some sort of resonant frequency applicable to each individual human.

Effects on humans

That experiment was suggested by the behavior of the monkeys we cited. These animals went through a sequence of behavior which would indicate that something besides thermal effects was operating. To discover if this "something" was subjectively noticeable by an individual, a weak oscillator was swept through the band from 300 to 600 mc with the request that the subject indicate any points at which he might notice anything unusual. The subjects were not allowed to see the dial. At a particular frequency, varying between 380 and 500 mc for different subjects, they repeatedly indicated a point with almost unbelievable accuracy (as many as 14 out of 15 times).

Subsequent experiments with the same subjects showed that at the "individual" frequency, strange things were felt. Asked to describe the experience, all subjects agreed there was a definite "tingling" in the brain, ringing in the ears and a desire to put their teeth into the nearest experimenter. The oscillator in this case was putting out only milliwatts of power, and was placed several feet from the subject.

Optical and growth effects

It was not the first time that such phenomena had been observed. Van Everdingen, a Dutch scientist, had discovered many years ago that radiation would affect the heartbeat of chicken embryos, when he was experimenting with the effects of high-frequency radiation on growth (specifically working toward any effect it might have on malignant growths). Van Everdingen used 1,875 mc and 3,000 mc and discovered that the kind of radiation would change the optical properties of a glycogen solution. Glycogen is a substance which occurs very abundantly in chicken embryos, particularly at an early stage of development. It is also the substance which provides our muscles with energy! Van Everdingen found that this change of optical polarization had some connection with tumor growth. He proceeded to re-rotate the polarization in extracts obtained from tumor-producing mice. When this optically "pure" substance was injected into mice with malignant tumors, and these mice were kept on a diet free of animal fats, the tumors would cease to grow. Only radiation at uhf or shf would produce these effects in the substances he used.

But Van Everdingen was not the only one who discovered important facts about radiation on living tissues. Years before, a Frenchman named Lakhovsky claimed to have removed tumors from patients with high-frequency radiation treatments, and his book, The Secret of Life, has a number of attestations in it from grateful patients who were cured. Lakhovsky stated that healthy plant growth is materially aided by placing a copper ring about 8 inches in diameter and supported on an insulating wooden stick (Fig. 2) around the plant. So-called tumorous growths on plants disappeared within such a ring. Lakhovsky's experiment with plants has been duplicated successfully. But then we should also note that the same kind of thing has been done by a group of devout citizens using group prayer!

But the people who have published the most data on the subject of uhf radiation effects on animals and human subjects are the Russians. In Biofizika, the Russian biophysics journal, a scientist named Livshits published two survey articles on the work that had been done in this field by 1958 and 1959. They are too extensive to repeat in great detail here, but some of the more impressive highlights will be reported.

Many experiments were carried out on animals with conditioned reflexes, and one by Glezer showed that a weak uhf field would inhibit the conditioned reflex, indicating that some inhibition of the cortex was taking place.

As in Van Everdingen's experiment with chicken eggs, Pardzhanidze showed that the EEG's of rabbits were drastically changed when the animals were subjected to a uhf field. Bludova, Kurilova and Tikhonova showed that the field produced an increase of sensitivity in the retina, and simultaneously reduced the area of color sensitivity. It is interesting to speculate how this would correlate with the Land effects. (Land, of Polaroid camera fame, has shown recently that our concepts of three-color vision may well be false, and that color vision seems to depend primarily on the presence of two images stimulated by two different frequencies of light.)

Turtygin similarly showed that the sensitivity of the eyes of dark-adapted subjects at marginal levels was increased as much as 100% by the presence of a uhf field.

Nerve effects

Of importance in the light of Lakhovsky's claims is the experiment by...
involved may well be drastically affected if we are subjected to a high enough power level. Tumors may be inhibited by the proper kind of radio waves yet, in other cases, particularly when coupled with the "wrong" kind of diet, radiation may also promote the growth of tumors. (This too was demonstrated by Van Everdingen in Holland.) We do not yet know if our longevity will be affected. Certainly we should consider the possibility that there may be some relationship between the increase of cancer and the amount of radiation we indiscriminately spew into the atmosphere. Or even that there may be some connection between that radiation and our sharply increasing crime rates. We simply do not know enough about the effects, but what little we do know would tend to make Mr. Gernsback's warning all the more urgent. For while there is nothing lethal about the doses of radio-frequency energy we absorb daily, neither is there anything lethal in the steady drip of water on a man's forehead—but it was effectively used by medieval torturers to drive him completely out of his mind. Perhaps we have a responsibility to mankind, before we fill all in the gaps in the radio spectrum, to discover once and for all if we are affecting human life on this planet. And if so, in what manner, as we finally had to do for another surprise out of Pandora's box, man-made radioactivity. END

A capacitor bank of 390,000 µfd—2,000 capacitors of almost 200 µf, 6,000 volts each—is being built for a Boeing Aircraft wind tunnel in Seattle by G-E. The capacitors contain 200 acres of aluminum foil and will fill a room 35 x 55 x 25 ft. In this huge bank will be stored 7,000,000 joules of electricity. It can be discharged in a few milliseconds, creating the highest-current are ever known, 5,000,000 amperes. Because there is no device capable of switching and carrying such a current, a piece of steel piano wire will be vaporized near the arc electrodes, releasing metal ions. These ions will close the circuit between the electrodes, allowing the capacitors to dump their enormous current. The speed of discharge must be very high. Since every bit of inductance in the current path slows up the rate of discharge, special engineering is being employed to keep the inductive reactance very low and to carry the huge current. The enormous energy loosed by the great arc heats the air in the arc chamber to 15,000 °F, creating air pressure near 30,000 pounds a square inch. This pressure ruptures a plastic diaphragm which permits a high-energy shock wave to rush through the test section of the wind tunnel. This shock wave is followed by a hypersonic flow of air past the model to be tested. Before each shot, the wind tunnel is pumped out to a high vacuum to increase further the pressure differential that creates the hypersonic air flow.

References
ELECTRONICS

EQUIPMENT

CAN BE EASY TO SERVICE

Intimate look at a big airport radar system shows how careful construction eases repair work

RADAR meant to operate 20 years without obsolescence means—by today's standards—very complex electronics. But this radar will be easy to service because the problem was considered when the equipment was designed.

The Texas Instruments ASR-4 airport surveillance radar now being installed at major airports throughout the country will be on the air continuously for 20 years, according to present Federal Aviation Agency (FAA) plans. It distinguishes between moving aircraft and fixed ground targets, displays only moving targets or a combination of moving and fixed targets, electronically adds data on navigational hazards and aids, measures distances between moving aircraft, operates with either linear or circular polarization, and has provisions for future inputs from air traffic control computers and for alpha-numeric code tags for individual aircraft. It is a "completely dualized" system, except for the antenna, so it is actually two identical radars with one on standby or being serviced while the other carries the load. It has advanced features for screening out interference from other radars—very important because of the increasing density of radiating equipment in the US today—and has moved the first "blind" speed (the speed at which a moving aircraft disappears from the scope) from 120 knots to a more tolerable 1,200 knots.

Obviously a radar that can do so much must be a highly sophisticated system. It is true that the ASR-4 is an advanced airport surveillance radar and is quite complex, yet it contains familiar components such as resistors, capacitors, vacuum tubes. These components are arranged to form special circuits which are not hard in themselves to understand. Because of its logical circuit arrangement and the many extra features to aid in troubleshooting, it is a relatively easy piece of equipment to understand and maintain. Layout of the equipment at the three sites (transmitter, equipment room and the instrument flight rules room) are shown in Fig. 1.

Built-in reliability

Twenty-year life on a piece of electronic gear is a pretty big order. On equipment the size of the ASR-4 (1,900 vacuum tubes), the problem becomes complex. To get such a life expectancy requires special techniques, such as derated components, conservative design and thorough evaluation tests. Resistors and capacitors, which make up the bulk of the parts list, are a good example of the derated components. Composition resistors do not exceed 50% of their rated dissipation, and 5% tolerance or less is specified for over 90% of the resistors used. Capacitors are derated to 70% of their voltage rating and even less voltage is allowed where temperature or humidity has an adverse effect. Except in very special cases, no electrolytic capacitors are used in the system.

Conservatively designed circuits operate reliably with "off-the-shelf" components as long as their performance falls within the manufacturers' stated parameters. Using components with typical loose tolerances means changes in circuit operation, but the ASR-4 includes maintenance adjustments that correct for these variations. Each circuit is checked in both individual unit...
tests and in a complete system test to
assure proper operation.

Check and test features

A radar the size of the ASR-4 can
keep several top technicians busy con-
tinuously making precise measurements
for various tests to assure it is operating as it should.
But this unit eases the technicians' job
by automatically making tedious and
time-consuming measurements such as
transmitter power output, voltage-
standing-wave ratio (from transmitter to
antenna), relative tuning of the local
oscillator with respect to the trans-
mittor frequency, and the system noise
figure. These and other quantities are
indicated continuously on panel meters.
The performance monitor makes these
measurements. It also checks receiver
crystals without removing them from
their holders.

Another valuable unit in the trans-
mittance is the fault panel with fault
indicating lights. Certain abnormal
conditions such as voltage and current
variations in the pulse modulator,
harmful to expensive components, will
cause a 6-second interruption in the
modulator and modulator driver high-
voltage supply. Afterward the system
recycles and continues to operate unless
the fault occurs again. If the system
recycles three times and the fault is
not cleared, it locks out and appropriate
indicator lights on the panel light to
tell the technician where the fault
occurred and what kind of fault it was.
More serious faults will cause the
equipment to shut down the first time.

All of the cabinets at either site con-
tain panel meters with switches so that
voltage and current for any power sup-
ply in the cabinet can be measured
without extra test equipment. Each
power supply is fused with indicating
type fuseholders that remain lit until
the fuse is replaced or the power shut
off.

Built-in oscilloscopes and auxiliary
test equipment are furnished with each
system. Test points (complete with
waveforms) are placed in circuits
throughout the system to allow sys-
tematic troubleshooting that pinpoints
the trouble to a very few stages. Additional
circuit tracing is made easier by component references on the panels.

Probably the most important single
aid to troubleshooting is the PPI (Plan
Position Indicator) display. Like a televi-
sion set, the PPI scope almost spells
out the type of trouble. By having a
maintenance console in the equipment
room and a monitor PPI at the trans-
mittor site, the technician can see the
trouble indications for himself. Also,
the PPI lets the technician view the
results of any maintainance adjustments
directly.

Accessibility

The ASR-4 represents a significant
advancement in component accessibility.
Technicians who have had to reach
awkward places in an operating piece
of equipment to make adjustments will
readily appreciate these extra features.

All cabinets contain front and rear in-
terior lights which can be switched on
to see in all corners. Hinged panels and
panels mounted on sliding tracks make
a simple matter of reaching components
in the remote equipment, while roonny
fixed panels allow plenty of elbow room
at the transmitter. Indicator consoles
are an excellent example of accessi-
bility. The CRT housing and attached
panels telescope out on sliding tracks
and lock in position. The attached
panels swing out, exposing all the com-
ponents. The panels at the bottom of
the console roll out on overhead tracks
and can be lifted by extension cables
to a comfortable working level for addi-
tional checks. In addition, a test junc-
tion box allows voltage measurements
and waveform checks on these units.
Maintenance adjustments or circuit
checks can be made while the console
is operating in this position.

The special features of the ASR-4
make it the most advanced airport sur-
veillance radar in use today. Advanced
circuits for better performance, built-in
test and test features, dual channel
operation, easy-to-get-at components
and built-in reliability add up to a
system that will find years of useful
service. With faster air traffic and more
aircraft, this radar will increase the
safety of air line travel and facilitate
the air traffic control around congested
airports.

(Sep) Side panels swung back, top
chassis turned over and
locked on its
own rack.

(Left) How the
equipment
below the tube
is rolled out.

(Right) Close-up
showing all
chassis turned
over for easy
servicing.

SEPTEMBER, 1960
Build a proximity relay with a minimum of parts and eliminate most of the troubles that often accompany a finicky oscillator

By LEONARD J. D'AIRO *

This novel relay circuit has uses ranging from a burglar alarm to an actuator for animated window displays.

A 2D21 gas tetrode is used to operate the relay and an OA2 is used for voltage regulation. A miniature power transformer delivering 125 volts at 50 mA and 6.3 volts at 2 amperes powers the unit. Peak power consumption is 5½ watts, while standby power consumption is only 4½ watts (about half the power drain of a night light!). This makes the unit suitable for long periods of operation.

Operation

The high-voltage output of the transformer is rectified and regulated to provide a dc bias for the control grid of the 2D21. The level of the bias is adjusted by pot R3. The plate of the 2D21 is connected direct to the unrectified high voltage through the relay. This places 60-cycle ac on the plate.

As soon as an ac voltage (whose peak is at least equal to the applied bias) is applied to the control grid, the gas within the tube ionizes, current flows in the plate circuit and the relay closes. The 2D21 conducts only as long as the ac voltage is applied to the grid and will cut off once the voltage is removed.

Since ac is applied to the plate, the gas within the tube is ionized only over a small portion of the positive half of
Tend board. Whether hand. Because this causes the relay to hum or chatter. A 50-\(\mu\)F capacitor across the relay eliminates this chatter. The capacitor charges during the conducting portion of the cycle, and discharges through the coil during the rest of the cycle, keeping the relay closed. Dc is not used on the plate since, once the gas within the tube ionizes, the tube cannot be cut off unless plate voltage is removed. This happens once every cycle if the supply is ac.

A high-vacuum tube may be used in place of the 2D21, but it is not recommended. If such a tube is used, the action of the relay may be sluggish and the circuit as a whole may tend to be erratic. The sensitivity will also vary with temperature and humidity.

The relay circuit was built into a Minibox. The power transformer and tubes are mounted on top while all other components are mounted within. The bias adjust pot (SENSITIVITY) is mounted below the terminal block to which the relay contacts and 2D21 grid are connected. Circuit layout is not too important (or critical), but take care to shield the grid circuit from any ac field within the box. Do not use the unused pins on the sockets as tie points. Both tubes have extra internal connections not shown in the schematic.

**Adjustment**

To operate the relay, first turn the pot to its maximum clockwise position (maximum bias). Connect a 2-foot length of wire to the control-grid terminal of the block, and turn on the unit. After the 2D21 has warmed up, rotate the pot in a counterclockwise direction until you hear the relay click. Then advance the pot until the relay clicks again. Bring your hand near the wire and see if the relay clicks when your hand is about 3 inches away. If not, rotate the control counterclockwise until it does. The relay should click on and off as your hand is moved nearer to and farther from the wire. The circuit is now set to its maximum sensitivity for that length of wire and is ready for operation.

The pot provides an ac-pickup sensitivity range between 100 millivolts and 100 volts, depending upon the ac field surrounding the circuit. The maximum length of wire that should be used is about 5 feet, although this length can be increased to 25 feet if shielded wire is used (5 feet of which can be exposed). The wire can be connected to any metal object, such as a chair, table, etc. as long as it is not grounded or too close to any ac carrying leads. As soon as a person or animal approaches the object or wire, the relay operates.

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**Miniature INDICATOR**

**Progress** toward using less panel space for indicators is shown by the two miniaturized units in the girl’s hand. Because miniaturization has come so far in the past few years, the amount of panel space the indicator takes up, whether it is a meter or a pilot light, is often the limiting factor in reducing the size of electronic gear.

This little panel meter is made by Alco Electronics of Lawrence, Mass. Just \(\frac{3}{4}\) inch square, it is mounted by drilling a \(\frac{3}{4}\)-inch hole in a panel and tightening the threaded ring on the rear of its case. The meters are available in the usual variety of dc voltage and milliampere ranges. The one shown here goes to full scale on 1 ma.

The other unit is a complete transistor-driven neon-lamp indicator circuit including three resistors, a transistor and the neon bulb (see diagram). Just three leads come out of the encapsulated body of the PCL (Printed Circuit Lamp). They connect to ground, B-voltage and a signal point. PCL’s are made by Transistor Electronics of Minneapolis in 14 stock models to indicate a change in polarity at any desired low dc point in a circuit. In a typical PCL circuit, a change in polarity from anywhere between -1 to -6 volts to anywhere between 1 to 6 volts will turn the neon light on. Reverse signal polarity extinguishes the lamp. END
PORTABLE

One-tube transmitter

PART 19, Vol. VI of the FCC rules and regulations (August, 1959) defines and prescribes class-C radio operation. It authorizes transmission for the "control of remote objects or devices by radio, and the remote actuation of devices which are used solely as a means of attracting attention." No intelligence of any kind may be transmitted.

Class-C offers a wonderful chance for youngsters (and oldsters) to learn radio operation. At the same time it is a means of doing useful work, turning on appliances, opening garage doors, etc. from a distance. Youngsters from 12 years up are permitted to use this band. All you have to do is fill out an FCC Form 505 and wait for your license. No technical skill or knowledge is required.

The schematic shows that the transmitter uses a single 3A5 tube. A tube puts out more power than can be obtained practically from a transistor at this time.

The A-battery consists of only one size-D cell. Furthermore, it is a rechargeable type that provides about 11 hours' continuous use, after which it may be recharged. Obviously, battery
TRANSMITTER

controls models. No license examination required

power is not a problem here.

Circuitry

V1-b is the oscillator triode. It is tuned to the third overtone of the crystal (in this case, 26.995 mc), selected for the class-C Citizens band. A fixed capacitor, C2, shunts the tuning capacitor, C5, to reduce its tuning range.

V1-a is an audio oscillator and modulator. Its signal amplitude-modulates the rf from V1-b. When push-button S2 is depressed, the set emits a CW (unmodulated) signal. Under this condition, the B-drain is 5 ma. When pushbutton S3 is depressed, an AM signal is generated and the drain rises to about 7.5 ma. C4 determines tone frequency. Increasing its value lowers the frequency.

L is a 10-turn air-wound coil 1/2 inch in diameter (spaced 16 turns to the inch), tapped at three turns. It may be a section cut from a Barker & Williamson Miniductor coil 3003. RFC is made of No. 26 enameled wire wound over a 100,000-ohm 1/2-watt resistor. Use 65 turns.

It is easy to adjust the transmitter. Insert the proper crystal and tune C3 for maximum output. An S-meter on a short-wave receiver or field-strength meter helps tune for maximum.

With a power input of about 300 milliwatts, the transmitter is far below the legal maximum of 5 watts. On the other hand, it is far above the field-power rigs described from time to time. On actual test, the tone has been heard clearly at least six city blocks away. On flat terrain with no obstructions, the range is greater.

If higher power is desired, omit the tone modulation and connect the triodes in parallel. Omit T, S3, C1, C4 and R1. Reduce R2 to 2,700 ohms.

BENCH

TESTED

- Battery-operated R/C transmitter.
- Crystal controlled (any class-C frequency usable).
- One tube—3A5.
- Output modulated or unmodulated rf.
- Power input about 300 mw.

Unit was tested and found to work as specified by author. Maximum range about 1/2 mile, line of site. Frequency steady.
A noise-immune squelch circuit is one of the new CB transceiver features discussed in this article

By ROBERT F. SCOTT
TECHNICAL EDITOR

The number of Citizens-band licensees is growing by leaps and bounds and the manufacturers of class-D transceivers are hard pressed to meet the demand for equipment and accessories. New manufacturers are entering the field and old ones are constantly improving their old models (and adding new ones). Circuit analyses and complete schematics of the International CTZ-5A Citizens Bander, RCA's Porto-Phone and the Multi-Elmac Citi-fone appeared in the September and December, 1959, issues along with abstracts of interesting circuits in the Vocaline ED-27 and Globe CB-100. This month we have some dope on the Apelco AR-9 along with interesting circuits from the Radson RT-70 and RT-71 and the Vocaline ED-27.

Circuit of the AR-9

The AR-9, a product of Applied Electronics Co. (213 E. Grand Ave., San Francisco, Calif.), is a five-channel transceiver available for 117 volts ac, and 12- and 32-volt dc operation. The 12-volt supply is shown as part of Fig. 1. A dynamotor is used on 32 volts dc and a conventional full-wave supply (with a 12X4 rectifier) is used on ac.

The receiver circuits are conventional with a 12AU6 rf amplifier, 6U8 mixer and crystal oscillator, 12BA6 455-kc if amplifier, 12CR6 detector, a. and first af amplifier, 6AQ5 audio output (and transmitter modulator) and a 12AL5 series-type noise limiter and squelch.

The noise limiter and squelch circuits are similar to those in the Globe CB-100 covered in detail in the December, 1959, issue. The audio from the cathode of
the noise limiter (V7-A) is fed to the cathode of V7-b, a series-gate squelch tube. V7-b's cathode is held at a constant positive voltage determined by the setting of the GATE control. The dc on V7-b's plate is taken from the screen grid of the rf amplifier.

When no signal is being received, the avc bias is low and the rf screen current high. This produces a large voltage drop across the 100,000-ohm screen-dropping resistor and reduces the voltage on the screen grid and on the plate of the squelch diode.

When the squelch is turned on, the GATE control is set so the background noise just disappears when no signal is coming in. This makes V7-b's plate slightly less positive than its cathode, so the tube is cut off. An incoming signal increases the avc bias and reduces the rf amplifier's screen current. V7-b's plate voltage rises, bringing the diode out of cutoff so it conducts and passes the signal to the audio amplifier.

The AR-9's transmitter is unusual in that it uses crystals ground for half the output frequency while most others use overtone crystals generating the channel frequency. Half of a 12AT7 is the crystal oscillator, the other section is an overbiased class-C rf amplifier operating as a frequency doubler. The doubler drives the 12AQ5 rf output stage.

Radson transceivers

These radiotelephone sets, made by Radson Engineering Corp. (Macon, Ill.), are available in four models. The
RT-70 (single channel) and RT-70A (two channels) units are made for base-station service with 117-volt ac supplies. The RT-75 (single channel) and RT-75A (two channels) are designed for mobile and marine installations powered by 6- or 12-volt batteries. The receiver of these units is a crystal-controlled superhet with two stages of 1.65-mc if and an automatic noise limiter. The transmitter is crystal-controlled with 5 watts input to the final amplifier. Unlike most Citizens-band transceivers which have built-in speakers, the Radson units have handsets with built-in push-to-talk buttons.

Another unusual feature of these instruments is the calling system that allows one station to signal another when communication is desired. Pressing the CALL button at one station sounds an alarm at the other. In the average Citizens-band transceiver—as well as many used in other services—the switch is opened by any station on the frequency. Thus, an operator, busy with other tasks, is often interrupted by calls not intended for him. In a network of Radson units, signals from other transceivers will be picked up but will not disturb the operator a few feet away because of the low audio output from the handset. On the other hand, a station in the net alerts others in the same net by pressing his CALL button. The transmitter sends out a tone-modulated signal that triggers signal buzzers in other similar transceivers.

**Signaling Circuits**

Fig. 2 shows the audio and signaling circuits in the RT-70 and RT-75. The CALL switch (S2) is a three-pole double-throw pushbutton mounted on the control panel. The diagram shows it in the normal (receiving) position.

When S2 is pressed, section S2-c connects V4's grid to the secondary of T4 and converts this stage to an audio oscillator tuned to around 2,200 cycles by C16 and C21. The signaling tone is fed through C16 to the grid of the 6AQ5 af output and modulator. S2-a of the CALL switch inserts R35 in series with the cathodes of the receiver's rf amplifier, converter and first if amplifier to disable these circuits. Simultaneously, the transmitter's rf section is turned on by grounding the cathodes through S2-b. The rf output is modulated by the audio tone developed across T5—half of which acts as the secondary of a modulation transformer.

In the receiver, the signal from the if amplifier is fed to the detector and ave diodes of V4. The detector's output feeds through the series type noise limiter V5-a and section S2-c of the CALL switch to V4's grid. V4's plate load consists of R26 and the primary of T4 in series. T4's primary is tuned to 2,200 cycles and appears as a very high impedance at this frequency. The coil of the alarm relay is in series with V4's plate supply. Normal plate current keeps the relay energized so the buzzer and auxiliary alarm are inoperative.

If the incoming signal is modulated by the calling tone, a high-voltage 2,200-cycle signal develops across T4's primary and secondary. The secondary voltage is rectified by D3 and applied as a negative bias to V4's grid. This reduces the plate current so the relay releases. This switches 6 volts to the auxiliary alarm circuit and connects the buzzer—a modified miniature PM speaker—across the secondary of output transformer T5. The buzzer is fed by the 2,300-cycle tone tapped off T4's primary and amplified by V7, the af output and modulator tube.

At most frequencies in the voice range, T4's tuned circuit has negligible impedance so V4's plate load is R26 alone and C21 is the coupling capacitor to V7's grid. V7's output is fed to the receiver in the handset through a resistive network across T6's secondary.

When transmitting, the transceiver's circuits are switched by S3 in the handset. This grounds the mike and transmitter cathodes and removes the short from across R35 to disable the receiver.

Most receivers use a pentode rf amplifier, a separate crystal oscillator and the send-receive relay switches the antenna between the transmitter output and the input to the receiver. The corresponding circuits in the Radson units
ground through the detector load consisting of R17 and R18. The squelch control places on V7's grid a delay bias which must be overcome by a voltage developed by an incoming carrier. The setting of the control determines the carrier strength required to open the squelch.

Under no-signal conditions V7 conducts heavily and its plate is close to zero voltage because of the drop across plate load resistor R25. The grid of af amplifier V6-a is connected to V7's plate through R23 and R30 and the tube (V6-a) is cut off by the high positive bias on the cathode.

An incoming rf carrier develops a negative voltage across R17 and R18, and C18 and C19 charge to a voltage proportional to carrier strength. As long as the carrier is not overmodulated, the voltage across C18 is sufficient to keep V7 cut off. (Overmodulation causes momentary breaks in the carrier, permitting C18 to discharge and bring V7 out of cutoff.) With V7 cut off, the voltage on the plate rises and C26 charges positively through R25. V6-a's grid is returned to C26 so its voltage rises to the point where the tube conducts and passes the audio signal to the power amplifier.

V6-a's grid resistor (R30) is connected to one of the diode plates in the tube. This diode is a clamp to prevent the grid from being biased positive with

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**Fig. 4 — Noise-immune squelch circuit of the Vocaline ED-27.**

are quite different (Fig. 3). The rf amplifier is a grounded-grid type with the cathode capacitance-coupled directly to the transmitter's output tank circuit. The oscillator is a triode type with the plate load consisting of a 27-mc tuned circuit C6-L6 and the primary of the first if transformer. The rf signal is fed to the cathode.

**Noise-immune squelch**

Most squelch circuits in AM receivers are opened by electrical noise impulses produced by lightning, neon signs, automotive ignition systems and other non-radio devices. During thunderstorms or in noisy locations, some squelch circuits will be open almost constantly and the set produces an almost continuous barrage of noise. Adjusting the squelch threshold control to eliminate all noise is likely to prevent a desired call from being received. This problem has been minimized by the patented Vocatron noise-immune squelch circuit used in the Vocaline ED-27. This circuit (Fig. 4) discriminates between noise pulses and a modulated carrier.

Detector V5-a and series type noise limiter V5-b are conventional and similar to those in the International CTZ-5A discussed in the September, 1959, issue. The grid of af amplifier V6-a is returned to the plate of the squelch tube (V7) — a sharp-cutoff high-transconductance pentode.

This tube is operated with its control grid connected to the B-plus line through the SQUELCH control and to

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**A Radson RT-75 mounted on a tractor.**

**The Vocaline ED-27**
the time constant of R17, R18 and C18 is so short that V7 conducts between pulses and prevents C28 from charging enough to override the cutoff bias on V6-a.

In other words, the time constant of the detector load circuit is so short (around 0.00005 second) and that of C26-R25 is so long (.05 second) compared to the interval between noise pulses that V6-a's grid remains substantially at zero (with respect to the ground) and the tube is cut off by heavy cathode bias.

**Transistor power supply**

The Vocaline ED-27 is one of the few transceivers using transistor type power supplies for direct-current operation (Fig. 5). A pair of power transistors is connected as a push-pull oscillator developing ac voltage in the collector winding on the power transformer. The secondary feeds a symmetrical (or full-wave) doubler set up to deliver 250, 225 and 150 volts without voltage dividers.

For ac operation, the circuits are switched automatically in the ac line connector.

END

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**IDENTIFY your calibration signals**

By RONALD L. IVES

The crystal-controlled calibration oscillator, introduced more than 20 years ago, has performed so satisfactorily that it is now either an integral part of or a standard accessory of almost all communications receivers. Dependable calibration points consisting of the calibration oscillator's fundamental frequency and harmonics are available throughout the tuning range of the receiver.

There is, however, one problem encountered when using the crystal calibration oscillator as it is commonly constructed: it is virtually impossible to distinguish between the calibration-oscillator signal and a strong unmodulated carrier. This is entirely understandable when it is remembered that the output of the crystal calibrator is a clean sine wave, just like any good CW signal.

By applying well known principles, a calibration oscillator can be modulated by a neon R-C oscillator at low cost, at negligible increase in power consumption and without performing major surgery on the receiver.

The circuit used is shown in the diagram. This includes a standard crystal-calibrator circuit—the one used in the Technical Material-GPR-90 receiver—and a conventional neon oscillator. The interconnection is made by inserting the neon-oscillator output between the suppressor grid and ground.

The neon-tube oscillator-modulator is controlled by a pushbutton switch which opens and closes the power (B-plus) lead.

Frequency of the neon oscillator is determined by R1 and C1, if all other factors remain the same. Decreasing their product will increase the frequency; increasing their product will decrease the frequency. The upper-frequency limit is above 10 kc and is determined by the re-ionization time of the neon bulb.

Coupling capacitor C2 can have any value from 100 µuf to more than .002 µuf without interfering with oscillator functioning, and suppressor grid resistor R2 can have any value from about 47,000 ohms to more than 1 megohm. If a very high resistance (such as 5 megohms) is used here, contact potential sufficient to reduce rf output markedly may be developed.

Construction is relatively simple and straightforward. The two capacitors, C2 and C1, and the suppressor resistor, R2, should be mounted as close to the tube socket as practicable to confine rf to the immediate area. The neon lamp—which can be either a socket-mounted NE-51 or an NE-2 soldered directly in place—can be mounted where convenient, but it and its leads should be kept away from low-level af circuits. The 10-megohm timing resistor, R1, should be as close as the neon lamp as practicable. The line from it through the pushbutton to the load side of the crystal-oscillator B-plus switch—can be run almost anywhere, as it carries only dc.

The calibration oscillator is operated conventionally until there is some doubt as to the origin of the signal. This is resolved by pressing the pushbutton which turns on the identifier. If it is a signal from the calibration oscillator, 1,200-cycle modulation will be added to the calibration signal. If the signal is not from the calibrator, pressing the button will not change it.

Cost of this identifier is about $3 if all parts are bought new at retail. Installation requires an hour of careful work. Six months of using the device on a communications receiver shows it is a good investment. END
HERE seem to be two types of pocket radios: superhet which work beautifully but are expensive and complicated to build, and simple one- or two-transistor sets that require as much as 50 feet of outside antenna really to pull in anything. This set, small enough to slip easily into a teenager's shirt pocket, is a nice compromise. It uses only two transistors and a minimum of parts, yet it pulls in all the stronger stations in an area without an external antenna. The original model was built as the result of much prodding from my son, who kept reminding me that this was the year to build the long-promised pocket radio in time for the World Series.

Secret of the set's excellent performance is a combination of a reflex and a regenerative circuit—a simplified version of an excellent circuit developed by W6WXU. With only two low-cost transistors and two diodes, the radio has a regenerative rf stage, diode detector and two audio stages. Although regenerative, which adds a great deal to the sensitivity, the regeneration is fixed, and volume is controlled by a smooth-acting volume control. The set has none of the cranky tuning so common with straight regenerative receivers.

The radio is built with readily available miniature parts. Even so, it is not particularly difficult to wire since all components except the volume control are mounted on a small, perforated plastic board. When mounting the parts, feed all leads from the various resistors and capacitors through the holes and bend them over to secure them to the board. This method reduces the need for soldering clips and lugs to a minimum. Sockets are provided for the two transistors to simplify replacement, should it become necessary.

Of course, since all parts are small, the builder must wire carefully. A blob of solder in the wrong place could cause a lot of trouble.

The parts layout is not particularly critical, with one important exception: the antenna coil must be kept as far as possible from the battery. Unless this is done, there will be a serious loss of signal strength. The perforated plastic chassis is secured to the plastic case with two small brackets and tiny bolts and nuts. The volume control is mounted on the case.

If you enjoy showing the "innards" of the set to friends, the clear plastic case is ideal. It can be dressed up by cementing panels, cut from heavy cover-stock paper, to the outside. For durability, spray the paper with clear lacquer before pasting it down.

The rf choke is a 2.5-mh unit—and it must be small. In the set shown, a standard choke was used, after the metal ends were removed by clipping the ceramic rod core close to the end of the coils and making connections right to the windings. The choke is cemented to the mounting board. The battery leads are simply soldered to the 7.5-volt mercury battery. The battery is taped on both ends to avoid accidental short circuits.

To use the set, simply turn it on and tune in a strong station. Then adjust
trimmer capacitor C3. With its screw almost all the way in, some stations will whistle as you tune across the dial with the main tuning capacitor, indicating that the set is regenerative and oscillating. Back off the trimmer adjustment until the whistling stops and the set remains slightly below the point of oscillation. Once this adjustment has been made, the trimmer can be left alone—and all tuning done with the tuning capacitor (C1) and volume control.

[Unfortunately, the volume control switch used by the author has been discontinued. As a result a slight change is necessary. The builder can use a larger unit such as the Lafayette VC-39 and a larger plastic case to make room for it. Or if a size increase is not wanted, you can use two separate subminiature units to replace the combined switch-volume control. In this case, use units such as the Lafayette VC-18 for the volume control and SP-88 for the switch. They can be mounted one under the other on the side of the case.—Ed.]

Transistors are not as uniform as tubes, and for that reason it may be advisable to try other transistors if the set does not work properly when tuned up. The 2N170 is the more critical of the two transistors, so if you run into trouble, try it first.

Likewise, the best value for bias resistor R1 may require some experiment for best results. This is especially true if the set exhibits some audio howl (a low-pitched growl just before the set breaks into oscillation).

The tiny antenna coil works surprisingly well—however, like all such coils, it is directional and some change in the position of the set may give an increase in volume. One more thing: use a good earphone. A really sensitive earphone gives a lot of extra volume.
KEY TV lets TV viewer talk back. Two buttons on top of unit make it possible to take a quiz at home, participate in opinion polls or show like or dislike for program. Recording unit is installed on a utility pole outside viewer's home. Device introduced by TelePrompTer, New York, N.Y., as part of new pay-TV system.

SMALLER TRANSFORMERS are result of nested laminations in transformer core. The construction shown, called Flexi-core, was developed by Sylvania. Nested laminations allow magnetic lines of force to flow continuously with the grain of the steel, rather than across grain.

SOLAR DISH turns sunlight into 100 watts of electricity to power coast-to-coast radio network. Two stations were set up by Army Signal Research & Development Laboratory, one at Ft. Monmouth, N. J., and another at Los Angeles, Calif. The 20-square-foot solar dish came from Hoffman Electronics; transistorized transmitter-receiver from Hallcrafters.

UPSIDE-DOWN image shows the near optical surface quality of this paraboloid radio mirror. Units are good uhf radiators (up to 100,000 mc). The 4-foot reflector shown was made by D. S. Kennedy & Co., Cohasset, Mass.

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The "eye" of the Air Force print reader. It scans a message fed from the left. Light (at right) is transmitted through an optical projection system to the type-written page where it is picked up by the scanning device.

This experimental address reader reads and sorts mail.
Electronics combines with optics to make a device that translates printed matter into the punched-card language of the computing machines, or sorts letters, for various destinations

By JULES GRONICH and HAROLD BRIEFEL*

Reading machines of this type are used by many firms. American Telephone & Telegraph uses them to process 1,600,000 dividend checks three times a year. Four machines do this job, which once took an army of clerical help to handle.

The First National City Bank of New York uses reading machines to process travelers' checks; the National Biscuit Co. uses them to read sales report lists; Ohio Bell Telephone speeds its cash accounting system with reading machines and the Reader's Digest Book Club uses reading machines to read the names, addresses and account numbers of its members.

One sophisticated reading machine, developed by Farrington for the Air Force, reads entire pages of typewritten material and translates them into electronic signals at the rate of 2.5 lines per second. Farrington optical scanners are also being used in the drive to automate the postal system. An experimental all-transistor unit has been developed—it will sort mail to 40 destinations.

Soon-to-come applications for optical scanners include completely automated billing systems for utility companies; processing for book, record, gift and other monthly clubs; reading automotive registration records and reading subscription lists for the publishing industry.

Gasoline credit cards

A common use of the Farrington optical scanner is in the gasoline credit-card system. A customer buys gasoline and presents his credit card. The attendant puts the invoice (tabulating card) through an imprinter which prints the customer's credit-card account number on the back and front of the invoice card. Periodically, the cards are forwarded to the oil company's central accounting office.

This is where the optical scanner enters the picture. It reads the carbon impression on the back of the cards. A built-in checking feature verifies the reading operation and, if necessary, computes the value of a missing digit. When it is satisfied, the machine punches into each card the code for the customer's account number. After punching, the cards are rechecked to verify the accuracy of the reading operation. Reading and punching is done at a rate of 180 cards per minute.

To understand how these machines operate, let's take a look at a basic reading system. A batch of cards is placed in a feed hopper. From here they are transported one card at a time to the reading station where they are scanned horizontally—because of the card's motion as it passes the scanner—and vertically by the optical system.

Fig. 1 shows how the vertical scanning works. An optical system transmits an image of the desired information (numerals on the card) to a rotating scanner disk that has 25 radical slits .01 inch wide spaced at equal intervals. As each slit on the scanning disk passes under the projected image, a thin slice of the image falls on a fixed horizontal plate located directly behind the disk. This plate contains two horizontal slits approximately one character width apart. Therefore, a portion of the image passes through these slits only when the radial slit intersects with the fixed slits. The two beams passing through the horizontal slits are separated by a beam-splitting mirror. One beam goes directly through a lens to a photomultiplier. The other beam is redirected by a focusing mirror to a lens and a second photomultiplier. Separating the horizontal slits in this manner creates two reading stations. One reads the right side of a character at the same instant the other is reading the left side. To insure high resolution, scanning is rapid (more than 20 scans per character). Thus a single vertical line of nominal width is scanned several times. Fig. 2 shows how scanning dissects a character.

Fig. 2—View of a character dissected by scanning.

Light beams passing through the slits are sensed by the photomultiplier tubes which convert the light energy to electrical signals.

Fig. 3 shows the photomultiplier.
hookup. Light falling on the tube's photocathode causes electron emission. The tube’s action (due to secondary emission) from the dynodes causes a much larger emission of electrons than received from the cathode. For this reason, small changes in current gain per dynode have a large effect on the output plate current.

A unique circuit much like TV agc automatically compensates for variables such as light sensitivity, temperature and voltage. It uses the voltage between one pair of dynodes and a voltage-sensing feedback device controlled by the photomultiplier's output.

This is how it works. Current leaving dynode 9 is attracted to the plate and develops an output voltage across $R_p$, the 100,000-ohm plate load resistor. The plate current is proportional to light intensity so an increase in light increases plate current. Current flow through the load resistor makes the output signal most negative when light intensity is greatest. The slits are so spaced that there is a point of no intersection between slits, resulting in total darkness. This causes a reference pulse having the greatest positive polarity. This “black pulse” denotes absolute black and is used as the reference level for compensation. Since the pulses that represent portions of the character are developed from a darkening of the reflected light (any character reflects some light) their amplitude is always lower than the black pulse.

Character sensing is based upon the use of digital sensing signals which say either “yes,” a portion of a character has been seen this instant” or “no,” a portion of a character has not been seen this instant.” This is done by having pulses of two standard amplitudes, +15 volts signifying “yes” and -25 volts “no.” To obtain these levels, the video pulses are sent to a pulse-shaping network which decreases the rise and decay times, and then are clipped at +15 and -25 volts. However, the signal still contains the black pulse which is not needed for character identification, so it is blanked by a main timing pulse.

The main timing pulse is developed by placing an exciter lamp and photomultiplier tube on opposite sides of the scanning disk. Every time a slit passes over the photomultiplier tube a pulse is generated. This system is adjusted so the timing pulse occurs slightly before the point of no intersection at the reading station (black pulse) and represents the end of each scan or frame. The black pulse is thus blanked out between frames. This pulse system uses a video channel to control sensitivity, shape the pulse and clip it to a standard voltage level.

With the black pulse eliminated, we have a signal of standard voltage levels which electrically represents the scan of a character. It is known as the recognition signal and is analyzed to determine the character being scanned. Fig. 4 illustrates the development of the recognition signal.

The method by which characters are recognized and the shape distinguishing features of the characters are closely related.

Selfcheck, the type face shown in Fig. 5, has been designed to give maximum recognition reliability by taking into account the most likely types of character deterioration caused by printing and handling. Also, the character segments are deliberately bold to increase the probability that they will be detected even if portions are missing. Characters are so formed as to avoid small enclosed areas which might be filled by dirt or extra heavy printing.

This arrangement provides that any one character differs from the other nine by at least two line segments. This greatly reduces the possibility of confusion in identifying characters, and allows maximum recognition reliability with a minimum of electronic logic.

Note that this special type face is not required for character identification. Many machines now in use can identify a variety of type fonts. In these systems which do not use Selfcheck, additional character-identification logic is employed to assure reliable performance.

Characters are identified by stroke logic. Each character is comprised of a number of short, straight vertical and horizontal line segments (Fig. 6).

Once the digits are identified, they must be checked to verify the reading operation and calculate the value of any single rejected digit if necessary. This is done by using a check digit that makes the sum of all the digits a multiple of 10. Also incorporated into this scheme is a method of detecting transmission errors. This is done by replacing the original digits in the units, hundreds and other alternate positions with a substitute digit (Fig. 7).

The substitute digit is obtained by multiplying the original digit by 2, the result being the substitute digit. However, if the multiplication results in a two-digit number, the digits are added to get the new number. For example, in Fig. 7 the units digit is 7. When doubled, it becomes 14. Then 1 plus 4 equals 5. The digits of the new account number are added, giving a total of 36. When the check digit, 4, is added, the total becomes 40. Since this is a multiple of 10, the number is correct. Any wrong number or transposition would have given another result and the card would have been rejected.

Here's how the checking logic works. When a digit is signaled, a control counter is set to the complement of the digit or of its substitute value, depending on whether the storage column is odd or even. The control counter is a 10-position counter and, when it is set, the pulse gate opens. Counting pulses pass through the pulse gate and advance both the control counter and checking counter. These pulses advance both counters until the control counter steps off the end, generating a reset pulse which closes the pulse gate. The number of pulses which have been admitted to the checking counter is equal to the value or substitute value of the input digit. Subsequent digits add into the checking counter so it always contains the units digit of the total as added according to the checking scheme. The condition of the checking counter is tested after reading the entire account number. If the checking counter is on zero (multiple of 10), the card is accepted and subsequent punching permitted.

The missing-digit calculation circuits use the 10-position control counter, the checking counter and a two-stage counter which counts the number of times that a digit is rejected. If one and only one character has been rejected at the reading field, the control counter is set on zero and the pulse gate opened. Counting pulses advance both the control counter and checking counter until the checking counter steps off the end and reaches zero. The number of pulses required for this is exactly the number 1234567890.

Fig. 5 — Numbers used in the SELF-CHEK type font. You'll find them on many credit cards.
ber which would have been entered into the checking counter had the number been read correctly. The control counter which stepped along with the checking counter remains on the position signifying the number of pulses required to satisfy the checking counter and the control counter inserts that number or its substitute into the empty storage position.

Now the coded holes corresponding to the card numbers are punched.

Then the punched card passes over a bank of light-sensitive photocells which are activated according to the punched holes. This output is checked again. If the summation of the digits is equal to a multiple of 10, the entire reading operation is adjudged correct. However, if an error is detected, a signal is sent to the feed control which stops the machine. The faulty card is removed from the stacker so it will not be processed. Remember, this description is lengthy, but cards are read and punched at the rate of 180 per minute.

After the tickets are properly punched, they are ready for mechanical sort, billing and mailing. The machines which do these things are actuated by the holes punched by the Farrington Optical Scanner.

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<td>Long Vertical Left</td>
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<td>Short Vertical Upper Left &amp; Lower Right</td>
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<td>Middle Projecting Right</td>
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+ Condition must be detected
— Condition must not be detected

Fig. 6—The correct combination of detected and not-detected conditions is used to identify numbers.

Fig. 7—How a credit card number is checked.

Customer Account Number: 6 4 1 2 9 8 0 3 7 (4) 4
Columns to be Substituted: x x x x x x x x x
Substitute Digits: 3 2 9 0 5
Digit Total: 3 + 4 + 2 + 9 + 8 + 0 + 3 + 5 = 36
Required Check Digit: 4
Total Including Check Digit: 40 (Multiple of Ten)
Customer Self-checking Account Number: 6 4 1 2 9 8 0 3 7 4

*Check number appears on credit card but not part of account number.

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The Most Trusted Name in Electronics
Simple professional-type instrument for checking industrial devices through audio signal tracing

By WILLIAM F. KERNIN

INDUSTRIAL electronics—a fascinating name for an equally intriguing field. Not only does it cover motor controls, welding timers, furnace and power controls, but also almost all phases of electronics from closed-circuit television to simple sound installations. Nevertheless, servicing and maintenance techniques are virtually the same for all these electronic units. Usually the industrial installation must be serviced on the spot, creating the need for portable and versatile test equipment. Transistor test gear can and does satisfy the need for compact self-contained equipment. One such device is the portable transistor amplifier described in this article.

Essentially, the unit is a high-gain transistor amplifier designed for industrial service. It is an efficient rf, if and af signal tracer. The prototype unit was developed for servicing field radar installations in 1954.

Timing, range marker, sweep and delay circuits in a typical radar set may be checked quickly for go or no-go operation by using audio signal-tracing techniques. All these are primarily pulse circuits of various audio frequencies. Therefore, their signal or waveform can be heard when properly amplified and converted to sound. This technique can also be applied to trace return signals or the echo-box test returns from the video detector to the CRT.

Video return information, if strong enough, can be tracked through the if section by using the rf-if probe with the transistor amplifier. In addition, rf output may be monitored by placing the rf probe near the antenna. The
The completed instrument and its IF-IF probe.

R1—pot, 10,000 ohms, audio taper with split switch
R2, R3—2,000 ohms, 5% (see text)
R4, R5—10,000 ohms
R6—100 ohms, 5%
R7—20,000 ohms
R8—2,000 ohms, 5%
R9—2,000 ohms (see text)
R10—100 ohms
All resistors 1/2-watt 10% unless noted
C1—variable capacitor, 365 μf (Lafayette MS-214 or equivalent)
C2—330 μf ceramic or silver mica
C3, C4, C5, C6, C7, C8, C9—10 μf electrolytic
C10—10 μf electrolytic
D1—2-HD215 (Hughes) or IN52
J1, J2—3-1p diodes
J3—mike connector
J5, J6—phone jacks, closed-circuit
L1—see text
L2—antenna coil with 400-ohm tap and adjustable ferrite core (Miller 2002 or equivalent)
S—split on R1
T1—2-interstage transformer; primary, 50,000 ohms; secondary, 500 ohms (UTC H-1 oucer or equivalent)
T3—line-to-voice-coil universal type transformer: 2,000 ohms to 6.8-ohm ratio is used (Chilton T-110 or equivalent)
V1—CK721
V2—3-GN722
Speaker, 12 ohms (Lafayette 5K-19 or equivalent)
Capacitors: 1 x 5 μf (Bud C1728 or equivalent)
Miscellaneous hardware

Fig. 1—Circuit of handy portable instrument.

Transformer T2's primary is the load for V2. Capacitor C6 couples the signal from T2's 500-ohm secondary to V3's base. This third stage is designed as a class-A power amplifier with a more elaborate bias network than the previous stages. It is needed because of the final stage's increased susceptibility to drift with temperature changes. Resistor R10 gives a good amount of de degeneration in the emitter circuit. Capacitor C8 effectively bypasses R10, thus retaining the stage's ac gain. The bias point is determined by the combination of resistors R8 and R9. Resistor R9 can be adjusted to provide a 30-mw power output. The value shown for R9 in Fig. 1 allows a maximum undistorted output of 8-mw. It is suitable for comfortable listening with the built-in speaker and is more than adequate for headphone use. If 30-mw output is desired, R9 should be approximately 18,000 ohms.

T3 is the output transformer. A standard 8-watt universal line-to-voice coil unit was used in place of the miniature transformer shown. It materially improved the amplifier's low-frequency response.

Numerous jacks are included to make the unit as useful as possible. Jack J4,
an Amphenol microphone receptacle, is the moderately high-impedance input. It also serves as a high-impedance tuner output. Jack J5 provides a low-impedance input to the amplifier. Jack J6 serves as the amplifier output jack when an external speaker or headphones are used. A built-in speaker. Headphones subdue ambient noise, especially in high-noise-level locations.

Fig. 2 is an alternate power amplifier for outputs up to 40 mw undistorted. Two CK722 transistors are used push-pull with another type of output transistor. The stage is run essentially class-AB to overcome the distortion introduced by the usual push-pull class-B amplifier—distortion resulting from the difficulty of selecting two transistors with matched dynamic characteristics, even though their static characteristics may be identical.

Power for the amplifier is obtained from a small 22.5-volt battery. With the values shown in Fig. 1, total current drain is about 4 ma and the battery should last a month or more, assuming the amplifier is used a few hours a day. A 22.5-volt mercury battery would last two or three times as long with little drop in its voltage over the period of its useful service life.

Higher-power output circuits require a larger battery. This in turn necessitates a larger cabinet for the complete instrument.

To use the amplifier as a sensitive af, if and rf signal tracer, two simple probes were designed (Fig. 3). For audio tracing, a dc isolating probe is used to couple the audio signal to the transistor amplifier via jack J4. A similar probe, with a smaller value, ceramic capacitor, is used for rf work. The characteristic impedance of J4 consists of the parallel combination of T1's high-impedance primary plus two high-back-resistance diodes connected in series from J4 to ground. Thus, with the small probe capacitor, we have an efficient shunt diode detector. The rectified signals are coupled to the amplifier by T1 and amplified in the normal manner. Jack J6 may then be used for an output meter or external speaker as desired.

Using and building the amplifier

As a general rule, any pulse or audio circuit may be checked aurally with the technician's transistor amplifier and the appropriate probe. Typical devices encountered in industry include photoelectric counters, high-speed camera timing and sync circuits, closed-circuit TV, industrial tape recorders and decimallinear systems used in chemical and nuclear research. Industrial paging and communications systems lend themselves readily to audible signal tracing.

Much of the low-level high-gain equipment used for instrumentation and precise industrial control rely on well regulated dc supplies. These range from the low-voltage supply for strain-gauge bridges to high-voltage sources. The regulation and filtering of these supplies can be checked with the audio tracing system. Place the audio probe on the line in question. Ripple content will be heard on the amplifier's speaker—or headphones, if used. If excessive, remedial action may be taken while monitoring the line. Because of the transistor amplifier's high gain, it is possible to monitor minute ripple voltages.

Regulation of dc supplies used for speech, pulse or audio equipment may be checked by listening for audio signal on the dc lines. The greater the the indication of signal on the supply line, the poorer the power supply regulation. Here again, the supply line may be constantly monitored while the necessary repairs are being made.

As mentioned before, don't exceed the probe capacitor's voltage rating in any of these checks.

An AM tuner added to the instrument becomes a handy source of accurate time signals. These are derived from a strong local broadcast station on the hour and every half hour. This station determines its time by station WWV. This secondary time standard proves helpful for setting or checking...
INDUSTRIAL ELECTRONICS

Fig. 5—Two protective circuits save components if battery is inserted incorrectly.

long-duration time switches and time clocks.

The tuner is a crystal set with a few design tricks that add to its quality. Coil L1 is used to couple a variety of antennas to L2. It consists of 75 turns of Litz wire scramble-wound on L2's coil form 1/4 inch from L2. The resultant coupling gives a good degree of selectivity with little sacrifice in sensitivity. A voltage-doubler detector circuit is used with L2's 600-ohm tap for increased signal output. As with any crystal detector, optimum operation depends on good as an antenna and ground as possible. A pair of meter leads with alligator clips are handy for connecting an antenna and ground to the tuner input jacks.

The photographs show the suggested parts layout. A 3 x 4 x 5-inch utility cabinet was used as the basic package. The construction detailed in Fig. 4 insures a rugged, reliable test instrument for industrial electronics service. However, layout is not critical and any desired construction can be used. Just keep the input leads as far from the output circuit as possible. A special terminal board (Fig. 4) was used for mounting resistors, capacitors and transistors.

The battery must be connected with the polarity shown. Reversal of polarity will immediately destroy the transistors. Fig. 5 shows two protection systems that eliminate the polarity-reversal danger. The single crystal diode allows current to flow in one direction only. If the battery is connected wrong, little current would flow. The bridge circuit permits the battery to be connected either way and still provides the proper polarity output. Note the voltage drop indicated—approximately 0.5 volt per crystal diode at 4 ma.

The technician's transistor amplifier's main advantages in industrial servicing lie in its portability, small size, high gain with no internal hum, and versatility of input and output jacks. CK721's and CK722's are used because of their dependability and availability. With the advent of new, low-noise transistors (2N131, 2N133), the unit's noise level can be improved and its size reduced.

The finished unit has a neat professional appearance. Its front panel is covered with silver gray speaker grille cloth for a good-looking textured finish. This covering was fastened to the front panel with rubber cement. Gray knobs are used for the controls to blend with grille cloth. To match the plating on the jacks, stainless steel L-stock with a fine sandpaper finish was used as a picture frame. It protects the edges of the grille cloth and gives the panel a finished look. Finally, a well proportioned, brushed, stainless-steel handle was attached to the case for easy carrying, and 1/4-inch thick felt was cemented to the bottom of the case to avoid the possibility of marring the finish of anything the unit is placed upon.

Although designed for industrial servicing, the transistor amplifier can also be used for radio, TV and hi-fi repair. It fulfills the requirements of a sensitive signal tracer with the added convenience of being self-contained and completely portable.

UNGROUNDED EQUIPMENT CAN BE FATAL

THREE Florida workers were killed in a single month last year while using ungrounded portable drills. All could have been prevented if the state electrical code had been complied with. The code states, in part, "All portable electrical tools are to be grounded prior to use. All exposed noncurrent-carrying metal parts of portable electrical equipment operated at more than 50 volts to ground absolutely must be grounded regardless of use or location.

In one case, a carpenter standing on a wet terrazzo floor held a tool ready to drill holes in the floor. The hot side of the line shorted to the case of the drill. The carpenter's body completed the circuit to ground.

In the second accident, a worker was drilling holes in a copper hood at a private residence. Although the house belonged to an electrical contractor and had polarized receptacles, the drill had a two-wire cord and was not grounded.

The third worker was drilling holes outdoors while standing on wet ground. The tools had three wire cables, but the location did not have the proper outlets. Adapters were used, but the man had not taken the trouble to attach the ground wire.

In the three electrocutions, one man had the correct tool, another had the correct outlet and the third had neither. But, none had a grounded drill and because of that, they will have no need for them in the future.

During the preceding 8 months, only one portable-tool electrocution was reported, according to the Florida Industrial Commission's Department of Safety.

SEPTMBER, 1960

END

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ANY service technicians feel that the scope is as dead as the dodo. Some feel that it is an unnecessarily complicated instrument which is not needed—that the work done by a scope can be accomplished quicker and easier by other methods. It has been suggested that a volt-ohmmeter is just as useful as a scope and can take its place.

The belief is quite false, but it is understandable. It is a matter of statistics. Most trouble is caused by tubes. It does not require a scope (or any other instrument) to locate a bad tube. All we need to do is to plug in new tubes and see if the set resumes operation. Even a PhD can do it himself.

Since bad tubes cause 80% or more of TV troubles, we can operate nicely 80% of the time without a scope. The second greatest troubleshooter in service work is the faulty capacitor. In many cases, it can be located by picture and sound analysis, plus a little trial-and-error substitution.

But we sometimes run into capacitor troubles that require a tremendous amount of trial-and-error to localize. Not all of these situations can be quickly cleared up by a scope, but a sizable number of them can be.

The same thing applies to other components, such as coils and even a few resistors. Parasitic oscillation is a very good example.

Because the scope is not usable as often as a volt-ohmmeter, we tend to become lazy. We tell ourselves that a scope is not worth using, and after a while we begin to believe it. So we forget how to work it and when we need it we are up the well-known creek.

It is all a matter of viewpoint. Some maintain that TV servicing requires no knowledge of circuit action. I attended a training course some years ago in which a presumably excellent college instructor said that “after all, TV repair consists of replacing a resistor or a transformer or a capacitor—what else does a technician need to know, if he can handle simple tools?” I quit the training course in disgust.

Unfortunately, we find this same type of thinking in some shops. It's the bunk. Let's clean house!

Shrinking picture

The picture shrinks about 1½ inches on each side after a Seltz-Carlson 551 has played about an hour. Taking the sleeve completely out of the yoke makes little difference. Can you help me?—O. P., Escanaba, Mich.

Your shrinking picture could be caused by several different things: the most likely prospect is a slightly weak or gassy 6BQ6-GA in the horizontal output stage. This is the cause of most shrinkage trouble with a 1-hour time constant. If the tube has already been changed, try replacing the horizontal oscillator and damper tubes.

The easiest way to catch a long-time-constant trouble like this is to monitor the various voltages which could cause it (as many of them at the same time as possible). These would be the dc drive voltage on the 6BQ6-GA grid, the plate supply voltage for the horizontal oscillator and the screen voltage on the 6BQ6-GA. For instance, set up your vtvm to read the grid-drive voltage and the bench vtvm the plate voltage. If another meter is available, hook it onto the 6BQ6-GA screen (Fig. 1). Turn on the set and log the readings while the width is sufficient. Now go ahead and do something else and come back in an hour. If the width has decreased, see which voltage has dropped off.

If it isn’t one of the tubes, look out for drifting resistors. I had a very similar problem with a 6BQ6-GA screen resistor that very gradually increased in value as the set warmed up until it had dropped the screen voltage enough to reduce the width. Incidentally, it might be wise to cover the set with a cloth or cardboard box to keep it warm (as it would be in the cabinet).

Orphan TV set?

We've got a set in the shop and can't figure out anything about it! It's a 20-inch DeForest, and the only numbers on it are 20A-05-A. We need a schematic and some information. Can you help us?—S. Y., Kansas City, Kan.

This is a TV set built by the students at American TV Schools, in Chicago. I am enclosing a schematic I finally obtained. The A-series is the only one I could find.

Fine-tuning

How is the fine-tuning control connected to the capacitor on an Admiral 152Y-P5D? I'm having trouble with this job. Is it advisable to install another fine tuner on the case or on the back?—T. H., Baltimore, Md.

The fine tuner on this series Admiral is a very small capacitor on the front wall of the tuner chassis for a broken connection between it and the tube socket; this is common. Because of added capacitance, I don't think it would be advisable to attempt to install an additional control.

Flashover in RCA yoke

Here's the problem. In an RCA 2760, I hear a snapping noise, I see a flash of light in the yoke, and the picture goes out completely. It comes back a few seconds later. After a while of this, the width shrinks and the brightness goes down. What can I do to get this set back to the customer in good working order?—A. C. R., Matawan, N. J.

Since this is not a new set by several years, I'd recommend taking the yoke off, drying it thoroughly, then spraying with HV insulation. This trouble seems to be caused by intermittent flashover in the yoke. Check the leads and the internal crossover wiring in the yoke, and replace aged spaghetti where nec-

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Fig. 1—Monitoring the different voltages that could affect the width will indicate which has changed.

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essay. If this doesn't help, replace the
yoke.

Glass for metal

I have a Stewart-Warner 21TP910 in
the shop with a 21AP4 picture tube. This
is a metal tube and the life doesn't
seem to be as long as for a comparable
glass tube. The customer would like to
substitute a 21-in. glass tube. Any
suggestions?—J. C. S., Carbondale, Pa.

The 21ZP4 is a direct electrical
replacement for the 21AP4 metal-cone
tube. In this chassis, I would recom-
dend using the 21ZP4B, which is alu-
mized. Both tubes use magnetic focus
and the bases are the same.

Your only problem will be mounting
the glass tube on the chassis. The eas-

![Fig. 2—Use a carpenter's square to
measure the distance between the
apron and the picture-tube face.]

iest way is to obtain one of the parts
kits made for just this purpose. They
are designed for specific TV sets. Order
by make and model number from your

When mounting the glass tube, be
sure to set it so that the faceplate is
exactly the same distance from the
front of the chassis so the control shafts
will come through the cabinet the cor-
rect distance. The best way is this:
Before dismounting the old tube, set a
large carpenter's square vertically
against the tube face. Then measure
the distance to the front of the chassis
(Fig. 2). When setting the new tube,
get this dimension exactly the same by
correctly spacing the wooden mounting
blocks provided. Then, the set will go
back into the cabinet easily. As the
glass tubes are some ¾ inch longer in
the neck, you may have to cut a hole
in the plastic cup on the back of the
set.

Burning resistors

In a Philco 7L40 chassis, the audio
output tube's cathode resistor is burn-
ing. Grid 1 reads 10 volts, cathode meas-
ures 15 volts, from 145 volt source. The
coupling capacitor and electrolytic fil-
ter have been replaced without effect.
Several 6CU5 tubes have been tried
also with no effect. B-plus reads about
255 volts. Any suggestions?—J. W.,
Columbus, Ohio.

This chassis uses a stacked-B-plus
circuit. The high voltage is applied to
the 6CU5 audio output plate; the video
if tubes are fed from the cathode of the
audio tube.

Since the cathode resistor is "burn-
ing up," it is obviously overloaded. The
voltage readings you give for the 6CU5
show that there isn't any trouble there:

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the grid reads —8 volts to the cathode. This bias will hold the plate current drawn by the 6CU5 itself down to normal values.

The most likely prospect and the one which gives the most trouble in the field is a heater–cathode short (or other short) in one of the video if tubes. Unlike as a heater–cathode short sounds as a cause of this trouble, it can do it if the cathode has a bias resistor in series. This causes the bias to drop to zero and the resulting increase in plate current is often enough to overheat the 6CU5’s cathode resistor. Grid-screen shorts are the most common causes of complete resistor burnouts. In any case, this trouble is going to be in that +150-volt line.

Measure the cathode voltage of each if tube. If the voltage is low, look for a heater–cathode short. If the voltage is high, the tube is passing excessive current.

**Loss of focus**

I have a Dumont RA-164. The raster on this set seems normal, but the picture is out of focus except on extreme closeups, when it seems quite clear. Do you think a de restorer would help this?

Can you suggest any circuit changes to improve the picture? —P. D. S., Salt Lake City, Utah.

This set will not need dc restoration, due to the circuitry used (Fig. 3). You already have partial dc restoration in the video amplifier stage in this cathode-coupled C-R tube. Therefore, your trouble must be somewhere else. It could be caused by a slightly gassy or weak picture tube. However, this would show up on other scenes such as the closeups you mention. The first step here would be to check the focus of the raster. Using a blank raster, set the ion-trap magnet very carefully for maximum brightness, moving the trap back and forth along the neck of the tube. Next, move it very slightly around the neck at this point, always keeping it at maximum brightness point. At some point very close you should notice a decided improvement in the focus of the scanning lines. Keep the brightness and contrast at normal setting. It might be necessary to change the focus voltage on pin 6. It now has about +260 volts. Try different values, to see if it helps.

Loss of fine detail in the background.

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**Fig. 3—Video-output circuit of Dumont RA-164, 165.**

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See Page 69
TELEVISION

could be due to poor alignment in the video if's. Run a complete sweep alignment on these stages, and check the peaking coils in the video amplifier plate. (Watch out for high-end regeneration.) The video detector might also be changed, as an experiment.

No raster

In a G-E 2177 TV set, we have plenty of high voltage (we can draw a fat spark from the lead), the bias on the picture tube grid is exactly right and varies like it ought to, but no raster. We measured the voltage between the picture tube grid and cathode and it goes up and down between the limits. Cathode voltage runs from 20 to about 110 when the brightness control is moved. We used another picture tube out of another set of the same kind and it won't light either. We tested both tubes, and they're OK. What do you think is the matter?—T. H., Ft. Smith, Ark.

In this chassis (and several others of the same vintage, not the same make) the accelerator grid of the picture tube, pin 10, is supplied from the B-plus boost line, through a 2.2-megohm resistor (Fig. 4). There is a 3.9-megohm resistor connected from this grid to chassis, bypassed with a .01-µf capacitor. This is at the horizontal blanking tube (half of a 12AX7) socket. I think you'll find this capacitor shorted out, and no voltage at all on pin 10 of the CRT.

If all other voltages on the picture tube are OK, the tube(s) are good and the brightness control varies the grid-cathode voltage within the rated limits for the tube, this must be the trouble. In a case like this, there are only two possibilities: the CRT itself is defective (open elements, such as cathode grid) or the electron beam is cut off by excessive bias. As you have properly eliminated both of these possibilities, there is only this one left. This is a fairly common trouble in sets using this circuit. Later models connected the accelerator directly to the B-plus line, eliminating this bypass capacitor.

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Fig. 4—Picture-tube socket connections in GE 2177. If the circled capacitor is shorted, no raster will appear.

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JUST a couple of months ago, Motorola introduced a portable transistor TV that has a 19-inch screen. A lot of these sets are going to appear in homes throughout the country and from time to time, the TV service technician is going to be called upon to repair them. To do a proper repair job, there are several things he must know about the set—how to get at the chassis, how to remove the back, how to remove the picture tube. And just as important, he must know something about the circuits he will encounter—they are not the same as the ones he is accustomed to seeing.

This article will show how to get at the chassis should repairs be necessary, we will see how to change the picture tube and we will take a brief look at the set's circuitry to learn a little about how it operates.

To get inside the set, the first step is to remove the knobs and the two screws from the plate where the carrying handle is mounted (Photo 1). The plate lifts right off and reveals four more screws—the two in the rear are unscrewed if you want to remove the set's back cover; the two above the picture tube are removed if you want to take off the front bezel (Photo 2). As a final step there are four more screws on the bottom of the set—again, two for the back and two for the bezel (Photo 3). When the back and bezel are both off, the face of the picture tube and the back of the chassis (the side the transistors are mounted on) are exposed.

As transistor failure is not common, you will probably want to get at the wiring side of the chassis. To do so you have to take out six more screws, four on the top of the set and two on the bottom, that hold the chassis to the picture tube (Photo 4). Once these screws have been removed, slip the chassis off the picture tube, reverse it and place it back around the tube (Photo 5).

To remove the picture tube, take the chassis off as just described. Then disconnect the yoke, high-voltage lead and CRT socket. Next remove the two screws that hold the retaining band around the picture tube. Now the CRT will come out easily.

So much for disassembly, now let's look at the circuit. The set uses 24 transistors, 10 diodes, a vacuum-tube high-voltage rectifier and a 19-inch picture tube. There are controls for tuning, brightness, contrast, volume and a range switch to adjust for: strong, medium or weak signals. Of course, there is the usual group of rear chassis service controls.

The tuner
There are three transistors in the turret type tuner, Fig. 1. The incoming signal, either through the 300-ohm input for an external antenna or through the 75-ohm monopole antenna, is fed to the base of the if amplifier. The gain of this common-emitter transistor
stage is controlled by a forward-bias agc voltage fed to its base. The base and collector circuits are tuned to the desired channels by turret switched coils. The rf amplifier’s collector is inductively coupled to the mixer’s emitter. The oscillator output is capacitively coupled to the mixer emitter. The output to the if strip is taken off the mixer collector.

**Video if strip**

A three-stage video if strip is used (Fig. 2). The first and second if’s are controlled by a forward-biased gated agc system. To avoid variations in the if response curve with changes in the agc voltage, the first- and second-stage outputs are broadly tuned. The if transistors are operated common emitter for best gain. Neutralizing networks and emitter stabilizing resistors provide maximum stability.

**Video detector and amplifier**

A junction-diode detector rectifies the if output to form the signal input to the video amplifier. The first video amplifier operates in a dual fashion. A 4.5-mc trap in the emitter circuit acts as a high impedance at video frequencies. As far as video signals are concerned, the first video amplifier operates as an emitter follower that provides a high-impedance input for proper matching to the video detector and low-impedance output to drive the video output stage.

At the sound if, the 4.5-mc trap bypasses the emitter resistor and the 4.5-mc tuned circuit in the collector circuit rises in impedance and loads the collector. At 4.5 mc the stage operates as a common-emitter amplifier. At video frequencies the stage operates as an impedance-matching device while, at 4.5-mc audio if, it is an amplifier.

**Sound if and audio system**

The 4.6-me sound if signal is amplified by the first video and the 4.5-me if stage. Limiting is in the audio if collector circuit and the ratio detector. A matched pair of junction diodes comprises the ratio detector which feeds an audio driver and, in turn, a pair of matched class-B output transistors which provide a 500-mw output.

**Gated agc circuit**

The transistor agc circuit uses the saturation characteristics of the transistor rather than the cutoff characteristic. This is necessary since transistor cutoff characteristics are rather abrupt and not very well suited to age control. The basic difference between tube and transistor agc circuits is that the transistor is biased into saturation rather than cut off to reduce gain.

**Range selector switch**

There are three range positions—FRINGE, SUBURBAN and LOCAL. For fringe reception, the rf amplifier is operated at full gain. This is done by disconnecting the rf transistor from the agc system and returning its base to its emitter in the FRINGE position.
The first two if stages are still fed an age voltage. On suburban or medium strength signals, it is still desirable to operate the rf amplifier for full gain for best signal-to-noise ratio.

However, at the high end of the suburban signal range, signal strength reaches a point that will cause overloading with full rf gain. So age to the rf amplifier is delayed until the signal reaches a point near the overload level. At this point if afc comes in fast to protect against overload. This is done by inserting a 390-ohm resistor between the age line and the if amplifier bases. It places a fixed amount of age on the if stages to produce, say, 20-db attenuation. This is equivalent to a 20-db delay on the rf age and lets the signal rise to a level where noise is no longer a factor before rf age is developed. In the LOCAL position the circuit is set up the same as in the SUBURBAN position. The only difference is that an antenna pad is switched into the antenna circuit.

Horizontal circuits

The basic requirements for a horizontal deflection system are a deflection yoke, a source of dc voltage to supply deflection current and a means of switching the applied voltage at the horizontal frequency. In the Astronaut the switch is, of course, a transistor.

Bias applied to the bases of the output transistors is arranged to drive them just into saturation. If the 2.7-ohm resistors between emitter and base should change in value, bias may go up or down. If it goes up, the driver transistor will have to supply a stronger pulse to the output transistors, and the driver will draw excessive current. If the bias goes down, the output transistors will not saturate, causing their internal resistance to rise, raising dissipation. So always check this carefully.

If the drive voltage should fail, the output transistor is cut off and no damage is done. The thing most likely to damage the output transistor is improper drive waveform or off-frequency operation. When in doubt, remove the yoke plug, turn on the set and check the waveforms and frequency of the horizontal circuit. If you think the output transistor is bad, check it with a vacuum-tube type ohmmeter—short-circuit from base to collector indicates a bad transistor.

The high-voltage supply uses a conventional flyback type circuit with a 152-A vacuum-tube rectifier to power the picture tube anode. Two taps on the flyback supply voltage to silicon rectifiers to provide positive and negative voltages (about 70-100 volts). The positive tap supplies a positive bias for the CRT cathode and G2. The negative tap supplies the collector of the video output transistor.

To check the high-voltage use a high-voltage probe. Never draw an arc from the high-voltage system or you may damage the output transistor. For this reason if any of the high-voltage rectifiers show signs of corona, replace them immediately.

The high-voltage secondary is resonant at the horizontal frequency. The high voltage is greatest at resonance and is controlled by the HORIZ SIZE, an adjustable air gap.

Phase detector and horizontal oscillator

The phase detector circuit compares the incoming signal with a sample waveform from the horizontal output circuit. The 180° out-of-phase sync pulses are fed to opposite ends of the comparison network. The sawtooth waveform from the horizontal deflection circuit is fed to the center of the two selenium diodes. When the oscillator is out of phase with the signal, an unbalance occurs, resulting in dc voltage at the junction of the two 100,000-ohm resistors. This voltage is positive or negative, depending on the type of correction required.

The balance point of the phase detector is returned to ground through a divider network which furnishes adjustable forward bias to the blocking oscillator. This bias is fed to the base of the horizontal blocking oscillator. The phase detector adds or subtracts from this voltage to hold the blocking oscillator in sync.

To set up the oscillator, short the ringing coil and disconnect the phase detector. Now adjust the free-running oscillator to bring the picture into horizontal sync (sync will hold only momentarily, but this is normal). Next the ringing coil is reinserted into the circuit and adjusted for best sync. Lastly, reconnect the phase detector.

(continued on page 90)
Fig. 2 - Complete circuit of Motorola's Astronaut. See Fig. 1 for tuner.
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$237. 2 vols., soft cover, $6.60; 257H, cloth, $7.75.

TELEVISION

Servicing Motorola

(Continued from page 54)

Sync separator and phase inverter

The sync signal is taken off at a 560-ohm point on the video output collector load resistance. The age system maintains the sync tips in the video output at or near saturation. Therefore, a lot of sync clipping has taken place when the signal reaches the sync clipper. The output of the sync separator remains constant for all settings of the control contrast. As the transistor is driven far into saturation, noise clipping is very effective. The stage is a common-emitter type, so the negative output pulse is out of phase with the input pulse. The negative pulse from the sync separator drives the phase inverter in the forward direction. The phase inverter provides a balanced output to the input of the horizontal phase detector. The full value of the negative-going sync at the collector is integrated to form the vertical sync pulse.

Vertical deflection system

Vertical sync is integrated and coupled to the vertical blocking oscillator through the third winding in the blocking oscillator transformer. The vertical hold control is part of an R-C network which determines the rate of the base return circuit and determines the free running time of the oscillator. The transformer provides a positive feedback loop from the collector to the base circuit. The output is controlled by a variable-emitter resistor which is used to adjust vertical size.

Power supply and charging circuit

The set is powered either by the ac line or its own Energy Cell (battery). The Energy Cell is a silver-cadmium unit that requires no maintenance. It will operate the set for 4 or 5 hours and recharges overnight.

For ac operation, the line cord is plugged into the back of the set. This activates an automatic changeover switch that connects the power transformer to the ac line, disconnects the negative terminal of the Energy Cell from ground and connects it to the charging relay. The charging relay (which is then turned on) connects the receiver to the ac power supply and opens the charging circuit.

When the ac switch is turned off, the power transformer is disconnected from the charging circuit. When the Energy Cell is fully charged, the charging relay opens. The CHARGING CUTOFF control sets the point at which the cutoff relay operates. The control must be set so that the relay opens when the battery is charged to 20 volts.

For battery operation, simply remove the line cord. This connects the Energy Cell into the circuit. Then turn on the on-off switch and the Energy Cell powers the set.

END
By HENRY O. MAXWELL

INNOVATIONS in TV circuitry have a way of appearing and disappearing at fairly regular intervals. One of these features (now making a comeback) is an automatic brightness control that adjusts picture brightness according to the level of the light in the room.

A photosensitive device is mounted on the front of the TV receiver where it receives the full effects of the ambient light level. Changes in the voltage output (or resistance) of the photosensitive element are used to adjust the set's brightness level. The latest automatic brightness control is Hoffman's Lite Scope used in the series 354 TV chassis. The photocell is visible just below the center of the right edge of the cabinet in the model shown.

Without an automatic brightness control, the receiver's brightness control must be set to balance the light level in the room. Assume that the set is turned on in the late afternoon while the light level is still high. The brightness control must be set fairly high for a good contrast ratio. As the afternoon wears on, the sun sets and the brightness must be turned down to prevent glare. Shortly afterwards, the room's lights are turned on and the brightness must be reset to prevent the picture from washing out. Thus, without automatic brightness control, the viewer may adjust brightness three times within a comparatively short period.

**Lite Scope circuit**

The Lite Scope circuit is shown in Fig. 1. The control element is a cadmium-sulphide photocell bridged across a large section of the picture tube's cathode-biasing resistance. The cell's resistance varies inversely as the light falling on its sensitive surface as in Fig. 2.

When a set with the Lite Scope is turned on, the effective value of the C-R tube's cathode resistance is determined largely by the light on the CdS photocell. When the ambient light increases, the photocell's resistance decreases. This reduces the C-R tube's bias and increases the brightness. Similarly, a decrease in light level decreases picture brightness by increasing the cathode resistance and picture-tube bias.

The earlier version of the automatic brightness control, used in some 1953 Westinghouse receivers, was much more complex than the Lite Scope. It used a 1P41 phototube and a 12AU7 or 6B7T-A as a 2-stage dc amplifier controlling the screen voltage of a video amplifier tube. The basic circuit and its explanation appeared in the article "Automatic Contrast-Ratio Control" in the August, 1953, issue.
Electronic technicians and experimenters often face the problem of stripping a large quantity of wire. When only a hand stripper is available, this can be a very tedious task. However, with a few parts from the "goodie box" and 10 minutes you can make a foot-operated stripper.

The drawings show a hand stripper mounted to the bench. A spring about 2 inches long from an old phonograph turntable is connected between the movable arm of the stripper and the bench. A pulley is needed so the stripper can be foot-operated. I use a standoff spacer and washer on a nail. Any board from 2 to 6 inches wide and 1 to 2 feet long makes a good foot pedal. To keep the pedal from slipping, fasten the heel to the bench foot rest, or to a rung of the stool. This is not intended to be a permanent installation, so heavy cord will do to tie the foot pedal to the stripper.

A much neater job of stripping can be done if all the wires are stripped to the same length. All you need is a backstop made from a block of wood and clamped to the bench with a large C-clamp. Cut all the wires to length first. Then feed them to the stripper. — Harlan H. Hughes

For An Important Prophecy From

General David Sarnoff

See Page 68
Have you ever seen the SYLVANIA "Bakery"?

"Bakery"? An "Oven"? Yes, but not for bread. For Silver Screen 85 Picture Tubes! Giant ovens (Lehrs)—each about one-third the length of a football field—"bake in" the big differences that make Sylvania Silver Screen 85 the finest replacement TV picture tube...second to none!

The giant ovens heat-treat the glass and bake the phosphor screen and other internal coatings. Important, too—this process removes residual volatile materials such as lacquer and water used in applying the phosphor screen.

This treatment must be done slowly, under careful controls and is very essential to the proper processing of the bulb. This process also assures "stronger" glass, free of undesired strains. It extends picture tube life by ridding the bulb of contaminants that could later cause inter-element leakage, gassing and loss of emission. The manufacturer who employs expensive equipment such as this can assure you of a consistently top-quality product.

So, when you recommend a replacement picture tube, recommend the finest...a Sylvania Silver Screen 85. It gives your customers what they want: better pictures for a longer time. Gives you what you need: profitable TV service calls.

Electronic Tubes Division,
Sylvania Electric Products Inc.,
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Disassembled unit shows construction details.

Fig. 1-a—Circuit of the 3-tube amplifier; b—metered battery power supply; c—battery arrangement. Batteries connect to corresponding terminals of TS.
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Combined with scope or vtvm, an instrument with a 1% accuracy for making really low-level measurements.

By C. L. HENRY

SERVICE technicians, laboratory workers, experimenters and amateurs would often like to measure voltages smaller than 0.1. However, millivolt vtvm's are costly and very few shops have them.

We often get around the lack of a millivoltmeter by using an oscilloscope. But in many circuits, even a low-capacitance probe loads the tiny signal and there isn't enough left to give a readable trace. For example, when troubleshooting the front end of a TV receiver, the signal is often too small to produce a scope trace.

The perfect solution to these problems is the amplifier described in this article. It has a gain of 100 from 10 cycles to 500 kc within 1%, and 8 cycles to 1 mc within 2%. Connect a vtvm to the amplifier's output and the meter's 0- to 1-volt scale now reads 0- to 10-mv. When connected to the input of a scope with a 50-mv-per-inch deflection sensitivity, the scope's total sensitivity is boosted to 500 av per inch.

The amplifier circuit is uncomplicated and straightforward. (See Fig. 1). Three 6AK5's are used, powered by a self-contained battery or an ac supply. The amplifier is a feedback type. V1 is the controlled stage, V2 gives most of the amplification, and V3 controls the first stage. This is done with a wide-band feedback network from V3's cathode to V1's cathode resistor. The output thereby varies the bias on the input stage and tends to cancel any overall gain variations. Feedback potentiometer R9 adjusts the total gain to exactly 100.

The amplifier's rise time is 0.3 µsec, and the tilt on a 0.1-second pulse is 2%. Like all feedback amplifiers, frequency response cuts off very sharply at the higher frequencies. The cutoff frequency of this amplifier is 1.5 mc. Input impedance is 1 megohm shunted by 10 µf, and output impedance is 1,000 ohms shunted by 20 µf on the X10 position. A simple step attenuator at the output gives a ×10 position, which is sometimes useful. A ×0 position is also included. It is used to

S E P T E M B E R, 1 9 6 0
check the zero adjustment on the vtvm used with the amplifier. This \(x\times 0\) position short the amplifier's output jack.

When building the amplifier, I decided noise output should be as low as possible so I use deposited-carbon resistors for R1, R2, R3 and R4. Most noise in this type of battery-operated circuit can be traced to current flow in a standard carbon resistor. The amplifier's noise output with its input shorted is 300 \(\mu\)V. This is equivalent to an input noise of 3 \(\mu\)V. Such a noise level is so low that measurements in the 30- to 1,000-\(\mu\)V range can be easily made.

Capacitors C5 and C7 are trimmers in my unit. However, the listed values were established as optimum and fixed units as shown in the parts list can be used.

The amplifier input overloads at 0.25 volt, which is equivalent to a 25-volt output. A power socket is included for applications where an external power supply might be desirable. I recommend using an ac supply (Fig. 2) only where the amplifier is operated continuously for long periods of time. In ordinary measurement work, one set of batteries will last several months and the hum problems of an ac supply are avoided.

(For your protection it would be wise to take a jolt from the power supply and a plug on the chassis. This avoids the possibility of getting a jolt from a hot plug or accidentally shorting a battery.

---

**BENCH**

Connect to a vtvm and you have a meter that will read 0-10 mv on what used to be a 0-1 volt range. Hook the decade amplifier to a scope (50 mv-per-inch deflection sensitivity) and get 500-\(\mu\)V-per-inch deflection sensitivity.

This decade amplifier was tested by a member of the staff of RADIO- ELECTRONICS. His report states that the unit operates as described by the author. The amplifier was tested by feeding it signals of various frequencies. Their amplitudes were measured at the amplifier's input and output, both with a scope and a vtvm. Only minor slips off exact \(\times 10\) and \(\times 100\) multiplication were noted; both were within the tolerances of the test equipment used. Frequency response seems slightly different from that stated by the author—instead of 5 cycles to 1 mc within 2\% it is 7 cycles to 1.4 mc. Noise level is also somewhat better than stated—the author says 300 \(\mu\)V, the tests show 275 \(\mu\)V.

---

**TESTED**

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There are only three controls on the indicator's front panel.

By LYMAN E. GREENLEE

In all types of modern electronic gear there is an increasing need for measuring surge voltages. Sudden sharp voltage peaks do not register on an ordinary voltmeter. With the proper accessories, they can usually be observed with an oscilloscope, but a scope is not always convenient to carry for field use. A voltmeter is usually satisfactory for measuring ordinary ac and dc voltages encountered in routine service work. The amount of circuit loading depends on the sensitivity of the meter, but the input resistance is rarely more than 10 or 11 megohms. This resistance does load some electronic circuits to such an extent that accurate measurements are impossible.

A neon bulb is particularly good for indicating high-voltage surges. A good example of this is its use as an ignition tester for automobile spark plugs. Nobody would ever think of trying to measure an ignition pulse with an ordinary voltmeter, but the neon bulb, used with the proper load resistance, is perfect for such an application.

The problem of measuring and evaluating voltage surges becomes much easier and perhaps safer with the piece of equipment shown in the photos. Small 1/25-watt neon bulbs (NE-2) have an average starting voltage of 68-70. Two of them in series will start at 135-140 volts dc. By combining a series string of these NE-2 bulbs with 1-megohm protective resistors, we can make a voltage indicator that checks the applied voltage in steps of 70 volts. Unlike a voltmeter, this type of indicator puts no load on the circuit until the bulbs actually fire and start to conduct.

Using two 20-position switches, we get 99 multiples of 70 volts, or a total range of from 70 to about 2,700 volts ac or dc. Any unknown voltage surge can be spotted within 70 volts. This is close enough for checking vibrator power supplies and numerous other
MAKE A VOLTAGE INDICATOR

applications where a higher degree of accuracy is not required, since we are primarily interested in knowing whether a voltage surge is present and its approximate peak value.

Construction is simple. All the neon bulbs and series resistors are soldered directly to the switch contacts. The entire assembly fits a stock bakelite instrument case 6 13/16 x 5 9/32 x 2 5/16 inches, and the various parts are mounted as shown in the photographs. One neon bulb is mounted on the front panel in a 3AG fuse clip. It is covered with a socket well as a light shield to allow easy observation of short flashes of the neon bulb in daylight. (Paint the inside of this shell black.)

There are four pin jacks on the front panel. J2 and J3 connect directly to the series string of bulbs and resistors. J1 provides for inserting a 50-μf capacitor to eliminate the dc component from a circuit where both ac and dc are present. J4 allows the insertion of pushbutton switch S3, a big convenience if the circuit must be closed momentarily to observe electrostatic potentials or for safety reasons when checking an unknown voltage. Note that all bulbs and resistors are normally in series, and switches S1 and S2 short out the portion of the series string not being used.

The quantity of electricity required to flash the neon-bulb string is so small that it will produce no noticeable deflection on a 0- to 20-μa meter hooked in series. The discharge of a 10-μf capacitor can be observed. Pushbutton switch S3 is used when measuring small electrostatic potentials. Starting with S1 and S2 in positions 39 and 20, respectively, the bulbs and load resistors are progressively shorted out one at a time until there is a momentary flash in the indicator bulb on the front panel at the instant that S3 is depressed. This is done by turning S1 down from 39 to 20. If at 20 the indicator has not lit, turn S2 down from 20 toward 1. The total voltage is equal to the number of bulbs in the string multiplied by 70. This is the peak voltage within 70 volts. Polarity of dc circuits and capacitors may be checked, and any unknown voltage may be checked regardless of frequency. This includes rf voltages as well as surges. Probably the most unique and useful feature of the device is its ability to indicate the very minute charge stored in a very small capacitor. The voltage checker can readily connect to the test bench, and one preliminary check on an unknown voltage could easily save the cost of an expensive meter.

Internal construction gives a very symmetrical layout.

SEPTEMBER, 1960

TEST INSTRUMENTS

Internal construction gives a very symmetrical layout.

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- **7 AND 9 PIN FUSE STRAIGHTENERS** have been included on the front panel to eliminate possibility of damaging tubes with bent or out-of-line pins.

- **AN ULTRA-SENSITIVE CIRCUIT** is used to test large signals to within 10ths of a millivolt between each tube element.

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AN ELECTRONIC OMHETER: Because of its wide operating characteristics, the Model 95 provides a complete calibration of measurement equipment. The Model 95 is suited to servicing all electronic equipment.

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench—use it on the car. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle, only.

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Dot Pattern Generator (For Color TV): Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition is the "dot" or Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence.

Marker Generator: The Model TV-50A includes all the most frequently needed marker points. The following markers are provided: 180 Kc., 280.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1400 Kc., 2000 Kc., 2500 Kc., 3575 Kc., 45 Mc., 107 Mc., and 1287 Mc. (in the color burst frequency).

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**EXAMINE BEFORE YOU BUY!**

**RADIO-ELECTRONICS**

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The Model 88... A New Combination
TRANSISTOR RADIO TESTER and
DYNAMIC TRANSISTOR TESTER

The Model 88 is perhaps as important a development as was the invention of the transistor itself, for during the past 5 years, millions of transistor radios and other transistor operated devices have been imported and produced in this country with no adequate provision for servicing this ever increasing output.

The Model 88 was designed specifically to test all transistors, transistor radios, transistor recorders, and other transistor devices under dynamic conditions.

AS A TRANSISTOR RADIO TESTER

We feel sure all servicemen will agree that the instruments and methods previously employed for servicing conventional tube radios and TV have proven to be impractical and time consuming when used for transistor radio servicing. The Model 88 provides a new simplified rapid procedure—a technique developed specifically for radio's and other transistor devices.

Any R.F. signal source, modulated by an audio tone is injected into the transistor receiver from the antenna through the R.F. stage, past the mixer into the I.F. Amplifier and detector stages and on to the audio amplifier. This injected signal is then followed and traced through the receiver by means of a built-in High Gain Transistorized Signal Tracer until the cause of trouble whether it be a transistor, some other component or even a break in the printed circuit is located and pinpointed. The injected signal is heard on the front panel speaker as it is followed through the various stages. Provision has also been made on the front panel for plugging in a V.O.M. for quantitative measurement of signal strength. The Signal Tracing section may also be used less the signal injector for listening to the "quality" of the broadcast signal in the various stages.

Model 88 operates on a self-contained 4½ volt battery and is always ready for instant use on the bench or in the field.

Signal Injector:
The signal injector used in the model 88 is a new departure in signal source design. Previously, signal sources were provided by signal generators operating on a single frequency and requiring retuning. The Signal Injector of the Model 88 employs a transistor in a grounded emitter self-modulating blocking oscillator generating a broad R.F. frequency providing stable harmonics to 30 megacycles. A power output of over 2 ½ volts peak to peak is provided. An attenuator prevents overload at the receiver or the amplifier under test.

Signal Tracer:
Two high-gain grounded emitter transistors are utilized in a high gain amplifier with sufficient output to operate the built-in 4½" Alcoa V. Speaker. A diode is used as a "clamp" to prevent overloading of the output stage. A volume control permits attenuation of strong signals. Provision is also made on the front panel for the addition of a meter or an oscilloscope for quantitative evaluation of the signal strength, is self-evident. A further benefit of this service is that it will enable you to test new transistors as they are released!

SPECIFICATIONS:

Transistor Tester:
The transistor tester used in the Model 88 measures the two most important transistor characteristics needed for transistor servicing, leakage and gain (beta). The leakage test measures the collector-emitter current with the base connection open circuited. A range from 50 ohms to 100,000 ohms covers all the leakage values usually found in both high and low power transistor types. The gain test (beta) translates the change in collector current divided by the base current. Transconductance is the base current held to a fixed value of 50 microamperes, the collector current calibrated in relative gain (beta), is read directly on the meter scale. The Model 88 will test all transistor types, including NPN or PNP, germanium, silicon, gallium arsenide and the newer diffused silicon and mesa types.


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September, 1960

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AEROVOS

HIGH CAPACITY
...LOW VOLTAGE

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ELECTROLYTICS

by R. L. WINKLEPLECK

The power a piece of electronic equipment uses is an important indication of its condition. A watts or volt-amperes reading is a useful, though frequently overlooked, service aid because it narrows the field of possible faults.

Equipment cost is an ever-present problem and wattmeters are quite expensive. Fortunately, there is a simple way to get the information wanted by assembling a small, portable, power-measuring unit. The total cost is under $8 and the unit has one advantage over the more expensive wattmeter.

This power-test unit consists of two inexpensive meters; one to measure ac volts and the other ac amperes. The ranges selected seem best for radio-TV service work but other combinations may be used; for appliance repair, for instance. The wiring is almost a straight-through proposition from the line cord at one end of the small case to the convenience outlet on the other end. The voltmeter should be across the line on the input side so the ammeter measures only the external load. The ammeter may be inserted in either side of the line.

This unit measures power as the product of voltage and current (P = EI) for pure resistive loads such as heaters, broilers, toasters and coffee makers. For loads with a reactive component (inductance or capacitance) the EI product expresses volt-amperes rather than watts. To determine watts for a reactive load, the product of volts times amperes must be multiplied by the cosine of the phase angle (the power factor).

For all practical purposes, we can determine the wattage of any load by ignoring the power factor of the resistive loads previously mentioned since it is unity. Motor driven equipment such as vacuums cleaners, hair dryers and sewing machines can be treated the same way since their power factor will be around 0.99. Transformer-powered radio and TV receivers as well as the transformerless ac/dc types are handled by arbitrarily assigning them a power factor of 0.90 or 0.95. Thus, if we have a TV set which draws 1.5 amperes at 120 volts, we can figure that it is drawing 1.5 x 120, or 180 volt-amperes, and 180 x 0.95, or 171 watts.

Circuit of the instrument. Note that voltmeter is connected across input, the line on the input side so the ammeter measures only the external load. The ammeter may be inserted in either side of the line.

AEROVOS

Corporation

Distributor Division

New Bedford, Massachusetts

102

Radio-Electronics

Completed unit fits into 2 1/4 x 3 x 2 1/4inch case.

If it was rated at 150 watts, we can be sure some part of the circuit is working too hard. A filter capacitor may be getting leaky or a resistor has shorted or changed value, causing it to draw too much current or biasing a tube to overconduction. Too much heat is being generated somewhere and we look for a hot spot. Conversely, the set may be rated at 200 watts and we know that somewhere some circuit isn’t using its current allotment because of an open resistor, a nonconducting tube or something of the kind. The power reading doesn’t pinpoint the trouble but it does establish the category and can materially shorten the time required to locate the defective component. Many of the newer fact sheets give the power rating of radio and TV receivers as x amperes at 117 volts and the conversion to watts isn’t necessary.

Straightforward wiring makes assembly job a matter of minutes.

The advantage this unit has over its high-priced cousin the wattmeter? It measures line voltage and this you must always consider. Most electronic equipment is designed to operate over a moderate range of line voltage fluctuation. In many locations, however, the available voltage varies considerably. In rural areas and in some of the rapidly growing suburban developments, it’s not unusual to find a voltage shift of 25% or more. Many shrinking pictures and marginal performance difficulties can be traced to low line voltage with this little test box.
Remarkable New Precision Amplifier A-400

DRIVES 1 to 30 TV SETS

Performance and features never before available—Uses four of the new 6FY5 Neutro-electrode tubes (transconductance 13,000 MHOS). These new tubes have the extreme low noise characteristics of the latest triode RF tuner tubes with extra gain and stability normally obtained only with pentodes. Dual 75 ohm outputs, allows you to use two trunk lines right off amplifier if desired. 300 ohm balanced input with no strip disconnect plug and 75 ohm coaxial input. All parts operated well below maximum ratings for long, trouble-free life. Heavy-duty AC power transformer. Unit completely fused. Operates on 117 volt AC. 20 gauge cadmium luster plated chassis, blue-grey baked enamel, perforated steel cover. $79.95 list.

Try one, see the difference for yourself. Other amplifiers available for 1 to 4 sets, and up to 150 sets for Master System.


Winegard ANTENNA SYSTEMS
Everything from the Antenna to the Set
LIKE most summer months, new tube releases have run a little slow, but the few that did come through were interesting.

Entertainment types

We lead off with a vertical-oscillator output tube, continue with a note on when tetrodes may be triodes and end up with a tube for the hi-fi booster.

6HC8, 17HC8

These two triode-pentodes come in 9-pin miniature envelopes and are identical except for heater characteristics. The 6HC8 heater is rated at 1.2 amps at 6.3 volts. The 17HC8 at 450 ma at 16.8 volts. The tubes are intended for use as vertical deflection oscillator and amplifier in TV receivers.

The advance data sheet for the Sylvania 6HC8 and 17HC8 lists their average characteristics in vertical deflection use as:

<table>
<thead>
<tr>
<th></th>
<th>Triode Oscillator</th>
<th>Pentode Amplifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_T )</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>( V_G1 )</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>( V_G2 )</td>
<td>-3</td>
<td>-18</td>
</tr>
<tr>
<td>( I_B ) (ma)</td>
<td>1.4</td>
<td>38</td>
</tr>
<tr>
<td>( I_A ) (ma)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>( g_m ) (( \mu )hos)</td>
<td>2,000</td>
<td>5,100</td>
</tr>
<tr>
<td>( \mu )</td>
<td>68</td>
<td>8.7</td>
</tr>
<tr>
<td>( R_P ) (ohms) (approx)</td>
<td>34,000</td>
<td>55,000</td>
</tr>
</tbody>
</table>

The 7687 is a triode-pentode whose pentode section is particularly suited for preamplifier service while the triode is intended for use as a phase splitter. The 7687 features exceptionally low hum and noise. It is similar to the 7199 and is an improved low-noise version of that tube. Basing differs so the tubes are not directly interchangeable.

Characteristics of the Sylvania 7687 in typical operation are:

<table>
<thead>
<tr>
<th></th>
<th>Triode</th>
<th>Pentode</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_T )</td>
<td>215</td>
<td>220</td>
</tr>
<tr>
<td>( V_G1 )</td>
<td>-</td>
<td>130</td>
</tr>
<tr>
<td>( V_G2 )</td>
<td>-5.5</td>
<td>-</td>
</tr>
<tr>
<td>( I_B ) (ma)</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>( I_A ) (ma)</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>( I_A ) (ma)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>( g_m ) (( \mu )hos)</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>( \alpha )</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>( R_P ) (ohms)</td>
<td>7,200</td>
<td>500,000</td>
</tr>
</tbody>
</table>

Tetrode is a triode

When the 6ER5 was first announced it was called a tetrode. However, in the latest manufacturer's tube data, this has been revised and the tube is listed as a triode. This is what happened:

The original data called the tube a tetrode. However, the Electron Tube Industry Standards Group pointed out that the No. 2 grid was actually a shield and not an active element. As such the tube is properly classed as a triode. Also, the plate characteristic of the 6E55 is typically that of a triode. This same construction is used in the 6ESS, 6FH5 and 6FGQ5. These tubes are also classed as triodes.

Industrial types

We have an interesting tube with a split-plate tetrode section, a group of p-n-p-n silicon switches, a ceramic-metal uhf beam power tube and a few new notes.

6FA7

A diode, sharp-cutoff twin-tetrode in a 9-pin miniature envelope that is very useful in frequency-divider and complex-wave generator circuits of electronic musical instruments.

The diode and tetrode use a single cathode. The twin plates of the tetrode are on opposite sides of the cathode to minimize interaction between the electron streams from the cathode to each plate.

Maximum ratings of the RCA 6FA7:

Tetrode Unit

| \( V_A \) (volts) | 330 |
| \( V_B \) (volts) | 330 |
| \( V_C \) (volts) | 330 |
| \( I_A \) (neg bias) (ma) | 50 |
| \( I_B \) (pos bias) (ma) | 50 |
| \( P_A \) (watts) | 1.5 |
| \( P_B \) (watts) | 3.5 |

Diode Unit

| \( I_A \) (ma) | 1 |
| \( I_B \) (ma) | 1 |

7649

A ceramic-metal tube with perfectly aligned grids that is specifically designed for pulse applications where dependable performance under severe shock and vibration is essential. The small forest-air-cooled uhf beam power tube is used in grid-pulsed and plate-and-screen pulsed rf oscillator and amplifier service at frequencies up through 2,000 mc.
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- SIGNAL INJECTOR
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- PLIERS-CUTTERS
- ALIGNMENT TOOL
- WRENCH SET
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE (SQUIZZES)
- TELEVISION BOOK + RADIO TROUBLESHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE + FCC AMATEUR LICENSE TRAINING + PRINTED CIRCUITRY

ZEALING LESS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of troubles in home, portable and car radios. You will learn how to use the professional Signal Tester, the unique Signal Injector and the standard Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and earn fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have, in the use of our "Progressive Radio & Electronics Testers" and make money. The "Edu-Kit" paid for itself. I was ready to spend $26.95 for a Course, but I found your ad and sent for your Kit.

FROM OUR MAIL BAG

Ben Valerio, P. O. Box 21, Maption, Utah: "The "Edu-Kits are wonderful. I am sending you six questions and also the answers for them. I have been enjoying them very much. I have been experimenting with Radio Kits, and I like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tester works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Ralph L. Shult, 1544 Maine Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my "Edu-kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and electronic parts. My friends were really surprised to see me out of the way of it so quickly." The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

THE "EDU-KIT" IS COMPLETE

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world and is universally accepted as the standard in the field of correspondence in the progressive radio. This unique radio kit, the "Edu-Kit," uses the modern educational principle of "Learn by Doing." Through the kit, you construct, learn schematics, study theory, practice trouble-shooting—will in a closely integrated program devoted to provide an easy-to-learn, thorough and interesting background in radio. You have by examining the various radio parts of the "Edu-Kit." Then you learn the function, theory and wiring of the parts. Then you build a simple, single, with this first set you will enjoy listening to regular broadcast stations, tuning theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and technology. Gradually, in a progressive manner, and at your own pace, you will find yourself constructing more and more complex circuits, and daily work like a professional Radio Technician. Radio kits are twenty-resistant RECEIVER, Transmitter, Signal Generator, Signal Tracer, Square Wave, complete radio construction is "Printed Circuit". This circuit operates on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build 20 different radio and electronic circuits, each guaranteed to operate. Our kits contain tubes, tubs, sockets, variable, electrolytic, nics, capacitors and other diode components, resistors, for strip, coils, hardware, panels, chassis, and all parts of your own radio. You will receive all parts, tools, instructions, etc. Everything is yours to keep.

ORDER DIRECT FROM AD—RECEIVE FREE BONUS RESISTOR AND CONDENSER KITS WORTH $7

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Address

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SEPTEMBER, 1960

www.americanradiohistory.com
NEW JBL UTILITY ENCLOSURE FOR BUILT-IN SYSTEMS

"What's the best way to build a JBL Linear-Efficiency Speaker into a wall or cabinet?" This is the question most frequently asked of us since the introduction of the precision-made, long-linear-exursion, relatively-high-efficiency JBL loudspeakers. The answer is provided in the new Wilton systems. The Wilton is a minimum-volume acoustical enclosure for use with either the LE8, eight-inch, full-range, Linear-Efficiency Speaker (System D47LE8) or with the S5 two-way, network-divided Linear-Efficiency System (D47SS). It must be ordered with a system factory-installed; it is never available separately. The Wilton is an unfinished birch enclosure measuring 11\(\frac{3}{4}\)" x 23\(\frac{3}{8}\)" x 11\(\frac{3}{8}\)". The surface is sanded at the factory on four sides ready for finishing, and may be used as a free-standing enclosure either vertically or horizontally. You have your choice of either a flush-mounted grille for this use or an overlapping grille for custom, built-in installations. Using the Wilton is an excellent way to convert a piece of furniture into a components cabinet. For a complete description write for your free copy of JBL Bulletin SB1019.

JAMES B. LANSING SOUND, INC., LOS ANGELES 39, CALIFORNIA

NEW TUBES & SEMICONDUCTORS (Cont'd)

Maximum continuous commercial service ratings of the RCA 7649 are:

<table>
<thead>
<tr>
<th>Grid-and Screen-pulsed</th>
<th>Plate-and Screen-pulsed</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_g)</td>
<td>1,500</td>
</tr>
<tr>
<td>(V_{gs}) (peak pos)</td>
<td>750</td>
</tr>
<tr>
<td>(V_{gs})</td>
<td>-200</td>
</tr>
<tr>
<td>(I_g) (during pulse) (ma)</td>
<td>3,000</td>
</tr>
<tr>
<td>(I_g) (ma)</td>
<td>80</td>
</tr>
<tr>
<td>(P_{g_{in}}) (watts)</td>
<td>4.5</td>
</tr>
<tr>
<td>(P_{g_{out}}) (watts)</td>
<td>2</td>
</tr>
<tr>
<td>(P_{g}) (watts)</td>
<td>115</td>
</tr>
</tbody>
</table>

TI 010, TI 025, TI 050

Three 1-ampere 50-volt p-n-p-n diffused-silicon switches that have selected switching specifications. All come in a welded case and are ruggedized to meet military requirements.

Maximum ratings of these Texas Instruments semiconductors at 125°C:

| \(V_g\) (peak inverse voltage) | 50 |
| \(V_{gs}\) (forward voltage in off condition) | 50 |
| \(I_g\) (avg rect fwd current) | 300 |
| \(I_g\) (forward gate current) | 100 |

Switching specifications at 25°C:

| Max anode current for gate switching off (ma) | 10 | 25 |
| Max gate current to switch on (ma) | 5 | 10 |
| Max gate voltage to switch on | 1.5 | 1.5 |
| Max gate current to switch off (ma) | 5 | 10 |
| Max gate voltage to switch off | 5 | 10 |
| Max holding current (ma) | 5 | 10 |

Semiconductor briefs

Philco has begun marketing microwave coaxial MADT transistors in engineering quantities. The devices are said to have a power gain of 8 db when operating into a cavity under matched neutralized conditions at 1,000 mc.

GE announces a 47% price reduction for two lines of medium-current silicon controlled rectifiers and a 51% cut for a third line. This was made possible by widespread acceptance of the controlled rectifier in military and industrial applications which has lowered manufacturing cost per unit.

END
TV ANTENNAS. All-channel units eliminate side-lobe pickup, reducing co- or adjacent-channel interference. Models 707-6.

and 707-8 (shown) for local, medium and fringe-area reception, respectively. Technical Appliance Corp. (TACO), Sherr- burne, N. Y.

ANTENNA TOWER No. 55. Rigidity and strength in heights up to 450 feet, 10-foot hot-dipped galvanized sections constructed on 1½-inch triangular pattern—Rohn Manufacturing Co., 6718 W. Plank Rd., Peoria, Ill.

BOOSTER for single TV channel mounts on antenna mast. Model CB, 15 to 17-db gain on 700-ohm input, 75-ohm output. Built-in power supply—Blonder-Tongue Laboratories, Inc., 9 Alling St., Newark, N. J.


TWIST-TAB CONTROLS model 77. It takes from 200 ohms to 7.5 megohms. Short shaft used in hidden TV con-}


trols. Polyethylene shaft extension. 15-watt rating, 15/16"-inch diameter, 7/16"-inch depth. —Centralab, 900 E. Keefe Ave., Milwaukee 1, Wis.

CRT TESTER and reactivator model 660 handles black-and-white and color tubes. Checks emission, shorts, leakage, opens. Burns out shorts, rewelds, opens.

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OMMETER model 269 covers 0-20,000, 0-20,000 ohms, 0-2 and 0-20 megohms. Zero-adjust control on side of case. Triplett Electrical Instrument Co., Bluffton, Ohio.


STEREO CHANGER model 1007. Handles up to 10 records. Moisture-proof crystal cartridge. Response 20 to 16,000 cycles: 20 to 10,000 cycles:+ 1/4 db. Output 0.4 volt. 1/4" wire with magnesium input adapter (both at 5 cm/sec). Eliminates center-hole chipping with "elevator-action" spindle. 4 speeds; intermediate idlers of different sizes rather
NEW PRODUCTS (Continued)

than stepped motor shaft—Electronic Instrument Co., Inc. (EICO), 38-00 Northern Blvd., Long Island City, N. Y.

STEREO CARTRIDGE model MBD for record changers. Response 40 to 15,000 cycles; channel separation at 1,000 cycles, more than 20 db. Tracking force .5 to .8 grams. Vertical and lateral compliance 3 x 10^-4 cm/-.


dy. Output voltage 5 mv per channel. Recommended load impedance 47,000 ohms. Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill.

PICKUP ARMS Micropointec Model S-240, 12 inches; S-260, 16 inches. Permanently attached cable has two color-coded plug-in leads, shields, ground wire. Gimbal have twin 5-ball 1-mm


RECORD PROTECTOR, Se-

lecto allows needle to be placed lightly anywhere on the record.

Small brush sweeps dust out of grooves ahead of needle.—Duo-
tone Co., Kenport, N. J.

BOOKCASE in unfinished birch holds hi-fi components, books and records. Model 10 60% inches high, 26 inches

wide, 12 inches deep. —Homewood Industries, 26 Court St., Brooklyn 1, N. Y.

FM TUNER model S-8000 III. Inverse feedback improves re-

sponse, lowers distortion. Space on chassis for plug-in multiplex adapter. Sensitivity 0.95 mv for

20-db quieting. 1.8 mv for 30 db. Response 20 to 20,000 cycles ± 1/2 db. Hum and noise — 60 db. Has automatic noise aqulture. Mutting eliminates hash.—Sher-

wood Electronic Laboratories, Inc., 4300 N. California Ave., Chicago 18, Ill.


Tuning meter may be used for level indicator when tapping off air. Noise suppressor. If bandwidth — 6 db at 200 kc. 2 amplifier, 2 recorder outputs.—Fisher Radio Corp., 21-21, 44th Dr., Long Island City 1, N. Y.

SPEAKER SWITCH No. 1496. Either main or remote or both pairs of stereo speakers may be used. Supplied with knob and

instructions.—Centralab, 900 E. Keefe Ave., Milwaukee 1, Wis.

COAXIAL SPEAKER. Improved version of model 8201. Response 28 to 15,000 cycles. Built-in 2,500-cycle crossover. Handles 35 watts. Brilliance control on 5-foot cable. Impedance 8-16 ohms.—University

of California.

Speaker Switches for home recording—12-foot cable. Model 820C (Ceramic): output level — 60 db. Model 824X (crystal): output level — 64 db. Both response 60 to 10,000 cycles. Desk

stand and lavalier assembly.—Turner Microphone Co., 909 17th St. N. E., Cedar Rapids, Iowa.

TAPE HEAD for 4-track record and playback. Right- or left-hand mounted. Response 15-

000 cycles at 3 4 ips with standard compensation. Meets

dimensional requirements of EIA.—Fidelitone, Inc., 6415 Ravenswood Ave., Chicago 26, Ill.

FROM TURNER...QUALITY MICROPHONES FOR EVERY APPLICATION

Model 210

FOR BROADCAST AND HI-FI RECORDING

Crisp, clean sounds; vivid, high-note sounds... all reproduced faithfully — just as you hear them. Every subtle shading picked up without distortion. Has excellent suppression of unwanted background noise. Superior sensitivity and very high frequency range make the Model 210 ideal for monaural and stereo taping. The 210 Dynamic is electrically phased. Non-
directional pattern to 2,000 cps, be-
comes somewhat directional at high frequencies. Response: 40 — 20,000 cps. Level; 50 ohm — 86 db, 200 ohm

— 80 db (—59 db Ref Hi Z). Complete with 20-ft. rubber covered three conductor shielded cable. High im-

pedance models also available. List Price $125.00.

The Turner Model 95D dynamic combines beautiful styling with good performance and economical price. Has high impedance wired single ended (single-conductor shielded 20-

ft. cable). 50 and 200 ohm models wired for balanced line. Response; 100 — 10,000 cps. Level; — 58 db. List price $37.50. List price with on-off switch $41.00.

Model 95D

FOR AMATEUR USE

Model 95D

FOR MOBILE USE

Ideal hand-held mike for mobile communications. Clear voice repro-
duction. Designed to fit hand com-
fortably with switch in normal grip. Zinc alloy case in permanent satin chrome. The Turner Model SR90D is furnished with hook for hanging and bracket for wall or dash mount-

ing. Response; 200 — 10,000 cps. Level; — 45 db at high impedance. 11" (retracted) shielded Koiled Kord. List price $42.50.

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www.americanradiohistory.com
NEW PRODUCTS (Continued)

RIGID CHANGER COVERS. Heavy plastic on collapsible metal frame. Models CC-6 white; CC-7, brown; CC-8.

POWERPAGE model PP-1T. 25-watt transistor PA system. One push button with microphone depressed, music level reduced 6 db so dubbed voice can be heard. Leather carrying strap.—University Loudspeakers, Inc. 80 S. Kensington Ave., White Plains, N. Y.

2-WAY RADIO TEST SET Model 500 combination crystal checker, crystal-controlled rf signal source, field-strength indicator, monitor and transmitter tuning and loading aid. Self-contained and portable transceiver. Checks activity of fundamental and overtone type crystals, supplies unmodulated rf for checking receiver squelch action, modulated rf for peaked receiver circuits. May be modulated by external source. Transmitter modulation can be checked on meter and phones. 2½ x 3 x 6½ in., 1½ lbs. Supplied with battery and 15-foot remote cable.—Seco Electronics, Inc. 8015 Penn Ave. S. Minneapolis 19, Minn.

TRANSCIEVER kit for Cit-izens band. Kit-Kit C-27. Crystal-controlled or tunable dual-conversion superhet receiver. Sensitivity (tunable) 1 µv, crystal-controlled 0.5 µv.


Input power 5 watts. Noise limiter and squelch. High-impact styrene case.—Allied Radio Corp., 100 N. Western Ave., Chicago 90, Ill.

An, squelch, panel-mounted speaker, slide-rule dial. Built-in 117-volt ac and 12-volt dc power supply. 20 lbs.—Gonset Div., Young Spring & Wire Corp., 801 S. Main St., Burbank, Calif.

TRANSCEIVER for 6-meter amateur band. Built-in vfo, Mobiline Six either mobile or fixed. Power supply 117 volts ac, 12 or 6 volts dc. 20 lbs. Final amplifier 2226 rated at 20 watts input. Built-in squelch.—Globe Electronics, 22-30 S. 34 St., Council Bluffs, Iowa.

ADJUSTABLE WRENCH. Jaws lock in any position. Select-O-Lock series in sizes from 4 through 12 inches.—Utica Drop Forge & Tool Div., Kel-sey-Hayes Co., Utica 4, N. Y.

LOOP WRENCH, Persuader, turns round objects without scratching. Loop material will not soak up grease or oil. 4- and 5-inch loop sizes.—Long Industries Inc., 15 N. Madison St., Chilton, Wis.


FLYBACK TRANSFORMERS, Exact replacements. Models HO-309, HO-310 (shown), HO-311 replace Emerson Nos. 738138 (A), 738142, 738155, respectively.—Chicago Standard Transformer Corp., 3501 Addi- son St., Chicago 18, Ill. END

All specifications on these pages are from manufacturer's data.
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to encourage the "illegitimate" part-time and the "tube-jerk." As to how to determine fair charges—that is up to the individual. The shop's overhead must be taken into account as well as what a technician would consider a fair standard-of-living return (comparably to a similar profession).

Mr. DeFranco goes on to say that it is the responsibility of all concerned to intelligently explain to the consumer what shall be determined by each as a fair charge according to their technical knowledge, etc. This can and should be accomplished by mass consumer education (locally and nationally), he says.

"This should be undertaken by groups in other sections of the country. With so many concentrated publicity, this business might be placed on the higher plane where it belongs," he says.

**FORM COUNCIL**

A new group, the Washington State Electronic Council, has been formed by delegates from several sections of the state according to TASA Service News. Mr. Verne Slichter was elected chairman; Dean Thompson, vice chairman; and Ansel Heckman, secretary-treasurer.

The bylaws call for semi-annual meetings with other meetings as necessary.

Each local association will have two delegates to the council (two votes). Where no local associations exist, individual council members, one each from those areas, will have one vote. Reports given by delegates at the first meeting indicated that all areas in the state [and most of the country. —Editor] are bothered by the same problems:

Retailing "distributors" who sell to everybody; illegal operators who pay no taxes; do-it-yourself tube testers (sometimes stocked with used or reject tubes); captive price, and the price-cutting untrained opportunists.


tubers at the meeting, the council adopted a resolution to introduce a licensing bill into the State Legislature in January.

**APPLIANCE TECHS ALSO**

The TV technician has long believed that he has been singed out from all the repair: fringe to bear the brunt of the customer's complaints of bad service, incompetence and sharp business practices. He is apparently not entirely alone. A group of appliance service dealers in the Long Island (N.Y.) area have formed the Association of Home Appliance Service Companies.

Mr. Jack Averbuch, head of the association, says the group was formed to combat the bad image the public has of technicians and eliminate petty bickering among the firms.

While most of the shops handle appliances only, one or two of them do some TV service work. According to Mr. Averbuch, the association and the Radio-TV Guild of Long Island may get together for cooperative advertising to try to improve public opinion of technicians in general.

The association also hopes to set up a service training school, get manufacturers to hold clinics in the area and set up a consumer charge plan. They are negotiating with a local bank to handle the plan at a cost of 1 1/2% of the total charge. The group represents

**SOUND OFF:**

Since August, 1959, RADIO-ELECTRONICS has been publishing a list of a technician's service associations. The areas covered so far (in the order they happened) are: Pennsylvania, New York, Ohio, North Carolina, Kansas, Arizona, Michigan, California, Ontario (Canada), Massachusetts, Mississippi, Michigan, Oregon, and Texas. Sometime in the near future, depending on when we complete the individual area lists, we will reprint the entire list in one issue. Will those associations whose officers are no longer as listed, please give us the names of the new secretaries and presidente, and changes of address or other useful information?

We cannot list a state (or area) unless the association has itself shown its existence know. If your group has not yet been listed, please send us the names and addresses of the officers and the association. Please indicate which officer is to be contacted by potential members.

To list an association or to find out the name of the one nearest you write to: Associations Editor, RADIO-ELECTRONICS, 154 W. 14 St., New York, N. Y.

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Overhaul charge includes labor and minor parts; tubes and major parts are extra at net prices. Tuner to be overhauled should be shipped complete; include tubes, shield cover and any damaged parts. Quote model and state complaint. Pack well and insure.

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IMPEDANCE 8 ohms
DISPERSION 120°
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See the WT-6 at your local distributor. Send for catalog RE-

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TECHNICIANS' NEWS (Continued)

about 14 companies or about 100 technicians.

One idea used by association members might be adaptable by TV service associations. If a technician needs a replacement part and is quite a distance from his shop, he can pick up the part at the nearest member shop and charge it to his shop.

FIRST LADY

The Radio Television Technicians Association of California, Inc., Pasadena Chapter, now has its first lady member, Mrs. Frances Sheppard of Sheppcraft Electronics. She is one of the several technicians who have joined up since the start of RTTA's membership drive, "60 in 60."

WARNING

NATESA Scope warns that it is possible for a customer to get a dangerous shock when using a transistor-radio battery charger. When selling one of these units, be sure to instruct the customer to insert the line plug after the battery is in place and remove the plug before removing the battery.

HELD COURSE

Tired of sitting around, complaining about their problems and doing nothing, Dayton Area TESA (Ohio) organized a course on business management, says TESA News (Dayton Area). The course was conducted by Dr. John K. Pfaul, associate professor of business administration at Ohio State University. Dr. Pfaul prepared the General Electric Co.'s profitable service management course.

The course was sponsored jointly by Dayton Area TESA and SREPCO, a local distributor. It was held in four parts, one each Wednesday evening in July.

CHECK THOSE LEAD-INS

A live cabinet or lead-in can be dangerous. Edgar G. Shelton Jr., an ABC vice president, received a full-line-voltage shock while cleaning leaves out of a copper rain gutter on his house.

A short in his TV had applied line voltage to the antenna lead-in which apparently shorted to the gutter.

Always use a meter or neon tester to check for a live cabinet or lead-in as the last step before handling the customer your bill. A set that is "cold" at the shop may be "hot" when plugged in at the customer’s house (insulators have been known to break and tuners to shift).

It takes only a few seconds to make this check and it may uncover a dangerous situation. As a final precaution on ac–dc sets, make sure the line plug is in the socket in such a way as to keep the chassis a ground potential.

CHAPTER OFFICERS

The San Fernando Valley Chapter of California State Electronics Association (CSEA) has elected Ernest C. Larsen, president; Conrad Breil, vice president, and Ed Stevens, secretary-treasurer.

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Remember that twin-coupled amplifier in the November 1957 issue of Radio-Electronics? Thousands of readers built it—and many hundreds of them asked for a more powerful version. Here it is—a 35-watt job using EL-34’s. Printed circuit boards are available to make it easier to build.

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The TV screen itself often gives you the clue to pinpointing troubles in vertical deflection circuits. Here is how to interpret them—along with some timely tips on the vertical multivibrator and output stages and how to troubleshoot them fast.

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Ever lose a model plane or boat that strayed too far off the beam? Never again if you build this hefty (30-watt) little R/C unit that uses the new Citizens Radio class-C control regulations. No license exam needed either.

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Lightning does strike twice! Especially at high TV towers or masts. Here’s how to save lives and property by making TV antennas a protection against, instead of a welcome to lightning. Proper installation is the answer.

ONE TRANSISTOR OPERATES 8-INCH SPEAKER
Dr. Grace’s latest transistor radio brought in stations at loudspeaker volume in a New York apartment! And it’s so easy to build and operate.

RADIO-ELECTRONICS — the complete, accurate, and timely magazine for service technicians, electronic experimenters and engineers, hi-fi fans and industrial technicians. It’s the liveliest-reading magazine in the field.

SUBSCRIPTION RATES
1 year $4.00 2 years $7.00 3 years $10.00 Rates go up to $5, $9, $12 after October 31st Subscribe now
Sylvania Phono Model 4312

A couple of these sets came into the shop with the same complaint—there wouldn't work. In each set one of the series-string heaters was open. Upon replacing the bad tube, the sets still wouldn't work. A check showed burned-out silicon rectifiers, no B-plus. Replacing the rectifier with a 150-ma selenium unit put the phono back into operation.

What had been happening was described in a Sylvania Service Digest. If the receiver was on when the tube burned out and was then turned off, the collapsing field produced by the phono motor would kick back across the rectifier, shorting it out. Ordinarily, the load of the heater string damps the kickback but, when one tube's heater is open, there is no longer any such protection. The 150-ma selenium rectifier used as a replacement has a higher inverse voltage rating and is not damaged by such a kickback.—C. S. Lawrence

G-E 17PI330

Complaint: Poor vertical blanking. Shows up as faint white retace lines in the picture.

This trouble can be corrected by replacing R221, 47,000 ohms, with an 82,000-ohm resistor. As changing R221's value results in a dc voltage change in the circuit, resistors R182 must be changed from 1.2 to 4.7 megohms and R180 should be changed from 1.2 to 2.2 megohms.—Al Black

TAPE-RECORDER WOW

I have found that tape-recorder wow problems are often caused by power-consuming appliances such as electric toasters, irons, refrigerators and stoves. The heavy current drawn by them causes the line voltage to fluctuate. This in turn makes the recorder motor wow.

Since it is virtually impossible to

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TECHNOTES (Continued)
predict when such appliances in the neighborhood are going to be turned on or off. I find that countermeasures must be taken at the recorder to minimize or eliminate the trouble. Connecting a constant-voltage transformer or voltage regulator between the power line and the recorder input will often correct or minimize the distortion.—John A. Com- 

FM INTERFERENCE

Frequency-modulation interference shows up as diagonal bars or a herringbone pattern on the picture tube. A direct FM signal overloads the TV set's tuner, creating cross-modulation which can fall on any TV channel.

A second harmonic of an FM signal falling on a high-band TV channel can do the same thing. It is also caused by an FM station on an image frequency of a low-channel TV station.

To stop this type of interference, carefully adjust the FM trap in the receiver to attenuate the interfering signal. In severe cases, an additional trap may be needed. Details of such a trap—designed for installation in the transmission line—are shown in the diagram. The trap should be tuned to the interfering signal and installed at the antenna input.—C. S. Lawrence

CORONA CURE

Several TV receivers have insufficient clearance between the 1B3-GT high-voltage rectifier cap and the top of the high-voltage cage. Corona or arcing results (especially in damp weather) which is hard to cure with corona dope. A sure cure for this condition is to replace the 1B3-GT with a 1G3-GT. The 1G3 is electrically identical to the 1B3 but more than 1/4 inch shorter. This additional clearance will completely eliminate any corona or arcing from the high-voltage rectifier plate cap.—Albert J. Krukowski

PHILCO P5703

This hybrid auto radio came into the shop with a complaint of no sound. A burned-out fixed bias resistor (0.27 ohm) in the audio output stage pointed to the trouble. An ohmmeter check showed that the AR-6 transistor used in this stage had failed. (Forward and reverse resistance were approximately the same.)

The fun began when the distributor

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TECHNOTES (Continued)

did not have an AR-6. The AR-8A he substituted was the pin type; the original has coded, flexible leads. Fortunately, the heat sink had been drilled to take either type, so mounting was no problem. Some clips that came with a phono cartridge fit snugly on the transistor pins and made good connectors. I cut the leads close to the original transistor and removed and discarded it. Then I soldered one clip to the yellow (emitter) lead and one to the black (base) lead. The red (collector) lead I eliminated as the case of the pin type transistor is the collector and is automatically connected to the heat sink when mounted. (The heat sink on this model is isolated from chassis ground.) After replacing the 0.27-ohm fixed bias resistor, I mounted the new transistor, first noting carefully which pin was marked B(base) on the case. To this pin I connected the black lead. The yellow lead I connected to the remaining (emitter) pin. Be careful not to push the clips so far down on the pins that they short to the heat sink and ruin the transistor.

Collector current should be adjusted for 750 ma. Connect a voltmeter between the heat sink and chassis and adjust collector current for a .75-volt drop across the output transformer primary with no signal and 14.0 volts input.—Chase Base

CORRECTIONS

There are two errors in the article on the subminiature tape recorder beginning on page 76 of the July issue. The diagram of the record amplifier at the bottom of page 77 is Fig. 4, not Fig. 5 as indicated in the caption. On page 78, fifth line of the third column, change C10 to C11.

Our thanks to N. M. Haynes, Amplifier Corp. of America, New York, N. Y., for calling these errors to our attention.

The transformers are labeled incorrectly in the photo of the Super Eight radio on page 44 of the August issue and do not agree with the schematic and parts list. To correct the photo callouts, change L1 to T1, L2 to T2, T1 to T3, T2 to T4, T3 to T5, T4 to T6 and L5 to T7.

We thank Mr. William J. Studlez, of Milwaukee, Wis., for this correction.

Just a few changes I made in my radio pill.

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September, 1960

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Rad-Tel Tube Co.

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Newark, N. J.

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Bi-Pass Condensers

Over 50% are 600V

at LESS THAN $ .95 each

Goodall Semi-Molded Paper and MYLAR

Made up of approx.

16-200V, 20-400V and

64-600V.

Values .001 to 1 mf

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64-600V.

Values .001 to 1 mf
Alertness can be measured by checking the time lag between a given stimulus and the corresponding response from an individual. It is an important factor for airplane pilots or persons doing monotonous or fatiguing work. A definite relation between alertness and certain bioelectric potentials within the body has been found by the inventors. These occur at frequencies above 40 cycles and can be measured through metallic contacts placed on the forehead.

Fig. 1 shows how muscle potentials vary with alertness. When alertness is low (when a person is tired or drugged), there is considerable time delay between stimulus and response. The energy generated at certain muscles is very weak. When the individual is alert, the energy pulses are much stronger.

A block diagram of this invention appears in Fig. 2. The muscle signals are amplified, filtered to remove frequencies below 40 cycles (which
are mainly brain waves) and rectified. An evalu-
ing network integrates the pulsed energy to
measure the average alertness over a predeter-
ned period. When alertness falls below a criti-
cal point, trigger tubes are generated to operate a
relay and sound an alarm.

ULTRASONIC SYSTEM FOR MOTION STUDY
Patent No. 2,914,730
Gerald N. Nadler, Olivette, and Jay N. Goldman, Richmond Heights, Mo.

Doppler effect is the shift in frequency when a signal source moves toward or away from an
observer. For example, the sound of a siren seems higher when it is approaching than when
receding.
The effect is used here for time and motion study. A tiny ultrasonic sound source is at-
tached to the hand of a worker to analyze his
motion. This sound is received by three micro-
phones along perpendicular axes. The sound is
converted to voltage and recorded. From the
change in pitch, it is possible to determine in-
stantaneous hand velocity.
Actually, the ultrasonic frequency (20 kc) is
mixed with a local frequency (91 kc) before it
is analyzed. Thus the shift is relatively large
compared with the base (1 kc). A Doppler chan-
ge of 186 cycles is observed for a velocity of
10 feet a second.

STABLE OSCILLATOR
Patent No. 2,930,002
Norman E. Edwards and Anthony W. Muonio Haddonfield, N. J. ( Assigned to Radio Corp. of
America)

This circuit is so stable that it shows less
than 1 cycle variation when various transistors
are used. Also no frequency change occurs when
voltage is varied over a wide range.

The following table shows suggested values for
C1 and C2.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Value</th>
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<tbody>
<tr>
<td>below 75 ke</td>
<td>940 pF</td>
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<tr>
<td>above 75 ke</td>
<td>470 pF</td>
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</tbody>
</table>

TRANSISTORIZED THERMOSTAT
Patent No. 2,932,714
John B. Merrill, Rochester, N. Y. ( Assigned to General Dynamics Corp., Rochester, N. Y.)

This heat regulator uses a pair of transistors. V2 should be a high-power transistor.

At lower ambient temperatures, V1 has nearly
zero leakage current so V2's base is at ground
potential. This transistor conducts heavily and

considerable current passes through heater coils
R2 and R3. At higher ambient, V1's greater
leakage current biases V2 to lower its conduc-
tion. Thus R1, R2 temperatures are lower to
compensate for the higher ambient.

When R1 is properly adjusted, the heater coils
are maintained at nearly constant temperature.
They may be used to regulate the temperature
of a transistor (see R2 alongside V1) or any
other device.

HONEST—I'M HONEST!
By Phyllis Barlow
She said she wouldn't pay her bill.
Her reason had me floored.
She said she heard me plainly say,
I'd used a "cheater cord!"

For the discriminating audio enthusiast who is
searching for high quality at a moderate cost, the new
PILOT "lge" Stereo FM/AM Tuner-Preamplifier-Amp
is a most logical choice. Here is extreme FM sensitivity—
assured by the Amperex 6A8/Q/ECC85 dual-triode. To
reduce hum and noise to complete inaudibility (and to
prevent microphonics)—5-12AX7/ECC95s. For precise
and effortless tuning—the 6F6G/EM84. For distortion-
free power—4-6BQ5/EL84's. For absolute dependable—
Amperex throughout!
These and many other Amperex 'preferred' tube types
have proven their reliability and unique design advan-
tages in the world's finest audio components.
Applications engineering assistance and detailed data
are always available to equipment manufacturers. Write:
Amperex Electronic Corp., Special Purpose Tubc Divi-

AMPEREX TUBES FOR QUALITY HIGH-FIDELITY AUDIO APPLICATIONS

POWER AMPLIFIERS
6CA7/EL34: 60 w. distributed load
7218; 20 w. push-pull
6B6S/EL84: 17 w. push-pull
6CW5/EL86: 25 w. high current, low voltage
6BM4/ECL82: Triode-pentode, 8 w. push-pull

VOLTAGE AMPLIFIERS
6247/6E46: Pentode for pre-amps
12AX7/ECC81: Twin triodes, Hw
12AT7/ECC82: hum, noise and
12AX7/ECC83: microphones
6F8A/ECF80: High gain, triode-
Pentode, low hum, noise and
microphones

RF AMPLIFIERS
6ES5: Frame grid twin triode
6ERS: Frame grid shielded triode
6E47/E183: Frame grid pentode
6E57/E184: Frame grid pentode
6A28/ECC85: Dual triode for FM tuners
6GB/EBF85: Duo-diode pentode

RECTIFIERs
6Y4/EZB0: Indirectly heated, 50 mA
6GA6/EZB1: Indirectly heated, 150 mA
6A9A/6Z5A: Indirectly heated, 250 mA

INDICATORS
6F6G/EM84: Bar pattern
IM3/D707: Subminiature "excita-
tion" pattern

SEMICONDUCTORS
2N1517: RF transistor, 70 mc
2N1516: RF transistor, 70 mc
2N1515: RF transistor, 70 mc
2N1542: Matched pair discriminator
diodes
2N17A: AM detector diode, subminiature

STAMP OF APPROVAL
A mail-order tube advertisement in RADIO-ELECTRONICS is
its own stamp of approval—your assurance that you will get
what you pay for when you order. Since January, 1936,
RADIO-ELECTRONICS has insisted that mail-order tube adver-
tisers tell you that their tubes are new and unused, or,
if they're not—that they are seconds, rejects or otherwise imperfect.
Over the years this has cost us thousands of dollars in adver-
tising—but it has protected you.

FREE! CATALOG OF HI-FI, RADIO, TV
PARTS & ACCESSORIES—yours for the asking!

Look no further . . . If you're searching for hi-fi sav-
ing, Write us your re-
quirements now.
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10A Liberty St., N.Y., N.Y.
Clovisdale: 8-4288

Vidaire ELECTRONICS MFG. CORP.
44 Church St. • Braidwin, N. Y.
NEW PATENTS (Continued)
TRANSPORT AMPLIFIER

This three-transistor circuit is an unusual amplifier. It has a single-ended

input stage followed by a class-B output stage. This arrangement

needs no output transformer and the

harmonic distortion at this output is

10% -- RCA Transistor Data Sheet
NOTEWORTHY CIRCUITS (Continued)

But for a successful service job, the customer's cost must also be kept in mind. If reception (noise-free) is too expensive, a lot of people just won't use their radios, and others may decide to endure the noise. This definitely means the simplest and lowest-cost filter circuits should be the ones that you try first.

Fig. 1 shows a variable filter system used with a rotary double-deck switch. By changing the setting of the switch and connections, six types of filters can be used (Fig. 2) to find which is the best cure for the interference present. The components for this variable filter unit can be bought at your local electronic parts distributor. All the capacitors in the circuit should be rated at not less than 600 volts. The choke coils should be able to handle at least 6 amperes. This unit is connected to the ac line. Use an insulated case and make sure the switch shaft is not hot. The alligator clips must be insulated and handled with care.

I mounted this simple circuit in a small wooden box with a clear plastic top. Single chokes, capacitors and filters can be obtained by using one lead at A and one at C or G. When using capacitors alone, always start with the lowest capacitance. Increase the capacitance to 1 µf before using the chokes.

—George E. Lytle

END
TRY THIS ONE

TEST-LEAD EXTENSIONS

Here are three wire extensions that are useful with telephone-type test probes. I formed the ones I made from plastic-covered bell wire but any insulated No. 20 or No. 22 solid-copper wire may be used. Bend a hook on the end of one (Fig. 1) and it can be hung on leads and socket lugs. Leave 1/4 inch of bare wire extending beyond the spaghetti (Fig. 2) and it is handy for taking readings down under a jumble of wires in some "New York Subway" chassis. Fig. 3 shows an extender that has its end bent into a clip.

The prod tip against the spaghetti of the extender holds the extension firmly in place but it's better to put a rubber band over the prod tip and pig-tail of the extender to be sure.—Frank W. Dresser.

HOME-MADE CABLE CONNECTORS

When a plug and socket connector of the seven- or nine-pin variety is not readily available . . . you can make one out of two miniature sockets and an ordinary paper clip. Cut the clip into 1/2-inch lengths, insert in the tube end of one socket and solder in place. This makes the male plug. The other socket of course is the female connector.—J. Simrin

DOUBLE CLIPS ARE USEFUL

I have found that, by fastening two ordinary test clips together, they can be made into "twin-clips" and their usefulness around the shop greatly improved. They can be used for making fast temporary connections, for increasing or decreasing the value of components by connecting them in series or parallel, or for clipping a test prod to a wire or terminal. I often use the clips to hold a part reminder or note to a chassis.

To fasten two clips together, simply cut off the wire supports at the rear of each clip, remove the screws and use...
just one screw to fasten both clips together. Twin clips are also sold commercially, but are not always obtainable.—Albert Mayor

(TRY connecting them with about an inch of flexible wire between clips—much more versatile.—Editor)

LIQUID METAL ANCHORS WIRE
When you need some sort of clamp to keep a long insulated wire positioned correctly, Duro plastic aluminum or steel can be used as liquid metal for making a clamp. Apply the liquid to the wire and to a spot on the chassis as shown. The liquid will dry metal-hard and hold the wire securely in place.

—James C. Conrad

CRT CLEANING AID
Many TV house calls are for a familiar trouble—a dim picture due to a heavy coating of dirt on the CRT and safety glass. Most technicians rely on the customer to provide the cleaning materials for this job, but all too often none are readily available.

I solved this problem by equipping my tube caddy with a plastic spray bottle, such as used for deodorants, filled with a 10% solution of ammonia and water. The tops of most spray bottles are easily removed for quick filling. This handy applicator makes the job of cleaning CRT's and safety glass an easy job.—A. J. Krukowski

MOUNTING SPEAKER TRANSFORMERS
When you fit a new output transformer onto an old speaker, the mounting holes are rarely in the same place and, if you are not careful, you can spend a lot of time getting it on firmly. Stop fiddling around with it. Cut a narrow strip of metal just long enough and wide enough to cover the trans-
TRY THIS ONE (Continued)

former mounting lugs. Drill two holes to
match those on the replacement
transformer. Now slip the metal strip
through the square mount at the back
of the speaker and mount the trans-
former on top, securing it with two
small nuts and bolts. The sketch is
easy to follow.—Thomas Crowe

SOLDERING AID
You can hold a wire still while you tin its tip by using a spiral of solder
wrapped around a heavy tool such as
a pair of pliers. Small parts can be
held the same way. Try this "second-
hand" idea sometime.—Joe C. Allen

PARTS SUBSTITUTION IN DOGS
When working on an exceptionally
tough "dog" where the only recourse is
to change parts one after another until
the bad one is tagged, I use a simple
method to keep track of what's going
on. On a blank piece of paper I sketch
in the base diagram of the tube in the
circuit in question and then draw each
component as it is checked. In this way
I know that each part that has been
drawn in is known good and all missing
components are still in doubt.—Frank
A. Salerno

END
Sweet Deal

Cornell-Dubilier Electronics Div. announced another in its series of special 50th anniversary dealer-service-technician capacitor promotions—the CDE Sweet Deal kit made up of 45 minia-

turized dipped silver-mica capacitors housed in a clear plastic compartmented dispenser. Dave Prepon (behind counter) of Aaron Lippman & Co., Newark, N. J., explains the Sweet Deal offer.

JFD Electronics, Brooklyn, N. Y., is offering dealers a new wrought-iron merchandiser for its exact replacement TV antennas for portable and tote-able receivers.

Pyramid Electric Co., Darlington, S. C., designed a new Capac-o-mat storage and display rack for parts distributors.

It holds 54 electrolytic twist-mount capacitors packaged in transparent Vupaks.

Lt. Col. John F. Rider, USA (ret.), received a bronze plaque for outstanding service in World War II and for his contributions to the American way of

SEPTEMBER, 1960
Install hi-fi systems to make money? Want the best system in the neighborhood? Either way this book can help you. The writing team—an audio technician and a professional furniture designer—touch all the basic problems facing both audiophile and professional hi-fi technician. They consider both stereo and mono systems, weigh the advantages of different types of tuners, pick-ups, tone arms, turntables, changers, preamps and amplifiers for specific jobs. They outline standards for speaker and enclosure selection, show you how to eliminate noise and interference, and even discuss effects of temperature and climate. The chapters on cabinet construction, design, and installation for best acoustic and aesthetic effect can save you many many times the price of the book in avoiding costly errors—or correcting mistakes already made.

Both professional technician and casual audiophile will turn to this reference again and again. It belongs in every hi-fi specialist shop and every home that boat's a hi-fi system.

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- New books are released about every three months. You receive these automatically. Of course, you may cancel any time after you have accepted four books—no time limit.

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STEREO—HOW IT WORKS—By Herman Burstein. All about stereo—what it is. What it can do. What it can't do. Warnings about pitfalls. Covers everything—from fundamentals to installation and advanced techniques and applications.

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Audio Measurements
Audio Design Handbook
Elements of Tape Recorder Circuits
Maintaining Hi-Fi Equipment
Understanding Hi-Fi Circuits
Basic Audio Course

Deluxe gold-stamped cloth bound edition $5.00

BUSINESS AND PEOPLE (Continued)

Javex Electronics, Redlands, Calif., is offering dealers a compact rubber-suctioned revolving counter rack for its line of antenna accessories, wall outlets, switching attenuator plates and similar accessories. It holds 16 items.

Edward E. Bauer joined Aerovox Corp., New Bedford, Mass., as vice president and general manager of the New Bedford Div. He comes from General Electric where he was general manager of the Irmo, S.C., capacitor plant.

Harold A. Goldsmith, co-founder of Magnetic Amplifiers, Inc. recently merged with Siegler Corp., was appointed president of Bogen-Presto Div. of Siegler Corp., Paramus, N.J.

Ray D. Barr joined Globe Electronics, a division of Textron Electronics, Council Bluffs, Iowa, as vice president and controller. He had been with Carpenter Paper Co.

Albert Coumont was appointed sales manager of Sprague Products Co., North Adams, Mass. He joined the company in 1956 as assistant to the president. He will
be responsible for management of field sales. Harry Kalker, president, will continue as chief executive officer with responsibilities for setting corporate policies and internal management.

R. R. Forbes was appointed manager of the Semiconductor Dept. of P. R. Mallory & Co., Elk-on Div., Du Quoin, III. He had been sales manager of the division.

Donald Gorham joined Vocaline of America, Old Saybrook, Conn., in a technical position in the Electronics Products Div. He had been senior calibration technician with Avco Lycoming Missile Div.

Rene Neppvangera joined Electrosonic Laboratories, Inc., Long Island City, N. Y., as director of Engineering. An audio pioneer instrumental in the development of the LP record, he was most recently with Fairchild Recording Equipment Corp.

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Versatile MULTITESTER KIT

for laboratory, service shop and amateur use


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WITH STAGE-BY-STAGE ASSEMBLY AND CHECK SYSTEM

Unique ARKAY tuner kit permits checking of each stage as it is finished. Modern slimline chassis. Five separate controls plus fine tuning ring on channel selector. Clean design, superb performance.

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5 tube radio DYNAMIC DEMONSTRATOR mounted on easy-to-read schematic board

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Educational, practical. Build a radio receiver, phono-microphone amplifier, broadcast station, signal tracer, electronic timer, five other projects. Teaches functions of circuitry while you have fun building. With detailed 12 pg. instruction manual.

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U.S. Atomic Energy Commission states about the severe shortage of trained people in nuclear technology: "...the immediate goal is to retrain, through short courses... those already grounded in traditional disciplines." Through CREI Atomics you can now combine your present technical education and your professional experience with knowledge in nuclear engineering and technology. The result: increased career opportunities and corresponding income advantages to the nuclear field develops.

Program of study includes:
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Any or all of those catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

TUBES AND TRANSISTORS, A Comparative Study, discusses characteristics, progress, and design considerations. Diagrams, graphs, charts and illustrations improve subject coverage in this 61-page book. For design engineers. Please write on your letterhead.—Electronic Tube Information Council, 554 Fifth Ave., New York 36, N.Y.

CATALOG of wired and kit stereo and hi-fi equipment, ham gear, test instruments and Citizens-band transceivers.

Descriptions, specifications, prices and photographs of the company's products are presented. 28-page catalog available from distributors or manufacturer.—Electronic Instrument Co., Inc. (EICO), 33-00 Northern Blvd., Long Island City 1, N.Y.

CATALOG No. 28/Industrial lists test equipment and panel meters. Voms, vtvs, scopes, tube testers, signal and sweep generators, decade boxes and accessories are described and illustrated. Write on company letterhead.—Precision Apparatus Co., Inc., 70-31 84th St., Glendale 27, N.Y.

TAPE DECKS and preamplifiers are described in a 20-page brochure. Using the decks described a low-priced system can be improved by adding a second preamp for stereo, etc.—Teletronics Corp., 35-18 37 St., Long Island City 1, N.Y.

UTILITY TESTER is described in 4-page folder. Tester measures voltage (3 ranges each: ac and dc, 0-150-500) resistance (6-500-5000 ohms and current (6-15 amps, ac and dc) drawn by household appliances. —Mass Electronic Inc., 3849 Tenth Ave., New York 34, N.Y.

FIELD-STRENGTH METERS are described in a 4-page folder. 5 models available: Citizens, marine, vhf aircraft, 30 to 50 mc and all-band (un-tuned).—Quaker Electronics, Plymouth, Pa.

BULLETIN describes radio and TV

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Radio-Electronics


**Helpful Hints** for technicians on Getting Started in the Sound and Intercom Field. Subjects covered include locations, surveys and quotations, collections and cost accounting, advertising programs, installation and customer goodwill. - Bogen-Presto Co., Box 500, Paramus, N.J., 25c

**Cartridges**, pick-ups and needles are listed in Catalog No. 33-4. Other manufacturer's cartridges, stereo and monophonic, are listed in a 12-page cross-reference CRC-60. - Astatic Corp., Cincinnati 5, Ohio

**Antenna Replacement guide** lists antennas for portable TV's. 16-page book lists set manufacturer, model number, picture-tube size and antenna numbers. Free to technicians who make their request on their letterhead. - JFD Electronics, 6101 16th Ave., Brooklyn 4, N.Y.

**REPLACEMENT PARTS** is the title of a 48-page illustrated catalog. Listed are composition, wirewound and metal-film resistors, diodes, fuse resistors and controls for TV sets and radios. - International Resistance Co., Distributor Div., 401 N. Broad St., Philadelphia 8, Pa.

**Loudspeakers**, baffles, transformers and crossover networks are listed in 16-page Catalog 2-60. Specifications and prices are given. Included in the listing are the Magnat-Magic series with inverted design (magnet placed inside the cone). - Utah Radio & Electronic Corp., Huntington, Ind.

**Mobile Radio** is the subject of 24-page booklet ECR-97B. Base and remote stations are covered. All equipment described is illustrated. - General Electric Co., Schenectady 5, N.Y.

**Reference Guide** lists replacement drive wheels, idlers, motor mounts and belts for tape recorders and phonographs. The manufacturer's model and part numbers are listed. Free to technicians requesting booklet on letterhead. - Robbins Industries Corp., 36-27 Prince St., Flushing 54, N.Y.

**Battery Bulletin** No. 9 discusses construction and use of Eveready Alkaline and Carbon Batteries. Tells how useful the life of these heavy-drain cells and batteries for different loads.

**Don't Throw Old Radios Away!**

Here's the data you need to fix them fast... and good as new!

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MATHEMATICS FOR ENGINEERS (2 volumes) by W. N. Rose. John F. Rider, Publisher, Inc., 116 W. 14 St., New York, N. Y. 5 1/2 x 8 1/2 in. $6.60 each vol.

Vol. I, 9th edition, has 627 pages. It begins with basic rules and methods of algebra, trig and geometrical progressions gradually to the binomial theorem, exponents and logs. Many worked-out examples are given to help the reader.

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CLASSIFICATION OF ELECTRON TUBES, by J. Haantjes and H. Carter. Macmillan Co., 60 Fifth Avenue, New York 11, N. Y. 8 1/4 x 10 1/2 in. 96 pp. $3.50.

An interesting, well illustrated (in color) text that is intended to give the student a brief and simple description of how electron tubes work and present a system for classifying them. The illustrations are beautiful and give excellent cutaway views of vacuum-tube interiors. The text has a British slant.—LS


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Handbook of Electronic Tables and Formulas (First Edition). Howard W. Sam's & Co. Inc., 1720 E. 38 St., Indianapolis, Ind. 514 x 8 1/2 in. 128 pp. $2.95.

A lot of information is packed between the covers of this book. Numerous charts, nomographs, formulas and tables are here to help the engineer, technician and student save time and energy. The text's contents include: codes, TV data, formulas, weights and measures, FCC allocations, conversion factors, service data, and wire tables, WWV schedule, logs and trig functions, etc.

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This book covers all phases of radio and TV broadcasting from FCC rules through color TV, antennas, towers and studio facilities and finishes up with 61 pages of charts and graphs. It is intended for the broadcast engineer, but many others will find much useful data between its covers. —LS

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