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JULY 1966
50 CENTS

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Splash Alarm

BUILD
Hydronics Receiver
To Pick Up Fish Talk

QUICKIE
SUMMER
PROJECTS

• Electric Dice Game
• $2 Intrusion Alarm
• Integrated Stereo Record Player
• Sure-Shot Q5'er
• 2-Wire, 3-Way Circuits

(See page 41)

AmericanRadioHistory.Com
Have you ever wanted to learn electronics but don't know how? NRI offers a variety of courses to fit your needs. Whether you're interested in personal projects or a career change, NRI has got you covered!

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- **BASIC ELECTRONICS**
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  - This course prepares you to install, maintain, service aircraft communications equipment. Covers direction finders, ranges, markers, Loran, Shoran, Radar, landing systems. Earn your First Class FCC License with Radar Endorsement.

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  - Covers transmitters, direction finders, depth indicators, radar, sonar, other equipment used on commercial ships and thousands of pleasure boats. Prepares you for a First Class FCC License with Radar Endorsement.

- **MOBILE COMMUNICATIONS**
  - Learn to install and maintain mobile equipment and associated base stations. Covers transmitters and receivers used by police and fire departments, public utilities, construction projects, taxi, etc. Prepares you for a First Class FCC License.

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Raytheon, in one great upward surge, introduces not merely one or two but seven bright, entirely new 2-way C-B designs plus a host of functional accessories including an entirely new tone signaling device. Fact! Each of the seven models has from two to six performance, operational or appearance features that have not appeared previously in any other C-B equipment! At the same time, prices throughout are lower—not higher. These are some customer benefits that accrue when one of America's leading manufacturers of electronic equipment goes into high gear.

TWR-7 MOBILE RADIO
Retained in the Product Power C-B Line, still unchallenged as the style and concept pace setter for all solid-state mobile designs. 5 channels, 5 watts. Very low current drain. 129.95

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C-B base station of the future for home or office, available now. Introducing new operating simplicity for busy people. No unwieldy microphone! 2-way panel speaker has directional acoustic lens grill structure. Focuses voice, reduces background noise. Exclusive! Unit tip touch switches in wired single station or all-call intercom! Many other all-new features. 5-watts, 6 channels. 117V AC operation. 99.95

TWR-8 2 WATT, 2 CHANNEL PORTABLE
Powerful "Packaged"—supplied with 2 antennas, 51" telescoping whip and short, base loaded plug-in "stubby," leather carrying case, earphone in case, ni-cad batteries, battery charger, crystals for Channel 11. No other hand-held unit offers such power, versatility, and operating range in so small a housing or at so low a "package" price. 119.95

TWR-11, TWR-11T MOBILE/BASE STATION
Truly de luxe 10-channel unit with push button selection. Fully solid-state for low battery drain. Converts quickly to 117V AC for base station using pedestal power supply accessory. Exclusive! Accepts new Ray-tel all-solid-state tone signaling accessory inside cabinet with push buttons on panel! Tone accessory is half the price of equivalent-quality tone units! Also available: TWR-11T with tunable receiver for 23 channels and optional supplies for 117V AC and 24/32V DC. TWR-11, 159.95 TWR-11T, 169.95

100 MILLIWATT TRANSCEIVERS
Three brilliant new 100 milliwatt transceivers offer many never-before combinations of features and outstanding values. Features include: Tone signaling—AM BC band plus full-featured C-B transceiver—117V AC adaptors for fixed station/portable operation—2 and 3 channels—Earphones.

WRITE FOR "QIK FACTS" GIVING DETAILS ON ANY RAY-TEL EQUIPMENT DESCRIBED HERE CIRCLE NO. 34 ON READER SERVICE PAGE

July, 1966
SPECIAL FEATURE
C. G. CUNNINGHAM 41 CAPACITOR KNOW-HOW SIMPLIFIES ELECTRONIC CIRCUITS
Don't let capacitors bug your projects

ELECTRONIC CONSTRUCTION PROJECTS
FRED MAYNARD 48 SWIMMING POOL SPLASH ALARM
The sentry that never sleeps
R. L. WINKLEPLECK 50 $2 INTRUSION ALARM
JAMES E. ROHEN 51 INEXPENSIVE INTEGRATED SOLID-STATE STEREO RECORD PLAYER
DONALD E. LANCASTER 56 MUSSETTE COLOR ORGAN
Music to watch by—in color, too
KEN GREENBERG 78 ELECTRIC DICE GAME
BRADLEY J. THOMPSON 87 SURE-SHOT QS-ER HOOKUP
R. C. HITCHCOCK & G. E. WEBER 88 TWO-WIRE THREE-WAY SWITCHING CIRCUIT

COMMUNICATIONS
MARSHALL LINCOLN 68 HOW TO GET THE MOST OUT OF YOUR KEY AND BUG
Accuracy, not speed, is the keynote
GARY OLSON 73 RIDING THE TV DX TRAIL
MATT P. SPINELLO, KHC2060 79 ON THE CITIZENS BAND: WRIST RADIO AND COMMUNICATIONS
HANK BENNETT, W2PNA 83 SHORT-WAVE LISTENING: NOTES FROM SHORT-WAVE EDITOR'S DESK
ROBERT LEGGE 84 ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA
HERB S. BRIER, W9EGQ 85 AMATEUR RADIO: INSTALLING ANTENNAS IN RESTRICTED SPACES
E. H. MARRINER, W6BLZ 92 BC-454 GOES MARITIME

ELECTRONIC FEATURES AND NEW DEVELOPMENTS
CARL KOHLER 38 JUST WHEN I FORGOT MY (SOLDERING) GUN
Is plasmonics for the birds?
J. DRUMMOND 63 THE CONNUBIALLY-ORIENTED COMPUTER OF OTTO TRONIX
LEWIS. A. HARLOW 72 EXTENSION SPEAKERS ARE NO PROBLEM
HANS F. KUTSCHBACH 72 GERMAN TV PIONEER
THOMAS F. KIRBY 75 INFRINGERS BEWARE!
ROBERT P. BALIN 77 TV TROUBLE QUIZ
LOU GARNER 80 SOLID STATE

DEPARTMENTS
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What is he—a genius or a nut? 53

You can build this color organ in your home 56
ELECTRONICS
WHERE CAN YOU EQUAL THIS OPPORTUNITY

TO EARN A GOOD PAYING JOB IN A FAST GROWING FIELD?

DeVRY’S "BIG 3" AIDS TO PROGRESS ARE DESIGNED TO SPEED YOU QUICKLY TO A REAL FUTURE IN ELECTRONICS

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ELECTRONICS is one field that spells OPPORTUNITY in big capital letters for many men 18 to 45. This widespread but fast growing field offers trained men some of today’s finest, good-paying job opportunities — or a chance to start a profitable servicing shop!

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Regardless of how you complete your educational program with DeVry, you can count on industry-recognized, effective training aimed directly at providing on-the-job-type "know-how." This is followed by actual EMPLOYMENT SERVICE to help you get started in Electronics. Or, if you are in the field already, remember that a DeVry recommendation has meant plenty of ADDED DOLLARS in income to many who made themselves more valuable to employers.

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Please give me your two free booklets, "Pocket Guide to Real Earnings," and "Electronics in Space Travel"; also include details on how to prepare for a career in Electronics. I am interested in the following opportunity fields (check one or more):

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☐ Communications
☐ Computers
☐ Microwaves
☐ Broadcasting
☐ Radar
☐ Industrial Electronics
☐ Automation Electronics
☐ Electronic Control

☐ Check here if you are under 16 years of age.

Name
Address
City, State Zip
Apt
Code

HOME STUDY AND RESIDENT SCHOOL TRAINING AVAILABLE IN CANADA

July, 1966

DeVry Technical Institute
4141 Belmont Avenue
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Accredited Member of National Home Study Council
Good starting point for any performance worth recording...

Sonotone full fidelity microphones

Wondering why your "live" home recorded tapes sound dead, lack professional quality? Stop wondering.

That accommodation mike given with your tape recorder just isn't in the same league with your recorder's pick-up capabilities.

Want results you'll be proud of? Plug a full fidelity Sonotone microphone into your tape recorder. The improvement will delight you! Because Sonotone microphones capture all the richness and vibrancy of live sound to take full advantage of your tape recorder's output capabilities.

For fine dynamic, as well as ceramic microphones... ask for a Sonotone microphone at your hi-fi dealer. Or write to...
Choose Your Tailor-Made Course in N.T.S. "PROJECT METHOD" ELECTRONICS!

Now! N.T.S. — one of America’s oldest leading home-study and resident technical schools — offers you GREATER CAREER OPPORTUNITIES IN ELECTRONICS. N.T.S. "Project Method" home training lessons are shop-tested in the Resident School in Los Angeles. You work on practical job projects, learn to use shop manuals and schematics. Your N.T.S. training is individual. You proceed at your own pace. The Schools’ practical methods, plus more than 60 years of experience, have helped thousands of students all over the world to successful careers. Prepare now for a secure future in one of 8 N.T.S. Electronics Courses designed to fit your own particular needs.

CHOICE YOUR FIELD — INSURE YOUR FUTURE!

1 ELECTRONICS-TV-RADIO-SERVICING & COMMUNICATIONS A basic course thoroughly covering fundamentals of electronics, radio, TV servicing and communications.

2 MASTER COURSE IN ELECTRONICS-TV-RADIO, PLUS ADVANCED TV & INDUSTRIAL ELECTRONICS This course covers everything included in Course No. 1 plus Automation and every phase of the Electronics industry.

3 FCC LICENSE Preparation for this government license essential for interesting jobs in radar, radio, television, communications, guided missiles, many others. Upon completion of this course, if you do not pass the FCC exam for a 1st Class Commercial Radiotelephone License your tuition will be refunded.

4 RADIO SERVICING (AM-FM-Transistors) Train for radio sales and service with dealer or distributor.

5 TELEVISION SERVICING (Including Color) Covers installation, adjustment, repair and servicing of black and white and color television — prepares you for your own sales and service business.

6 STEREO, HI-FI AND SOUND SYSTEMS A growing field. Prepares you to build, install and service modern sound equipment for home or industry.

7 BASIC ELECTRONICS Gives you the fundamentals you must know to build on for a future Electronics career. Also offers an excellent background for Salesmen, Purchasing Agents, and others in Electronics.

8 ELECTRONICS MATH Simple, easy-to-follow instructions in the specialized math you need in many electronics jobs.

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Please Rush FREE Electronics "Opportunity Book" and sample lesson on course checked below:

☐ Electronics-TV-Radio Servicing & Communications
☐ Master Course in Electronics-TV-RADIO
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☐ Radio Servicing (AM-FM-Transistors)
☐ Television Servicing (Including Color)
☐ Stereo, Hi-Fi and Sound Systems
☐ Basic Electronics
☐ Electronics Math

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☐ Check here if interested ONLY in Classroom Training at L.A.

☐ Check here for High School Department Catalog only.

July, 1966
STEREO REQUIRES MATCHED MICROPHONES...

Pianos sound like barrel organs? Violas like musical saws? Voices lost in a welter of "hollow" background sound? Friends—look to your microphone! You'll be amazed by the clear, life-like tapes you can make with the new Shure Unidyne A...a low-cost, fine quality unidirectional microphone that picks up sound from the front uniformly while rejecting sounds from the rear. Equipped with plugs to match most tape recorder inputs. Unidyne A matched pairs can detect the subtle differences that "localize" sound for realistic, spatially-correct stereo tapes.

NEW!

SHURE UNIDYNE/A

MATCHED STEREO MICROPHONES

In the quality tradition of the famed Unidyne family of unidirectional dynamic microphones...at a new dramatically low price! Never before such quality at so low a price! Model 580SA(MP) Only $70.80 net for the pair.

SHURE UNIDYNE III

The favorite of performers and public speakers. Dual impedance, ultra-small size, true-cardioid pick-up pattern, symmetrical about the axis in all planes, at all frequencies. Wide-range response. Amazingly faithful voice and music reproduction. Model 545S (with On-Off switch) $53.97 net. (Matched pairs available).

Shure Brothers, Inc.
222 Hartrey Avenue, Evanston, Illinois
CIRCLE NO. 27 ON READER SERVICE PAGE

LETTERS FROM OUR READERS

Address correspondence for this department to:
Letters Editor, POPULAR ELECTRONICS
One Park Avenue, New York, N.Y. 10016

COMPUTERIZED MATE SELECTION

Your article on computerized mate selection (March, 1966) was interesting and informative, but your reporter left out the most advanced and effective system of all—Selectronics. The Selectronics organization has offices in San Diego and Seattle, and is now negotiating franchises in many other Western cities. Unlike most other methods, which merely apply computers (and often only card sorters) to speed up long-available and marginally effective methods, the Selectronic system bypasses the psychologists' old-fashioned preoccupation with hypothetical personality "traits" and concerns itself with the client's actual everyday choices and behaviors.

BERNARD RIMLAND, Ph.D.
San Diego, Calif.

SWIMMING POOL SPLASH ALARM

I would like to build a pool warning system, and wonder if you could run an article containing a circuit for this purpose. I'm sure a lot of your other readers have outside pools, too, and would appreciate such an article.

LOUIS W. KOGLEMANN
Milwaukee, Wis.

Your request and our editorial efforts are on the same frequency, Louis. You'll find exactly what you want on page 48 of this issue.

MINIATURE ROBOT READOUT

The digital readout circuit in "Parts Profiles" (May, 1966) was just what I've been looking for. About six months ago, I started designing an electromechanical robot which called for digital readouts in many of its systems. By substituting "flea-power lamps" for the 12-volt pilot lamps in the original circuit, I managed to put together an assembly of lights that made up a matrix only one-inch square.

RANDY WOOD
Cahokia, Ill.

(Continued on page 8)
Why does one of these men earn so much more than the other?  
More brains? More ambition?  

No, just more education in electronics.  

You know that two men who are the same age can work side-by-side on the same project, yet one will earn much more than the other.  

Why? In most cases, simply because one man has a better knowledge of electronics than the other. In electronics, as in any technical field, you must learn more to earn more. And, because electronics keeps changing, you can never stop learning if you want to be successful.  

But your job and family obligations may make it almost impossible for you to go back to school and get the additional education you need. That's why CREI Home Study Programs are developed. These programs make it possible for you to study advanced electronics at home, at your own pace, on your own schedule. You study with the assurance that what you learn can be applied on the job to make you worth more money to your employer.  

CREI Programs cover all important areas of electronics including communications, servo-mechanisms, even spacecraft tracking and control. You're sure to find a program that fits your career objectives.  

You're eligible for a CREI Program if you have a high school education and work in electronics. FREE book gives all the facts. Mail coupon or write: CREI, Dept. 1207-D, 3224 Sixteenth Street, N.W., Washington, D.C. 20010.  

Send for Free Book  

The Capitol Radio Engineering Institute  
Dept. 1207-D, 3224 Sixteenth Street, N.W.  
Washington, D.C. 20010  

Please send me FREE book describing CREI Programs. I am employed in electronics and have a high school education.  

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TYPE OF PRESENT WORK__________________________  

GI BILL

I am interested in  

Electronic Engineering Technology  

Space Electronics  

Nuclear Engineering Technology  

NEW! Industrial Electronics for Automation  

NEW! Computer Systems Technology  

July, 1966
Is the installation job keeping you from going mobile?

Don't let it, Mr. CB'er!

With the All New Mosley SUC-1 Cadet, 'Hole Drilling' is unnecessary. And here's why. Mosley features a suction cup within the Cadet base making the installation job a snap. Just moisten the suction cup, plop on the antenna, make your connection and you're ready for mobile action. Antenna grips tightly.

Use it on all smooth surfaces — even wood and fiberglass. Operates as an electrical half wave. No ground required. Antenna is center loaded. Length 3'. Ideal for boats, cars, trailers, campers or wherever a communication antenna is needed temporarily. Quick to use in emergencies.

Why wait? Go mobile today! 

Code 104 Mosley Electronics Inc.
4610 N. Lindbergh Blvd., Bridgeton Mo. 63042

Please send me complete information on your Mosley Citizens Band: No. 104
☐ Cadet SUC-1 (for temporary mounting)
☐ Cadet PER-1 (for permanent mounting)
☐ Entire CB line

Tell me how I may become a CB'er.

Mosley Electronics, Inc.
4610 N. Lindbergh Blvd., Bridgeton Mo. 63042

LETTERS (Continued from page 6)

"REVERB" LONG AWAITED

Congratulations to Daniel Meyer for a long-awaited construction project. I built the "Reverb for Your Car" (February, 1966) and have been well pleased with the results. I added two components, however, to improve the listening quality of the unit, as per the enclosed diagram. High frequencies can now bypass the mechanical delay without any ill effect on the lower frequency sounds.

Franklin W. Wilson
Wichita, Kan.

Can you tell me how I can adapt the "Reverb for Your Car" for use with a guitar amplifier?

J. C. Roberts
Yuba City, Calif.

In modifying the reverb unit for my electric guitar, I found it easier to replace S1, and the input and output terminals with phone jacks.

Steven C. Green
Livingston, N. J.

I placed a small 100-pf. capacitor across the base-to-collector of Q3 to eliminate a very high frequency oscillation on the negative peaks.

James T. A. Nagnost
Culver City, Calif.

Jim, parasitics can creep into the best of places; apparently you caught one right in the act... nice going. J.C., you can consider your guitar amplifier as the car radio—the balance of the hookup is the same. Steve, meet J.C. Frank, it's a matter of taste as to what sounds better, but if you're happy—we are, too.

WOOFER IMPROVEMENT

There was an omission in the article "Put an Air Brake On Your Woofer" (March, 1966) that may bother people who want to use the system "as is" without testing. About 80 ¾" holes (8 rows of 10 each) should be located
FINCO-AXIAL COLOR-KIT
Model 7512 AB
High performance Indoor and Outdoor Matching Transformers convert old-fashioned and inefficient 300 ohm hook-ups to the new Finco-Axial 75 ohm color reception system.

List price for complete kit...
7512AB ........ $8.95
7512A Mast mounted matching transformer ... list $5.40
7512-B TV Set mounted matching transformer ... list $4.15

FINCO-AXIAL SHIELDED COLOR CABLE, CX Series
Highest quality, 75 ohm swept coaxial cable (RG 59/U) complete with Type F fittings, weather boot ready for installation.

Available in 25, 50, 75 and 100 foot lengths. List price ... $5.55, $8.65, $11.50 and $14.20.

For the best color TV picture
eliminates color-fade, ghosting and smearing!
Improves FM and Stereo, too!

QUICK, EASY INSTALLATION
ENJOY brilliant "TV-Studio" color reception today by changing over to the new Finco-Axial Color Reception System. NOW, color fade, ghosts and smears are a thing of the past. Finco-Axial shields color sets against signal loss ... eliminates outside interference and mismatch problems.

Bubble packaged on beautiful 4 color card

Write for Color Brochure #20-349
THE FINNEY COMPANY 34 WEST INTERSTATE STREET, DEPT. PE BEDFORD, OHIO

July, 1966
within the woofer compartment. The holes in each row should be spaced one inch apart (center-to-center), and the rows should be 3/8" apart.

David B. Weems
Neosho, Mo.

ONE ELECTROMAZE SOLVED

Just thought I'd write and tell you that I completed the April "Electromaze Puzzle" successfully without peeking. I believe that doing this unique type of crossword puzzle truly expresses how much one knows about all fields of electronics, and I find the "Electromazes" both challenging and entertaining. I hope you continue to have them in the future.

William B. Farnsworth
West Springfield, Mass.

TWO "SWEET SIXTEENS," NO LESS

I combined two "Sweet Sixteens" with a University "Sphericon" tweeter in one unit—per channel—and have obtained the best results I have ever heard as far as sound reproduction without coloration is concerned. Your articles, "Sweet Sixteen" (January, 1961) and "Sweeter with a Tweeter" (April, 1961) inspired the idea. Enclosed is a picture of one of the units (grille cloth not yet attached) taken during construction and testing.

William Jensen
Gardena, Calif.

Nice work, Bill. But what's "Jensen" doing with a "University" speaker?

DAMAGING QSL'S

I have been an SWL for years. I DX'ed a few communist countries in the past and always received polite non-political answers. In 1964 I joined the Air Force and continued with my hobby on a limited basis. Last year
A bunch of us were sitting around trying to come up with a really big new idea in citizens band base station antennas, when suddenly ... a light went on!

Meet the Speakin' Beacon — totally new idea in CB base antennas from the idea people!

Model M-148 CO-AX OMNI ANTENNA WITH VISUAL RF OUTPUT INDICATOR!

- Neon light works on RF energy — no separate electrical connection!
- Stati-light ball dissipates static electricity, minimizes noise.
- Beautiful, brawny polished aluminum construction — built to withstand 90 MPH winds!
- Efficient co-axial design. No horizontal radials needed — easily installs anywhere you can mount a vertical pipe!
- Exceptionally low angle of radiation — maximum talk power down where you want it!
- Gamma matched — very low VSWR!
- Built-in lightning protector!

Lights up when you transmit! Here's a tremendously effective and rugged base antenna for all the range and performance you need, built to the highest quality standards in the industry — but with a sensational new feature never before available on a communications antenna.

Up topside, built right into the famous field-proven A/S "STATI-LIGHT BALL," there's a permanent-circuit neon light. Push to transmit — it lights up, triggered instantaneously by the keying of your microphone, visibly verifies your RF power output! Also helps to guide mobiles visually to your 10-20.

CB net price: $29.95
I sent a report to Radio Havana, Cuba, and ever since have been deluged by a wave of trash in the form of communist propaganda. I implore your readers not to make the mistake I made. I have jeopardized my security clearance and possibly my military career. So please, SWL's, don't send reception reports to Radio Havana.

AN AIRMAN
U. S. Air Force

While we generally do not publish anonymous letters, the overall message this one contains is of vital importance to people in sensitive jobs. Unfortunately, there are numerous opportunities for anyone to unknowingly get into trouble... signing a petition, joining a club, donating money to an organization, subscribing to a newspaper, or even associating with people, and listening to the radio. It is wrong to adopt an ostrich-like attitude to shut out knowledge about opposing political philosophies, and to pass up opportunities to get to know the other fellow, but it is just as wrong to disregard the temper of the times and to place your career or ability to support yourself in jeopardy.

BARIUM TITANATE OUT OF DATE

In your "Electrochemistry Quiz" (March 1966), you indicate that barium titanate is supposed to match up with a ceramic phonograph cartridge. This is no longer true and has not been for several years. Barium titanate or rather modified barium titanate compositions are still used in some transducer applications, but by and large they have been replaced by PZT (Clevite Corporation trade-name) or equivalent ceramic. The "newer" ceramic is basically a lead-titanate-zirconate composition similar to barium titanate but far superior to it.

C. P. GERMANDO
Clevite Corporation
Bedford, Ohio

When will you publish the article on transistorized voltage regulators that you promised to run?

CLARENCE H. HANSON
Santa Barbara, Calif

Just in case you missed it, Clarence, check the June, 1966, issue, page 39.

POPULAR ELECTRONICS
The International MO-23 citizens radio transceiver hides...

under the dash .......... in the console ...... in the glove compartment

The MO-23 remote control unit is so small it will rest on the palm of your hand (1½" H x 4" W x 2½" D). You can install the MO-23 under the car dash . . . in the glove or console compartment. Compare this versatile mobile two-way radio with other makes. See for yourself how little space this unit really requires. Technically speaking, the MO-23 combines the best advantages of tubes and silicon transistors.

CHECK THESE FEATURES:
- 23 Crystal Controlled Channels
- Miniature Solid State Remote Control
- Illuminated Channel Selector
- Transmit/Receive Trunk Unit
- Transistor Power Supply

Ask your dealer to show you the International MO-23. We think it's a great new transceiver. You will too!

WATCH FOR INTERNATIONAL "FLYING SHOWROOM '66": WELCOME ABOARD!

July, 1966

CIRCLE NO. 16 ON READER SERVICE PAGE
Here's your new catalog of quality electronic kits and assembled equipment... your shopping guide for TV set kits, transistor radios, voltmeters, scopes, tube testers, ham gear, PA systems, and a host of other carefully engineered products. Every item in the Conar catalog is backed by a no-loopholes, money-back guarantee. It's not the biggest catalog, but once you shop its pages you'll agree it's among the best. For years of pleasurable performance, for fun and pride in assembly, mail the coupon. Discover why Conar, a division of National Radio Institute, is just about the fastest growing name in the kit and equipment business.

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THREE-CONDUCTOR PHONE PLUG HOOKUP FOR MONO HEADSETS
If you are in need of a 2-conductor phone plug and you happen to have only a 3-conductor type, you can try this simple modification. All you have to do is to convert a 3-conductor plug for use with a 2-conductor mono headset is to jump the plug's sleeve (S) and ring (R) connectors as shown. Solder the headset leads to the ring and lug tips (T). —Carl Dunant

CARDBOARD BOX SERVES AS QUICKIE ELECTRONIC CHASSIS
Small cardboard boxes can be turned into quick, temporary chassis for electronic projects such as the one-transistor radio shown in the photo. Component leads are pushed through appropriately spaced holes in the cardboard, and potentiometers, switches, and other hardware are mounted in the normal manner. Batteries can be taped inside the box. You can also use this cardboard box idea to optimize component layout before assembling a project on a more permanent type of chassis. —Robert E. Kelland

RE-USE OLD LICENSE PLATES TO DISPLAY CALL LETTERS
Hams living in those states which require but one license plate on a car, and where it isn't illegal to re-use an old plate, can display their call letters on the other bumper. (Actually, any piece of metal cut to the size and shape of a license plate will do.) Paint the whole plate a dark color and, as artistically as you can, (Continued on page 20)
You can get additional information promptly concerning products advertised or mentioned editorially in this issue.

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Circle the number on the coupon below which corresponds to the key number at the bottom of the advertisement or is incorporated in the editorial mention that interests you.

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VOID AFTER AUGUST 31, 1966

July, 1966
This important job (and its big salary) is reserved for a qualified electronics technician. It can be you!

It's a fact. There are thousands of jobs like this available right now for skilled electronics technicians. What's more, these men are going to be in even greater demand in the years ahead. But how about you? Where do you fit into the picture? Your opportunity will never be greater... so act now to take advantage of it. The first step? Learn electronic fundamentals... develop a practical understanding of transistors, troubleshooting techniques, pulse circuitry, micro-electronics, computers and many other exciting new developments. Prepare yourself now for a job with a bright future... unlimited opportunity... lasting security... and a steadily-increasing salary.

Over 16,500 ambitious men are using Cleveland Institute Electronics Training Programs as a stepping stone to the good jobs in electronics. Why not join them? You will learn at home, in your spare time, and tuition is remarkably low. Read the important information on the facing page. Then fill out the postage-free reply card and drop it in the mail today. Without obligation we'll send you all the details. But act now... and get your high-paying job just that much sooner.
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Cleveland Institute offers not one, but five different and up-to-date Electronics Home Study Programs. Look them over. Pick the one that is "right" for you. Then mark your selection on the reply card and send it to us. In a few days you will have complete details ... without obligation.

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   A comprehensive program covering Automation, Communications, Computers, Industrial Controls, Television, Transistors, and preparation for a 1st Class FCC License.

2. First Class FCC License
   If you want a 1st Class FCC ticket quickly, this streamlined program will do the trick and enable you to maintain and service all types of transmitting equipment.

3. Broadcast Engineering
   Here's an excellent studio engineering program which will get you a 1st Class FCC License and teach you all about Program Transmission and Broadcast Transmitters.

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   Mobile Radio, Microwave, and 2nd Class FCC preparation are just a few of the topics covered in this "compact" program. Carrier Telephony too, if you so desire.

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   This exciting program includes many important subjects such as Computers, Electronic Heating and Welding, Industrial Controls, Servomechanisms, and Solid State Devices.

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In addition to providing you with comprehensive training in the areas indicated, programs 1, 2, 3, and 4 will prepare you for a Commercial FCC License. In fact, we're so certain of their effectiveness, we make this exclusive offer:

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NEWS FOR VETERANS: Now G. I. Bill may entitle you to Government-paid tuition for CIE courses if you had active duty in the Armed Forces after Jan. 31, 1955. Check box on reply card for complete information.

Cleveland Institute of Electronics
1776 East 17th Street, Dept PE-42, Cleveland, Ohio 44114

July, 1966

TIPS (Continued from page 14)

letter in your call-sign in a bright color. You can also use this type of plate to dress up your rig—and you may want to hang one outside your shack.

—Ross A. Sheldon, K4HKD

SPRING-TYPE CLOTHESPIN LENDS A GENTLE THIRD HAND

When you hold a soldering iron in one hand, and solder in the other, you may need a friend to lend another hand to hold the component. A spring-type clothespin will do it for you. Just cut off one end of clothespin and clamp the adjacent end in a vise as shown. The opposite end will hold the component. When you want to support two components or wires, two clothespins clamped back-to-back can be employed. If you don't want to use a vise to hold the clothespins, you can mount one or more pins on a small block of wood.—Robert E. Kelland

SINK WASHERS HELP KEEP TABLE TOPS CLEAN

You can avoid scratching your workbench or table top simply by installing small "bumpers" on the bottom of your radio or other electronic equipment. Ordinary sink washers and countersunk flat-head machine screws or self-tap screws can be used. Drill a hole in each corner of the base of the chassis or cabinet and attach the washers. Be sure that the screws are countersunk deep enough to prevent contact with the table top. Almost any size of washer will do. Actually, you could use almost any other type of rubber, plastic, or nylon washer.

—R.A. Boyll, W9IFG

LAMINATING PLASTIC PROTECTS FRONT PANELS

The lettering and finish on the front panels of often-used equipment become scratched and worn with time. But they can be protected by applying self-adhering clear plastic to the panels—the type used for laminating photos. Available at most camera and stationery stores, it can be cut to any shape with a pair of scissors.

—Tim Callan

169.
Courier's 23-channel solid-state CB rig.
Guaranteed for 10 years!

Eci, electronics communications inc.
56 Hamilton Avenue, White Plains, N.Y.
Yes! I'd like to know all about the $169 Courier TR-23S with the 10-year guarantee.

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POPULAR ELECTRONICS
This amazing new "computer in a case" will save you time the very first day. CIE's patented, all-metal 10" electronics slide rule was designed specifically for electronic engineers, technicians, students, radio-TV servicemen and hobbyists. It features special scales for solving reactance, resonance, inductance and AC-DC circuitry problems...an exclusive "fast-finder" decimal point locator...widely-used formulas and conversion factors for instant reference. And there's all the standard scales you need to do multiplication, division, square roots, logs, etc.

Best of all, the new CIE Slide Rule comes with an Instruction Course of four AUTO-PROGRAMMED lessons. It includes hundreds of illustrations, diagrams and practice problems. You'll learn ingenious short cuts...whip through exacting electronics problems quickly and accurately. This course alone is worth far more than the price of the entire package!

Electronics Slide Rule, Instruction Course, and handsome, top-grain leather carrying case...a $50 value for less than $20. Send coupon for FREE illustrated booklet and FREE Pocket Electronics Data Guide, without obligation. Cleveland Institute of Electronics, 1776 E. 17th St., Dept. PE-122, Cleveland, Ohio 44114.

GET BOTH FREE!

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NEW PRODUCTS

Additional information on products covered in this section is available from the manufacturers. Each new product is identified by a code number. To obtain further details on any of them, simply fill in and mail the coupon on page 15.

HOME TAPE CARTRIDGE PLAYBACK

So far as we know, Roberts Electronics' Model 838 eight-track stereo cartridge playback is the first such unit designed for use in the home. Compact and lightweight, it was engineered specifically to play back Lear Jet auto cartridges in the home. Housed in a hand-rubbed walnut cabinet, it plugs into any hi-fi component, console system, or home phonograph. Features include manual and remote control program track selection, and both high and low preamp output.

Circle No. 75 on Reader Service Page 15

CLOSED-CIRCUIT TV CAMERA

Is a closed-circuit TV camera out of your price range? Maybe not. Squires-Sanders has put on the market a unit which employs solid-state circuitry, is simple to install and operate, and is said to use less space than a telephone. Intended for both commercial and hobbyist applications, the Model SS-310 delivers high-resolution pictures on video monitors or conventional TV receivers, and may be linked to as many screens as desired. A clear picture can be obtained with a minimum amount of illumination, using f1.4 lens supplied with the camera, and a special automatic electronic circuit instantly compensates for wide and sudden lighting changes. A complete complement of accessories is also available.

Circle No. 76 on Reader Service Page 15

MOTOR SPEED CONTROL

Automatic torque compensation is featured in the SCR-1 solid-state speed and power controller announced by Scientific Equipment Co., providing high torque at all settings. Mounted in a rugged, vinyl-coated, shock-resistant, steel, electrical "handy box," the SCR-1 controls the speed of universal type a.c./d.c. motors such as are found in many hand drills, sanders, saws, stirrers, beaters, etc. Once set for a speed, it will maintain that speed even under varying loads. The SCR-1 is supplied with a 6', 3-wire grounded line cord, automatic circuit breaker, and pilot light.

Circle No. 77 on Reader Service Page 15

Q-MULTIPLIER

With the Heathkit GD-125 Q-multiplier, the i.f. selectivity of any communications receiver having an i.f. frequency between 450 and 460 kHz can be greatly increased (effective "Q" of 4000). The GD-125 will produce a sharply peaked i.f. curve for CW reception, a broad peaked i.f. for phone operation, or a deep rejection notch to eliminate a closely interfering heterodyne. Both peak and notch positions are tunable to any point on the receiver's i.f. bandpass. The GD-125 comes complete with a built-in power supply, connecting i.f. cable, plug, and socket.

Circle No. 78 on Reader Service Page 15

SPEAKER SYSTEMS

Two air-suspension speaker systems formerly supplied as part of Harman-Kardon's complete music systems are now available separately: the HK-40 with 10" woofer and 3¼" tweeter, and the bookshelf HK-30 with 8" woofer and 3" tweeter. The HK-40 has a virtually flat frequency response from 30 to 18,000 Hz and measures 23" x 13¼" x 10½". The HK-30 has a virtually flat frequency response from 40 to 18,000 Hz and is only 17" x 11¼" x 8". Both speakers have continuously variable high-frequency controls for adjustment to room environment and personal taste. They are housed in oiled walnut cabinets with...
No matter where in the world the excitement is, the Fisher R-200-B will bring it right into your living room. Noise-free and with pleasure. Because the R-200-B is the first multi-band tuner built to high fidelity standards.

The R-200-B is an accomplished world traveler. With its three AM bands it can receive long-wave, medium-wave and short-wave broadcasts. Everything from local news and weather to live broadcasts from concert halls throughout the world. Wide-band for full concert fidelity, regular bandwidth for normal broadcasts, narrow-band to eliminate interference.

But the R-200-B is also an elegant stay-at-home. It includes a magnificent FM-stereo tuner with automatic mono-stereo switching and the famous Fisher Stereo Beacon* multiplex decoder.

Behind the remarkable Nuvistor front end, the R-200-B is completely solid state. And completely reliable. Because Fisher is the largest and most experienced manufacturer of high fidelity components.

You would expect a tuner this fine to be very costly. But the price of the Fisher R-200-B is surprisingly modest. Only $349.50. That's really not much to pay for a direct line to the world.

The Fisher R-200-B

Fisher Radio Corporation, 11-35 45th Road, Long Island City, N. Y. 11101

FREE! $2.00 VALUE! Send for your free copy of the new 1966 edition of The Fisher Handbook. This revised and enlarged version of the famous Fisher high fidelity reference guide is a magnificent 80-page book. Detailed information on all Fisher components is included.

Name____________________
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City________________ State____ Zip_____
PRODUCTS (Continued from page 22)

changeable snap-out grille cloths, have furniture protection pads, and 24 feet of plug-in speaker leads.

Circle No. 79 on Reader Service Page 15

ALL-SILICON STEREO TUNER

Said to be the first solid-state tuner to utilize silicon transistors exclusively, the Sherwood Model S-3300 achieves a sensitivity of 1.6 μV. (IHF) with circuitry which is immune to overloading. A unique stereo noise filter reduces high-frequency background noise without affecting frequency response, and a specially designed dual a.g.c. system maintains selectivity under the strongest signal conditions. Other features include: noise-thresholded automatic FM stereo/mono switching; a D'Arsonval zero-center tuning meter; and a front panel level control. Sherwood is offering a 3-year warranty against defects in materials and workmanship.

Circle No. 80 on Reader Service Page 15

UNUSUAL SOUND TRANSDUCER

"Rolen-Star" can transform an entire wall surface into a speaker. Developed by Rolen Electronics, Rolen-Star is a sound transducer that transfers sound from its original source to any flat surface to which it is attached. When attached to a wall, ceiling, table, door, etc., it projects even, non-directional sound, and an equal volume from both sides of the flat surface. A full stereo effect can be obtained by connecting two Rolen-Star units to a stereo sound source. Each unit weighs approximately two pounds.

Circle No. 81 on Reader Service Page 15

MULTI-PROBE

 Actually four probes in one, the Model MP-1 multi-probe introduced by Mercury Electronics offers unusual convenience. A rotating probe head with detent action enables you to select the function needed with just a quick quarter turn of the probe head. The MP-1 provides isolation for all d.c. measurements; as an a.c./ohms probe, it can be used for all low-impedance, low-frequency voltages and waveforms; it serves as a demodulator for checking r.f. voltages, waveforms and signals in TV/radio r.f. and i.f. stages; and as a low-capacity probe, it can be used for high-impedance sync circuits where ordinary probes would load the circuit.

Circle No. 82 on Reader Service Page 15

"CONVERTIBLE" SPEAKER SYSTEM

With louvered front panels and a hand-rubbed satin walnut finish, Empire Scientific's new $400 "Convertible Grenadier" speaker system is designed for either standard shelf placement or mounting on its own custom-made walnut bench. Speakers include a low-frequency hyperbolic horn, and a mid-range direct radiator and ultrasonic domed tweeter, both coupled to die-cast acoustic lenses. Frequency response is 25 to 20,000 Hz; nominal impedance, 8 ohms; and power handling capacity, a maximum undistorted 100 watts. The matching bench is optional.

Circle No. 83 on Reader Service Page 15

DELUXE D.C. OSCILLOSCOPE

If you want to own a "sophisticated" precision oscilloscope, you might investigate Heath's new IO-14 d.c. model which is available either as a kit or factory-assembled. The vertical channel of the IO-14 has a d.c. to 8 MHz bandwidth, a sensitivity of 0.05 volt/cm a.c. or d.c., a rise time of 0.04 μsec., a precision delay line with 0.25 μsec. delay, and a 9-position, fully compensated vertical attenuator. The horizontal channel has 18 triggered sweep rates in 1, 2, 4 sequence from 0.5 sec./cm to 1 μsec./cm with an accuracy of ± 3%. The IO-14 provides all of the features you would expect in a superior scope.

Circle No. 84 on Reader Service Page 15

CARDIOID MICROPHONE PLUS

Turner Microphone has introduced the Model 505 cardioid microphone, an advanced version of the Model 500, which also has the acoustical advantages of an adjustable bass response dynamic unit. Adjustable bass response is achieved by the use of a rotary switch marked "Normal" and "Less Bass." It switches in a ferrite core inductor to modify the low frequency response. When the switch is in the "Normal" position, frequency response is 40-15,000 Hz. When the switch is in the "Less Bass" position, the response is 100-15,000 Hz. Model 505 is furnished with 20 feet of cable; impedance is Hi or 150 ohms adjustable at the free end of the cable.

Circle No. 85 on Reader Service Page 15

U.S. POPULAR ELECTRONICS
Faulty, fragile, filament failures.

Phooey.

Yes, phooey to filament failures and costly tube replacements. CB radios should be solid state to take the bumps and knocks of mobile use.

That's why all Amphenol Citizens Radios are solid state. We don't believe in thin filaments that heat up and short or snap. Or in fragile glass enclosures. Or in tubes at all, when transistors have more than ten times the life and warm up instantly. That's why Amphenol has the broadest line of solid state equipment available today.

Take the new Spokesman 650 for example. This ten crystal-controlled channel receiver is complete with spot button, S and RF meter, squelch control, 23 channel RF tuner, solid state switching (no relay, making it possible to provide communications even at 25°F below zero), and most importantly, Amphenol dependability.

Remember, when you want the reliability of solid state circuitry, think of the industry's broadest line, Amphenol. See your local Amphenol distributor for more information on Amphenol solid state, and the Spokesman 650, or write us direct.

AMPHENOL DISTRIBUTOR DIVISION
AMPHENOL CORPORATION
2875 South 25th Avenue, Broadview, Illinois 60153

CIRCLE NO. 3 ON READER SERVICE PAGE
New! Deluxe 10-Band AM/FM/Shortwave Portable

Tour The Voice Capitals Of The World! 7 bands cover 2-22.5 mc to bring you the intrigue of foreign shortwave, amateur and weather stations . . . a 550-1600 kc AM band keeps you posted on the latest news, weather and sports . . . and a 88-108 mc FM band offers you quiet, relaxed listening of high fidelity music. There's even a 150-400 kc longwave band for aircraft and marine broadcasts, plus a logging scale for relocating unknown frequencies.

Boasts 16 Transistors, and 44 Prebuilt & Aligned RF Circuits; separate FM tuner & IF strip (same as used in deluxe Heathkit hi-fi components); 2 built-in antennas; 4" x 6" speaker; battery-saver switch. Operates anywhere on 7 flashlight batteries, or on 117 v. AC with optional charger/converter, $6.95. Build in only 10 hours. 19 lbs.

Deluxe 5-Band Shortwave Radio! Low Cost AM/Shortwave Radio!

Compare it to $150 sets! Covers 200-400 kc, AM and 2-30 mc. Tuned RF stage, crystal filter for greater selectivity, 2 detectors for AM and SSB, tuning meter, bandspread tuning, code practice monitor, automatic volume control, antenna trimmer, built-in 4" x 6" speaker, headphone jack, gray metal cab., FREE SWL antenna. 25 lbs.

4 bands cover 550 kc to 30 mc. Built-in 5" speaker; bandspread tuning; signal strength indicator; 7" slide-rule dial; logging scale; BFO control for code & SSB; 4-tube circuit plus 2 rectifiers; noise limiter; external antenna connectors; Q-multiplier input; gray metal cabinet; AM antenna. 15 lbs.

23-Channel 5-Watt Solid-State CB Transceiver!

23 crystal-controlled transmit & receive channels for utmost reliability. Low battery drain . . . 0.75 A transmit, 0.12 A receive. Only 2¼" H x 7" W x 10½" D . . . ideal for car, boat, any 12 v. neg. gnd. use. “S” meter, adjustable squelch, ANL, built-in speaker, PTT mike, aluminum cabinet. 8 lbs. Optional AC power supply, Kit GWA-14-1, 5 lbs. $14.95. Optional 6 to 12 v. DC converter. Kit GWA-14-4, 3 lbs. . . . $14.95. Special 23-Channel Crystal Pack (46 crystals), GWA-14-2, reg. $137.50 value, only $79.95. CB crystals $1.99 each with any Heathkit CB transceiver order.
Other 242 In FREE Catalog!

New 30-Watt Transistor FM Stereo Receiver

31 transistors, 11 diodes for transparent transistor sound; 20 watts RMS, 30 watts IHF music power @ ±1 db, 15-60,000 cps; wideband FM/FM stereo tuner, two pre-amplifiers, & two power amplifiers; compact 3¾" H x 15¼" W x 12" D size. Assemble in around 20 hours. Mounts in a wall, or optional Heath cabinets (walnut $9.95, beige metal $3.95). 16 lbs.

Kit AR-14
$99.95
(less cabinet)

Best Hi-Fi News of ’66 . . . New Low Cost Transistor Stereo Twins!

New Transistor FM/FM Stereo Tuner
Assembles in only 4 to 6 hours! 14 transistor, 5 diode circuit; 5 uv sensitivity; less than 1% distortion; phase control for best stereo; 4-stage IF; filtered outputs; automatic stereo indicator light; preassembled & aligned "front-end". Install in a wall or either Heath cabinet (walnut $7.95, beige metal $3.50). 6 lbs.

Kit AJ-14
$49.95
(less cab.)

Matching 30-Watt Stereo Amplifier
Assembles in 10 hours! 17 transistor, 6 diode circuit 20 watts RMS, 30 watts IHF music power @ ±1 db from 15-50,000 cps; Handles tuner, phono, auxiliary. No audio transformers . . . assures lower distortion, minimum phase shift. Install in a wall, or either Heath cabinet (walnut $7.95, beige metal $3.50). 10 lbs.

Kit AA-14
$59.95
(less cab.)

Deluxe 6-Transistor AM Portable!

Surpasses miniatures in performance and economy! Boasts large 4" x 6" speaker for a crisp, bold sound; slide-rule dial; "thumb-touch" controls; smooth vernier tuning; tuned RF stage & double-tuned IF stage for greater sensitivity and selectivity; big ½" diameter rod antenna for distant station pickup; handsome black simulated leather case. Build in 4 to 6 hours. Uses long-life "D" size flashlight batteries (not included). 5 lbs.

Kit GR-24
$28.25

FREE 1966 Catalog!
Describes these and over 250 electronic kits . . . world’s largest selection. Mail coupon, or write Heath Company, Benton Harbor, Michigan 49022.

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Enclosed is $_______ plus shipping. Please send model(s)

Please send FREE 1966 Heathkit Catalog.

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CIRCLE NO. 14 ON READER SERVICE PAGE
SELLING YOUR TRANSCEIVER?
BUYING THAT AMPLIFIER?

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This, the largest readership in its field in the world, offers the perfect market for making contacts. It's possible a great many of these readers are practically neighbors of yours, yet it is only through the medium of our classified columns that your mutual needs may be met.

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SEPTEMBER ISSUE CLOSES JULY 1ST

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ELECTRONICS LIBRARY

ELIMINATING ENGINE INTERFERENCE
by John D. Lenk

If you're a ham or CB'er and have a couple of bucks lying around, get out and snap up this handy little book. John Lenk has been collecting information on mobile noise suppression problems for many years (he has written about this subject in POPULAR ELECTRONICS) and this volume is the distillation of his experience and library /reference facilities. If you have a noise problem in your mobile rig that he doesn't cover—get a horse.

Published by Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis, Ind. 46206. 118 pages. Soft cover. $1.95.

ELECTRONICS CONSTRUCTION TECHNIQUES
by George L. Ritchie

Detailed information on home or lab construction of prototype electronic equipment is contained in this workbook. Tools, chassis bending, layouts, and printed circuits are discussed as junior college level assignments.


ABC'S OF SILICON CONTROLLED RECTIFIERS
by Allan Lytel

Silicon-controlled rectifiers (SCR's) are finding increasing application in electric motors and production machinery, and in electric irons, mixers, motor-driven hand tools, and countless other items that are a part of everyday living. This book is intended to provide a basic knowledge of SCR's—how they work, what they can do, and where they can be used. Many typical circuits illustrating various applications are included.

Published by Howard W. Sams & Co., Inc., 4300 W. 62 St., Indianapolis, Ind. 46206. Soft cover. 128 pages. $1.95.

(Continued on page 30)
Hallicrafters' new CB-19 transceiver is about as sleek and trim and compact as an infantry boot.

That's why there's room for the "S" meter, the receiver tuning VFO, the king-size communications speaker and unsurpassed basic performance —for only $149.95

- 8 crystal-controlled channels. 23-channel receiver tuning with frequency spotting switch.
- Built-in, amateur-type "S" meter.
- All-electronic push-to-talk circuitry.
- Dual conversion, superheterodyne receiver. Superior sensitivity—less than 1 microvolt for 10 db S/N.
- Hallicrafters' exclusive "Racket Buster" built-in noise limiter.

Hallicrafters
5th and Kostner Aves.
Chicago, Ill. 60624


"Quality through Craftsmanship"

CIRCLE NO. 13 ON READER SERVICE PAGE
BASIC ELECTRICITY FOR ELECTRONICS
by Robert G. Middleton and Milton Goldstein

Here is an exceptionally well-prepared and comprehensive book for the hobbyist and electronics experimenter. The breadth of the material contained in its 23 chapters is a little awesome. Although written to illustrate "electricity" in "electronics," this book turns out to be one of the very best beginner's texts that has crossed our desk in many a day. Everything in it is up to date and has been written with a distinct "feel" for the novice experimenter, or anyone who might need a refresher course in the fundamentals of both electricity and electronics.


ELECTRONIC BRAINS
by Rolf Lohberg and Theo Lutz

This book—originally published in Germany—is a non-technical explanation of the how and why of electronic computers. The reader is carefully guided along in an entertaining, but very elementary, fashion. Ideal for junior high school level students and readers.


FREE! HOW TO IMPROVE YOUR TWO-WAY RADIO!

The right communications microphone may double the talk power of even the finest transmitters! Learn how unwanted noise can be eliminated—reliability improved—intelligibility increased by proper microphone selection.

Write for our helpful free booklet today!

ELECTRO-VOICE, INC., Dept. 762P
630 Cecil Street, Buchanan, Michigan 49107
Please send the free E-V booklet on choosing communications microphones. I am interested in the following areas of two-way radio: _Amateur_, _Aviation_, _CB_, _Business_.

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COMPANY ________________________
ADDRESS _________________________
CITY __________________ STATE ______

CIRCLE NO. 9 ON READER SERVICE PAGE

POPULAR ELECTRONICS
NOW...GET THE FINEST REO TEST RD ever produced for just $4.99 each for A

UNIQUE FEATURES OF HIFI/Stereo REVIEW'S MODEL 211 STEREO TEST RECORD
- Warble tones to minimize the distorting effects of room acoustics when making frequency-response checks.
- White-noise signals to allow the stereo channels to be matched in level and in tonal characteristics.
- Four specially designed tests to check distortion in stereo cartridges.
- Open-air recording of moving snare drums to minimize reverberation when checking stereo spread.

All Tests Can Be Made By Ear
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NEW LITERATURE

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Computer-programmed in a matter of minutes, the 1966 Cartridge Replacement Manual released by Sonotone Corporation cross-references a total of 5700 cartridges. Sonotone cartridges are related to competitive cartridges in Section I, to phonographs in Section II. All listings are arranged in alphabetical order and there is an index for fast and easy reference. While the three-hole punched manual carries a price of 50 cents, it is being offered free for a limited period of time.

Circle No. 86 on Reader Service Page 15

A condensed 20-page "Catalog of Compactors" has been announced by General Electric Company. Ninety-seven GE compactors and their essential characteristics are listed and compared to conventional tubes. Advantages cited for the compactors are economy, space savings, higher reliability, ease of connection, and higher voltage capabilities.

Circle No. 87 on Reader Service Page 15

Over 4000 useful home, hobby, workshop, photographic, scientific, and educational items are represented in Edmund Scientific's latest catalog, No. 865. Among the products featured are their new vacuum base, a vacuum-base vise with removable metal jaws and slipover rubber jaws, a fully transistorized metal detector, flip-flop computer toy, diffraction jewelry, and a wire bending-cutting jig.

Circle No. 88 on Reader Service Page 15

The 1966 Summer Catalog put out by Lafayette Radio is now available. Within its 110 pages you'll find auto tape players, marine accessories, and garden tools, in addition to the complete line of CB 2-way radio, hi-fi equipment, cameras, power tools, amateur gear, and many other interesting items.

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Kraeuter & Co., Inc., has a 20-page catalog describing the complete line of Kraeuter tools. Those shown include a broad selection of solid joint pliers, alloy wrenches, slip joint pliers, snips, wrench sets, punches, and chisels.

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CIRCLE NO. 15 ON READER SERVICE PAGE
CAPACITOR KNOW-HOW
SIMPLIFIES ELECTRONIC PROJECTS

Many electronic projects are assembled with newly purchased capacitors, and many with capacitors already on hand. Sometimes you can get the exact capacitor specified in a project's parts list and sometimes you can't. What

A practical approach to the selection of fixed capacitors

By C. G. Cunningham
do you do when you can't get the called-for capacitor? Do you accept a substitute? Or do you abandon the project? 

There's no need to abandon a project, and there's no reason to lack confidence in selecting a proper "or equivalent." Quite often you can save some money by using a substitute, and in some instances, even come up with an improvement in the circuit.

Of course, the closer you can get to the required capacitor's ratings and characteristics, the better. But what ratings and characteristics are significant? Chances are that you would answer "capacitance and working voltage." While this is essentially correct, it's only a starting point. Physical size of the component and method of mounting are important, especially if chassis and cabinet space is small, or a printed circuit board is used.

Still other capacitor characteristics should be considered—stability and several different types of losses, and how they are affected by different operating conditions such as: environment (heat, moisture, vibration); circuit applications (bypassing, filtering, coupling, d.c. blocking, timing); and types of circuits (r.f., audio, high voltage). Price is not a characteristic but it may be a factor. However, the knowledgeable experimenter should be able to take all of these things in stride and have no difficulty in selecting a proper capacitor.

The task of selecting a capacitor is really quite simple if you are duplicating a circuit or building a project from instructions in which all the values are given, and a specific type is called for. Your main concern in this case, if you can't get the exact component, is how far from the specifications you can go, and in what direction, without getting into trouble. Sometimes you can get by with a higher value, sometimes with a lower one, sometimes with either a higher or a lower value. And sometimes you have no choice: you must put your value money right on the nose. (The term "value" is used here rather loosely and refers to various capacitor characteristics, not just to capacitance.)

A few tricks of the trade are revealed here. In most cases it is possible to fit capacitors into a chassis or printed circuit board by laying them flat, standing them on end, or suspending them between two terminals. Most commonly used shapes are tubular (A), rectangular (B), and disc (C). The electrolytics (D) are also tubular in shape, but because of their massive size often require special mountings, such as straps, brackets, sockets, etc. True, you can usually identify the type of capacitor by its appearance, but not all rectangular types are mica, nor are all tubulars paper. Even the experts have to check the specifications.
On the other hand, if you are designing a circuit, especially if you want the circuit to lend itself to mass production or easy duplication, you should select a "design-center" value within normal capacitor tolerances to avoid the need of having to try out a large number of capacitors before you find one that will work in your circuit. While you can use a "cut and try" type of technique to select a capacitor, there's less chance of swapping transistors, resistors, and other components for smoke if you know what you are doing.

One or more of four factors—cost, size, loss, and stability—make the choice of a capacitor for a power supply filter entirely different from one for an oscillator circuit. Even if these two types of circuits called for exactly the same capacitance and voltage rating, you would usually select different types of capacitors for each circuit. For example, the power supply filter capacitor can usually afford fairly high losses and its capacitance need not be particularly stable. This is a far cry from the prissy high-Q factors, and are largely a matter of degree—what may be inexpensive to you may be priced too high for someone else, and what may be too big for one project may fit perfectly into another. However, if a comparison is made on the basis of capacitance or working voltage, a relative indication of price and size can be obtained. It is obvious that capacitor design and materials used should be adequate to withstand both the d.c. potentials as well as the a.c. peak voltages. It's good practice to select a component that can withstand at least one and a half times more voltage than would normally be handled in the circuit.

CIRCUIT APPLICATIONS

The same circuit applications in different types of circuits call for different types of capacitors. It is not unusual to parallel a 40-µf. electrolytic in a power supply filter with a 0.01-µf. paper tubular or ceramic type. Normally you would expect the big 40-µf. unit to handle everything above 60 cycles with ease, especially the higher frequencies. It

Tantalum electrolytic capacitors are noted for stability, low loss, high capacitance in a small container, and high price. At present, they are used mostly in miniaturized military electronic equipment, but it will only be a short time before more of them will get into consumer channels, perhaps at a lower price.

component required by the tuned circuit of an oscillator, which demands reasonably constant capacitance to keep the oscillator frequency from wandering all over the spectrum.

Briefly, and without getting involved in the chemistry and physics of capacitors, here's a "broad-brush" way to consider what's important. Physical size and price of capacitors are easily discernable doesn't quite work out that way for the big electrolytics. The small unit is installed to bypass any high frequencies that can't get by the electrolytic.

Even the same capacitor may act differently depending on how it is installed. Lead length and lead dress can be critical factors in high-frequency circuits. It's a good practice to keep lead lengths as short as possible.
Filtering. As opposed to coupling, filtering is essentially a bypassing function to remove all or part of an a.c. component and put it where it will not adversely affect a circuit. This action is used to smooth out the ripple voltage in a power supply rectifier circuit, as well as to put various tube and transistor elements at a.c. ground potentials without disturbing d.c. voltages. Since the purpose here is to get rid of as much of the a.c. component as possible, larger capacitance values are desirable. If capacitance is too small, the lower frequencies may not be bypassed. However, there may be times when it is desired to bypass only a portion of the a.c. component without materially affecting another portion.

A common practice in certain audio amplifier circuits having both high and low frequencies present is to remove some of the highs simply by placing a small capacitor across the output load. In this case, the capacitance value must be just large enough to bypass the “undesirable” highs. (Too much capacitance will rob you of the low frequencies.)

Coupling. Instead of bypassing the a.c. component to ground as in a filter, coupling is simply a process of passing the a.c. component (signal) from one point to another. Here again, the larger the capacitance, the easier it is to pass the lower frequencies. If money and space are limited, there are certain practical limits that can be taken advantage of.

In most coupling functions a certain amount of voltage divider type of action takes place between the capacitor and other circuit components. If the coupling capacitor has a relatively low impedance as compared to the resistors, coils, tubes, or transistors in the immediate vicinity of the capacitor, the capacitance will appear to be large enough to handle the low frequencies. (The larger the capacitance, the lower the impedance.) In high-impedance tube circuits, a 0.01-μf. capacitor will work just as well as a 10-μf. capacitor in a low-impedance transistor circuit.

Regardless of the type of circuit, if B+ is present on one side of the capacitor and bias voltage is present on the other side, the capacitor must serve as a d.c. blocking device to prevent confusion of d.c. voltages.

Timing. Oscillators, tuned circuits, and other timing networks usually require an exact amount of capacitance and high stability. Temperature coefficient (TC)—the rate of change of capacitance with temperature—should be low, or controlled. Most tuned circuits require a low-loss type of capacitor.

Energy Storage. This covers a multitude of applications ranging from a.c. pulse circuits to battery-powered flash bulbs. Most TV sync circuits use energy stored in a capacitor to trigger the vertical sweep oscillator. How often have you seen the picture start to roll after a set warms up? You could use a fan, but it is more practical to obtain a temperature-
stable component. Capacitors used in this type of function must have little leakage and must be able to retain the potentials developed across them long enough to work related circuits.

**TYPES OF CAPACITORS AVAILABLE**

With the advent of the space age and the growing body of knowledge about new materials, the number of different types of capacitors has mushroomed like weeds. It used to take a lifetime to learn all about resistors, but with capacitors it conceivably will take a little longer.

**Impregnated Paper.** Two pieces of foil are rolled between and separated by double sheets of paper impregnated with wax or oil. Characteristics depend upon the impregnating material and size of the foil.

This type of capacitor is inexpensive and small, and is usually tubular in shape. It has high insulation resistance, fair stability, and moderate losses—losses increase with temperature and frequency. Voltage rating decreases at high operating temperatures.

Impregnated paper capacitors can be used as filters and couplers in most circuits. Capacitance range is 0.001-µf. to 20 µf., with voltage ratings up to several kilovolts.

**Impregnated Paper/Plastic Film.** Generally available and similar to the impregnated paper type, except that one layer of paper is replaced by a layer of plastic film to improve insulation resistance and increase temperature operating range, this type of capacitor has a longer life, slightly higher cost, and is similar in size, ratings and applications to its paper mate.

**Metallized Paper or Plastic.** To reduce physical size, a metallic film is deposited on opposite sides of impregnated paper or plastic film and rolled up. Usually, only one layer of dielectric is used.

This type of capacitor has a self-healing characteristic: an arc at a defect in the dielectric simply evaporates the metallic film until there is no place for the arc to continue. Small size is the chief selling point.

Metallized capacitors have lower insulation resistance, higher losses, tend to be less stable, and cost more than the other impregnated paper types. Should they arc internally, they will be too noisy and unsuitable for coupling noise-sensitive circuits. Available from 0.01 µf. to 20 µf., up to 600 volts, they are best restricted to filtering and bypassing functions in tight places.

**Plastic Film.** Plastic film is used here instead of impregnated paper. Insulation resistance is extremely high, losses are low and nearly independent of frequency, stability is excellent. These capacitors are larger and more expensive than the paper types, and may not be usable at high temperatures. Available from 0.001 µf. to 1 µf., with voltage ratings up to 2000 volts, they can be used in most circuits.

**Mica.** An old-timer, mica has superior insulating qualities and can be used in very thin sheets. Either separate layers of foil or thin metallic films deposited directly on both sides of the mica are used as plates. This type of capacitor is usually sealed in a plastic case, and has excellent high frequency, low loss, excellent stability, and high voltage ratings.

Mica capacitors can be manufactured with great precision, but capacitance changes with temperature and large values are expensive. They range from 5 pf. to 0.1 µf. with voltage ratings up to 2500 volts. (Special types are available with much higher ratings.) No restrictions on use.

**Ceramic.** A metallic coating is deposited on opposite sides of a ceramic disc or tube. The dielectric constant (K) of the ceramic material determines most of the capacitor's characteristics.

Low-K capacitors have low loss, high stability, and excellent high frequency performance. An outstanding characteristic is controlled capacitance change with temperature; this change can be made zero or some known value to compensate for temperature-caused changes in value of other components. Low-K capacitors are fairly small and inexpensive. Capacitance is limited to about 1000 pf. No limitations on use.

Medium-K ceramic types provide higher values of capacitance and have fair

June, 1966
stability (about 20%). Large capacitance changes can occur outside the rated operating temperature range. High-voltage types having moderate losses are available and insulation resistance is high. Medium-K capacitors are small and low priced. Ratings range from 1.5 pf. to 0.15 μf., up to 5000 volts. Use should be restricted to filtering and coupling.

High-K ceramic capacitors pack a lot of capacitance into a small package. Insulation resistance is good, and they are inexpensive. However, losses are fairly high, and capacitance is unstable and can change value readily. Capacitance range is 0.001 μf. to 0.1 μf., up to 1000 volts. High-K capacitors are usually rated in terms of guaranteed minimum capacitance and are very useful for filtering, bypassing, and decoupling.

Electrolytics. Electrolytic capacitors did much to further the use of single-phase motors and a.c. power supplies for electronic circuits. In transistor circuits they have assumed renewed importance. They are famous for packing the most capacitance into the smallest volume of space.

These units are made by "forming" an exceedingly thin oxide layer on a metal plate and immersing it in a conducting electrolyte solution. The forming process is a very interesting and easy one to understand. Because it plays such an important part in actual use, and because it more or less takes place every time you flip a switch, its "chemistry" is presented here briefly. It is a process similar to electroplating.

A metal plate, most often aluminum, is immersed in a chemically related solution, and connected to one side of a d.c. power source. The other side of the power supply is connected to the solution (electrolyte). As current flows, an incredibly tough oxide film is plated (formed) onto the metal. Since the oxide is an excellent insulator, it virtually stops both the flow of current and further plating action when the coating becomes thick enough to withstand the applied voltage. The higher the applied voltage, the longer the plating action and the thicker the oxide coating.

It should now be easy to appreciate why the capacitor's voltage-handling abilities depend on the forming process. Because the oxide film is an insulator in only one direction, polarity of electrolytic capacitors must be observed. The polarity of the applied voltage determines the capacitor's polarity. (Polarity markings on paper tubulars merely indicate which terminal is connected to the outside foil.)

One precaution should be observed when forming a capacitor either for the first time or after it has been out of service for a long time. Until the capacitor is properly formed, it will draw a relatively large amount of current—the higher the applied voltage and the less formed the capacitor, the higher the current flow. High current usually causes

Coupling capacitors C1 and C3 in a transistorized audio amplifier generally require higher values than their counterparts in a tube circuit. Bypass capacitor C2 is not critical, but must be very high in value to prevent low-frequency degeneration. The main reason for the higher values is that transistors have a lower impedance.

Value of C1 is critical here—both capacitor and coil determine the frequency of this Hartley oscillator. Capacitors C2 and C3 merely serve as d.c. blockers and should be high enough to offer very little impedance at the operating frequency. As with most coupling capacitors, C4 blocks d.c. and should be large enough to easily pass the signal.
Disadvantages are high heat and possible destruction of the capacitor. An easy way to control the situation is apply a small amount of voltage at the start of the forming process and gradually increase it to the desired rating. Some capacitors will form quicker than others—you can monitor both temperature and current while judiciously increasing the voltage.

Understanding the forming action is also important if you use electrolytic capacitors in solid-state circuits, or in circuits that remain off for months at a time. The oxide film is not perfectly inert. When it remains in contact with the capacitor's electrolyte for long periods of time, with no current flow, it slowly dissolves. This decreases the thickness of the oxide coating and, correspondingly, its voltage rating. Therefore, a 15-volt electrolytic that has been stored for a few months may really be the equivalent of a 10-volt unit.

If an electrolytic is connected in a circuit (for instance, as a coupling capacitor between the collector of one transistor and the base of another) with 15 volts across the capacitor, substantial current can flow, sometimes enough to destroy the transistor. In fact, if the same 15-volt electrolytic is used in a circuit with only 10 volts across it, it eventually becomes a 10-volt capacitor. The "extra" oxide is dissolved into the electrolyte.

Small size and low price are the main advantages of this type of capacitor. Disadvantages are high losses, great in-stability, and limited shelf life. Electrolytics are available from 0.5 to 150,000 μf, up to about 500 volts. There are some units marketed with 700-volt ratings. They are best suited for filtering and brute-force energy storage. When properly used, they can serve as coupling capacitors.

The disadvantages of electrolytic capacitors have been overcome by the prince of the breed, the tantalum electrolytic. At restricted voltages and temperatures, this type of electrolytic is nearly as good as an impregnated paper capacitor. However, it commands a princely price for these favors.

Other Types. There are many other capacitor types. Their variations and combinations usually result from the need to perform in highly specialized sophisticated circuits in environments other than one in which man can live and breathe. There are oil, vacuum, glass, and air types, just to name a few.

Just as ceramic has achieved broad use in the past few years, it is quite reasonable to expect that newer materials will exhibit still more desirable characteristics. Actually, hopefully, this may simplify the problem of capacitor selection rather than complicate it. Someday we may have an ideal capacitor, small and inexpensive like an electrolytic, but with the low losses and high stability of the low-K ceramic type. It could make the rolls of foil and paper as rare as the Leyden jar.

![Diagram of Circuit](AmericanRadioHistory.Com)
IF YOU THINK that putting a fence around your swimming pool and locking the gate—and praying—is all that you, or anyone else, can do to keep out determined youngsters hell-bent on scaling the fence for a dip the moment your back is turned, you are wrong! You can build and install a splash alarm that’ll warn you the instant anyone enters—voluntarily, or falls into the pool—accidently.

With the alarm—equipped with a buzzer or a bell—located inside your house, or on your porch or patio, you simply install the sensor probes $\frac{1}{8}$" or so above the surface of the water. Then, if the water rises, or splashes on the probes—even for a split second—the alarm sounds, and stays on until you turn it off.

By FRED MAYNARD
Motorola Semiconductor Products, Inc.

It’s almost like having an around-the-clock guard keeping an eye out for you.
Fig. 1. This innocent-looking pool alarm circuit can be set off by just a splash of water to warn you that an intruder has entered your swimming pool.

How It Works. The alarm circuit (Fig. 1) consists of transistors Q1 and Q2 in a modified Darlington configuration, and Q3, acting as a relay latch. With switch S1 closed and the probes in an open-circuit condition, Q1 and Q2 remain essentially off. Transistor Q3, reverse-biased through the upper contacts of relay K1, is also in an off state. When the probes are activated or short-circuited—by water or otherwise—Q1 and Q2 are instantly turned on, causing a heavy current to flow through the relay coil. This pulls in the relay to set off the alarm.

Now, let’s see what happens if the probes are open-circuited once more. With the relay upper contacts released from the base of Q3, this transistor is turned on by the forward bias developed across R1, and will continue to conduct as long as there is battery voltage. Since the emitter current flows through the relay coil on its way from the battery, the relay remains energized and the alarm stays on.

Thus, the only way to turn off the alarm is to switch the switch. The alarm is reset by closing the switch once more. Diode D1 protects Q1 and Q2 from reverse-current surges from K1.

Construction. The complete alarm circuit can be mounted in a 5" x 4" x 3" Minibox as shown in Fig. 2. Switch S1 is mounted through a cutout on the front of the chassis, and the batteries (four D size cells are used here, but any 6-volt unit will do) are mounted on the inside wall.

The buzzer is shown mounted on a piece of 1½" x 3½" perforated phenolic board that also holds the other circuit components. However, any other convenient mounting arrangement will do.

Since the circuit layout is not critical, the parts can be mounted in any order to

(Continued on page 97)
$2 INTRUSION ALARM

BLAST OF SOUND
GREETS ANY UNWELCOME VISITORS

That's right! For a two-dollar bill you can build a portable, dependable, effective alarm. It gives forth with a strident honk whenever a door or window to which it is connected is opened or moved.

The heart of this warning device is the innards from one of those cheap (79¢) bicycle horns seen in auto supply and novelty stores. These horns consist of a very loud honker, a single "D" cell holder, and a push button. While you're in the auto supply store, also purchase one of those tubular cans of tire patching material.

Cut a \( \frac{3}{4} \)" hole in the metal lid of the tubular can and solder the horn-battery unit to the inside of the lid. Then substitute for the horn button a glass tube mercury switch which is available from most electrical supply houses.* Attach the switch to the battery holder in such a position that the mercury closes the contacts and blows the horn when the unit is tilted from a vertical position.

When you place the alarm upright against a door (in the direction it opens), opening the door will knock the alarm over and sound a warning. If the door opens in the opposite direction, a length of string looped from doorknob to alarm will pull the alarm over. Similarly, a length of string from the alarm to a window will pull it over when the window is opened.

You can also attach the alarm to the door of a cabinet, the lid of a storage chest, a power tool you don't want moved, or anything of this kind. Its small size makes it very handy to take on trips (remove the battery first) for use on those poorly secured hotel and motel doors. And you'll probably think of many other uses for this two-buck alarm.

—R. L. Winklepleck

*Mercury switches are also available from Poly-Paks at about three for a dollar.

AmericanRadioHistory.Com
INEXPENSIVE INTEGRATED SOLID-STATE STEREO RECORD PLAYER

Cool, compact amplifier fits into record changer base

By JAMES E. ROHEN

ONE MAJOR TREND these days in hi-fi circles is towards integrated sound systems in which all components are in one cabinet. This trek towards compactness has been considerably aided by the availability of small all-transistor amplifiers that run cool and sound good.

The push-pull amplifier used here has 10 transistors, measures only 8½" x 6" x 1½", puts out about 8 watts (music power), and has a frequency response of 30 to 20,000 Hz. It costs only $19.95. According to the Burstein-Applebee catalog, the amplifier is marked down in price because of factory overproduction, and is a high-quality import. It requires only 10 volts a.c. for power, which can be obtained from a transformer selling for $1.00. See Parts List on page 52.

Assembly. You can spend an evening assembling a compact integrated stereo record player and enjoy many years of record listening. All you have to do is drill a few holes, mount a few components, and solder a few connections. The completed unit is adaptable to AM and FM tuners, tape decks, etc.

Connect the step-down transformer to the a.c. line through the record changer on-off switch to automatically shut off the amplifier after the last record has played. If you intend to connect a tuner to the amplifier, use a separate on/off switch to allow operation of the tuner without having the record changer running.

No dimensions are given for location of the holes in the changer base as different changers have different size bases, and different clearances inside the base. The bezel plate furnished with the amplifier can be used as a template for marking the position of the front panel controls. The transformer and other switches can be placed wherever they will fit. Before cutting any mounting holes, let the changer run through a change cycle to be sure that there is enough clearance between the amplifier and other components you install and the record changer mechanism.

Optional Features. A pilot light, and speaker channel and speaker phase reversal switches are optional items, but do much to enhance the record player's versatility and ease of operation. The wiring diagram shows how to hook up these switches.

The speaker channel reversal switch is handy when a friendly neighbor comments that the French horn is playing on the wrong side of the orchestra. The phase reversal switch enables you to quickly change the phase of the speaker in one stereo channel to agree with the phase of the speaker in the other chan-

July, 1966
Switches add versatility. You can instantly flip right and left channels, as well as check and change speaker phase, with S2 and S3 respectively. Stereo/mono switch S4 “desensitizes” cartridge to vertical stylus motion in mono position—a desirable feature for mono recordings.

Parts List

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Pilot light (Drake indicator lamp, Tinnerman nut mounting)</td>
</tr>
<tr>
<td>S1, S4</td>
<td>D.p.s.t. toggle switch</td>
</tr>
<tr>
<td>S2, S3</td>
<td>D.p.s.t. toggle switch</td>
</tr>
<tr>
<td>T1</td>
<td>Power transformer: primary, 117 volts; secondary, 20 volts with center tap (Burstein-Applebee, Kansas City, Mo., 18B508, $1.99)</td>
</tr>
<tr>
<td></td>
<td>1—Push-pull amplifier (Burstein-Applebee, 30C27, $19.95)</td>
</tr>
<tr>
<td></td>
<td>1—Stereo record player</td>
</tr>
</tbody>
</table>

Solid-state stereo amplifier runs cool and is compact enough to fit into record changer base. Parts location is not critical, but adequate clearance for the changer mechanism must be provided. It’s a good idea to run the changer through a cycle by hand in order to check clearance requirements.

Proper phase is achieved when the sound is best.

A stereo-mono switch is also shown and is optional, but it can improve the sound from many mono records. When the switch is open, normal stereo operation is obtained. When the switch is closed, both channels are paralleled and the cartridge becomes effectively insensitive to vertical stylus movement. (Vertical stylus motion on a mono record can cause undesirable responses in a stereo cartridge.) All wires leading to the cartridge and stereo/mono switch should be shielded and grounded at one end.
THE CONNUBIALLY-ORIENTED COMPUTER OF OTTO TRONIX

ONCE UPON a time and place there lived a chronically-shy person named Otto Tronix. Otto was exceptionally brilliant in things electronic but woefully lacking in confidence where members of the opposite sex were concerned. His pathetic shyness was due, in part, to the fact that—having been raised in an all-male orphanage—Otto’s initial contact with girls hadn’t been made until he was 34 years old. Consequently, long after he’d embarked on a highly successful career as a Communications Theorist, Otto’s life was still a relatively lonely one.

As long as he was only conscious of matters electronic, Otto behaved beautifully—speaking articulately, impressively, and knowledgeably in a voice both cultured and pleasant. Faced by a member of the opposite sex, however, he instantaneously gave every sign of mental retardation complicated by symptoms of mild terror and utter confusion, usually expressed in a staccato of squeaks that would’ve shamed a tenor mouse.

Otto’s shyness threatened to restrict his entire future to long evenings devoted to sundry electronic projects, and his heretofore astoundingly brilliant work as a Communications Theorist began to show his inner stresses and strains. Many were the days when he was actually slow in differentiating a standard Hydronics Velociter from a simple 75-meter loading coil.

Finally, when Otto was thinking seriously about investigating the possible need for trained Communications Theorists in monasteries, a Good Friend inadvertently brought a solution to Otto’s morbid and seemingly hopeless situation.

“You oughta try one of them Scientific Marriage outfits, man,” the Good Friend babbled happily. “That’s how Emma and
me found each other! It's the only way to find a wife nowadays! Takes all the blind chance outa the whole bit, y'know?"

"It does?" Otto murmured.

"Sure! According to the Scientific Selection File on our Correlation & Validation Ratios, me and Emma got it made in all them areas where it really counts! I mean, like there's no gnawing-type doubts about our Dominant Leadership and Dependent Suggestibility Factors! We know where we stand in all that old static, man!"

"You're pretty happy, huh?" Sheer envy flowed through poor Otto's love-starved emptiness.

"Naw, we loathe each other, but a grand's worth of Statistical Analysis, Probability Graphs, and Interpersonal Compatibility Audits say we're right for one another—and who's gonna argue with them psychology experts now that the bill's paid?"

It gave Otto pause for thought indeed.

So enchanted was Otto by the possibilities this concept excited within his technically alert mind that he immediately applied for his annual vacation and retired to his dwelling—a garish apartment house in one of the better Southern California neighborhoods—where he began sitting moodily beside the huge, dollar-sign-shaped pool under the smog-filtered sunlight, cogitating upon the idea of, perhaps, building a Computer that would eliminate the time and testing factors while offering the swiftest, most efficient method of locating the right girl to share his life. He knew his Computer would have to be a radical departure from all the commonly accepted notions of Scientific Marriage Investigating—mainly because Otto was not only terribly shy, he was also militantly independent and more than a little original.

"By heavens," he muttered determinedly, "my Tronix Tru-Luv Tester will revolutionize the entire field—if it works! It'll not only select the right kind of wife for me but it'll also provide me with the right kind of profits from leases and royalties! A winning combination if I ever saw one forming within the unprinted circuits of my mind!"

To celebrate the emergence of this brilliant idea, he poured himself a generously-fortified drink, and was gleefully sipping it when the luscious and outrageously constructed Redhead who occupied the apartment opposite Otto's came switching into the patio, moving more hippily than nature had intended she should but inspired by the sight of Otto sitting poolside. Otto froze at the sight of her.

"Hi, Genius-boy!" purred the Redhead. "Looks like you've decided to come out of your shell and join the human race. Which is just marvy because I've had eyes for the likes of you ever since you set foot on the premises!"

She stopped, a mere twenty feet distant, but still moving here and there in a manner of speaking.

"GUK!" said Otto, blushing furiously. "Man, that's the wildest thing I've ever heard!"

"GUK-GUGGITY-GUK!" Otto politely stuttered, his twitching vocal chords fighting desperately to convey the blazing sense of welcome her presence sparked, and failing to accomplish more than spewed nonsense sounds.

"You're cute!" the Redhead decided aloud, gliding toward him. "Mysterious, too!"

"G-G-GUK!" wailed Otto, sprinting for the safety and silence of his own
apartment, where he huddled in convulsive despair and misery.

Burying himself in the labor of building the Computer helped ease his shame and the pain of loneliness as well as accelerate the construction process—and the entire unit was completed in less than a week. Consisting of items and components chosen from the depths of Otto's fantastic wellspring of electronic know-how—which had been gradually seeping into his consciousness from the long-ago day when he'd created a carbon resistor from pencil leads and old dry-battery anodes to the recent past when he'd received a special company award for his thoughtful paper, "Generating Plasmonic Signals Via the Use of Denture Plates"—the Tru-Luv Tester closely resembled a hi-fi set that thought itself a commercial jukebox. Which was not accidental since mass-production problems were clearly alive in Otto's planning throughout the entire designing period (ten hours spent hunched over a breadboard propped against a stack of books such as Super-Advanced Boolean Algebra For Restless Neurotics, Galena Crystal Theory & Application For Those Who Refute Current Practices, and Servomechanisms Are Something Else If Improperly Installed.

Operational procedure was simplicity itself. Once a subject was positioned before the Reception Screen and a button depressed, activating a Receive System, the Tester scanned the subject—electrooptically and electro-telepathically absorbing every aspect of the subject until the subject's personality and appearance factors had been fully established—and then automatically converted to an Analyze System, sending the information through sundry channels until the factors had been coded, recoded, decoded, evaluated, compared to norms installed previously (Otto's tastes and hopes), and diverting the refined data to myriad Memory Banks for future reference. At this point the Tester competently turned itself off.

When the Transmit System button was depressed, the Tester's built-in Audio-Expression mechanisms immediately began delivering salient facts from the Memory Banks, routing them through the Risk Calculator and the Interpersonality Capacitor, and eventually sending immensely condensed evaluations over a series of interlocking circuits to the Phase & Phrase Selector which was cunningly adapted to the Audio-Expression Speaker which, in turn, broadcast aloud clear-cut statements of scientific opinion.

Otto now tested the Tester by slyly depressing the On-Receive button short-
BUILD THE

MUSETTE

A true high-fidelity multichannel musical kaleidoscope for home entertainment

BY DONALD E. LANCASTER

More colorful than a performance of Swan Lake by Disney's spectacular dancing waters... more vibrant than any discotheque party you've seen...

"Musette," the color organ par excellence, swings and sways as it interprets your favorite tunes in delightful kaleidoscopic animation.

Unlike most low-cost, low-power, photocell-operated color organs (see article in POPULAR ELECTRONICS, March 1965, p. 43), Musette is truly a high-fidelity, high-power instrument. It separates the applied audio from your hi-fi amplifier, AM, FM, or FM stereo receiver into component frequency bands (hereafter called channels). Five such channel separations are provided to cover the full frequency range (see Fig. 1).

The output from each of the five channels can operate up to a 150-watt color purity spotlight to put on a spectacular dancing performance indoors on your wall or ceiling, or outdoors on a special display. For, Musette plays tunes in lights—instead of sounds—by translating the pitch, rhythm, and loudness of speech or music to corresponding variations of color, hue, and brightness.

As a five-channel spotlight control center, Musette can be used for dance hall or patio decoration, as stage lighting for the "Little Playhouse," or as an advertising and sales attraction.

If you are willing—and able—to tackle a really advanced project, and can afford to lay out the 80-odd bucks for materials alone, the building of Musette should prove to be a rewarding experience. If, on the other hand, you can't swallow

![Frequency response curves](image-url)

Fig. 1. These frequency response curves show the relative attenuation of each band of frequencies in the audio spectrum. The low channel can be omitted, if desired, with little effect on overall performance.
the high price tag in one gulp, you can still bite off, build, and use the unit one channel at a time, adding more channels when money and time permit.

For maximum utilization of the organ while building, you should start with the high and medium frequency channels. These channels cover a relatively wide range of instruments. Then you can tackle the medium high, medium low, and low channel, in that order.

**Fig. 2. Simplified schematic shows how an SCR can be made to fire in synchronism with the line frequency. Pulsating c.c. acts as trigger pulses.**

**Simplified Circuit.** To understand the inner workings of Musette, first consider the simplified lamp control circuit of Fig. 2. A lamp in series with a silicon-controlled rectifier (SCR1) makes up the load across the output of a full-wave rectifier (D1 through D4).

The SCR that controls the lamp is triggered by a pulsing circuit consisting of avalanche breakdown (trigger) diode D5, a capacitor charging circuit (C1-R1), and biasing resistor R2.

When the charge on C1 reaches 30 volts, trigger diode D5, interposed between the charging capacitor (C1) and the SCR gate, switches on, causing the capacitor to discharge and trigger the SCR. The ratio of on period to off period, and thus the average brightness of the lamp, is determined by the adjustment of R1, which establishes the charging time of C1. Thus, if D5 turns on the SCR at the start of each half cycle, the lamp will stay on longer than if the SCR is turned on later in that half cycle.

Now, if a negative voltage is applied to the cathode side of D5, the effect will be to pre-bias the diode so that it conducts and triggers the SCR earlier during each half cycle. The greater the negative bias, the earlier the SCR will be turned on, and the longer will be the on cycle that applies power through the lamp. Initially, potentiometer R1 is adjusted to set the lamp at a minimum brightness level. Then, any varying negative voltage across R2 will produce a corresponding variation in brightness levels.
Fig. 3. Overall circuit of five-channel color organ is made up of five basic circuits easily identified by individual input transformers (T1 through T5). Each circuit operates its own display lamp.
PARTS LIST

C1-C6—0.04-µf., 200-volt Mylar capacitor
C7—330-µf., 600-volt disc capacitor
C8, C17-C21—0.005-µf., 600-volt disc capacitor
C9—0.02-µf., 200-volt Mylar capacitor
C10—0.068-µf., 200-volt Mylar capacitor
C11—0.15-µf., 400-volt Mylar capacitor
C12-C18—0.1-µf., 200-volt Mylar capacitor
D1-D10—1N4001 silicon diode (or equivalent)
D11-D15—1N4003 silicon diode (or equivalent)
D16-D20—Texas Instruments T1-42 pinpin trigger diode, or Motorola MT 30 trigger diode
F1—6-ampere fuse (and fuse holder)
I1-15—117-volt, 150-watt interference filter spotlight (General Electric PAR38 DICHROROCOLOR in red, orange, yellow, green, and blue, priced at $4.98 each, and available from electrical supply houses—or any combination of incandescent 117-volt lamps not exceeding 200 watts per channel nor less than 10 watts per channel)
I6-19—28-volt pilot light (GE 313)—optional
J1—Phono jack
P1—6-prong, high-current cable clamp plug (Cinch Jones P-306-CCT)
R1—100,000-ohm, 1/2-watt resistor
R2—68,000-ohm, 1/2-watt resistor
R3-R7—5000-ohm, 5-watt wirewound resistor (Ohmite 995-SB-5000 or equivalent)
R8-R12—39,000-ohm, 1/2-watt resistor
R13-R17—Centralab TT-2 potentiometer, 200-ohm Twist-Tap mount, linear taper
R18-TT-52—Centralab TT-50 potentiometer, 250-000-ohm Twist-Tap mount, linear taper
RECT 1—10-ampere, 200-volt, single-phase, full-wave bridge rectifier assembly (Motorola MDA 962-3 at $4.53—and no heat sink required)
SCR1-SCR5—2N3528 silicon-controlled rectifier (RCA), 1.6 amperes, 200 volts
SO1—6-prong, high-current socket (Cinch Jones S-306-AB)
S1—S.S. slide switch, 6 amperes, 100 volts
T1-T5—Thordarson 24534 audio output transformer: primary, 15-20,000 ohms; secondary, 3.5 ohms, 5 watts (do not substitute)
1—8 x 0.1 x 4 1/2" cabinet (LMB CB-2, available in grey, brown or black)
1—Set of Tenite translucent knobs (10 knobs colored red, orange, yellow, green, blue, and milky white)—optional
1—6¾" x 2¾" printed circuit board**
1—7" x 3 1/8" x 3/4" aluminum sheet (for bracket)
4—Bayonet pilot light sockets (Lecraft 7-11)
Misc.—1/4"-high spacers (4), 3/4"-high spacers (8), #6 hardware, pop rivets, line cord (minimum 6-amp. rating), Heyco strain relief, wire, solder, display cable (Belden $467), swirl-type outdoor sockets for display lamps, plywood base and junction box, display materials, reflectors or diffusors, 0-terminal strip

*Set of 10 knobs available for $3 postpaid from Musette, c/o Arthur Emerson, 4229½ N. 23rd Ave., Phoenix, Arizona 85015

**Etched and drilled fiberglass circuit board (less parts) available for $3.30 postpaid from DEMCO, Box 16297, San Antonio, Texas 78216

to prefire D16 and vary the brightness of the spotlight in the anode circuit of SCR1. Diode D6 and capacitor C17 isolate the negative voltage from the SCR's gate. All other components operate as described for Fig. 2.

Operating power is obtained from the a.c. line, and rectified by the diodes forming the full-wave bridge rectifier. Pilot lamps I6 through I9 provide illumination for the special translucent knobs used in the project. The display lamps (I1 through I5) are connected in series with their respective SCR's through plug P1 and socket SO1.

If you are an old pro and can wire directly from a schematic diagram, you may—but need not—use a printed circuit board for component layout. Actually, the only advantage you get from a printed circuit board is the elimination of point-to-point wiring which usually requires more layout space. Since space is not likely to be critical in this instance, you may prefer to lay out and wire the small components on a perforated phenolic board, or even on a metal chassis if you are careful to isolate the power circuits from the chassis, and ground only those circuits that are

In practice, this negative voltage is obtained from a rectified and filtered audio signal by an action similar to that which produces the a.v.c. voltage in an AM receiver.

Actual Circuit. Now, let's look at the overall schematic of the five-channel color organ (Fig. 3). Each channel is identified by a separate input transformer (T1 through T5).

Except for the fact that each channel responds to a different portion of the audio spectrum, and thus each colored light represents a specific band of frequencies, all the channels operate in the same manner. Therefore, it will suffice to explain how a single channel operates. To make matters easy, let's discuss the channel at the top of Fig. 3. This happens to be the high channel.

Potentiometer R13, in the primary of input transformer T1, is used to adjust the sensitivity of the channel. Capacitor C7, together with the inductance provided by the secondary of T1, forms a parallel resonant bandpass filter. The audio across T1 is rectified by D1 and filtered by C2 and R8, a changing negative voltage that is applied across R8

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shown grounded in the diagram (Fig. 3).

If the author's design is followed, you will come up with a presentable unit that will work just as well as it looks. But you can vary the packaging, as preferred, without any degradation in the performance of the unit.

Whatever you do, don't substitute any other type of input transformer for T1 through T5, and be sure to use the exact value of capacitors specified for C1 through C7. The reason is that each transformer and its corresponding tank capacitor comprise a parallel resonant circuit which determines the frequency bandpass of each channel.

**Construction.** You can start construction with the circuit board, which should be etched and drilled as shown in Fig. 4. If you prefer, you can buy this PC board (see Parts List). Mount the components on the PC board as shown in the layout guide (Fig. 5), and then put the board aside temporarily.

Cut and form an aluminum mounting bracket for the controls and pilot lamps as shown in Fig. 6. Both the dimensions of the bracket and the spacing for the mounting holes are determined by the chassis enclosure selected.

After mounting the controls and the pilot lamps on the bracket, install the bracket on the chassis, following the spacing shown in Fig. 7. Carefully measure the shaft positions, and drill or punch out the front panel holes to accommodate the potentiometer shafts. If
you plan to use the recommended Tenite translucent knobs, bear in mind that each hole should be slightly larger than the knob diameter.

To avoid costly errors when drilling the front panel holes, make a cardboard template to use as a drill guide once you have verified all the dimensions. If you decide not to use the special knobs, make the front panel holes just large enough for the shafts. (In this case, the pilot lamps may be unnecessary.)

Finally, drill the mounting holes for the power switch in the front panel. If you don't have a rectangular punch, you can make the rectangular switch cutout by first drilling a large enough hole, and then filing the hole into a rectangular shape as required.

Now turn to the rear panel and determine a suitable layout for the input and output connectors (J1 and S01), the fuse holder, and the line cord strain relief. From Figs. 8 and 9 you can determine the best place to mount the full-wave bridge rectifier, as well as resistors R3 through R7 which are installed on the inside of the rear panel. Observe the mounting position of the terminal strip.

Install the circuit board on the chassis (see Fig. 8) using four spacers. The transformers are secured to the top surface of the chassis, between the front

Fig. 6. The pilot lamps and controls are first preassembled on the aluminum bracket which is then mounted 5/16" behind the front panel.

Fig. 7. Be sure to allow indicated spacing between aluminum bracket and instrument's front panel, to clear the pilot lamps.

Fig. 8. This fully assembled unit shows printed circuit board mounted on four standoff spacers. Run all point-to-point wiring to the controls and pilot lamps before installing the transformers.
panel and the circuit board, with #6 hardware.

After all the parts are installed, you can begin the point-to-point wiring. Start with the power circuit by completing the connections on the rear panel. Then wire up the four pilot lamps in series as shown in Fig. 3. Wire the transformer and potentiometer leads next. After you have made all connections shown in the schematic, start testing out the instrument.

Testing. With the power switch set to the off position, connect an audio line from the output of your amplifier (across the speaker voice coil or the 16-ohm speaker terminals) to the input jack (J1) on the rear panel.

Measure the voltage, in turn, across capacitors C2 through C6. Depending on the input voltage from the audio amplifier, and the setting of the respective SENSITIVITY potentiometers (R13 through R17), the voltage across each capacitor should be somewhere in the range between —1 and —16 volts.

Best operation is usually obtained with the sensitivity control set approximately 1/8 of the way up from minimum resistance. In any case, avoid turning any of the pots all the way up as this will only overdrive the channel.

After testing and adjusting the sensitivity of each channel, disconnect the audio input. Finally, connect a 25-watt incandescent test lamp from the hot lead going from output receptacle SO2 to the anode of one of the SCR’s. Apply input power and vary the corresponding BACKGROUND potentiometer (R18 through R22) to check the operation of the channel under test. The lamp should glow smoothly from minimum brightness to full brightness. Then set the potentiometer for minimum brightness. Check each of the remaining channels in the same manner.

Preparing a Display. A typical display arrangement is shown in Fig. 10. It is made up of five swivel-type outdoor spotlights mounted on a sheet of 13” x 27” x ¾”-thick plywood. The size of the board can be varied to suit specific applications. If the lamps are to perform inside a display, you can use either diffused (Continued on page 98)
HERE'S AN EXPERIMENT that's really wild. The man sez that fish—of all things—broadcast weird sounds in their own mumbo-jumbo lingo that you can pick up on a homemade Hydronics receiver costing less than ten bucks.

Who's the man? Wallace L. Minto, the Sarasota, Fla., scientist whose discoveries in Hydronics and Plasmonics were presented in the March, 1966, issue of POPULAR ELECTRONICS. According to Minto, the receiver will pick up signals in any body of water that has fish in it, if used during the time of day when fish are "broadcasting."

To pick up fish broadcasts on their self-assigned frequencies—170 Hz to 28 kHz—all you will need besides the re-

By JOHN D. DRUMMOND

July, 1966
Basic Principles. The strange sounds that fish make when they are "talking" to one another are referred to—scientifically—as hydronic signals. Fish, of course, also possess other sensory abilities and can communicate with one another in different ways. For this reason, you may not pick up hydronic signals every time you stick an antenna into the water.

For example, when the fish are resting in a brightly lit environment, where nothing much is happening, they usually turn off their transmitters and just take it easy. Limited broadcasts also occur during other unfavorable environmental conditions—such as sudden temperature changes. According to Minto's research—which includes experiments with over 130 species of fish—noise, low tide, or even a storm can alter their transmitting schedule as well as their broadcast frequencies.

Fish emit two basic types of signals: one can be called a ping, and the other a chatter. When observed on an oscilloscope, the ping has the appearance of the characteristic echo return on a radar "A" scope, as in Fig. 1(A). Notice that the ping starts out at a peak ampli-
Both the Hydronics receiver and its speaker can be housed in the same cabinet, as shown here. For concentrated listening, a microphone jack can be used.

The antenna is attached directly to the input of the amplifier. If you are using an amplifier that has more than one input, connect the antenna to the input which provides the greatest gain. You can use either a single-element antenna—made of one copper plate—or a dipole antenna with two plates separated by a T-shaped wood bar (Fig. 2). For use in labs and aquaria, the single-element antenna is said to provide reasonably good results, although the signal will be weaker than with the dipole. In open waters, the dipole provides a greater range. In salt water, further signal improvement can be obtained by using an input transformer between the antenna and the amplifier.

When the dipole antenna is used, the end of the wood should be pointed towards the expected signal source. When the single-element antenna is used, the plate is turned in different directions until a signal is picked up.

The best way to hear fish emissions is to first record them on tape at, say, 15 ips, and then play back at the much slower speed of 1½ ips. This procedure also allows you to observe and study the waveforms oscillographically.

If your rig works, tell us about it. If not, forget it.

July, 1966
TERRAIN PROFILING—
The “Geodolite” is a laser distance measuring device that has an accuracy of a small fraction of an inch per mile. Developed by Spectra-Physics, it uses a modulated light beam from a continuous-wave gas laser and provides analog or digital readout of phase difference comparisons between transmitted and returned beams. At right, the chart shows a profile (along the horizontal black line in the photo) of a row of houses recorded while flying over Atlantic City at a speed of 180 knots and at an altitude of 600 feet.

LOOK, NO ELECTRODES!—An instrumented chair developed by Philco Corporation monitors vital body functions while the “patient” sits comfortably with her hands on conductive armrests. The upholstery of the chair contains a series of electrical pickups which serve the same purpose as strapped-on electrodes.

LOST AT SEA?—Containing transistorized microcircuits fabricated by ITT Federal Laboratories, miniature “Omega” receiver enables a ship to determine its location within half a mile at a distance of 5000 miles. These receivers are being built for use on U. S. Navy vessels around the world.
PUSH-BUTTON MEALS—Hot dogs, cheeseburgers, fried chicken, milk shakes, etc., are prepared automatically to order by American Machine & Foundry Company's new "AMFare" system. A computer called "ORBIS" (for ORdering and Billing System) receives customer's order, prints check, directs food and drink producing machines.

GIANT RUBBER NOSE—Big as a bungalow, and weighing nine tons, rubber nose attached to keel of U.S. Navy Destroyer "Willis A. Lee" is actually a giant sonar dome which protects sensitive sonar equipment housed below ship's water line. Made by B. F. Goodrich Aerospace and Defense Products, the dome has inch-thick rubber walls with acoustical properties similar to those of sea water, permitting sound to pass through with minimum distortion.

PORTABLE TV RECORDER—Now in production at Westel Company, Redwood City, Calif., is the world's first portable, battery-operated tape recorder. It weighs only 30 pounds including vidicon camera and power/recording module, and it will shoot 30 minutes of broadcast standard video with on-location audio.
As with a musical instrument, with practice you can make the air waves sing

By MARSHALL LINCOLN

If you operate in the amateur CW bands, you know that the sounds of the Morse code sent by many hams bear only a slight resemblance to the precise signals sent during the W1AW code-practice transmissions and those on your code records or tapes. Many operators fail to observe proper spacing between letters in a word and spacing between words. IF YOU ARE LUCKY THEIR Sending IS AS EASY TO READ AS THIS LINE OF TYPE. Other hams are apparently “rock and roll” fans. Some dashes are long; others are short. One word is sent fast, the next word is sent slow; or their dashes are sent at a sedate 10 wpm, but their dots rattle in your headphones at 30 wpm.

You have undoubtedly complained about these and other sending faults, but are you sure that other hams aren’t just as unhappy with your sending as you are with theirs? Before denying such a possibility, you should tape a sample of your transmission and then about a day or two later, listen to a replay of the tape. If you can copy your own fist, chances are you are in good shape. But if it sounds like a lot of garbage, or you swear that it isn’t you, or that you think your tape recorder distorts your signal, then you are eligible for membership in the fraternal order of Unfriendly Fists Anonymous.

Possibly, if all of us took a more critical look at our own sending, there would be fewer unanswered calls. Let’s briefly review the rules for good sending and take off from there. Like a spoken language, the Morse code is a coherent combination or grouping of sounds that make up a letter, word, or phrase. The letter “V” is not just three dots and a dash—it’s more like the opening bars of Beethoven’s Fifth Symphony.

Learn To Receive First. The experts generally agree that you should first learn...
to receive before you begin to send. If you start using a key before you know what good code sounds like, you're likely to form some bad habits which you'll have to unform later.

Where's a good place to find good code sounds? Probably the best is on the air—from a station sending CW from punched tape. This "machine code" is usually perfect, since it is untouched by human hands. Even if it's too fast for you to read most of it, you should be able to catch enough characters to sense the rhythm, and proper combination of sounds. Code practice records and tapes are also sources of good sound, and they better serve your purpose because they start with slow speeds, say 2 or 3 wpm, and work up to speeds of 20 or 30 wpm, or more.

Once you have learned to receive at least 5 wpm, you are ready to hook up a key to a code-practice oscillator and begin to learn how to send. The trick is to imitate as closely as possible the perfect code you've been listening to. No one expects you to measure off each dit and dah you send to be sure they fit a master plan, or timing sequence of dots, dashes and spaces. Such a plan is illustrated above; if you keep it in the back of your mind, it will help you considerably.

The length of the dit is the basic unit or time element. A dah is equal in length to three dit's. Spaces between dit's and dah's equal one dit. Spaces between letters in a word equal three dit's, and spaces between words equal seven dit's.

Key Adjustment. Your task will be easier if your key is properly adjusted. A good rule of thumb recommended for beginners is to set the gap adjustment screw on the key to obtain about 1/16" space between contacts. More experienced operators prefer less spacing. The smaller the space, the less distance your fist has to travel. But trouble begins and erratic and garbled sounds become the keynote when the gap is made too small. Spring tension should be adjusted to obtain comfortable but positive action.
If the tension is set too stiff, you will tend to clip your dit's and dah's; they will sound staccato—like a machine gun, instead of like a rhythmic language. Also, too much spring tension is likely to give you a quick dose of hand fatigue. If the spring tension is too light, your characters will have a tendency to run together.

Your Operating Position. There's an old axiom that says something to the effect that if you slouch down in your chair, your code will automatically become as sloppy as your posture. Sit up straight; not stiff as a ramrod, but comfortably erect. Put both feet flat on the floor.

Rest your forearm, right up to your elbow, on the table, straight back from the key. Not enough room on the table for that much arm? Then move things around so that there is room. You're arm acts as a support for your wrist. Your wrist is used as a lever, and it should not rest on the table. When in action, it bobs up and down slightly. Most of the action takes place in the wrist itself, causing your fist to move the most. Your fingers, once they grip the key, do not move around as if you were playing the piano or a violin.

The right way to grip the key knob, like the right way to adjust the key, is whatever way helps you to send good code comfortably. The way generally recommended is to have your thumb, first finger, and middle finger surround the knob as shown on p. 68. Your third and fourth fingers are allowed to rest in a relaxed position curled partly into your palm. Your fingers grip the key gently, and at all times.

Keep your wrist flexible. Don't let it tense up. When you press down to close the key, your wrist should spring up slightly. When your fingers come up with the key, your wrist should move down. Sounds backwards at first, but with a little practice you'll get the swing of it and find that it's quite comfortable.

Tips on Sending. Here are a few words of wisdom from the experts.

Don't rush your dit's. Keep the spaces between them the same length as the spaces between the dah's.

Don't send choppy code, with the dit's and dah's clipped. Just let 'em roll out at a smooth, even pace.

Don't force yourself to send fast. Your speed will build up gradually as you get more practice.

Don't try to send faster than you can receive.

Do take pride in your sending. Your reputation will be no better than the quality of your fist.

So You Want To Man a Bug. Well, there's certainly no harm in it. A lot of
very capable operators do just that. But, don't rush this step like too many fellows do. Don't believe that all hot-shot operators use a bug and you'll never amount to anything if you don't use one too. It's awfully easy to make a pest of yourself on the air with a bug if you don't know how to use one properly. As a general rule, you shouldn't use a bug on the air until you are able to send and receive at least 13 wpm.

Here's what the Air Force, in its tech manual on Morse code, says about sending with a bug, "The bug is designed to make sending easy rather than fast, and perfect control of the bug is far more important than speed."

A bug relieves you of the work necessary to form more than one dit in a sequence of dit's. All you do is move the bug paddle to the right and hold it there. The reed vibrates and whips out dit's like there's no tomorrow. When you get all you need (and no more), you relax your touch on the paddle and the reed stops vibrating. Dah's are formed individually by moving the paddle to the left, and then releasing it.

Posture and arm position are essentially the same as for a straight key. To move the paddle left and right, roll your arm from side to side. This helps produce proper rhythm and is less tiring than flexing the wrist or doing a jig with your fingers. Working the bug is like playing certain musical instruments: you have to listen to what you are doing.

Bug Adjustment. Like a fine watch, the bug must be properly adjusted to work right. While the adjustment screws that bristle from all sides of a bug can be set to please your own sense of touch and balance, there are some general rules to follow. The Bell System, for instance, offers this advice:

1. Adjust the back top screw until the reed lightly touches the deadener, and tighten the lock nut.
2. Adjust the front stop screw until the separation between the end of this screw and the lever is approximately 0.015 inch, and tighten the lock nut. A greater separation is permissible if you prefer more lever movement.
3. Move the lever to the right, hold it in this position, stop the vibration of the reed, and adjust the dit contacts until they just meet without flexing the contact spring, then tighten the lock nut. This is a very important adjustment; it should be checked after tightening the lock nut, to see that it has not changed.

Changing the position of the weight (which controls the speed of the reed), or changing the tension of the retraction and dah springs, should not throw the bug out of proper adjustment.

May your fist be as popular as a friendly handshake.

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Is the bug a monster or your best friend? It depends upon how well you are able to receive code. As with some musical instruments, you must listen to the sound as you strum away—you may think otherwise, but you can't send faster than you receive.

The main purpose of the bug is to make sending easier, not faster.
EXTENSION SPEAKERS ARE NO PROBLEM

PrACTICALLY every hi-fi enthusiast at some time encounters the problem of either temporarily, or permanently, adding extension speakers to a system. These speakers can be carefully matched to hi-fi equipment, insuring maximum power transfer at minimum distortion, or you can add extension speakers in a slapdash manner. For the relatively non-critical ear, the latter method has a lot to offer.

As the accompanying photos illustrate, almost any combination of speaker impedances can be handled. There will be a slight—probably imperceptible—loss of power and the introduction of some distortion. However, most experiments conducted by the author showed that even the worst possible mismatch did not seriously affect the music reproduction quality of a good hi-fi amplifier.
—Lewis A. Harlow

The regular speaker (dark leads) is of 8 ohms impedance. The extra speaker (light leads) is only 4 ohms. Connect them up this way.

In this situation both speakers have the same impedance; the extra speaker is simply connected across the 8-16 ohms output taps.

Worst possible case, but it may work in some installations. Main speaker is 16 ohms and extra speaker to be added only 4 ohms.

GERMAN TV PIONEER

THe West German Institute of Technology recently honored Dr. August Karolus for his pioneering work in large-screen television. Now living in Zurich, Switzerland, Dr. Karolus made a number of experimental telecasts back in 1924. Joining Telefunken, in Hannover, he worked on several light modulation methods for TV transmission. Pictures were received on a 35” x 35” screen as early as 1928.
—Hans F. Kutschbach

AmericanRadioHistory.Com
RIDING
THE TV DX TRAIL

One of the advantages of living in a fringe area is the chance to catch some unusual DX

By GARY OLSON

Those rolling black bars that have pestered your Channel 2 TV reception for the past few weeks are a sign that "sporadic-E" is back. At least a dozen times each year freak radio wave propagation conditions permit the transmission of TV signals out to distances of 1300-1500 miles or more. Since TV signals are supposed to die out rapidly at distances of 80-100 miles, the sudden appearance of a TV program transmitted a thousand miles away is real DX.

This time of the year—actually from mid-May through to the first week of August—is the time when a budding clan of TV DX’ers keeps scanning those vacant (no locals) TV channels. Sporadic-E, or "E-skip" as it is sometimes called, usually is first noticed on Channel 2. If conditions are right and the channels are occupied at the right distances, DX can sometimes be seen on Channels 2, 3, and 4. The chance of E-skip on Channels 5 and 6 is less than on the lower three channels, but many TV DX’ers have picked off choice stations by "viewing-in" at the proper moment.

Television DX is not limited to just the

This photograph was taken at a station break (as were all the others in this article) and serves as a "verie," or proof of reception. From Harrington, Ill., to Lafayette, La., is a distance of about 925 miles—a sizable hop for Channel 3 E-skip.

Wichita Falls, Texas, is just under 950 miles from the author—another example of E-skip. Note how the picture is tearing and that there is a strong ghost. This type of TV picture is typical of E-skip when the signal is undergoing heavy fading.

Here's an example of summertime tropo reception at a distance of over 300 miles. This is a high-band Channel 9 TV station located in Minneapolis, Minn.
most radio signals are simply passed through the earth's atmosphere, now a popular term because of space satellite activities. The ionosphere is plagued by freak conditions that scientists neither understand nor are able to predict the occurrence of. Sporadic-E is the most notorious—it affects all radio wave transmissions from 4 to 100 MHz.

While most ionospheric effects take place slowly, sporadic-E comes on in a sudden onslaught. Freak conditions may last a few minutes, or an hour or so, or even a whole day, but no one can say why. When sporadic-E is “in,” radio signals are reflected at a height of only 65-70 miles above ground level. Normally, most radio signals below 7 MHz would simply pass through this region.

Television channels were originally assigned by the FCC on the premise that nothing in the ionosphere would affect frequencies above 54 MHz. Sporadic-E, though comparatively rare, does affect low-band reception (Channels 2 through 6), and on occasion even the FM broadcasting band above 88 MHz.

Scientists have confirmed that sporadic-E ionization is cloudlike and that these clouds move along above the earth as if being pushed by a strong wind. Coupled with the phenomenon of suddenly appearing and disappearing sporadic-E are the erratic DX conditions which can change in a few minutes.

Television DX via sporadic-E is characterized by signals that fade in and out—somewhat akin to the fading due to airplane reflections, though at a somewhat slower rate. The distance covered by sporadic-E is rarely less than 500 miles, most commonly between 800 and 1100 miles, and rarely beyond 1500 miles. Sometimes TV DX can be seen in excess of 1500 miles, but this is due to so-called “double-hop” conditions where the signal is reflected by two separate sporadic-E clouds.

Tropo DX'ing. Summer is also the time of the year when TV DX signals can be seen at double or even triple the usual ground wave range via "tropospheric bending." This type of DX propagation is not affected by the ionosphere, but by weather and atmospheric conditions less than 5-6 miles above the earth’s surface.

On some occasions (far more frequent than for sporadic-E), an "inversion" of the temperature humidity rate takes place in the low atmosphere. Television signals are then trapped between the ground and the inversion, guiding the wave over distances of 300-500 miles.

(Continued on page 100)

<table>
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<tr>
<th>TYPE</th>
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<th>TIME OF DAY</th>
<th>DISTANCE</th>
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<tr>
<td>E-SKIP</td>
<td>2-6</td>
<td>Late May-Early August</td>
<td>0800-1100</td>
<td>500-1500 miles</td>
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<tr>
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<td>1700-2100</td>
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<tr>
<td>E-SKIP</td>
<td>2-4</td>
<td>Mid-November to January</td>
<td>1700-2100</td>
<td>600-1500 miles</td>
</tr>
<tr>
<td>TROPO</td>
<td>2-13</td>
<td>Mid-June to Mid-September</td>
<td>1900-0200</td>
<td>200-800 miles</td>
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<td>0500-0900</td>
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<tr>
<td>TROPO</td>
<td>14-83</td>
<td>May to Mid-September</td>
<td>2000-0100</td>
<td>200-450 miles</td>
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<td></td>
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<td>0500-0800</td>
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74 POPULAR ELECTRONICS
INFRINGERS BEWARE!

By THOMAS F. KIRBY

Most electronics experimenters are aware that almost every circuit diagram or construction project published in POPULAR ELECTRONICS has—in some form—been patented. And, as electronics technology becomes more complex and/or sophisticated, the chances of and opportunities for patent infringement are that much greater. Construction projects utilizing the most modern components are always built around existing patents.

The following article was prepared for POPULAR ELECTRONICS by a Registered Patent Attorney. It explores some patent problems that could arise from building electronic projects published in this magazine and any of the other electronics magazines, as well as various handbooks.

Unlike a patent, which is a “negative right” (it excludes others from making or using), this article looks at the positive side of things and states that experimenters CAN build projects for their own enjoyment.

THE EDITOR

MANY currently available transistor and tube handbooks and other manuals containing electronic circuit diagrams contain a warning similar to the following: The electronic devices and circuits disclosed herein may be covered by patents of the John Doe Company or others. The disclosure of information herein does not grant a license under any patents covering such electronic devices, such circuits or combinations of such electronic devices with other devices or other circuit elements.

Some readers may have never noticed this warning, others blithely ignore it, and some may not fully understand it. Therefore, a brief discussion of such warnings should be of interest—and could save someone money!

The Patent Owner. Many publishers of literature disclosing circuit diagrams are in the business of manufacturing and selling components such as transistors, tubes, and other basic electronic devices. Frequently, they also manufacture equipment using these components in various combinations and circuit arrangements.

Since these manufacturers want to sell their components and equipment to the widest possible market, they need to publish information about the components and how they can be used. Very often, the components themselves and many of the circuits in which they are used are patented or are the subject of pending patent applications. These patents (and applications) might be owned by the manufacturer, or by another firm...
from which the manufacturer has a license. Or, in some cases, the patents might even be owned by an independent party who has discovered or invented new ways of using the components.

In any event, the manufacturer-publisher wants it clearly understood that just because the information is published, it does not follow that the reader is free to exploit this information commercially. The patent owner still intends to benefit from his patent rights and may require a user of any patented invention to take a license.

**Patent Laws.** The United States patent laws are very strict. Whoever owns a valid patent has the right to exclude others from making, using or selling apparatus embodying the invention covered by any claim of that patent. Therefore, whoever without authority makes, uses or sells any patented invention, within the United States during the term of the patent, infringes the patent.1

In a patent infringement lawsuit, the court can award damages adequate to compensate for the infringement "but in no event less than a reasonable royalty for the use made of the invention by the infringer, together with interests and costs as fixed by the court." In some instances, the court may increase the damages up to three times the amount found or assessed.2

Faced with these stringent laws, what risk is there in building circuits disclosed in publications? It depends to some extent on the purpose for which the circuit is being built.

**The Electronics Hobbyist.** It is common knowledge that electronics experimenters and hobbyists are continually building circuits they find in publications. Frequently, many of these circuits are patented. As a practical matter, it is impossible for a patent owner to know which hobbyists and experimenters are actually infringing his patents.

Fortunately, however, the position of experimenters and hobbyists rests on sounder legal ground. There are court decisions which hold that experimental use of a patented invention for the sole purpose of gratifying curiosity or a philosophical taste, or for mere amusement, is not an infringement.3

But this rule cannot be invoked to protect persons (or companies) who use a patented invention commercially, as in the course of business or for profit. Commercial use of patented inventions of others invites a charge of patent infringement. This is true even though the publication from which the particular circuit was obtained did not contain a notice that the circuits disclosed therein might be patented.

Most companies are very careful to police and enforce their patents—against the small operator as well as the larger competitor. This is sound and necessary business practice. The patent owner can require an infringer to stop manufacture, use, or sale of infringing equipment, or he can require the infringer to take a license and pay a royalty. Having to stop manufacture and sale of apparatus could be costly or even ruinous to a small operator. Taking a license, even at a reasonable royalty rate, is another cost item on a product which could create problems if not considered in advance.

**Minimizing Infringement Risk.** It is wise to have a patent search made before getting into production on apparatus employing electronic circuitry to see if there are any "live" patents covering the proposed circuitry. If no such patents are found, the risk is minimized. (Note: There is always the possibility that a pertinent patent was not found in the search or that a patent was issued after the search was made.)

If patents are found which might be infringed, you have a chance to consider the desirability of some sort of license arrangement with the patent owner, or run the risk of a charge of patent infringement action.

Only a few high points on the subject of patent infringement are covered here. If you have any doubts about incurring liability for patent infringement through the use of circuits found in publications for commercial exploitation, the sensible thing to do is consult a patent attorney, before you make a big investment.4

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1Title 35, United States Code, Section 271
2Title 35, United States Code, Section 284
369 Corpus Juris Secundum 288

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**POPULAR ELECTRONICS**
TV TROUBLE QUIZ

By ROBERT P. BALIN

To be successful in TV servicing, you must be able to interpret the various trouble symptoms that show up on the TV screen. Test your skill by matching the common troubles illustrated below (1-12) with their listed remedies (A-L).

(Answers appear on page 101)

A Adjust deflection yoke or ion trap.
B Replace phase detector.
C Adjust automatic frequency control (AFC).
D Replace horizontal output tube.
E Adjust height control.
F Replace vertical oscillator/amplifier.
G Replace deflection yoke.
H Check horizontal output tube for Barkhausen oscillation.
I Replace low-voltage rectifier.
J Check tubes in video circuits for filament-to-cathode short.
K Replace sync separator/amplifier.
L Replace r.f. amplifier in tuner.

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SOME TIME AGO when the author saw an advertisement for a Mallory 24-contact point rotary tap switch, the thought occurred to him that this low-cost switch might be useful in a game or gambling device. The switch detent mechanism is easily removed, and when it is eliminated the switch rotor can be continuously rotated. The switch contacts are 15° apart, and in the unit pictured on this page the two switching decks are paralleled and the contacts paired. Thus, neon lamp 9 is lit when switch $S_4$ is at either lug 13 or 23, lamp 3 when $S_4$ is at lug 1 or 20.

To drive the rotor, the author used a 120-rpm, 117-volt a.c. motor. The $\frac{1}{4}''$ shaft of the motor is attached to the switch rotor through a flexible coupling to eliminate binding and permit the switch to be rotated freely. The wiring is obvious from the diagram, although a few words on the additional switching might be in order.

The motor is activated by a s.p.d.t. push-button switch ($S_1$). If all 12 lights are required in your game, switch $S_2$ is closed. If only 6 lights are preferred, $S_2$ is opened and only the neon lamps with the numbers 1 through 6 will be lit. Without switch $S_3$ in the circuit, the lamps will go out as the motor revolves the rotary switch rotor. With $S_3$ in the circuit (and closed), the neons blink on and off as the motor works.

—Ken Greenberg

Neon lamps with imprinted numerals are available from many electronics supply houses. The author obtained his from Herbach & Rademan, 1204 Arch St., Philadelphia, Pa., for $3.50. Operation of $S_1$, $S_2$, and $S_3$ is detailed in last paragraph of the text.

No attempt was made to "pretty up" the wiring. Result: this rat's nest of leads from neon lamps to switch contacts. The motor was also obtained from Herbach & Rademan (#B7-208).
ON THE CITIZENS BAND
By MATT P. SPINELLO, KHC2060, CB Editor

TO DATE Dick Tracy is still the only full-time user of the two-way wrist radio, now equipped with a TV screen to boot! Mobile or portable CB as we know it today is limited to hand-held walkie-talkies or vehicle installations, none too near the micro-sized unit wristed by the famed detective. But there's a new school of thought brewing, aimed point-blank at CB's 27 megahertz.

Whether the information presented here is fact, fiction, or legitimate brainstorming remains to be seen. Rumor thus far indicates proposals for two new types of Citizens Band applications which would not interfere with the users of existing equipment.

A new breed of CB enthusiasts in the future might be dubbed "Carmunicators." Their operation would involve mostly vehicle-to-vehicle (you guessed it!) carmunications! The equipment would be without license, involve no call-sign, and have a legal and quite limited range, possibly one block or less. The equipment would be available for permanent installation, or a few extra coins would afford a plug-in unit that, when removed, would serve as a limited-range walkie-talkie.

After digesting the proposal briefly, we came up with at least fifty useful ways to aid the mobilier via carmunications. For example, a stranger passing through your town late one evening might crack your squelch to let you know he is traveling directly behind you. "I'm afraid I've missed the turn to put me on Route 5," he continues. "Can you help me?" Your reply gives the stranger the necessary information and he is on his way. The conversation involved only two units, it interfered with no other CB units, and the message was received only by other vehicles within the limited range of one block.

A nighttime carmunicator approaching another auto without headlights would verbally warn the oncomer a block in advance without flashing his brights in the face of all other traffic within sight. He might also warn the car ahead that his tailpipe was falling off. More important, the lives of passengers in a speeding vehicle might be spared if the driver were warned by a trailing carmunicator of an impending flat tire.

Police departments could find the carmunications system useful to divert traffic (Continued on page 104)

1966 OTCB JAMBOREE CALENDAR

Planning a jamboree, get-together, banquet or picnic? Send the details to: 1966 OTCB Jamboree Calendar. POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016. For more information on the jamborees listed below, contact the clubs or club representatives at the addresses given.


SUPPOSE, as a statement of fact, one says: all horses are four-legged animals. Can a conclusion be drawn that, therefore, all four-legged animals are horses? Of course not! That piece of muddled logic would immediately be spotted by everyone. But how often do we use the terms "solid state" and "transistor" interchangeably? Probably more often than you think, for it's a common failing.

All semiconductor devices—transistors, diodes, FET's, SCR's, and so on—are solid-state components, but the converse is not true. Such familiar units as the crystals used in microphones and phonograph cartridges, as well as some exotic items such as the ruby rods used in lasers, are also classified as solid-state devices. And, to add confusion, not all solid-state devices are semiconductors.

Considerable progress has been made in developing new uses for solid-state components—but, unfortunately, much of this work has been overshadowed by the publicity attending new transistor and integrated circuit applications. Three interesting solid-state operated devices which may be widely used in the future are shown in Figs. 1, 2, and 3.

Shown in simplified form in Fig. 1 is a unit that has been dubbed a "Spark Pump Igniter" by its manufacturer, the Clevite Corp. (232 Forbes Rd., Bedford, Ohio 44014). It can be used with gasoline engines as well as with such gas-fired appliances as stoves, ovens, dryers, yard lamps, and furnaces. Supplying over 20,000 volts, the Spark Pump Igniter has only one moving part—the compression lever—and can be used to replace breaker points, transformers, spark coils, and a multitude of other electrical components.

The basic device consists of two \( \frac{3}{8} '' \) diameter by \( \frac{3}{4} '' \)-long slugs of lead zirconate-lead titanate ceramic mounted in a semi-rigid frame in such a way that pressure is applied longitudinally to the slugs when a simple lever is moved. Under pressure, the piezoelectric ceramic develops approximately 3 volts per pound/square inch (psi) pressure. With a maximum recommended pressure of 7000 psi, the unit delivers around 21,000 volts.

In practice, the pressure lever can be operated manually, as with home appliances, or by means of a rotating cam, as with gasoline engines. The device can be used with gasoline engines as well as with such gas-fired appliances as stoves, ovens, dryers, yard lamps, and furnaces. Supplying over 20,000 volts, the Spark Pump Igniter has only one moving part—the compression lever—and can be used to replace breaker points, transformers, spark coils, and a multitude of other electrical components.

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liver up to 7200 sparks per minute and has an infinitely long service life.

A new high-frequency loudspeaker driver that utilizes the movement of a piezoelectric ceramic tube to drive an aluminum diaphragm, eliminating the need for coils and expensive magnets, has been developed by Motorola (5005 E. McDowell Rd., Phoenix, Ariz.). Figure 2 shows the relatively simple construction of the driver.

A 2"-long ceramic tube is fastened at one end with epoxy cement to the mounting frame, and at the other end to a flexible aluminum diaphragm. When a signal voltage is applied, the tube expands and contracts along its length, moving the diaphragm and setting up corresponding sound waves.

A solid-state liquid pump assembly that eliminates the need for an electric motor and gear train has been introduced by Precision Chemical Pump Corp. (See Fig. 3.) Consisting of a pair of ball valves to insure unidirectional liquid flow, and a flexible diaphragm driven by a piezoelectric element, the design reduces the possibility of sparks which could ignite flammable liquids, and also simplifies remote control operation of the unit.

Looking to the future, we can expect an ever-increasing use of piezoelectric solid-state elements as new devices are developed. Clevite, a leading manufacturer in the field, states that its new "PZT-4" ceramic material can be used to convert mechanical energy into electrical—and vice versa—at efficiencies as high as 92%! In addition, power as high as several kilowatts can be handled easily by the new material.

Readers' Circuits. Submitted by reader Garry Boross, WPE2HHL (13 Fisher Ave., Nanuet, N.Y.), the circuit illustrated in Fig. 4 might well be called "the poor man's square-wave generator." Essentially a shunt diode clipper, the unit can be used with a standard audio signal generator and an oscilloscope for testing intercoms, p.a. systems, and other types of audio amplifiers.

The positive and negative peaks of an applied sine-wave signal are clipped by D1 and D2 when these peaks exceed the barrier potential of the diodes. Thus, R1 and one of the diodes perform the clipping function while R2 serves as an isolation resistor. The clipped output signal, essentially a square wave, will have a peak-to-peak amplitude equal to the sum of the barrier potentials of the two diodes.

Resistors R1 and R2 are half-watters, while D1 and D2 are a matched pair of standard silicon diodes. Garry emphasizes that silicon diodes must be used for best performance, although any general type—from detectors to power rectifiers—may be selected. The circuit can be assembled in a standard Minibox, with conventional binding posts serving as input and output connectors.

To use the square-wave generator, connect its input across the output of an audio signal generator and adjust the signal generator for maximum output (which should be over 5 volts r.m.s.) Observe the output waveform on an oscilloscope, then disconnect the oscilloscope.

Now connect the square-wave generator's output across the input of the audio amplifier under test, turning the latter's gain all the way up. Spot-check the amplifier by alternately setting the audio generator's frequency at, say, 50 Hz, 500 Hz, 5 kHz, and 10 kHz, while using your oscilloscope to observe the waveform at the output of the amplifier.

Severe tilting of a 50-Hz square wave indicates that the amplifier has low-frequency phase shift and, perhaps, poor low-frequency response. Severe rounding off of a 500-Hz signal indicates that the amplifier has poor high-frequency response, while a dip in the middle of the waveform indicates attenuation of the low frequencies. An overshoot or wiggle on the signal's leading edge at 5 kHz or 10 kHz indicates that the amplifier has poor transient response and an accentuated peak in gain at some high frequency.

In a well-designed amplifier, the input and output waveforms will remain essentially the same at all frequencies checked, although there may be some rounding of the 5-kHz signal if the amplifier's response does not extend to at least 50 kHz.

If a list were to be compiled of the "top ten" among experimental projects, chances are the AM wireless microphone would rank close to the "No. 1" position. For this general type of circuit is the one most often requested—and most often submitted—by readers. Sent in by reader Carl Bergquist (33 La Vonne Ave., Campbell, Calif.), the design in Fig. 5 features a single pnp transistor used as a modulated oscillator. As
required by FCC regulations, the unit's operating range is kept limited.

The circuit is relatively simple and straightforward. Transistor Q1 is used as a modified Hartley oscillator, with its basic frequency determined by tuned circuit L1-C1. Emitter resistor R1 serves to float the emitter above ground as far as r.f. is concerned, while C2 serves to couple the oscillator to the emitter while blocking the direct current. Base bias is provided through voltage divider R2-R3, with R2 bypassed by C3 to decouple the r.f. from the audio circuit. Base modulation is achieved with a standard high output crystal microphone (MIC), while operating power is furnished by battery B1, controlled by s.p.s.t. switch SI.

Transistor Q1 is a 2N107 or other general-purpose pnp type. Coil L1 is a tapped ferrite antenna coil (typically, a Lafayette MS-299). All resistors are half-watters, while the fixed capacitors are small ceramic units. Switch SI is of the push-button variety although a toggle or slide type can be used if preferred. Finally, B1 is a standard 9-volt transistor battery (Burgess 2N6 or Eveready 246).

For proper operation, the completed wireless microphone requires a 3' to 10' piece of antenna lead. Coil L1 must be adjusted so that the unit's output signal can be picked up at a "dead spot" where no local station is received on your AM broadcast receiver.

Manufacturer's Circuit. One of the most important differences between vacuum tube and transistor amplifiers is their respective relative input impedances. A vacuum tube circuit, in general, has a very high input impedance, ranging from 1 megohm to 20 or 30 megohms, or even more. The typical transistor amplifier, on the other hand, has an input impedance of less than 2000 ohms. Where a solid-state circuit must be used but a high input impedance is required, as when coupling to a high-impedance source, a field-effect transistor (FET) circuit can be employed. Such FET devices have electrical characteristics which closely approximate those of vacuum tubes.

Designed by Siliconix, Inc. (1140 W. Evelyn Ave., Sunnyvale, Calif.), the circuit in Fig. 6 is a unity voltage gain impedance-matching amplifier. It features a p-channel FET (Q1) coupled to a conventional npn junction transistor (Q2). With the component values shown, the circuit has an effective input impedance of approximately 1250 megohms—that's right, over one thousand megohms—and an output impedance of slightly under 600 ohms.

Transistor Q1's gate bias is established by voltage divider R1-R2 and applied through gate resistor R3. Resistors R4 and R5 serve, respectively, as Q1's drain and source loads, with Q1's drain direct-coupled to Q2's base. Capacitor C2 provides "bootstrap" action by effectively raising the circuit's input impedance. Operating power is supplied by B1 through switch SI.

Standard components are used throughout. Transistor Q1 is a 2N2606, and Q2 a 2N718. The resistors are all half-watters. Because of the circuit's extremely high input impedance, C1's value is not critical and may vary from 0.01 to 0.1 µf.; a high-quality ceramic or tubular paper capacitor is preferred. Capacitor C2 is a 25-volt electrolytic type, while B1 is a 12-volt battery and SI a s.p.s.t. toggle or slide switch.

In a practical application, the circuit can be assembled on an etched circuit board or on a small chassis. Due to the high input impedance, layout is somewhat critical and care must be taken to keep... (Continued on page 102)
NOTES FROM YOUR SHORT-WAVE EDITOR’S DESK

A NEW SWL Program Guide is available that lists the English-language broadcasts of over 40 major short-wave broadcast stations beamed to North America as well as a number of broadcasts beamed to other areas but receivable in portions of North America. The listings are arranged by the hour, with 5 to 20 listings for each of the 24 hours.

Each listing gives the duration of the broadcast, name of the station, areas to which the programs are beamed, frequencies, time of news coverage, and a short description of the program content. In addition, there is one page devoted to the proper use of the guide, two pages of hints on short-wave reception, conversion tables, and addresses for a number of stations.

The guide is printed on durable index bristol stock and bound with plastic. The contents are based on authentic, reliable data received from the stations. Copies can be obtained from SWL Program Guide, 218 Gifford St., Syracuse, N. Y. 13202, for $2, payable by check, money order, or cash. A “summer” bulletin giving seasonal frequency changes plus additional listings is provided free of charge.

The 1600-1750 kHz Band. How long has it been since you really tried to tune the 1600-1750 kHz band? We will be the first to admit that this particular band is not an easy one to tune, especially during summer months with the often-present static from thunderstorms roaming the countryside. But there are many evenings when the band is quite clear all during the night, and you could be pleasantly surprised at what you might hear.

Although this band is not famous for really long distance DX, we do have reports from listeners that would justify considerable monitoring of these frequencies. As an example, there are many aero beacon stations operating here. You could try for CEP, Concepcion, Bolivia, on 1620 kHz, or CZU,Corozal, Colombia, on 1670 kHz from late evening to early morning (your local time). Both of these stations send their call-signs continually in slow-speed Morse.

DX’ers, especially those in western areas, might try for the Canadian Department of Transport stations which operate on 1630 kHz. Operation is scheduled for the times (GMT) shown in parenthesis: Prince Rupert Radio (0340), Comox Radio (0350), Victoria Radio (0400), Vancouver Radio (0410), Alert Bay Radio (0420), and Bull Harbor Radio (0430). A letter from Alert Bay announces that reports may be sent to any of the above stations. A typical proper address would be: Alert Bay Radio, Department of Transport, Alert Bay, British Columbia, Canada.

Lightning Protection. Speaking of thunderstorms, how is your lightning arrester? Is it properly installed and are the wire con-

(Continued on page 106)
ENGLISH-LANGUAGE BROADCASTS TO NORTH AMERICA
FOR THE MONTH OF JULY

Prepared by ROBERT LEGGE

TO EASTERN AND CENTRAL NORTH AMERICA

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>CITY</th>
<th>TIME—EST</th>
<th>TIME—GMT</th>
<th>FREQUENCIES (MHz)</th>
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<td>Melbourne</td>
<td>7:15-8:15 a.m.</td>
<td>1215-1315</td>
<td>9.58</td>
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<td>CANADA</td>
<td>Montreal</td>
<td>7:15-8:15 a.m.</td>
<td>1215-1315</td>
<td>5.97, 15.32</td>
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<tr>
<td>DENMARK</td>
<td>Copenhagen</td>
<td>7:30-8 a.m.</td>
<td>1230-1300</td>
<td>15.165</td>
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<tr>
<td>FINLAND</td>
<td>Helsinki</td>
<td>7:15-7:45 a.m.</td>
<td>1215-1245</td>
<td>15.185 (Tues., Sat.)</td>
</tr>
<tr>
<td>GREAT BRITAIN</td>
<td>London</td>
<td>9:30-11:30 a.m.</td>
<td>1430-1630</td>
<td>15.35, 17.81</td>
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<tr>
<td>SWEDEN</td>
<td>Stockholm</td>
<td>7-7:30 a.m.</td>
<td>1200-1230</td>
<td>15.195</td>
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MORNING BROADCASTS

ENGLAND—LANGUAGE BROADCASTS TO NORTH AMERICA FOR THE MONTH OF JULY

Prepared by ROBERT LEGGE

TO WESTERN NORTH AMERICA

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>CITY</th>
<th>TIME—PST</th>
<th>TIME—GMT</th>
<th>FREQUENCIES (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARGENTINA</td>
<td>Buenos Aires</td>
<td>7-8 p.m. (Mon.-Fri.) (Tues.-Sat.)</td>
<td>0300-0400</td>
<td>9.69</td>
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<tr>
<td>AUSTRALIA</td>
<td>Melbourne</td>
<td>5-7:45 p.m.</td>
<td>0100-0345</td>
<td>15.22, 17.84</td>
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<tr>
<td>BULGARIA</td>
<td>Sofia</td>
<td>8-8:20 p.m.</td>
<td>0100-0120</td>
<td>9.70</td>
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<tr>
<td>CHINA</td>
<td>Peking</td>
<td>6:45-7:45 p.m.</td>
<td>2345-0045</td>
<td>15.135, 17.875</td>
</tr>
<tr>
<td>CUBA</td>
<td>Havana</td>
<td>8:15-8:30 p.m.</td>
<td>0115-0130</td>
<td>9.557</td>
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<tr>
<td>CZECHOSLOVAKIA</td>
<td>Prague</td>
<td>8:30-9 p.m.</td>
<td>0130-0200</td>
<td>11.76</td>
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<tr>
<td>DENMARK</td>
<td>Copenhagen</td>
<td>8-9:30 p.m.</td>
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<tr>
<td>ECUADOR</td>
<td>Quito (HCJB)</td>
<td>9-11:30 p.m.</td>
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<td>9.745, 11.915, 15.115</td>
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<tr>
<td>EGYPT</td>
<td>Cairo</td>
<td>8:30-10 p.m.</td>
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<tr>
<td>GERMANY</td>
<td>Berlin</td>
<td>8-9 p.m.</td>
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<tr>
<td>GREAT BRITAIN</td>
<td>London</td>
<td>4:15-10:30 p.m.</td>
<td>2115-0330</td>
<td>9.64, 11.795</td>
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<tr>
<td>HUNGARY</td>
<td>Budapest</td>
<td>8-8:20 p.m.</td>
<td>0100-1200</td>
<td>11.77, 15.385</td>
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<tr>
<td>ITALY</td>
<td>Rome</td>
<td>8:20-9:40 p.m.</td>
<td>2200-0240</td>
<td>6.025, 9.74, 11.925</td>
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<td>JAPAN</td>
<td>Tokyo</td>
<td>6:45-7:45 p.m.</td>
<td>2345-0045</td>
<td>15.135, 17.875</td>
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<tr>
<td>JORDAN</td>
<td>Amman</td>
<td>8:15-8:30 p.m.</td>
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<td>LEBANON</td>
<td>Beirut</td>
<td>8:30-9 p.m.</td>
<td>0130-0200</td>
<td>9.745 (Bonaire Relay)</td>
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<td>NETHERLANDS</td>
<td>Hilversum</td>
<td>8-9 p.m.</td>
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<td>9.745</td>
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<td>ROMANIA</td>
<td>Bucharest</td>
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<td>SPAIN</td>
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<td>0100-0230</td>
<td>9.63, 9.76</td>
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<td>Stockholm</td>
<td>8:15-9:45 p.m.</td>
<td>0115-0215</td>
<td>11.88</td>
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<td>SWITZERLAND</td>
<td>Berne</td>
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<td>Kiev</td>
<td>7:30-8 p.m. (Mon. &amp; Thurs.) (Tues. &amp; Fri.)</td>
<td>0100-0230</td>
<td>9.665, 9.685, 11.955</td>
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<td>VATICAN</td>
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<td>7:50-8:10 p.m.</td>
<td>0050-0110</td>
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TO WESTERN NORTH AMERICA

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<thead>
<tr>
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<td>0300-0400</td>
<td>9.69</td>
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<td>15.22, 17.84</td>
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<tr>
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<td>HUNGARY</td>
<td>Budapest</td>
<td>7-8 p.m.</td>
<td>0300-0400</td>
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<td>JAPAN</td>
<td>Tokyo</td>
<td>6-7 p.m.</td>
<td>0200-0300</td>
<td>15.135, 17.875</td>
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<td>KOREA</td>
<td>Seoul</td>
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<td>THAILAND</td>
<td>Bangkok</td>
<td>8-8:15 p.m.</td>
<td>0415-0515</td>
<td>11.943</td>
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<td>U.S.S.R.</td>
<td>Moscow</td>
<td>7-10:30 p.m.</td>
<td>0300-0730</td>
<td>9.735, 11.755, 11.85</td>
</tr>
</tbody>
</table>

84 POPULAR ELECTRONICS
INSTALLING AMATEUR ANTENNAS IN RESTRICTED SPACES

SUMMER is the time when smart amateurs work on their antennas. If you have plenty of room and lots of cash, installing an efficient antenna is simple enough: you just make it big and put it up high. But most amateurs have only a roof and possibly a small yard to put their transmitting antennas in. And under such conditions, two antennas of the same type in apparently similar locations only a few blocks apart often give radically different results. Why?

A couple of case histories may provide a clue or two. For instance, Bill, WA9MOE, installed a 40-meter inverted-V antenna, approximately 20' high at the center, which was supported on a small stick stuck out of his attic window. Its ends were tied to a fence and to a small tree and were approximately six feet high. This construction put the center third of the antenna parallel to the house and only a foot away from it. The antenna was fed with RG-8A/U coaxial cable and was resonant at 7150 kHz, where the feedline SWR was very close to 1:1; only at the band edges did the SWR go much above 2:1.

Although the antenna was well matched to its feedline, the installation certainly was not a very impressive one. It was, in fact, intended to be only a temporary arrangement until something better could be installed. The results obtained with it, however, were so good (even for foreign DX) that Bill was in no hurry to improve it. But one weekend changed everything.

In quick succession, Bill discovered that his Heathkit "Marauder" transmitter would not load properly, the resonant frequency of the antenna had changed, and the feedline SWR at the new resonant frequency was considerably higher than before. Worse, he had to fight to raise stations that he had previously worked easily.

There were no visible changes in the installation, and the antenna and feed system and transmitter all checked out perfectly okay. But Bill was able to diagnose his troubles quickly. He had thermally insulated the house with fiberglass packed in 2' square aluminum bags which were stapled to the wall and ceiling joists in the attic. As far as the antenna was concerned, this process raised the effective ground level to within less than two feet of its center.

The cure was a metal TV mast that extended 10 feet above the peak of the roof to support the center of the antenna, which put it 31' above the ground. Immediately, the

Javad Mesbaheem, EP2DM, is a Rotary International exchange student studying electronics at North Georgia Tech in Clarksville, Ga. He worked hundreds of U.S. amateurs from Shiraz, in Iran, with his Heath DX-35 transmitter, but can't operate from the U.S. since no reciprocal agreement has been negotiated between the two countries. We are sending Javad a one-year subscription for submitting the winner in the Amateur Station of the Month photo contest for July. To enter the contest, send us a clear photo of your station, with you at the controls, and some details on your ham career and the equipment you use. Entries go to: Amateur Radio Contest, c/o Herb S. Brier, P. O. Box 678, Gary, Indiana 46401.

July, 1966
antenna started performing as before—except for one thing: it now gets out even better than it used to.

So, if your house is insulated with the metal-backed stuff . . . and if your inverted-V antenna has its center supported on a small stub on the peak of the house with its legs running parallel to the slope of the roof, like a lot of other rigs working 80 and 40 meters . . . and if your lash-up isn’t working as well as you think it should—it might be a good idea to raise your skyhook.

But that isn’t all. Things other than metal in the field of an antenna can seriously affect its operation. Another ham installed a 20-meter, 3-element beam 38’ high on a home-built wooden tower on the roof of a house. It didn’t seem important at first that the buildings on both sides of his house were of brick construction and over 40’ high at their roof peaks, and that the ends of the beam elements were only a foot or two above and away from their walls.

After months of futile effort trying to make the antenna work in this location, however, the owner transferred it to a 38’ utility pole set in the back yard only 50’ away (the fact that both heights were 38’ was pure happenstance.) At this location, the array started working as a beam should; in fact, even a 1/2-wave dipole in the back yard outperformed the beam on the house.

Later, both 6- and 2-meter beams worked very well on the house tower, verifying the fact that the poor performance of the 20-meter beam was the result of trying to cram too much antenna into too small a space. The amount of clearance required around a beam for good results varies with the gain of the beam, because a high-gain beam has far more “capture area” than a low-gain antenna.

A workable rule of thumb when installing small beam antennas is to keep the minimum spacing between any part of the beam and any large object equal to or longer than the length of the longest antenna element or the supporting boom, whichever is the greater. You will usually get better results from a small antenna installation having sufficient breathing space than from a large antenna which is within “kissing” distance of your neighbor’s house.

Phone Procedures. Recent issues of the Collector and Emitter, the uniformly interesting bulletin of the Aeronautical Center Amateur Radio Club, Oklahoma City, Okla., have been carrying “dialogues” on poor phone procedures like screaming “break, break, break,” without signing call letters when trying to join a contact already in progress, saying “we” instead of “I,” and signing off with the contradictory “Over and out.”

Another target of scorn in these “dialogues” is the use of “kilowatt” as a phonetic word for the letter “K.” Why this common practice should so irritate some people escapes us. The claim that “kilowatt” is two words and must, therefore, be a phonetic for the letters “K” and “W” does not pass the dictionary test. Even if it did, the same reasoning could be applied to the phonetic word “fox trot,” which would stand for the letters “F” and “T.” But we all know that the International Phonetic Alphabet tells us to “tango” for “T” and to “fox trot” for “F.”

(Continued on page 103)
SURE-SHOT
Q5-er
HOOKUP
WHY DETUNE YOUR I.F.
WHEN YOU CAN ISOLATE YOUR BC-453

If you are in possession of a surplus BC-453 long-wave receiver, you have probably given thought to using the BC-453 as a "Q5-er." Unlike the commercially available "Q-multipliers" (Heathkit, WRL, etc.) that electronically increase the Q of an i.f. stage—thus increasing selectivity—the Q5-er is a separate receiver with its own highly selective i.f. strip. When you use the Q5-er, you disable your regular receiver's detector and audio and use those in the BC-453.

In the circuit shown on this page, the author modified the second i.f. stage in his short-wave receiver so that this stage could also act as a cathode follower.

*The BC-453 tunes through the 455-kHz i.f. of most receivers. The i.f. signal is converted to 85 kHz where better selectivity can be obtained without resorting to Q-multiplier gadgets.

In the "Normal" position, the receiver operates as originally designed. In the "Q5-er" position, the output of the i.f. stage is bypassed to ground and the 455-kHz i.f. signal fed into the connection to the Q5-er.
IF YOU ONLY have a two-wire cable to work with, you can still hook up a three-way switching circuit for your garage, or hallway, to enable you to turn a light on and off from either of two different locations.

For a dollar or two, you can purchase a couple of four-way light switches and a couple of silicon diodes (1N1344, 1N1614, or equivalent) and connect them as shown in the diagram below. Observe the usual precautions to avoid short circuits, and do your switching in the hot lead; do not break the ground lead. If you prefer to work with three-way switches, you can, but you'll need two more diodes.

Since the voltage available at the lamp is reduced from 117 volts to about 83 volts, you'll get a little less light but a lot more life out of the light bulb. To get more light, simply use a higher wattage lamp, but do not exceed the wattage and current ratings of the diodes.

—R. C. Hitchcock and G. E. Weber
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**CIRCLE NO. 6 ON READER SERVICE PAGE**
If you have a hobby or interest in addition to amateur radio and would like to talk about it on the air, you can contact other hams with the same hobby through this column. To be listed here, just send a legibly printed postcard to Ham Hobby Clearinghouse, Popular Electronics, One Park Ave., New York, N.Y. 10016, including on it your call letters, other hobbies, the frequencies you use, mode of operation, when you operate, and your name and address.

WA1BEB—Astronomy, biology, books, camping, chess; 3580, 3600, 3675, 7040, 7062, 7125, and 7145 kHz CW, 21.3 MHz phone; daily from 1800 to 0300 GMT. (Jim Loring, Jr., RFD 2, Gilead, Bethel, Maine 04217)

W2LCZ—Fiction and non-fiction writing. (Milt Gottlieb, 204-15 Foothill Ave., Holliswood, N.Y. 11423)

WB2THB—Astronomy; 15 meters, phone, CW. (John Reilly, 316 Virginia Ave., Jersey City, N.J. 07304)

WB2UFF—Model airplanes and railroading, SWL'ing: 20 and 15 meters, phone and CW. (Thomas Golembiewski, 501 Marshall, Hoboken, N.J. 07030)

WN2WHE—Chess, mathematics, physics, designing electronic equipment; usually 3720 and 3709 kHz; 8:30 to 9 p.m. weekdays, 9 to 11 p.m. Saturdays. (Richard M. King, 3-25 Dorothy St., Fair Lawn, N.J.)

WA3DUM—Recording music, stamp collecting, chess; 80 meters SSB, 40 meters SSB and CW; 1800 to 2100 EST, Fridays and Saturdays. (Jim Hicks, 107 Tyre Ave., Newark, Del. 19711)

WN5NAZ—Science, reading, swimming, SWL'ing: 40 meters CW; 5 to 7 a.m. daily, all day weekends. (Jack Clark, 2318 Hickory St., Texarkana, Ark.)

KSUPX—Electronic experimenting, bio-medical electronics, scuba diving, pigeon racing, tape recording, and many more; 20 and 40 meters, SSB, CW, AM; weekends. (Charles Bautsch III, 5650 Sylvan, Houston, Texas)

WB6QWH—Science, chess, would like to start 40-meter teen net; 40 meters CW and AM; afternoons. (Earl Arbuckle, 718 Strub Ave., Whittier, Calif.)

WN7DKA—Stamp and coin collecting, old radio restoration, designing ham equipment. (Phillip Kelly, Rt. 1, Box 638, Camas, Wash. 98607)

WN9RM-Coin collecting, camping, fishing, SWL'ing; 3731, 7182, and 21,171 kHz CW; evenings and weekends. (Ralph Anderson, 1456 N. Eagle St., Taft, Texas)

WN8MXS—Stamp and coin collecting; 3.725 MHz CW; weekday mornings before school, and weekends. (Danny Pilken, P.O. Box 631, Pineville, Mo.)
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ANY small boat owner or SWL can change a BC-454/ARC-5 receiver into a bandspread 2.5-MHz marine band receiver. The BC-454 24-volt unit is easily modified for 117-volt a.c. operation (see “Converting Your First Command Receiver,” POPULAR ELECTRONICS, June, 1963). To confine the original 3.0-6.0 MHz tuning range to 2.2-2.8 MHz, the builder need only buy three capacitors and wire them in parallel with the existing tuning gang.

Turn the receiver over and remove the bottom plate. The tuning capacitors are ganged together under the aluminum box cover that runs from one side of the receiver to the other. Temporarily remove this second protective cover. Using the diagram as a guide, mount three silver mica capacitors in the approximate physical positions indicated. If you wire-trace the electrical position of these capacitors, you will see that they are in parallel with the tuning gang and r.f., mixer, and oscillator coils.

When the capacitors are soldered in place, tune in a station around 2500 kHz and peak up the antenna trimmer capacitor on the front panel. Next, adjust the mixer tuning gang (the middle capacitor) paddler for maximum signal strength. And you’re in business. If you find the oscillator frequency needs adjusting to cover the approximate frequency range mentioned above, touch up the oscillator paddler. Then replace the capacitor cover and the bottom plate.

Keep in mind that radiotelephone conversations are not to be revealed to a third party. Discussing, recording for playback, and disclosure of such conversations is a violation of the 1934 Communications Act.
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CIRCLE NO. 31 ON READER SERVICE PAGE

July, 1966
Superior Model 1240 tube tester. Schematic and tube testing data needed. Superior Model 671 signal genera-
tor; schematic, operating data, and parts list needed. (Roger A. Longhorn, RDF #1, New Hampton, Iowa 50650)

Vanguard receiver, circa 1959; tunes AM and FM from 80 to 200 MHz. Schematic, operating instructions, and parts list needed. (Cari McCormick, 1502 Debra, Bos-
sier City, Las. 71010)

Midwest "Royal" receiver, circa 1937; tunes 6 bands; has 24 tubes. Schematic, source for parts, or complete chassis needed. (Roy R. Brown, Nashua, Minn. 55565)

BC-611-F receiver, surplus, made by Electrical Research Laboratory. Schematic needed. (Charles Welte, 146 Lin-
den Ave., Kearny, N.J. 07032)

Esper Model 174 receiver/photograph, ser. 403875; tunes AM and FM; has 12 tubes. Schematic needed. (Dave Dumitrus, Box 265, E. Orwell, Ohio 44043)

Emerson Model 520 receiver; tunes BC; has 5 tubes. Schematic needed. (Joseph D’Allo, 383 Pittsburgh Ave., Massapequa Park, L.I., N.Y. 11762)

Stromberg-Carlson Model 20A receiver, circa 1928; tunes BC. Schematic needed. (H. B. Gillies, 50 Ardmor Rd., Hohokus, N.J. 07423)

T-22/ARC-5 transmitter, surplus, made by Command; tunes 8 bands; 500 kHz to 18 MHz; Schematic and operating manual needed. (H.L. Coombs, 7006 Corbin Ave., Reseda, Calif.)

E.H. Scott Model SLR-H receiver; tunes BC plus 5.55-
15.6 MHz; has 12 tubes. Schematic and parts list needed. (Edward F. Froot, 103 Glen Keith Rd., Glen Cove, N.Y. 11542)

Silvertone car radio, chassis 528 55041. Schematic needed. (Alphord Hays, 2024 Paradise Rd., Modesto, Calif. 95351)


Crosley Model 587W receiver, ser. 990014; has 5 tubes. Schematic needed. (Robert Schneider, 301 Franklin St., Waterford, Wis. 53185)

BC-221-AF frequency meter, surplus. Continental RDF CC-6726; technical data and operating manual needed. (Frank E. Curran, Box 75, St. Davids, Pa. 19089)

Zenith Model 9-537 receiver; tunes 550 kHz-24 MHz on 3 bands; has 8 tubes and magic eye. Schematic and other data needed. (Edwarld Jesson, 1 Lorraine Dr., Trenton, N.J. 08619)

Calvin "Movie Sound Eight" 8-mm. sound projector, circa 1953. Schematic needed. (Bob Koontz, 1018 Wash-
ington St., Huntington, Pa. 16622)

Zenith Model 26-145 receiver; tunes 0.55-18 MHz on 3 bands; has magic eye. Croswell Model 86-CS receiver/ photograph; tunes BC, s.w. and FM; has 8 tubes. Schematic needed. (Norris Going, 2814 Meadowlark, Great Bend, Kan. 67530)

Clough-Bringle Model CRA oscilloscope; has 6 tubes. Operating instructions needed. (M. Ray Schweizer, 1853 28th Ave., San Francisco, Calif. 94122)

RCA receiver, ser. 2186, type CND-4155; tunes 15-600 kHz; has 8 tubes. Schematic needed. (C.H. Ostermiller, 1060 Cedar Blvd., Pittsburgh, Pa. 15223)

Star Measurement Model M18 voltage meter. Schematic needed. (Bruce Pistole, 2318 Todville Rd., Charlotte, N.C.)

Motorola Model 99FM21 audio amplifier/tuner, ser. 6580; circa 1950; tunes AM and FM; has 9 tubes. Schematic, operating manual and source for tuner capacitor tuning slugs, type 65A7 converter, tone control, set of knobs needed. AMPRO Model 730 tape recorder, ser. 239769, circa 1953. Schematic and source for motor, rewinder belt, and head cleaner needed. (Lawrence grandmother, Box 435, Arizona Form, Ariz. 1004)

Supreme Publications Radio Diagrams, Volume 2, covering 1939 radios needed. (Gerald D. Crottinger, McCracken, Kan.)

Grumman Model 662 receiver, chassis 6-C, circa 1930; tunes 5.5-17 kHz and 5.5-16 MHz; has 6 tubes. Schematic needed. (Jimmy Heiler, Sandy Springs, S.C. 26767)

Hallicrafters Model SR10A receiver; tunes 540 kHz to 31 MHz on 4 bands; has 6 tubes. Schematic and tuning guide needed. (Grey Gentile, 811 Ralph St., San Francisco, Calif. 94112)

Cossor Model 1037C dual beam scope, circa 1956; has 8 tubes. Schematic and operating manual needed. (J.W. Kominou, R. R. #4, Calumet, Mich.)

Northern Electric Model R21 receiver, ser. B04013, circa 1921. Schematic, source for tubes, and battery voltages needed. (Harry L. Jack, Box 56, R.R. #1, Dugais, Manitoba, Canada)

BC-454-B receiver, surplus, made by Western Electric; tunes 3.6 MHz; has 7 tubes. Schematic needed. (Loyd H. Richley, Star Route, Geraldine, Ala.)

TCS-9 receiver, surplus, type COL-4679, made by Col-
lin Radio, circa 1943; tunes 1500-12,000 kHz. Schematic
and source for speaker and speaker-transformer needed. (Emil Minkin, 7 Pushkin St., Jaffa, Israel)

Graymark Model B receiver. Schematic or location of manufacturer needed. (J.A. Lopez, Box 505, Woodside, W.V. 2277)

Westinghouse Model H-107 B receiver; tunes 550-1800
kHz and 5-18 MHz on 2 bands; has 7 tubes. Schematic and source for speaker and speaker-transformer needed. (John M. Rosenbaum, 25245 Roosevelt Rd., South Bend, Ind. 46614)

National receiver, surplus type NC-156-1, Navy R.B.H. 1953; tunes 5 bands; has 10 tubes. Schematic and operating manual needed. (Jack W. Billington, 18 Bailey Dr., Charleston Heights, S.C. 29403)

RCA Model V-300 receiver, circa 1939; tunes 4 bands; has 11 tubes. Schematic needed. (William H. Payne, Rt. 3, Box 466-A, Madison, N. C. 27025)

Crosley Model 51 receiver, circa 1922. Schematic needed.

RCA Model "Rodiola IIL" receiver. Schematic and source for WD11 and WD12 tubes needed. (Ted Whitus, 178 Floral Ave., Tonawanda, N.Y. 14151)

GE Model M-86 receiver; tunes BC and s.w.; has 8 tubes. Schematic and service and wiring data needed. (John F. Ring, 8 Burner Pl., Jamestown, N.Y. 14701)

GE Model A-87 receiver; tunes 140 kHz-10.5 MHz on 4 bands; has 8 tubes. Schematic and service data needed. (Claude Masse, 1833 Northview Dr., Colorado Springs, Colo. 80909)

Kay Model 710 echo unit. Schematic and source for parts needed. (Steve Green, 6 Langtree Dr., Livingston, N.J. 07639)

Hallicrafters B-35B receiver; tunes 0.55-31 MHz; has 5 tubes. Schematic and operating manual needed. (Don Singleton, Box 687, Route 1, Pisgah Forest, N.C. 28768)

Garard Model "T" A turntable, schedule 50530 1R, Source for parts needed. (Hillar Ilves, ARPA R & D Field Unit, CSU I/T, APO San Francisco, Calif. 96346)

CBS-Columbia Model 5110 receiver, ser. 5160; has 4 tubes. Schematic and source for parts needed. (Robert M. Balick, 37 Westwood Dr., Westfield, Mass. 01085)

OS-29/UMP-4A oscilloscope, surplus. (Gray Gentile, 811 Ralph St., San Francisco, Calif. 94112)

Lafayette Model HE 15B transceiver; has 6 tubes. Schematic and source for crystal needed. (Kurt Knoll, 59 Wilmington St., Rochester, N.Y. 14620)

EMENEE "Intercomunitron." Manufacturer’s name and address needed. (Carl Collins, 4010 Lawn Ave., Tampa, Fl. 33611)

E.H. Scott Model RCH receiver, surplus, Navy C2C-
46209, circa 1941; tunes 80 kHz-24 MHz. Schematic needed. (C. Baker, 8 Valley View Ln., Newtown Square, Pa.)

GE Model CRO-3A oscilloscope. Schematic, tube layout, and source for GL-3AP-1A oscilloscope tube needed. (Fred Johnson, 1028 S. Union St., Aurora, Ill. 60005)

Aireon Model 1221A amplifier needed. (Isaac K. Smith, Rt. 2, Box 45, Campbellsville, Ky. 40111)
ly before the cleaning-lady arrived to perform her regular duties.

Hearing the faint hum of electronic activity, the cleaning-lady wandered over to the Tester—unaware that she was stationed before an instrument that was industriously measuring her as she stood there glaring suspiciously at the gleaming steel cabinet which housed the Tester.

No sooner had she departed than Otto re-entered his apartment (he'd been hiding in a large planter just outside a back window) and activated the Transmit System.

The loudspeaker boomed: SUBJECT IS NOT YOUR TYPE. SHE'S TOO OLD FOR YOU. SHE'S MARRIED TO SOMEONE ELSE. SHE THINKS YOU ARE SOME KIND OF FOREIGN SPY ENGAGED IN DEADLY RESEARCH. FORGET IT.

The Tester went silent.

"Boy!" breathed Otto. "Have I ever hit the old jackpot! This bby'll find me exactly the kind of girl I'll want to marry!" He pranced around the Tester, joyously gyrating in a victory dance of triumph. "All I have to do now is start bringing girls in here and let the Tester—"

Otto stopped dancing. Suddenly, the gap in his plan was painfully obvious. "Oh, no!" he cried, an agony of disappointment wrenching the joy and happiness from his mind. "I'm too shy to invite girls over here! The whole idea is down the tubes! Utter Failure! Waste Of Time, Energy & Materials! I oughta get drunk!"

Finding that his own supply of potables was practically non-existent, Otto went down to the corner tavern and quietly huddled in the most isolated booth in the darkest corner—ordering one round after another from the bar by hand-signals.

Four hours of this steady beverage intaking and he was a new man. More stoned than an Irish wall, he returned to the apartment house, singing bawdy mathematical equations set to the off-key melodies learned in his far-distant

July, 1966
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PAYMENT MUST BE ENCLOSED WITH ORDER.

Sleepily, she blushed at him.

childhood and vaguely groping in the dim light of the patio for his apartment doorway.

Inside the apartment, he stumbled woozily over to the Tester. Bitterly, he jabbed the Receive System button, hearing the instrument "hum up" and knowing it was vainly trying to absorb male-gender data despite the fact that it had only been developed to successfully take in information when the subject was female-gender.

"I hope you blow up in my stupid face!" wailed Otto. "It'd serve me right for trying to be so smart!"

The Tester went silent.

Otto violently depressed the Transmit System button, closing his eyes and awaiting the electronic devastation he knew was almost certain to follow as the instrument exploded its circuitry once electrical frustration overlapped and backwashed its innards.

"SUBJECT IS QUITE SUITABLE!" boomed the Tester. "SINGLE, EMPLOYED IN COMPATIBLE WORK AND POSSESSED OF INTERESTS ALMOST IDENTICAL TO NEEDED ELEMENTS OF COMPUTED STANDARD."

Otto opened his eyes, bewildered.

"SUBJECT CONSTITUTES EXACT TYPE SOUGHT TO MEET EVERY LISTED REQUIREMENT. SUBJECT IS UNDER THE INFLUENCE OF AL—"

"What's going on, here, anyway?" Otto shouted. "Your voice has changed!"
July, 1966

That’s when he suddenly saw the Brunette Doll.

She stood in a bedroom doorway, sleepily staring at him and shyly adjusting her horn-rimmed glasses which somehow went well with the rather skimpy shortie-nightie that accentuated her compactly curved little figure.

“Oh, good grief!” groaned Otto thickly. “I’m in the wrong apartment!”

His eyes reluctantly went back to the Tester which was still evaluating. “But if I’m in the wrong apartment,” he gasped, “how come this gismo is—”

He glanced at the Brunette in confusion.

She blushed.

Otto blushed.

“G-G-G-G-GUK!” said the Brunette nervously.

---

**SPASH ALARM**

*(Continued from page 49)*

suit the convenience of the builder. Bear in mind, however, that there are practical limits to the distance at which the probes can be located away from the circuit and continue to operate efficient-

When installing the alarm, bend the probes close together and make tests to determine optimum separation. Best results will be obtained by installing the probes at the pool, with the alarm being remotely located at a convenient listening post.
ly. This distance is best determined by trial.

The probes are constructed of ⅛"-diameter brass welding rods spaced approximately ¼" apart. Length is not critical, but it should not exceed 12 inches.

Installing the Alarm. Although the accompanying photographs show the alarm installed at the pool, it is preferable to install the unit at some other location. Select a convenient spot that will provide a good listening post most of the time.

Mount the probes close together on a piece of board, allowing the probe tips to extend a few inches beyond the edge of the board. Before mounting the probes, waterproof the board with several coats of oil-base paint and allow it to dry. The probes can be connected to the alarm via ordinary bell wire.

After installing the probes on the swimming pool wall about an eighth of an inch above the surface of the water, flip the switch on for a few "dry" runs. It may be necessary to adjust the spacing between the probes, as well as the height of the probes above the water, for optimum performance.

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**MUSETTE COLOR ORGAN**

*(Continued from page 62)*

rear projection through a plastic or glass screen, or reflected projection from a crumpled aluminum foil surface.

For best results, use red, orange, yellow, green, and blue spotlights to obtain a full spectrum of colors. It has been found that spotlights with built-in optical interference filters perform best, yielding the deepest colors, the coolest operation, and providing the best overall effect. These lamps readily produce all hues, and varying degrees of saturation.

The choice of a display, as well as the arrangement or sequence of colors for the various channels, is yours to make. One logical scheme is to drive the low-frequency color lamp—the color red—with low-frequency audio, and so on up the spectrum to blue.
Regardless of your final arrangement, we believe you will have the best color organ available, in terms of sensitivity, power output, and performance. Enjoy it.

Fig. 11. Actual-size illustration of printed circuit board. For hole drill sizes, refer to Fig. 4.

July, 1966

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Only the Squires-Sanders Noise Silencer eliminates noise caused by ignition, power lines, etc. Only two transceivers have this exclusive feature—the Squires-Sanders "23'er" with full 23-channel capability (all crystals supplied) at $235 and the "S5S" 5-channel model at $185. Other features include an ultra-sensitive receiver and a powerful, long-range transmitter (special high efficiency RF output amplifier clipped and filtered audio, 100% modulation). 12 VDC power supply.
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One of the important ingredients for topnotch tropo and E-skip DX is an antenna farm. The author used these high gain VHF and UHF rotatable antennas.

Equipment. The impression that TV DX'ing necessitates an extra investment in equipment is false. Unless you live in the metropolitan New York, Los Angeles, or Chicago areas, your chances of seeing some TV DX in the next few weeks are quite good. They are better if you have an outdoor antenna, and still better if that antenna is on a rotator.

Most TV DX'ers take photographs of the catches they have made to serve as proof of reception.

PHOTOGRAPHING TV SCREEN

There is a precise technique for photographing pictures on a TV screen. The TV picture is being produced at a rate of 60 fields and 525 lines per second. The fields are interlaced to 30 frames. The number of lines determines the picture definition. To take usable photos, the camera must be slowed down to either 1/25 or 1/30 second. Use film with an exposure index of 100, or slightly higher. With normal TV picture tube brightness, a typical exposure would be at f stop openings of either 2.8 or 4.0. If you have a choice, try not to use a camera with a focal plane-type shutter.
**TV TROUBLE QUIZ ANSWERS**  
(Quiz appears on page 77)

1 - G This keystoneing effect may be the result of a short in the horizontal winding of the deflection yoke, or a short in the balancing capacitor across the winding.

2 - C Slanting bars that change in number, width, and slant angle as the a.f.c. coil is adjusted are the result of the horizontal oscillator operating off frequency.

3 - A Neck shadows are produced by the deflection yoke being positioned too far back on the neck of the tube. They are also produced by an incorrectly positioned focus coil or ion trap.

4 - F A horizontal line across the face of the picture tube is an indication of no vertical deflection. This may be caused by failure of the vertical oscillator/amplifier tube, vertical output transformer, or other components in the vertical section.

5 - K When the picture wobbles from side to side while rolling slowly from top to bottom, the indication is a loss of synchronizing pulses. This is usually caused by a defective sync clipper or sync amplifier tube, or failure of some other sync component.

6 - J This dark bar is produced by 60-cycle hum in the video signal. It usually results from a filament-to-cathode short in one of the i.f., r.f., or video amplifier tubes.

7 - E Elongation of the bottom portion of the picture is usually caused by an improperly adjusted height (SIZE) control. This control also has a slight effect on the top portion of the picture during adjustment.

8 - I A picture having insufficient height and width (and usually poor brightness, focus, and sync) is usually caused by low B+ voltage. Try a new low-voltage rectifier.

9 - L A weak r.f. amplifier tube, as well as a poor antenna, will usually produce an abundance of snow in addition to a weak, washed-out picture.

10 - D A picture which fills out completely at top and bottom, but which shrinks at the sides, can be traced to a weak horizontal output tube. Low line voltage—during peak evening hours—can also cause a similar effect.

11 - H Beadlike, black vertical lines on the left-hand side of the picture tube are usually due to what is generally known as Barkhausen oscillation, which takes place in the horizontal output tube. Sometimes, mounting a small magnet on the tube will cure this condition.

12 - B Loss of horizontal sync, as evidenced by this split image, can be caused by an incorrect phase relationship between the horizontal sync pulses and the horizontal oscillator output. Try changing the phase detector.
SOLID STATE
(Continued from page 82)

feedback and leakage paths at a minimum. The circuit has excellent frequency response, although its input impedance drops rapidly above 100 Hz from over 1000 megohms to about 0.5 megohm at 100 kHz. If a lower input impedance is acceptable, C2 may be omitted. With this modification, the input impedance remains above 10 megohms throughout the audio range.

New Experimenter Components. In response to user interest in the popular "X-line" of experimenter components, General Electric (Owensboro, Ky.) has expanded the line to cover several new items, including a Triac (X12), a Diac (X13), a thyristor diode (X14), a thermistor (X15), and a low-voltage SCR (X16). In addition, GE has introduced a new "Hobby Kit." Netting for less than one dollar, the kit consists of a 3¾" by 4½" assembly board, rubber mounting feet, and more than a dozen push-in terminals. Component leads can be attached to terminals with or without soldering.

These new items—as well as other components in the "X-line"—are described in detail in GE's recently published 18-page "Entertainment Semiconductor Almanac." Copies of the booklet, publication ETR-4311, can be obtained from GE component distributors or by writing directly to General Electric Co., Schenectady, N. Y. 12305.

Silicon Rectifier Handbook. The new Silicon Rectifier Handbook put out by Motorola Semiconductor Products should be useful to both newcomers and old-timers, since all phases of the art are covered in its 216 pages. The book provides the necessary information for effective selection and application of silicon rectifiers. Circuits for both single and multiphase systems are described and analyzed, as well as rectifier voltage multipliers and circuits for regulation, arc suppression, and other specialized applications.

Priced at $1.50, the Handbook is available through your local authorized Motorola distributor or from Motorola's Technical Information Center, Box 955, Phoenix, Arizona 85001.

Transitips. If you wanted to design your own transistor amplifier, how would you determine the values of the bypass and coupling capacitors? By guess and by golly? By "rule of thumb?" By experimentation? By checking values in similar published circuits? Why not use the methods design engineers employ? It isn't as hard as you might think.

A capacitor's reactance can be calculated by using the equation: \( X_c = \frac{1}{2\pi fC} \), where \( X_c \) is in ohms, the constant \( 2\pi \) is approximately 6.283, \( f \) is in Hertz, and \( C \) is in farads. This equation can be simplified to: \( X_c = \frac{159,000}{fC} \), where \( C \) is in \( \mu F \). Transposing, the simplified equation can be changed to: \( C = \frac{159,000}{fX_c} \). This single equation is all you'll need.

Let's try a practical example. A typical common-emitter amplifier stage is illustrated in Fig. 7. Here, base bias is provided through voltage divider \( R1-R2 \), and stabilized by emitter resistor \( R3 \) bypassed by \( C1 \). Resistor \( R4 \) serves as the collector load, while the output signal is coupled through \( C2 \) to the following stage. Operating power is supplied by \( B1 \). We'll assume that the stage is an audio amplifier with a desired response extending down to 100 Hz.

In general, bypass and coupling capacitor values are chosen so that their reactance is no more than 1/10 that of the impedance bypassed (or coupled to) at the lowest frequency to be handled by the stage. In a practical amplifier, emitter resistor \( R3 \) might have a typical value of 100 ohms. The lowest frequency to be handled is 100 Hz. This means we must choose a capacitor with an \( X_c \) of no more than 10 ohms at 100 Hz. Using the equation we've developed, we find that \( C = \frac{159,000}{100} \times 10 = 159 \mu F \). Hence, \( C1 \) should be a 159-\( \mu F \) capacitor. Chances are you can't obtain this exact value, however, so you would use the next larger commercial value... either 160 \( \mu F \) or 200 \( \mu F \).

Next, let's determine \( C2 \)'s value. Assume that \( Q1 \) is coupled to another amplifier stage having an input impedance of approximately 2000 ohms (typical of low-power transistor amplifier). Then, using the same equation, but substituting 200 for \( X_c \).
and, again, 100 for f, we find that C = 7.95 μf. As before, you would use the next larger commercially available value for C2—either 8 μf. or 10 μf.

In both cases, capacitor working voltages are determined by the highest voltage (d.c.) expected in the circuit in which the units are to be used. With, say, a 9-volt power supply, 10- or 12-volt capacitors would be satisfactory.

Isn’t engineering fun?

—Lou

AMATEUR RADIO

(Continued from page 86)

NEWS AND VIEWS

Hank Hamburger, K3YDX, 4317 Varney Ave., Fort Meade, Md., spent six months as a Novice and then saved $4 by passing the General test just before the new FCC schedule of license fees went into effect. He operates his Hallicrafters HT-44 transmitter. National NC-300 receiver, and 40-meter dipole mostly on 40-meter CW with occasional excursions to 40- and 15-meter bands. While not a DX’er, Hank has most recent curosions. He is a member of two radio clubs and teaches code at one of them. Ronald Piper, WKN2VEO, Box 46, Port Kent, N.Y., works more DX on the 80-meter Novice band than many do on the higher frequencies. Feeding a vertical antenna with a Heathkit DX-40 transmitter and receiving on a Hallicrafters SX-99, he has worked 30 states and 4 Canadian provinces. His best catches are California and British Columbia with RST-589 reports. Bruce Wompler, WKN7EWC, 1305 S. Mitchell, Casper, Wyo., would probably rate as a “rare catch” with most amateurs. In his first three weeks on the air, Bruce put Wyoming in logbooks in 44 states, 4 Canadian provinces, and Puerto Rico. Separate dipoles for 80, 40, and 15 meters, an EICO 720 transmitter, and a Hallicrafters SX-111 receiver helped establish this record.

R. H. Mattson, W9ADT/MM, S.S. “Green Bay.” (KGPS), Box 63366, New Orleans, La., started out with a 1-tube transmitter and a 1-tube receiver—both operating from two 45-volt batteries—and worked 13 states. This was in 1939. He now operates with a Heathkit SB-900 receiver, SB-400 transmitter combination in conjunction with a W2AU Cubical Quad antenna on the S.S. “Green Bay.” The “Green Bay” is an air-conditioned freighter (quite a rarity, incidentally), and Bob is its chief radio operator. It would take all our space to tell you what Bob has done in radio since he first got on the air, like swimming ashore under fire with a 35-pound rig strapped to his back or operating on 75-meter phone with a 425-tube broadcast tower as an antenna. But he still thinks that amateur radio is the “most,” and he is happy to work anyone on phone or on CW—any speed... Mike Forsyth, WB6S5A, 789 Colusa Ave., El Cerrito, Calif., tells us where he operates and what he uses, but he is mum about his results. The statistics are 60 watts to a 2-element beam on 50 MHz, 20 watts to a 3-element beam on 144 MHz, and 6 watts to an 80-element beam on 232 MHz. He gets to 222 MHz with an International Crystal Company frequency multiplier. Dennis Quinn, WKN3EIP, 88 Woodrow Court, Sharon, Pa., finds that going to school and servicing his paper route—to
In about six weeks, James Carefoot, WNBSP, Marquette, Mich., exchanged comments with amateurs in 30 states. He uses a Heathkit DX-40 transmitter and GR-64 receiver (plus home-built Q-multiplier).

pay for his radio gear—cuts down on his air time. Nevertheless, he has managed to get in 30 states and Canada and earn a Rag Chewers’ Club certificate—all on 40 meters. He cranks the power on his Heathkit DX-100 down to 75 watts to transmit, and he receives on a Hammarlund HQ-110.

Michael Socha, WN8RUK, 7751 Warwick, Detroit, Mich., has found out that a good receiver makes a difference. In three months he has his Heathkit DX-40—feeding a 100’ end-fed antenna—and his old receiver worked eight states. In the few days since he got his Lafayette HA-225 receiver, he has pushed the total up to 14 states and Canada. The antenna is 20’ high, by the way, and this work has been on 80 and 40 meters. A 15-meter ground-plane antenna is now under construction... Richard W. Snyder, WASP, Mich. Tech. University, 1220 E. Wadsworth, Houghton, Mich., together with WASFD and W3NQ, is building 450-MHz TV gear. Dick also has equipment for most of the lower-frequency amateur bands, but 50 MHz seems to be his favorite. Maybe the 5-element HY-Gain beam that helps his 35-watt transmitter raise almost everything he hears has something to do with this preference... Brent L. Twitchell, WNZDEH, 5715 South 4000 West, Kearns, Utah, has eased his signal into 42 states and six countries on 15 and 40 meters. An end-fed 40-meter dipole antenna works well on both bands, the receiver is a Hammarlund HQ-170, and the transmitter is a Heathkit DX-40. A home-brew electronic keyer bugs the DX-40. When informed of the CB wrist radio proposal, we wondered if the new user would be called a Wristacator? Would his equipment be a wristceiver, a wristmitter, or a wristacom? Maybe the simplest arrangement would be to whistle it down to a 2-way radio!

Whatever the final decision, the micro unit will definitely not be designed as a toy. It will be aimed at business executives who would not normally care to walk down hallways or between offices carrying a walkie-talkie with a lengthy extension of antenna.

**HAMFEST PICNIC**

The Tenth Annual W6SD Hamfest Picnic sponsored by the San Fernando Valley Radio Club will be held July 24, starting at 10 a.m. Place: Lockheed Employees Recreation Center, 2814 Empire Ave., Burbank, Calif. Prizes include a Swan 350 transceiver and power supply, and a Hallicrafters SR-42 2-meter transceiver. Tickets are available for a donation of $1 sent to the above address.

**ON THE CITIZENS BAND**

(Continued from page 79)

from a chance near or road hazards ahead. Caravans of autos on field trips or excursions could be kept in constant touch. The two-car family could "verbally" ride together, although a block apart. You might also use the system to invite a friend to join you after he has passed you going in the opposite direction.

Bugaboos: Every car on the road would have to be communications-equipped to make the proposal effective; all equipment would require tone signaling to spare communicators from beam-powered CB signals crossing their paths; and all equipment would have to be on the same channel.

The CB wrist radio appears to have a bright future as proposed during a recent engineering gafest. It is possible to create a portable-type wireless intercom, operable on Citizens Band channels, contained in a slim package that would be strapped to the wrist, complete, without dangling wires, separate power supplies, or over-the-shoulder antennas. However, the range might be even less than with the communications system.

When informed of the CB wrist radio proposal, we wondered if the new user would be called a Wristacator? Would his equipment be a wristceiver, a wristmitter, or a wristacom? Maybe the simplest arrangement would be to whistle it down to a 2-way radio!
Users might also include secretaries, custodians, factory maintenance people and foremen, doctors and nurses. Department stores could equip each of their security guards and department heads with such a unit, as might large supermarkets and drive-in theatres.

The CB wrist radio would not eliminate the walkie-talkie. Rather, it would open up a new market for manufacturers, and create a compact means of instant communications. The new facility might be worn by everyone in a large concern from president on down to the mail clerk. It could be used in-office, indoors and out, from the top floor to the basement.

Due to advances in microelectronics, manufacture of such equipment is now feasible. One of the largest electronic firms in the world developed a CB receiver smaller than the proposed wrist model some time ago (they did not, however, answer our inquiry on the unit).

We're not sure when or how the communications idea might be tackled in the future. We feel more certain, though, that sooner or later someone will call Tracy's bluff by putting a CB wrist radio on the market. Like this year, maybe?

1966 OCTB CLUB ROSTER

The following clubs are represented on the OCTCB Club Roster for the first time. Active CB clubs not yet registered with this column are urged to fill us in on their operation, giving us the club history, membership totals, public service assistance that have been made, and a listing of current officers. Include a good, clear photograph if you can shake your publicity chairman loose, and we'll show the rest of the CB world what your operation really looks like. Send all material to Matt P. Spinello, CB Editor, POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.


Defiance, Ohio—Maumee Valley Emergency Citizens Band Radio Corps, Inc. Present membership is 73. Club has emergency patrol that meets first Friday of each month; sponsors annual CB jamboree; and publishes informative monthly, the "Squawk Box." Current officers: Ed Morehouse, KH12349, president; Joe Sauber, KLL1830, vice president; and Linda Hahn, KH19912, secretary; Harold Roth, KGH2550, treasurer; and a four-man board of directors.

Bloomsburg, Pennsylvania—Columbia County Five Watters Club. Membership is restricted to the "under 21" set. Applicants must be licensed CB'ers or members of the immediate family of an adult CB'er. First official meeting was held last January. Elected officers include: Eugene Radice, KINP812, president; Robert Longenger, KPQ2988, vice president; and George G. Stradman, Jr., secretary/treasurer.


I'll CB'ing you,

—Matt, KHC260

July, 1966

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SHORT-WAVE LISTENING
(Continued from page 83)

Money Can’t Buy...". The widely heard "Kiss Me Honey" clandestine station on 11,697 kHz now has a new recording of "Money Can’t Buy Me Love" by the Beatles. In the usual manner, the station will sign off somewhere in the middle of the record at about 1850, with no announcement at any time.

We’ve had many requests for the name of the singer and/or orchestra of the "Kiss Me Honey" record. Can anyone provide the answers?

CURRENT STATION REPORTS

The following is a resume of current reports. At time of compilation all reports are as accurate as possible, but stations may change frequency and/or schedule with little or no advance notice. All times shown are Greenwich Mean Time (GMT) and the 24-hour system is used. Reports should be sent to SHORT-WAVE LISTENING, P.O. Box 338, Cherry Hill, N.J., 08034, in time to reach your Short-Wave Editor by the fifth of each month; be sure to include your WPE identification, and the make and model number of your receiver.

Bechuanaland—According to the BBC, its Central African Relay station in Francistown is now operating at 0400-0730 and 1015-1145 on 7285 kHz and at 1545-2015 on 4845 kHz.

Brazil—Station ZYN50, R. Cultura de Pocos de Caldas, is noted at times on 4885 kHz from 0100 in Portuguese; don’t confuse it with ZYG26, R. Pionirea de Terezina, on the same frequency. Station ZYF23, R. d’f, Maranhao, Sao Luis, is now on 4710 kHz (a move from 4730 kHz) and is heard well around 0100-0130. Station PRCA, Radio Clube do Para, Belem, is heard well evenings on 4885 kHz; beware of ID’s given during sportscasts—with extensive networking, the call-sign may be that of the flagship station, usually one of the Sao Paulo or Rio de Janeiro outlets.

R. Guarani (no known call-sign) in Belo Horizonte is one of the few all-night stations. On 6175 kHz, it is usually good from 0600 on. Listen for a time signal every half hour from the State University of Minas Gerais.

Listed as inactive, R. Timbira, Sao Luis, 15,215 kHz, has been testing around 0215-0300 with beautiful music but having trouble in keeping the xmt on the air. Station ZYR38, 3285 kHz, R. Aparecida, has been “tentatively” logged with news at 0000-0005; Emissora de Educativa Rural is also listed for this channel.

Canada—The new and experimental xmt directed to the CBC for simultaneous rebroadcast to West African listeners is now scheduled for 5990 kHz instead of 5955 kHz. The time remains the same: 0725-0815.

China—R. Peking broadcasts to N.A. in Eng. at 0000-0055 on 15,060 and 11,820 kHz and at 0100-0155 and 0200-0255 on 15,060, 11,945 and 9480 kHz; in Spanish at 2300-2355 and 0000-0055 on 15,065, 11,945, and 7080 kHz and at 0100-0155 and 0200-0255...
ALL radio listeners interested in furthering the hobby of SW'ing—regardless of whether you DX on the BCB, VHF, TV, SW, or FM bands—are eligible to apply for a POPULAR ELECTRONICS "Certificate of Registration." You must have verified (have QSL cards from) a minimum of five radio stations, of which one was outside the borders of the United States. There is no age limit, or special equipment qualification; the only requirement is that the applicant have a sincere interest in radio communications.

All certificates are filled in and lettered before mailing; they are mailed flat and un-folded. If you want to register and receive your WPE identification sign, fill in the application blank below. Mail with 50 cents in coin (or stamps) to: MONITOR, P.O. Box 333, Cherry Hill, N.J. 08034. (Personal checks will not be acceptable). Canadians should use their own currency, and other applicants not in the U.S.A. should use 10 International Postal Reply Coupons. Allow 4-6 weeks for processing.

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Make Model

Age Occupation

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CIRCLE NO. 28 ON READER SERVICE PAGE

July, 1966
on 15,115, 11,980, 11,820, and 9940 kHz; in Chinese at 0000-0055 on 15,115, 11,980, 9940, and 9480 kHz and at 0100-0155 on 15,065 kHz. Other xmsns noted:
Peking, on 9365 kHz in native language from 2000 s/off to 2125 s/off, on 7820 kHz (dual to 7620 kHz) at 2207 in Russian; on 6825 kHz in French at 2130 dual to 7000 kHz, 735 kHz and 7435 kHz; in Chinese on 6645 kHz at 2025-2057 s/off; and on 6620 kHz in English from 2030. China Press Agency, Peking, was noted on 16,105 kHz at 0137 with normal-speed news in Chinese. Fukien is assumed to be the station noted on 3189 kHz around 0955-1015, with a weak signal.

Colombia—Station HJCF, La Voz de Bogota, has been testing in the 60-meter band using the 5041-kHz channel and suffering heavily in the Venezuelan 5040 kHz. When HJCF uses 5041 kHz, the regular 5040-kHz channel will be used.

Costa Rica—Station TSHCRG, R. Reloj, San Jose, 6206 kHz, is scheduled at 1100-0600 daily with best signal heard from 0100 to 0600, all Spanish. The ID is Estrad el Radio Reloj de Costa Rica. Listen for the “No Maria” daily at 0600. Reports go to Sistema Radiofonico HB, Roger Barahona and Hnos. Ltda., San Jose.

Dominican Republic—R. Television Dominicana, Santo Domingo, now back on the air on 9560 kHz after a long absence, was noted from 2220 to 0600 s/off in Spanish with a strong signal. Overseas sources list the 3200-kHz xmrtr as R. San Pedro, San Pedro de Macoris; this is strong around 0200.

Another station to reappear is HJJP, R. Comercial, Santo Domingo, 4880 kHz; it was noted at 2300-0200 in Spanish with music and commercials.

Ecuador—Station HCS4P, La Voz del Volante, Portoviejo, has been noted with Ecuadorian music and very few anmts on 6100 kHz to 0400 closing; it may run later at times. The Spanish speaking station on 3395 kHz is R. Zaracay, noted at 0600-0530 with typical Ecuadorian programming at excellent level.

Egypt—Cairo’s N. A. xmn is now on 9565 at 2330-0030 in Arabic at 0030-0130 in Spanish and at 0130-0300 in English. The South America xmn is on 9475 kHz at 2330-0030 in Portuguese at 0030-0130 in Spanish and at 0130-0230 in Arabic. They also have news in Eng., at dictation speed at 0300-0655 on 9115, 9475, and 7075 kHz. Monitors might check a “tentative” logging of Cairo on 15,135 kHz around 2200 with Eng. but very poor modulation.

England—According to “Wireless World,” time signal station GBR on 16 kHz is off the air while the xmrts are being modernized for frequency-shift keying. The service is being carried temporarily by the Criggan very low frequency xmrtr on 19.6 kHz.

Germany (West)—The planned N. A. relay station of Deutsche Welle will not be on Bonn as originally planned because of R. Nederland’s plans to build their relay station there, but it is still scheduled to be located somewhere in the Caribbean or Central American area. Later this year, medium-wave DX’ers might well look for Langenberg on 1586 kHz; the power is being raised from 400 kw. to 800 kw. Deutsche Welle is the only station in the world to have regularly scheduled Sanskrit programs; they are aired every second Thursday at 0845-0905 on 11,785, 15,275, and 17,845 kHz.

Ghana—Accra has been heard on 15,180 kHz at 0115 with a test xmsn and on 6110 kHz at 0330-0430 with its external service xmn in English. The 3280-kHz outlet carries a program preview in Eng. at 0540.

Gilbert & Ellice Islands—Station VTVW2, Tarawa, 4912 kHz, was observed from 0640 with a variety of music; an Eng. ID was given at 1028, closing anmts at 1030, and off with “God Save The Queen.”

Guinea—Thessaloniki, 9710 kHz, was logged at 1215-1300 with India-type native vocals and Greek (or similar language) anmts between each selection. The station goes off at 1300 without any anmts or anmt.

Korea (North)—Confirming the item in the March issue, R. Pyongyang has a xmn on 9935 kHz at 0000-0027, opening with a seven-note IS given twice, a short anmt, a march, then news in native language.

Kuwait—The Government of Kuwait has signed a contract with the British Marconi Co. for the supply and installation of three xmrts of 750 kw. each for the Voice of Kuwait. The xmrts will operate on 1215 kHz, on the medium waves and will cover the Middle Eastern countries extensively. Thus, Kuwait will have one of the most powerful medium-wave stations in the Middle East.

Lebanon—Beirut has moved to 9575 kHz for the N. A. service at 0130 s/off in French, at 0200 in Arabic, at 0230 in Eng., and at 0300 in Arabic. Another new frequency, probably being used for South America, is 11,760 kHz, currently noted with the usual IS and fanfare at 2300 s/off.

Mali—Bamako, 4875 kHz, was noted on three occasions at 0635, replacing 4783 kHz.

Mauritania— Nouakchott, 9610 kHz, is fair at 0755 with a guitar IS and Arabic at 0800 on Sundays only.

Mauritius—Any CW monitors needing this Indian Ocean country might check 6726 kHz, where they can be found working ships from G2C4. 7 kw.

Mongolia—A press time schedule from Ulan Bator lists Eng. at 2130-2230 and 0220-0320 (Mondays, Thursdays, and Fridays only) on 11,850 and 9540 kHz, and Mongolian from 2200 to 1500 on “27, 47, 50, 53, 72, and 73 meters.” An overseas source also lists 4164 kHz as opening daily at 2255.

Peru—Station OAX9E, R. Tropical, Tarapoto, 4937 kHz, has been heard with s/off anmts at 0354 over a male vocalist singing “Buenas Noches”; s/off is with a march or anthem. An unidentified R. Union on 6115 kHz is believed to be OBZ40, moved from 0500 kHz; tune around 0500 kHz.

Reunion—Contrary to last month’s listing, St. Denis is being noted very weakly on 4807 kHz at 0300-0310. Considerable fading and a nearby telepy station take the joy out of trying to hear much from this one.

Rwanda—Deutsche Welle’s relay station in Kigali has this new schedule: to West Africa at 0645-0630 in Eng., at 0630-0700 in Hausa, and at 0700-0745 in French on 11,905 kHz, at 1200-1245 in Eng., at 1245-1315 in Hausa. 1315-1400 in French on 17,765 kHz.
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