

# How to Pick a CB Handle - How One CBer Got Started

Elementary  
Electronics

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JULY-AUGUST

1976

\$1.00

# Elementary Electronics

FOR  
BEGINNERS

UNDERSTANDING  
RADIO  
TRANSMITTERS

OUR BASIC COURSE

**CHIP-TOCK** is a  
**LED Clock**  
put together  
for \$10

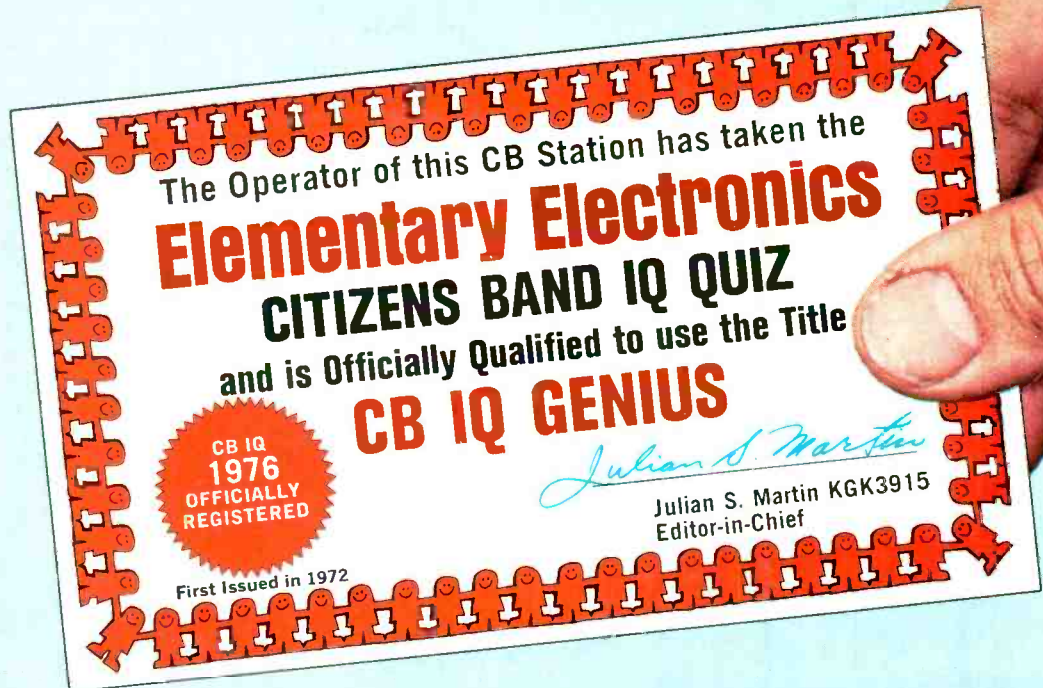
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SPRUCE MI 48762



**FLASH!!!**  
In this issue  
**THE NEW**  
**CB**  
**INSTANT PERMIT**  
**APPLICATION**

**FREE to CBers**  
-if you're smart  
enough!

Win this   
**CB IQ GENIUS**  
**AWARD**  
by reporting  
your passing  
score on our  
**CB Quiz!**



Beginning this issue-

**COMPUTER  
READOUT**

Our new Mini-Computer  
column for Hobbyists

**Special**  
for Photographers!  
**Build our Flashgun Genie**  
and let a slave give you better snaps!

 A DAVIS PUBLICATION

# Learning with CIE is



# Electronics no picnic.

**It takes work.  
And a few  
sacrifices.  
But  
it's worth it!**

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That's why we're so thorough. We've got a 40-year reputation to uphold and we're going to keep it by giving our students the best *independent home-study* training we can.

Sure, some of our weaker students drop out. (Learning Electronics with CIE is no free ride.) But you can bet on this... the ones who do make it are ready! Ready to go out and make it in the rewarding world of Electronics. And that's the reason you want to learn, isn't it?

## **You can have attractive job opportunities**

There have already been many exciting developments and breakthroughs in

Electronics and some people might assume there will be no new frontiers... no new worlds to conquer. Not so.

Electronics is still growing. In nearly every one of the new and exciting fields of the Seventies you'll find electronics skills and knowledge in demand. Computers and data processing. Air traffic control. Medical technology. Pollution control. Broadcasting and communications.

### **Importance of an FCC License**

If you want to work in commercial broadcasting... television or AM or FM broadcasting... as a broadcast engineer, federal law requires you to have a First Class Radiotelephone License. Or if you plan to operate or to maintain mobile two-way communications systems, microwave relay stations or radar and signaling devices, a Second Class FCC License is required.

But even if you aren't planning a career which involves radio transmission of any kind, an FCC "ticket" is valuable to have as Government certification of certain technical skills. It's a job credential recognized by some employers as evidence that you know your stuff.

A good way to prepare for your FCC License exam is to take one of the CIE career courses which include FCC License preparation. We are confident you can successfully earn your license, if you're willing to put forth an effort,

because the vast majority of CIE students have. In fact, based on continuing surveys, close to 9 out of 10 CIE graduates have passed their FCC exams!

So if you are serious about getting ahead in Electronics... if you are willing to put in the extra work... get in touch with us.

We have many *career* courses for you to select from. If you already have some electronics training, you may want to skip our beginner-level courses and enroll in an intermediate program. Or, if you're really hot, there's a tough, college-level course called "Electronics Engineering" that can make you even better.

### **Send today for FREE school catalog**

Send today for our FREE school catalog and complete package of *independent home-study* career information. For your convenience, we will try to have a representative call to assist in course selection. Mail reply card or coupon to CIE... or write: Cleveland Institute of Electronics, Inc., 1776 East 17th Street, Cleveland, Ohio 44114.

Do it TODAY.

### **G.I. Bill Benefits**

All CIE career courses are approved for educational benefits under the G.I. Bill. If you are a Veteran or in service now, check box for G.I. Bill information.

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| <input type="checkbox"/> Color TV Maintenance    | <input type="checkbox"/> Other _____             |       |
| <input type="checkbox"/> Mobile Communications   | _____  |       |

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Apt. \_\_\_\_\_

City \_\_\_\_\_

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Zip \_\_\_\_\_

Age \_\_\_\_\_

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On Active Duty

# elementary electronics

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Electronics  
Hobbyists

Including Electronics Digest®

## WIN A BEAUTIFUL CB AWARD

- ☆ 75 CB IQ Quiz—take this exam and get a certificate from the editor (Polish Ham)

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# BUILD 20 RADIO

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- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ **SCHOOL INQUIRIES INVITED**
- ★ Sold In 79 Countries

### YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price. Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics, how to wire and solder in a professional manner; how to service radios. You will work with the standard type of Punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

### THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment. Many thousands of individuals of all

ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

### PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will be listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a Professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

### THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

### FREE EXTRAS

#### • SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

### SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

### FROM OUR MAIL BAG

J. Statatils, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend \$240 for a Course, but I found your ad and sent for your Kit."

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

### PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 579DJ Hewlett, N.Y. 11557

Please rush me free literature describing the Progressive Radio-TV Course with Edu-Kits. No Salesman will call.

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ADDRESS .....

CITY & STATE ..... ZIP .....

### PROGRESSIVE "EDU-KITS" INC.

1189 Broadway, Dept. 579DJ Hewlett, N.Y. 11557

Experience is the best teacher. You might settle for any CB first time around. Understandably. A lot of people think they're all pretty much alike. But you'll soon discover that, like everything else, there are exceptions.

Ask the pros. America's long distance truckers. These guys talk CB day in and day out. And they demand the best. That's why truckers refer to the Cobra 29 as "The Diesel Mobile."

**Listen to Cobra.** You'll hear a big difference. Because the Cobra 29 gives you features which assure crystal clear reception. Like switchable noise limiting and blanking, to cut out practically all pulse and ignition interference. Add squelch control and RF gain and you've got exceptional — adjustable — receiver clarity. Even in the heaviest CB traffic. You also get Delta Tuning which makes

**IF YOUR FIRST CB ISN'T A COBRA  
YOUR SECOND ONE WILL BE.**



up for the other guy, because even off-frequency transmitters are pulled in. Perfectly.

**Talk to Cobra.** And you know you're punching through. One glance at the 29's over-sized illuminated meter tells you just how much power you're punching out and pulling in. For voice modulation the DynaMike delivers at 100%. Same way with power: The 29 transmits at maximum power levels.

**Sooner or later you'll get a Cobra.** And you'll get engineering and craftsmanship second to none. Performance that will make your first CB seem obsolete. Reliability and durability that have set standards for the industry.

Above all, you'll get power. The power to punch through loud and clear like nothing else. Because when it comes to CB radio, nothing punches through loud and clear like a Cobra.



**Punches through loud and clear.**

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# Using Your Citizens Radio Station

(See Part 95 of FCC Rules & Regulations for complete instructions on authorized station use.)

## Welcome to the Citizens Radio Service

Citizens Band Radio is a shared communications service with many people using the same frequencies and channels.

The guidelines provided in this form are not intended as a substitute for FCC Rules, but as a general reference to those operating practices and procedures which will benefit you and other users of Citizens Radio.

Your compliance with these guidelines and your consideration for the rights of others in your radio service is necessary if the full potential and enjoyment of Citizens Radio is to be realized.

## Go CB Today

As a special bonus to our readers, the Editors of **ELEMENTARY ELECTRONICS** have included in this issue a copy of the FCC's new Temporary Permit Form for CBers. The form (555-B) is intended for use only by those who have applied for a CB license using Form 505, but who have not yet received their license.

By completing the Temporary Permit Form according to the instructions, you can get on the air immediately with your own self-assigned call sign. This Temporary Permit is valid for a maximum of 60 days from the date you mail your regular CB license application to the FCC.

For example, if you mailed your CB license application on July 4, 1976, then you can fill out Temporary Permit, FCC Form 555-B on the other side of this page, and go CB that same day. If your name is George Washington and your Zip Code number is 20024, your temporary CB call sign will be KGW20024. It's all in the form, so fill it out today if you still have not received your CB license.

If you have not yet applied for your CB license, first fill out FCC Form 505 and mail it to the FCC with a check for \$4. You can get a copy of Form 505 from the FCC or from the front of the 1976 CB BUYERS GUIDE. After you have mailed the application to the FCC, you may then fill out your temporary permit.

Why wait—go CB today!

1

## Who May Operate Your Citizens Radio Station?

You, members of your immediate family living with you, and your employees, while on the job.

2

## How Many Transmitters Does this Permit Authorize?

A maximum of five (5).

3

## Can the FCC Inspect My Station?

Your station and station records must be available for inspection by an authorized agent of the FCC.

4

## Where Should I Keep This Permit?

Keep it in a safe place. Post photocopies at all fixed station locations. Indicate on photocopies the location of this permit. Attach a card with your name, address and temporary call sign to each transmitter.

5

## How Shall I Identify My Station?

Identify transmissions in English with your temporary call sign.

6

## How Can I Use My Station?

Use it for private short-distance radio-communications for your personal or business activities. Channel 9 is reserved solely for emergency communications and to assist motorists.

### Prohibited Communications Include:

- Activities contrary to law
- Transmitting obscene, indecent or profane messages
- Communicating with non-Class D stations
- Intentional interference to other stations
- Transmitting for amusement, entertainment, or over a public address system
- Transmitting false distress messages
- Advertising, selling, or for hire

7

## How High Can My Fixed Station Antenna Be?

See Section 95.37 if your antenna will be over 20 feet above ground. Additional information is available in SS Bulletin 1001-h.

8

## May Amplifiers Be Used With My Transmitter?

'Linear' amplifiers are absolutely prohibited. 'Power' microphones may require adjustments to your transmitter.

9

## Who Can Make Adjustments to My Transmitters?

Adjustments affecting proper operation may be made only by, or under the supervision of a licensed first or second-class radio operator.

# Temporary Permit

## Class D Citizens Radio Station

# 1

### Instructions

- Use this form only if you want a temporary permit while your regular application, FCC Form 505, is being processed by the FCC.
- Do not use this form if you already have a Class D license.
- Do not use this form when renewing your Class D license.

# 2

### Certification

Read, Fill In  
Blanks, and Sign

#### I Hereby Certify:

- I am at least 18 years of age.
- I am not a representative of a foreign government.
- I have applied for a Class D Citizens Radio Station License by mailing a completed Form 505 and \$4.00 filing fee to the Federal Communications Commission, Box 1010, Gettysburg, PA 17325.
- I have not been denied a license or had my license revoked by the FCC.
- I am not the subject of any other legal action concerning the operation of a radio station.

\_\_\_\_\_  
Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Address

**If you cannot certify to the above, you are not eligible for a temporary permit.**

**Willful false statements void this permit and are punishable by fine and/or imprisonment.**

\_\_\_\_\_  
Date Form 505 mailed to FCC

# 3

### Temporary Call Sign

- **Complete the blocks as indicated.**

Use this temporary call sign until given a call sign by the Federal Communications Commission.

<b>K</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
----------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

↑                      ↑                      ↑  
 Initial of            Initial of            Applicant's Zip Code  
 Applicant's        Applicant's  
 First                Last  
 Name                Name

# 4

### Limitations

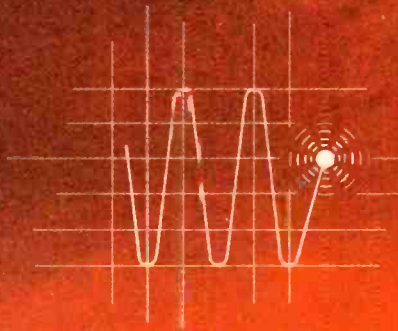
Your authority under this permit is subject to all applicable laws, treaties and regulations and is subject to the right of use or control by the Government of the United States.

This permit is valid for 60 days from the date the Form 505 is mailed to the FCC.

**You must have a temporary permit or a license from the FCC to operate your Citizens Band radio transmitter.**

**Do Not Mail** this form, it is your Temporary Permit.

See the reverse side of this form for a summary of operating instructions.



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Mee-The Messenger 123SJ—the first CB radio with LED meter readout! Bright, ruby-red LEDs let you read signal strength, transmit power and modulation precisely and at a glance, or use your meter as a "visual call alert" while keeping your eyes on the road. The Johnson LED meter is all solid-state so it's completely reliable, regardless of temperature, dust and humidity. Add the proven performance of built-in electronic speech compression, mechanical "steep skirt" filtering, voice-tailored audio and plus/minus ground ... and you'll know why it is *clearly* the most advanced CB radio in its class. \$169.95.



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### Semiconductor Tester

An improved version of the popular in-circuit semiconductor tester featuring a new Hi-Lo Power Drive system is now available from B&K-Precision, Dynascan Corporation. The new tester, designated



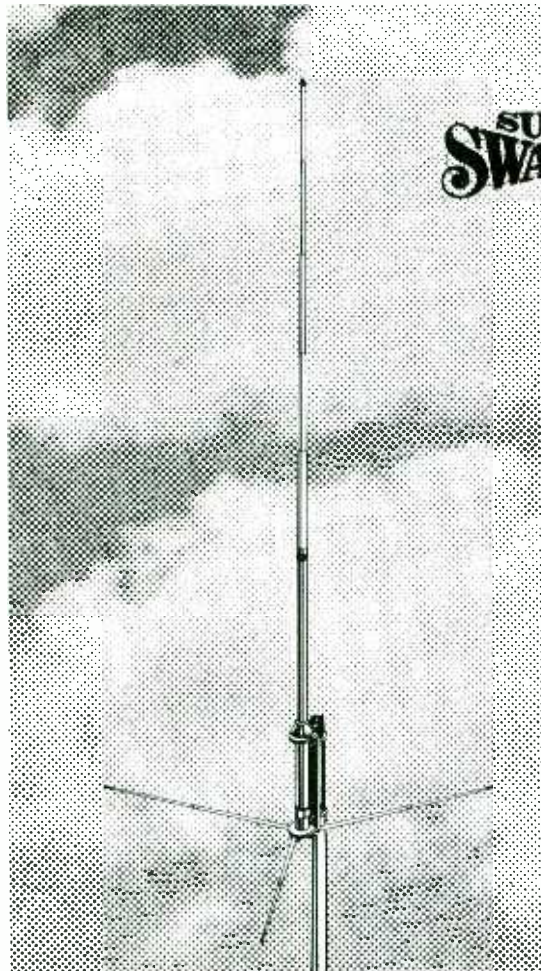
CIRCLE 52 ON READER SERVICE COUPON

the Model 520B, is AC-powered and designed to offer maximum operating convenience for technicians at the service bench. In Lo Power Drive, the base, emitter, and collector leads of the device being tested are automatically identified. Hi Power Drive enables a technician to perform accurate in-circuit gain tests on devices in circuits with shunt resistance as low as 10 ohms and shunt capacitance as high as 15 uF. An audible tone indicates proper operation, and LED indicator lamps identify the functioning device as PNP or NPN. According to the manufacturer, the Model 520B can perform a complete in or out-of-circuit leakage test with automatic identification of silicon or germanium semiconductor types. The polarity of diodes, FETs, and SCRs also are indicated. The Model 520B has a net user price of \$160.00. The unit is available nationwide through authorized B&K-Precision distributors. For more info, write to B&K-Precision, 1801 W. Belle Plaine Ave., Chicago, IL 60613.

### AM/FM Car Antenna Booster

The Stereo One by Finney is an automobile FM signal booster designed to help eliminate signal fade and flutter associated with weak signal FM reception. A unique electronic circuit design allows the Stereo One to be used with any auto AM/FM radio without any adverse effect on normal AM/FM reception. The circuit more than triples the received signal to provide crisp, clear FM reception in fringe signal areas. Even in

(Continued on page 14)



**SUPER SWAMPER**

## Why you need a Hustler CB base station antenna.

Your antenna is your link with other CB'ers. The more effective that link, the better you hear, and the better you're heard. Hustler CB base station antennas are electrically longer for greater range—up to 20%—to extend your signal over the miles. And they're easy to install, stay tuned for peak performance no matter what Mother Nature does. Each Hustler is manufactured to the highest standards of the industry with the very best materials. Get outstanding all directional coverage with a Hustler "Super Swamper"—Model 27TD or "Jam Ram" Model 27JR.

**HUSTLER**

new-tronics corporation

15800 Commerce Park Drive  
Brookpark, Ohio 44142  
(216) 267-3150

**Available from all distributors who recognize the best.**

Hustler designs are patented under one or more of the following assigned to New-Tronics Corporation 3287732, 3513472, 3419869, 3873985, 3327311, 3599214, 3582951

"the home of originals"

# Move up to Teaberry the Quality CB People



TEABERRY ELECTRONICS CORPORATION Indianapolis, Indiana 46218

CIRCLE 11 ON READER SERVICE CDUPON

[www.americanradiohistory.com](http://www.americanradiohistory.com)

HEY, LOOK ME OVER



CIRCLE 51 ON READER SERVICE COUPON

strong signal metropolitan areas, the Stereo One will not overload, thus making the unit useful under all receiving conditions. The Stereo One is a two-piece unit consisting of an amplifier section that amounts close to the auto radio, and an aesthetically designed On-Off control switch that self-mounts on the dash in any convenient location. The control switch also has an LED On indicator light. Sells for \$24.95. For additional information, write to The Finney Company, 34 W. Interstate St., Bedford, OH 44146.

TR Metal Detector

You used to have to pay \$100 or more for a transmitter/receiver metal detector,



CIRCLE 48 ON READER SERVICE COUPON

but now you can get one of surprisingly good quality for \$69.95. Edmund Scientific's TR Earth Challenger is a fine intermediate unit with super sensitivity. It's an excellent way to get into treasure hunting. Its great selectivity is determined by a 10-turn metal/mineral tuner. Its sensitivity and TR power enable the six-inch waterproof search coil to find a penny six inches away. Because it is ruggedly constructed of all metal and featherweight (just 38 oz.), you can take the TR Earth Challenger to field, forest, mountains, or seashore. Perfectly balanced, the unit has a telescoping adjustable coil shaft to give you an extended length of 44 inches. Other features include a 1/4-inch stereo earphone jack, 8 "AA" batteries, and a snap-lock battery door. It comes with a lifetime warranty. The TR Earth Challenger (Stock No. 80,251) is available by mail from Edmund Scientific Co., 380 Edscorp Bldg., Barrington, NJ 08007. It's a thoughtful gift for putting someone on the fascinating road to treasure hunting this summer and fall.

GOLD LINE CB ACCESSORIES

ANTENNA MATCHER



GLC 1046 \$9.99

250 Watts 13-18 MHz  
Gives a perfect VSWR match for full power every time. Stops power loss due to and easy to install!

SWR MINI-BRIDGE



GLC 1008A \$15.95  
• Perfect for mobile applications.  
• Very stable meter readings.  
• Negligible insertion loss.

**WATTMETERS**

**1000 WATT INLINE WATT METERS**

Gold Line 1000 Watt wattmeters provide all you need to get the most out of your transmitter. Attracting negligible power, these inline units will continuously monitor radiated power.

- 1000 Watts continuous
- Handsome vinyl case
- 3 Scales: 0-10, 0-100, 0-1000 Watts
- VSWR Function
- 50 Ohm Impedance

GLC 1091 \$43.95

GLC 1091 \$43.95

GLC 1091 \$43.95

COAXIAL SWITCHES

GLC 1048 \$6.50  
50 W  
40 W x 1/4" W x 1/4" H  
7/8" K x 1/4" P x 1/4" S



GLC 1070 \$7.95  
50 W  
1/2" x 1/2" x 1/2" A x 1/4" H  
3/4" x 1/4" P x 1/4" S



**EXTRA LONG — HEAVY DUTY RETRACTILE CABLES**

Rugged cables for microphone or telephone. 18" retracted, full 50' extended — Stranded center conductors, tough PVC jackets — 5' tail on each end.

PART NO.	# OF COND.	WIRE GAUGE	O.D.	PRICE
328	3	23	250	1 shielded \$4.58
329	4	23	240	0 shielded 4.99
330	5	28	180	1 shielded 8.08

FREE! New how to use CB accessories brochure. It includes tips on soldering. Schematics and other valuable information. Available only at your Gold Line dealer or distributor.

Dealers and Distributors - Write for details

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INTERNATIONAL DIVISION, 2200 SHAMES DRIVE, WESTBURY N.Y. 11590  
CABLE—CHURCHIN WESTBURY N.Y. TELEX—0961474



CIRCLE 22 ON READER SERVICE COUPON

Mobile Monitor Match

Put your standard car radio antenna, either outside mount or windshield auto type, to good use when installing a monitor radio under the dash. It's all possible with the new Huster Monitor Match, model LY-5. Plug in the cable from the antenna into the Monitor Match antenna jack and plug the cable for AM/FM reception into your radio. Now



CIRCLE 50 ON READER SERVICE COUPON

you have the car's radio on the air, you still have two cables available for reception on VHF (25-175 MHz) and/or UHF (300-515 MHz). Monitor Match comes with all the cables you need; no fancy installation is required; and it's priced at \$8.95 at most CB/Monitor suppliers. Made by New-Tronics Corp., 15800 Commerce Park Drive, Brook Park, OH 44142.

# Shakespeare Powers the Citizens Band™

No other factor—  
not even the cost and quality  
of the CB radio set itself—makes such a  
dramatic difference in CB performance as the  
antenna that puts out and takes in the signal.

A Shakespeare pre-tuned fiberglass  
antenna can increase your talkpower  
and improve clarity over ordinary  
antennas. On both transmit and receive.

So don't let a "do nothing"  
antenna put a muzzle on your  
Citizens Band communications.

Power up with a gleaming  
white Shakespeare antenna,  
and get top performance  
everytime you go on the  
air. They're in a class  
by themselves.

© 1976 The Shakespeare Company



*Shakespeare*

...the Royal Line of Fiberglass Antenna™

Shakespeare Company—Antenna Group P.O. Box 246 Columbia, South Carolina 29202  
In Canada: Len Finkler, Ltd. 25 Torc Road, Downsview, Ontario M3J 2A8

CIRCLE 8 ON READER SERVICE COUPON

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**BIG SPEAKER CATALOG**

1001 BARGAINS IN

SPEAKERS—PARTS—TUBES—HIGH FIDELITY  
COMPONENTS—RECORD CHANGERS  
Tape Recorders—Kits—Everything in Electronics  
1901 McGee Street, Kansas City, Missouri 64108

**New** INTERNATIONAL  
**broadband  
amplifier**

MODEL 150-299



**14 db gain — 10 to 1,000 MHz**

International's inline amplifier provides 14 db gain flat within 1 db over a range of 10 to 1,000 MHz. Impedance 50 ohms. Requires 20 VDC @ 50 ma. For increased gain additional amplifier may be added. Uses BNC type terminals.

**SPECIFICATIONS**

**Range:** 10 to 1,000 MHz

**Impedance:** 50 ohms

**DC Input\*:** 20 VDC 50 ma

**Gain\*\*:** 14 db

**Flatness:** ± 1 db (Ref. 500 MHz)

**Operating Temperature:** -25 to +70°C

**Noise Figure:** 9 db

**VSWR Output:** 2.0

**Output capability for -60 db near**

**intermodulation distortion:** 100 MV

\*Will operate 12 to 24 VDC with some loss in characteristics.

\*\*May cascade for additional gain with consideration of noise and flatness.

Price **\$40.00** plus postage



INTERNATIONAL CRYSTAL MFG. CO., INC.  
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Oklahoma City, Oklahoma 73102  
405 236-3741

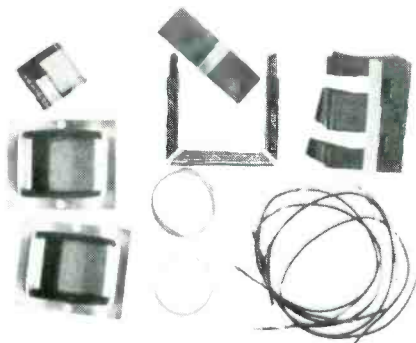
CIRCLE 27 ON READER SERVICE COUPON

**HEY, LOOK ME OVER**

380 Edscorp Bldg., Barrington, NJ 08007. As with everything Edmund sells, it carries a 30-day money-back guarantee.

**Build Your Own Power Transformer**

A new kit series containing everything needed to build a quality Power Transformer has just been introduced by King Magnetics Company. Anyone who is into hobby electronics can now build their own power transformer for electronic projects without settling for just any off-the-shelf transformer. The "PT" series Power Transformer Kits gives the hobbyist the ability to fabricate his own custom-designed transformers quickly and easily. All kits are available in two forms: the Standard Kit (ranging in price from \$3.75 to \$45.00) includes a pre-designed and completely wound primary coil for 115 VAC, 60 Hz operation. For all applications requiring other than 115 VAC, 60 Hz, "A" kits are available (ranging in price from \$3.00 to \$35.00) with a nylon bobbin, but the primary coil is designed and wound by the kit builder.



CIRCLE 49 ON READER SERVICE COUPON

These kits may be designed for such applications as 230 VAC, 60 Hz, 115/230 50/60 Hz, 115 VAC, 400 Hz, or any other required inputs. There is also a Design Manual available (PTDM) that includes the technical information necessary to build a custom-made transformer. Some of the information is confidential from various manufacturers and never before published. The price for this manual is only \$4.50 each, postage paid. For more details and prices on these kits or to order your Design Manual, write to King Magnetics Company, 18219. Parthenia Street, Northridge, CA 91324.

**Big On Sound**

The new Realistic Mach One breaks the sound barrier between high power



CIRCLE 32 ON READER SERVICE COUPON

handling capability and cost with the first moderately priced theater-type speaker system, according to Radio Shack. The speaker features a massive 15-inch acoustic-suspension woofer with brass voice coil, 4-cell midrange horn, and a high-compliance horn tweeter. Response is given as 20—25,000 Hz, and the Mach One is said to be able to easily handle 100-watt musical surges. Midrange and tweeter level controls may be adjusted to suit the acoustics of any room; and a special L-C crossover network blends all speaker elements for a response free of peaks and valleys. The system has 8-ohms impedance. A removable grille allows custom installation. The grille cloth is said to be almost acoustically transparent to prevent treble attenuation. The Mach One has a genuine walnut veneer finish. Size 28 3/8 x 17 3/8 x 12-in. The Realistic Mach One speaker system is priced at \$199.50. Available exclusively from nearly 4,500 Radio Shack stores and dealers in all 50 states, Canada and from Tandy International Electronics abroad.

**Tape Drawers**

A handsome woodgrain finish storage case for cassettes is being offered by TDK. The new case, called the CP-36, holds 36 cassettes in three drawers, each of which has an individual handle. The



CIRCLE 47 ON READER SERVICE COUPON

woodgrain finish makes the storage esthetically compatible with hi-fi components. The CP-36 has been designed so that a cassette deck can be placed directly on top of it to save shelf space. Suggested retail price is \$33.95. For information on this product and for TDK tapes, write to TDK Electronics Corp., 755 Eastgate Blvd., Garden City, NY 11530.

**TTL-5 Power Supply Kit**

All parts and materials needed for constructing a power supply to provide the rigid power requirements of the TTL-5 and C-MOS digital circuits are included in the TTL-5 Power Supply Kit offered by GC Electronics' Calectro Division. The Kit (Cat. No. G2-110) features a 5-volt lamp output with no adjustment required, internal short circuit, internal thermal shut down, and safe operating area protection. Also included are low output impedance, ripple rejection, excellent voltage regulation, and transient suppression. An illustrated step-by-step instruction booklet containing helpful hints and construction techniques is also included. Sells for \$19.95. For more information, write to GC Electronics, 400 South Wyman, Rockford, IL 61101.



# One look inside proves it! The new Royce Wireless Module CB's are years ahead of competition.

Look, no wires!

Modular construction. With not one single wire on any module.

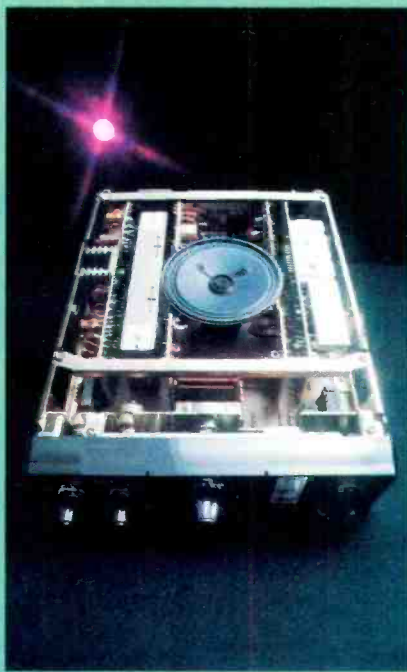
And, no hand soldered connections to vibrate loose.

Plus the things you want and need — peak power, better reception, greater range. All in a rugged, vinyl-clad metal cabinet.

And, automated module assembly at the factory — plus computer tuning and testing — assures you of the highest quality no matter which Royce Wireless Model you choose.

What does it all add up to? You know already. Greater reliability and performance in CB than you had ever dreamed possible!

See all 6 Royce Wireless Module Mobile CB Transceivers at your



Royce dealer's soon! Write today for information on these models plus other innovative Royce CB's, antennas, and accessories.

**Royce Wireless Model 1-650** — 23 channel mobile CB has Amplified Automatic Gain Control (AAGC) circuit to amplify weak signals, yet reduce nearby overload. Large, readable (1" X 1") S/R/F meter. Exclusive IC audio stage for maximum clarity, power. 3 ceramic filters reduce channel interference. Dual conversion receiver + tuned RF stage pulls in even weakest signals. Rugged metal (not plastic) RF output transistor.

**Royce Digital Wireless Model 1-660** — 23 channel mobile CB has digital readout dial system with bright L.E.D. numerals for fast channel selection. Phase Lock Loop Tuning adds greater reliability. ANL automatically minimizes noise, static. Pushbutton PA/CB activates powerful P.A.. AAGC. 3 ceramic filters. Exclusive IC audio stage for maximum clarity.



## Royce



Royce Electronics Corporation  
1746 Levee Road

Kansas City, Mo. 64116  
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*Follow the new leader!*

CIRCLE 16 ON READER SERVICE COUPON

[www.americanradiohistory.com](http://www.americanradiohistory.com)

# Where do the pros get their training?



**Almost half of the successful TV servicemen have home study training and with them, it's NRI 2 to 1.** It's a fact! Among men actually making their living repairing TV and audio equipment, more have taken training from NRI than any other home study school. More than twice as many!

A national survey\*, performed by an independent research organization, showed that the pros named NRI most often as a recommended school and as the first choice by far among those who had taken home study courses from any school. Why? Perhaps NRI's 62-year record with over a million students . . . the solid training and value built into every NRI course . . . and the designed-for-learning equipment originated by NRI provide the answer. But send for your free NRI catalog and decide for yourself.



### 25" Diagonal Color TV.. And 4-channel Quadraphonic Stereo.

As a part of NRI's Master Course in color TV/Audio servicing, you build a 25" diagonal solid state color TV with console cabinet. As you build it, you perform stage-by-stage experiments designed to give you actual bench experience. And you get a Quadraphonic system with 4 speakers. NRI's instruments are a cut above the average, including a transistorized volt ohm-



meter, triggered

### Two Famous Educators... NRI and McGraw-Hill.

NRI is a part of McGraw-Hill, world's largest publishers of educational material. Together, they give you the kind of training that's geared for success . . . practical know-how aimed at giving you a real shot at a better job or a business of your own. You learn at home at your convenience, with "bite-size" lessons that ease learning and speed comprehension. Kits designed to give you practical bench experience also become first-class professional instruments you'll use in your work.

sweep 5" oscilloscope, CMOS digital frequency counter and digital integrated circuit color TV pattern generator. They're top professional quality, designed to give you years of reliable service. You can pay hundreds of dollars more for a similar course and not get a nickel's worth extra in training and equipment.

### Widest Choice of Courses and Careers.

NRI doesn't stop with just one course in TV/Audio servicing. You can pick from five different courses (including an advanced color course for practicing technicians) so you can fit your training to your needs and your budget. Or, you can go into Computer Technology, learning on a real, digital computer you build yourself. Communications with your own 400 channel digitally-synthesized VHF transceiver. Aircraft or Marine Electronics. CB, Mobile Radio, and more.

### Free Catalog... No Salesman Will Call.

Send the postage-paid card for our free color catalog showing details on all NRI electronics courses. Lesson plans, equipment, and career opportunities are fully described. Check card for information on G.I. benefits. No obligation, no salesman will call. Mail today and see for yourself why the pros select NRI two to one!

If card is missing, write,



### NRI SCHOOLS

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3939 Wisconsin Avenue,  
Washington, D.C. 20016

\*Summary of survey results upon request.

# Don't broadcast the fact that you've got a CB radio.

Now you don't have to let everyone know that you've got a mobile CB radio. Our model MR234 disguise antenna looks and acts just like a normal car radio antenna operating on AM and FM as well as CB. We know the disguise is effective because we've been making them for law enforcement agencies for years. If you don't need a disguise antenna, but you do want superior CB performance in a cowl mounted 3-way antenna, check out our model M-267. Both models feature a stainless steel whip that detaches easily so your antenna won't get ripped off in the car wash either. When you're looking for antennas, 3-way, disguise or otherwise, take advantage of our 20 yrs experience. Look for the Stripes of Quality



**the antenna specialists co.**



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12435 Euclid Avenue  
Cleveland, Ohio 44116  
Export: 2200 Starnes Drive  
Westbury, L.I., New York 11591  
Canada: A. C. Simmonds & Sons, Ltd.

**Distinctly Superior Performance.**

© 1976 by the Antenna Specialists Co.

# newscan

Electronics in the News!

## Star Trek Research

The future is here if you want to squint at it. The Air Force laboratory has developed a futuristic mini-TV screen based on liquid crystal technology unlike the conventional cathode ray tube types. Small in size, only two-inches square, the screen has four, one-inch chips each containing 10,000 pixels or picture elements. No, don't look to a new generation of TV receivers this fall. The mini-screen liquid crystal TV display is still in the experimental stage.



A little bigger than a business card, this two-by-two-inch liquid crystal TV screen displays the emblem of the Air Force Avionics Laboratory.

## \$100,000 CB Song Contest

Radio Shack is offering \$100,000 in cash prizes for the best original music and lyrics in a song centered around the theme of Citizens Band radio, its operation, everyday use, or any phase of CB activity, real or imagined. The 1976 Realistic® \$100,000 CB Song Search is a unique songwriting contest open to any U.S. or Canadian resident. There is no entry fee and entrants do not have to be professional musicians or songwriters. Any number of songs may be entered as long as each is recorded on a separate cassette tape.

Entrants may perform their own song, or have it performed for them as long as it is an original creation. Songs may be country, folk, rock, rhythm and blues, or any style desired.

Each entry will be judged on the basis of originality, musical quality, and lyric content. Elaborate or professional instrumentation, special vocal arrangements, or production will have no bearing on judging.

*Exclusive Double-Header feature allows use as a conventional power mike or a superior, noise-cancelling power mike.*

*From out of the blue comes a dramatic improvement in CB communications from Telex, the aviation experts.*

*Patented design fits every hand — the same style used by pilots around the world.*

*Unique aircraft-type front mount eliminates mike fumbling. Mike comes off the bracket in the talk position. Standard rear mount also included.*

*Built-in variable gain power amplifier.*

*All Telex communications equipment is made in the U.S.A.*



# The first "loud and clear" mike.

Unique Telex CB-73 Double-Header puts you through *loud* — thanks to the power mike — *and clear* — thanks to the special noise-cancelling mode.

Now, the engineering expertise that made Telex the quality standard in aviation communications is available to CB'ers. It's the Telex CB-73 — the Double-Header. A 3-stage built-in integrated circuit amplifier maximizes "talk power" without distortion. And in a high noise environment, switch on the unique noise-cancelling mode and talk close to mike.

Don't be surprised at all the "wall to wall" comebacks you get or other CB'ers asking what kind of mike you're using.

Telex has a full range of aviation-type communications products for better CB. Try'em and you'll get the message — loud and clear.



Telex CB-88 Headset — Lightweight, aviation-type with maximum comfort.



Telex CB-1200 Headset — specially suited for high noise environments.

**The Pilot People**

**TELEX**  
COMMUNICATIONS, INC.

9600 ALDRICH AVE. SO., MINNEAPOLIS, MN 55420 U.S.A. EUROPE: 22 rue de la Legion-d'Honneur  
93200 St. Denis, France CANADA: Telak Electronics, Ltd., Scarborough, Ontario

CIRCLE 25 ON READER SERVICE COUPON

# FCC LICENSE STUDY GUIDE

If you have experience or training in electronics, but need specific help in preparing for FCC license exams, perhaps you need *Grantham's FCC License Study Guide* — not a Q&A book, not a correspondence course, but simply an authoritative, down-to-earth presentation of what you should know to pass your FCC exams for 3rd, 2nd, and 1st class radiotelephone licenses. Included are four information sections, and 1465 FCC-type multiple-choice questions with more than 65,000 words "explaining" the correct answers. The book is 7 x 10½, with 377 pages. Self-study presentation. Now, only \$9.95 *postpaid*. Order from:

**GSE Book Company**

2000 Stoner Ave., Los Angeles, CA 90025

## GRANTHAM OFFERS YOU College-Level Training and a college degree.

Electronic circuit design, engineering analysis (including math through calculus), classical and solid-state physics, computer science, etc., etc., are all part of the Grantham home-study electronics degree program.

### PUT PROFESSIONAL RECOGNITION IN YOUR CAREER.

By adding college-level home training and a college degree to your experience, you can *move up* to greater opportunities in electronics.

Grantham offers the A.S.E.T. degree by correspondence. After earning this degree, you may continue with additional correspondence plus a 3-day residential seminar and certain transfer credits, to earn the B.S.E.E. degree. Our *free* bulletin gives complete details of the program itself, the degrees awarded, the requirements for each degree, and how to enroll. Write, or phone (no collect calls please), for our free BULLETIN K-76.

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2000 Stoner Ave., Los Angeles CA 90025

● Telephone (213) 477-1901 ●

Worldwide Career Training thru Home Study



## NEWSCAN

A total of 63 cash prizes will be awarded. Each of the top 50 entries will receive \$1,000 and the ten semi-finalists will win an additional \$2,000. Third place winner will receive \$5,000 more, second place an additional \$10,000 and \$15,000 more will be awarded to the first place winner for total first place winnings of \$18,000. The ten winning songs will be recorded by Radio Shack in a professionally arranged and produced album.

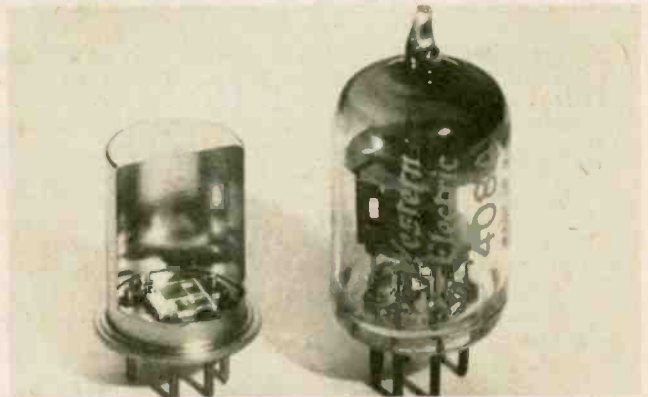


Entry forms and complete contest rules are available from Radio Shack stores and dealers in all fifty states and Canada. Hurry, though, because all entries must be postmarked no later than August 31, 1976.

### It's HIncredible!

New HIN devices (Hybrid Integrated Networks) are replacing vacuum tubes in Bell Telephone Company's central offices all over the nation. Using HIN devices will provide the Bell System with significant savings—particularly in the use of energy.

The savings will come about in several ways. HIN devices, for instance, use 60 to 90 percent less operating power than vacuum tubes. This means they produce less heat, thus reducing the air-conditioning load in central offices. The devices last about 10 times longer than vacuum tubes. Using them reduces replacement programs drastically, and, with HIN devices there's no need for periodic tuning of telephone transmission circuits. Added together, these factors produce savings that are, well, HINcredible.



What's HIN a Name? HIN is the designation for a new device (left) which stands for Hybrid Integrated Network. At left, the metal shell of HIN is cut away to show the IC chip. Size is smaller than vacuum tube at right, and uses less power.

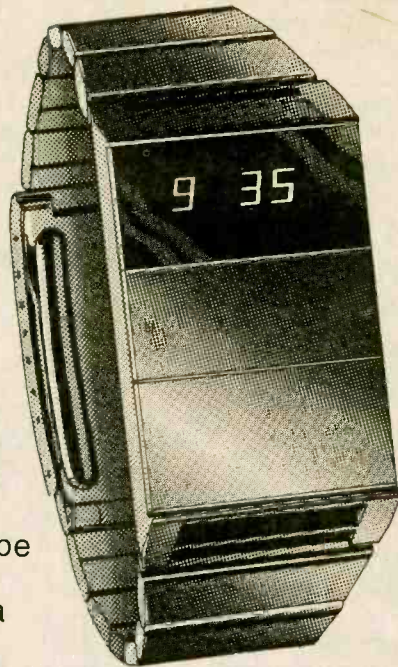
# The Black Watch kit

At \$29.95, it's

★**practical**—easily built by anyone in an evening's straightforward assembly.

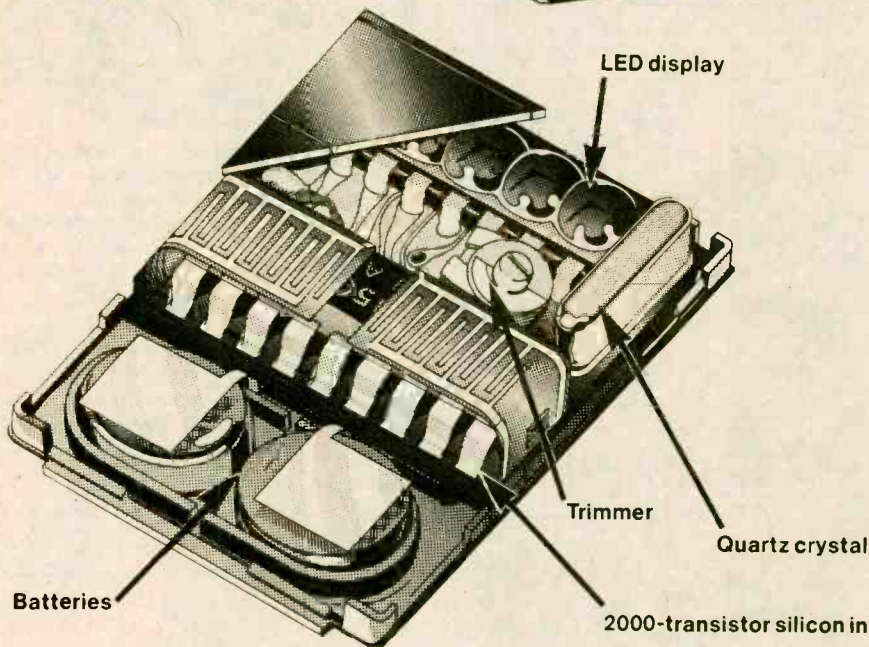
★**complete**—right down to strap and batteries.

★**guaranteed.** A correctly-assembled watch is guaranteed for a year. It works as soon as you put the batteries in. On a built watch we guarantee an accuracy within a second a day—but building it yourself you may be able to adjust the trimmer to achieve an accuracy within a second a week.



The Black Watch by Sinclair is unique. Controlled by a quartz crystal . . . powered by two hearing aid batteries . . . it's also styled in the cool prestige Sinclair fashion: no knobs, no buttons, no flash . . . just touch the front of the case to show hours and minutes and minutes and seconds in bright red LEDs.

The Black Watch kit is unique, too. It's rational—Sinclair have reduced the separate components to just four. It's simple—anybody who can use a soldering iron can assemble a Black Watch without difficulty. From opening the kit to wearing the watch is a couple of hours' work.



**Complete kit  
\$29.95!**

**The kit contains**

1. printed circuit board
2. unique Sinclair-designed IC
3. encapsulated quartz crystal
4. trimmer
5. capacitor
6. LED display
7. 2-part case with window in position
8. batteries
9. battery-clip
10. black strap (black stainless-steel bracelet optional extra—see order form)
11. full instructions for building and use.

All you provide is a fine soldering iron and a pair of cutters.

**sinclair**

Please send me

\_\_\_\_\_ Black Watch Kits @ \$29.95

\_\_\_\_\_ plus \$2.50 shpg. & hndlg.

\_\_\_\_\_ Stainless steel bands  
@ \$5.50

NY residents please add sales tax

I enclose my check/MO for \$ \_\_\_\_\_

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EE-7

**IMPORTANT**

Print your name and address here →  
for use as a shipping label.  
Thank you.

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Address \_\_\_\_\_

Zip \_\_\_\_\_

**FREE 10 DAY TRIAL**

If you decide not to keep your Black Watch Kit, return it undamaged within 10 days for a full refund on the kit.

Mail to: **SINCLAIR RADIONICS**

**sinclair**  
DEPT. 227  
Suite 400  
888-7th Avenue  
New York, N.Y. 10019







**Ask Hank,  
He Knows!**

#### CBer Heading South

*I am a Canadian citizen and want to use my CB in the U.S. on my vacation this coming fall. What do I have to do?*

—J. L., Ottawa, Ont.

Write to FCC, 334 York Street, Gettysburg, PA 17325, U.S.A. requesting Form 410B. The instructions with the form will give you full details.

#### To LED-Chip Photo Helper Project Builders:

In our March-April 1976 issue, the gremlins changed two numbers in the schematic diagram on page 71, in the article, "Use this LED/Chip Photo Helper." The ICs should have been marked 558 (as they are in the Parts List and text). Also, the lead from the bottom of R2 should have been shown going to ground, instead of to the positive (+) inputs of the ICs.

#### Noisy Fair Sex

*My sister has a makeup mirror which interferes with my radio from 1000 to 1500 on the AM dial. Do you know of any filter which will cut out this interference without affecting the reception? (I listen to 1220).*

—T. G., Kernersville, NC

The noise comes from the fluorescent tube in the mirror's illuminating circuit. Install a .001 disc capacitor across the line cord in the mirror. If this doesn't work, too bad! There's not much you can do except convince your sister that this type of light is poor for making up.

#### As the Wind Blows

*We were indeed pleased to see your recent well-prepared article on the construction of an anemometer ("Measure the Wind," ELEMENTARY ELECTRONICS, Vol. 16, No. 1, January/February 1976). There's not a sailing club in the country that doesn't either already have an anemometer or need a good one badly. And the state of the art in wind velocity measurement is such that most who already have an anemometer also need a*

Got a question or a problem with a project—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. Personal replies cannot be made. Sorry, he isn't offering a circuit design service. Write to:

**Hank Scott, Workshop Editor  
ELEMENTARY ELECTRONICS  
229 Park Avenue South  
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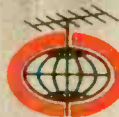
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## ASK HANK, HE KNOWS!

good one badly! The instrument you described affords many advantages usually found only in very expensive instruments. Remote sensing and direct digital readout make it particularly attractive.

We would like to suggest one improvement which you might want to pass along to your readers. Your article describes calibration from a moving automobile. Many are unaware that this is not an accurate method. Its errors are not much related to the accuracy of the speedometer in the auto. Instead, there's an aerodynamic reason. The auto seriously disturbs the air through which it moves. The disturbance is difficult to predict with much accuracy, varies greatly with the speed of the auto, and generally appears as a higher air velocity than the speedometer reading would have indicated. Errors as great as 30 percent would not be uncommon. Your instrument, with its two-digit resolution, deserves a better calibration!

A simple but accurate calibration device that can be used in anybody's back yard is described in the October 1971 issue of Scientific American. Total cost of the materials needed for the calibrator is about two dollars, and construction is a half-hour job. The method has been verified both analytically and in precision wind-tunnel tests. Accuracy is generally better than six percent—far better than with automobile calibration. Good sailing!

—C. T., Tullahoma, TN

Thanks for the tip! The October 1971 issue of Scientific American may be ordered by sending a check or money order for \$2.50 to the following address. Scientific American, Attention: Back Issues Dept., 415 Madison Ave., New York, NY 10017.

### CB Can't Do Everything

Just think, Hank, if our forefathers had had CB, they could have read the Declaration of Independence to the troops in the field.

—B. F., Philadelphia, PA

Try to break any channel in Philadelphia on a holiday and you will suffer like the Hessians at Trenton—total defeat!

### Sound on the Move

I'd like to have good FM and tape sound in my wagon and would like to cut the price tag. It's the installation I cannot afford. Where can I get some hook-up tips?

—D. M., Portland, OR

Send a letter to Steve Tillack, Pioneer Electronics, Carson, CA 90746 asking for his book entitled, "How to Install Car Stereo." It's a nice book and Steve will send it free.

### The Good Guys Dig Us

Picked up a copy (for the first time ever) of CB YEARBOOK a couple of weeks ago, and I wanted to congratulate the staff. I received my first CB license in 1959, and in all the years since, the CB YEARBOOK is the very best and most definitive book I've seen that tells it all: what CB is, how

it works, why, and how to use it. I think the YEARBOOK should be required reading for every CBer, especially for the newcomers who have joined the rush into CB during the past couple of years. I'm writing this with raw egg rampant on my face. Just before I saw and bought the YEARBOOK, I sent Uncle Sammy a check for a copy of the latest Class D rules and regs. Of course, now I learn you generously include all that in the YEARBOOK. My subscription order for ELEMENTARY ELECTRONICS went into the mail several days ago. Keep on modulating!

Ted McCoy  
WTAX AM Radio  
Springfield, IL

Mercy sakes, good buddy, your praise pinned our meter. We're all lit up like a Tijuana taxicab bugging a Roger Ramjet. Threes, ol' buddy. We gone.

### Help Needed!

Please help out these ELEMENTARY ELECTRONICS readers.

△ Sheldon Polansky of 7042 Wavell Rd., Cote-St. Luc, Quebec, Canada H4W-1L7 needs the schematic diagram for the Heathkit DX-100.

△ If a reader has a Zenith Model M660A shortwave /AM receiver and would part with it, write to Joseph J. Ganje, P.O. Box 12074, Tucson, AZ 85732.

△ Anthony Brown of 6255 Old York Rd., Philadelphia, PA 19141 would like a manual for the Hallicrafter Model P38 4-band receiver.

△ Have a schematic diagram for the old Knight Star Roamer (I wired one a long time ago), please send it to Wm. A. Latham, 11907 Amerado Blvd., Apt. 617, RR-33, Papillion, NE 68046.

△ Gary G. Blauvelt of 126 E. 6th Street, Hastings, NE 68901 needs the schematic diagram for Motorola Aviation Electronics, Inc. VHF receiver, Model 5613A, Schem. 717601E.

△ L. Smith needs the schematic diagram for the Genometer, Model 156 made by Accurate Instruments Co., Inc. Mail to 142 West 5th Street, Bayonne, NJ 07002.

△ I have an old Heathkit GW-22 6-band CB transceiver. Does anyone have info or suggestions? Write to: Richard Wolfert, 480 East 21st Street, Brooklyn, NY 11226.

△ Does anyone have a schematic for a General Electric AM/FM 5-band radio with "FM the Armstrong system," Model X415 with a chassis #2501? Send it to James R. King, 16 Vine Circle, Whitesboro, NY 13492.

△ Bill Fleming needs the schematic diagram to an Atwater-Kent receiver, model 47. Would also like info on obtaining the older tubes, for instance: numbers CX326 or UX226. Write to Bill at Box 153, Glen Elder, KS 67446.

△ Bob Dissler would like to get a schematic diagram or any information at all for a Hammarlund "Super Pro" SP-400-SX. He's located at 52 Fairview Avenue, Bergenfield, NJ 07621. ■

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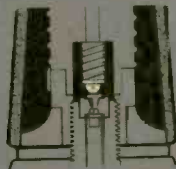
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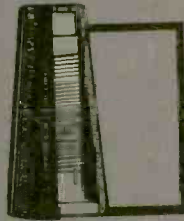
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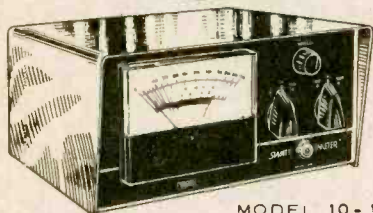
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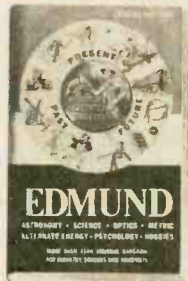
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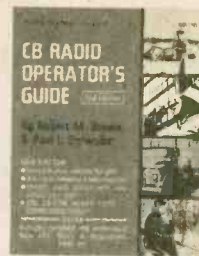


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*(Continued on page 86)*

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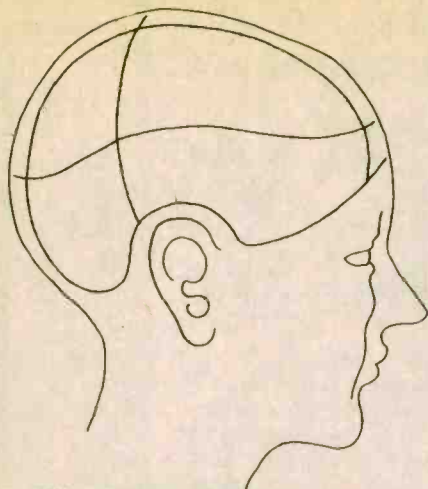
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## DX central reporting

A world of SWL info!

BY DON JENSEN

□ Summer is vacation time. For some it is a week or two at the seashore, at a northern lake, in the mountains, or back home on the old family farm. For others it is traveling cross-country in a camper, or a fishing expedition.

Summer is also a time when many SWLs take a vacation from shortwave listening. Reception isn't at its best and there are so many other things to do during the warm weather months. Besides when you're away from home you leave your DX "shack," your receiver, and other associated listening gear, behind.



This is really armchair DXing. The fellow holding the Barlow-Wadley XCR-30 shortwave portable is Jerry Lineback, St. Joseph, Illinois, an experienced DXer and an editor for the North American Shortwave Association.

But you don't have to. It might be fun this summer to take your SWling along with you on vacation. All you really need is a portable receiver that tunes the shortwave frequencies. If you don't have one, maybe you can borrow one from a friend or relative for a couple of weeks. Of course, a small portable multi-band receiver isn't going to do the job of the set you have back home, with its longwire antenna set up, but there is quite a lot you can hear anyway. And it is a different sort of "kick" to do your listening in the outdoors, surrounded by tall pines, or serenaded by the sound of the surf.

First, you should be able to "hype" up the performance of your little portable, at least somewhat, by adding to the built-in whip antenna. Take a length of insulated wire—hookup or bell wire is fine—about 50 to 75 feet long. Strip the insulation off one end of your "antenna" wire and clip or

wrap it around the whip antenna on your receiver. Toss the other end of the wire over a handy tree branch.

One major problem with the small portable receivers is the dial marking. It is, quite frankly, usually difficult to tell just where you are tuning on the shortwave bands. To get your vacation DX session going, I've selected some stations you can try for.

I've selected stations which are usually well received but, more importantly, most of them are a bit off-the-beaten-track frequency-wise. Not being right in the middle of a crowded DX band, but on the fringes, they should be easier to find on a less sophisticated sort of receiver.

See how many of these 15 countries you can hear during your two-week vacation!

- **USA**—This is starting you off the easy way. You're familiar, I am sure, with the standard time and frequency station, WWV, the station that ticks the hours away on a number of frequencies including 5,000, 10,000 and 15,000 kHz.

- **Canada**—The second country is just as easy thanks to a Canadian station similar to WWV. This is CHU, Ottawa, which can be heard on 3,330 kHz.

- **Israel**—The IBA, the Israeli government broadcaster, has a habit of changing frequencies a lot and, lately, choosing some frequencies out of the normal shortwave bands. As this is written, the IBA has been using 7,412 kHz for its English program at 2000 GMT. The theory behind the choice of these stations is that if a station is, more or less, by itself on an out-of-the-way frequency, it will be easier for you to find, even with a vaguely marked SW receiver dial.

- **Vietnam**—Hanoi uses a strange frequency, 10,040 kHz. A good way to track this one down is to first find the WWV time signal on 10,000 kHz and tune slowly up the band. A couple of times to try for English programming are 1300 and 1800 GMT.

- **Egypt**—It is evening. You're sitting around the campfire after supper. Turn on your shortwave portable and take a "look" through the very low end of the 31 meter band. The frequency is 9,475 kHz and, at about 0230 GMT, you should find *Radio Cairo* in English.

- **France**—*Radio France International* has an English broadcast at 1700 GMT. It is called "Paris Calling Africa," but it puts a pretty good signal into North America as well. One frequency to try is at the low end of 25 meters, 11,705 kHz.

- **Colombia**—Here is a Spanish-speaking Latin American station for those SWLs who hate—or know very little about—Latin American DXing. It is HJGC, *Radio Sutatenza* in Bogota, Colombia. It puts in a strong signal generally and it is easy to find on the dial. It is all alone on 5,075 kHz. Try this one almost anytime during the evening.

- **North Korea**—English programming at 2300 GMT on the strange frequency of 11,535 kHz should be the tip off that you have tuned the Korean Central Broadcasting Station, which also announces as *Radio Pyongyang*.

- **China**—When you finish with North

(Continued on page 34)



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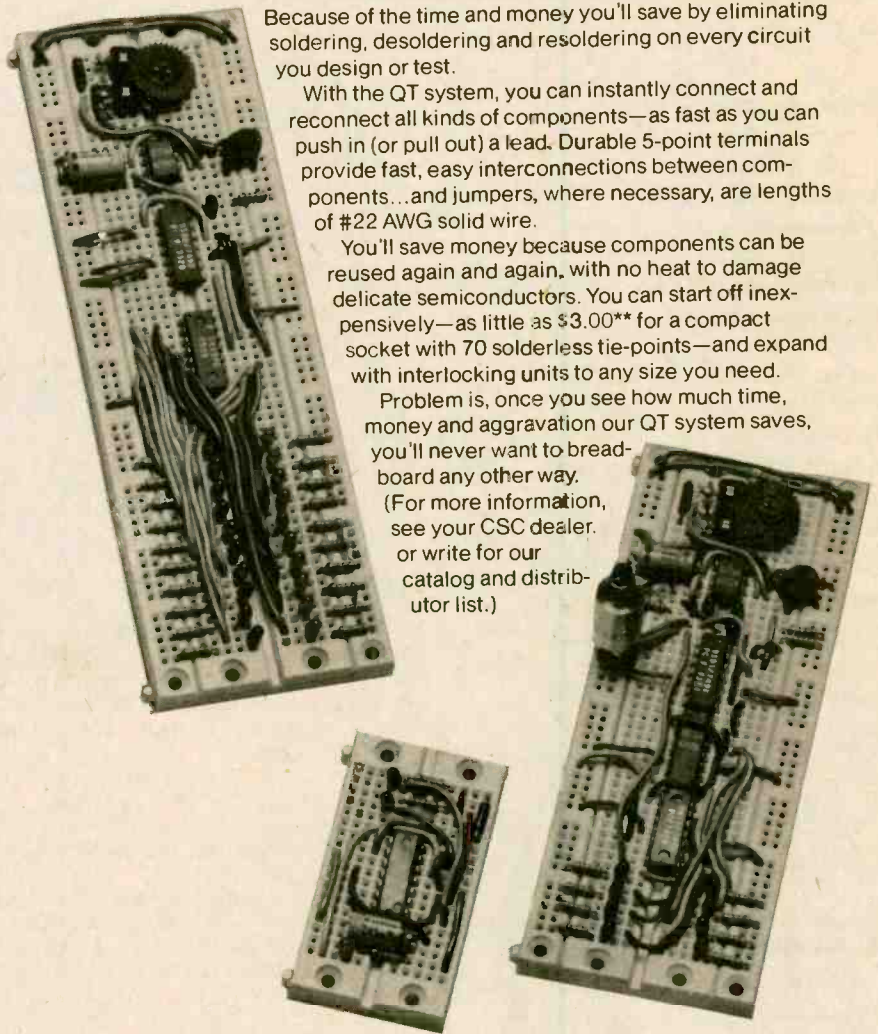
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CIRCLE 7 ON READER SERVICE COUPON

## DX Central Reporting

(Continued from page 32)

Korea, your portable receiver can jump you right across the border into China. *Radio Peking* has an English language program at 0000 GMT. Start at WWV's 10,000 kHz frequency and tune down to 9,940 kHz.

- **Czechoslovakia**—*Radio Prague* often is heard with good solid signals on 7,345 kHz. The time to tune for English language programming is 0100 GMT.

- **Albania**—Right up at the top end of the 49 meter band, usually with a rather strong signal, is *Radio Tirana*. This one can be heard with English at about 0230 GMT.

- **Iran**—*Radio Teheran* is one perhaps you haven't heard on your DXing set up back home. If not it may be because you don't normally tune around the off-beat frequency where it broadcasts . . . 9,022 kHz. You may hear an English language newscast at 2000 GMT.

- **South Africa**—*Radio RSA's* frequency isn't really out of the ordinary, although it is toward the upper end of the 25 meter band on 11,970 kHz. But it usually has a strong signal and around 2200 GMT, in English, you should be able to log it.

- **Great Britain**—Almost everyone knows the British Broadcasting Corp., the BBC, which can be heard on many frequencies, most of the day and night. But try 9,410 kHz at 1700 GMT for world news in English.

- **Ecuador**—HCJB, the *Voice of the Andes*, is an old friend to many DXers. With many frequencies, it should be easily heard sometime during your vacation DX session. How about 15,300 or 17,730 kHz around 1900 GMT, or 6,095 or 9,560 kHz at 0230 GMT?

**Tip Topper.** This month's best bet for DXers is Greece. Oh yes, an SWL could always hear Greece thanks to the Voice of America relay station at Kavala. But it was a bit harder to hear programs that were truly Greek.

For that sort of programming you have to hear the station of the Hellenic National Radio and TV Institute; in Greek, Ethnikon Idhryma Radiophonias Tileorasios—EIRT for short.

Recently, North American DXers have reported better reception, particularly on the west coast, of the institute's Voice of Greece. The Voice of Greece can be heard during its beam to North America, beginning at 1500 GMT, on 9,520 kHz.

If you tune in right at sign-on time, you should hear the flute interval signal and opening announcements in Greek. And if you stay tuned for 15 or 20 minutes, you will hear an English identification and newscast. Reception reports may be sent to the Voice of Greece, P.O. Box 19, Aghia Paraskevi, Athens, Greece.

**Bandsweep.** Times in GMT, frequencies in kHz: 764—An East Coast medium wave listener reports a "whopper level" signal from the station at Dakar, Senegal, after 0700. . . . 3,250—Strong signals have been reported from the home service station of the South African Broadcasting

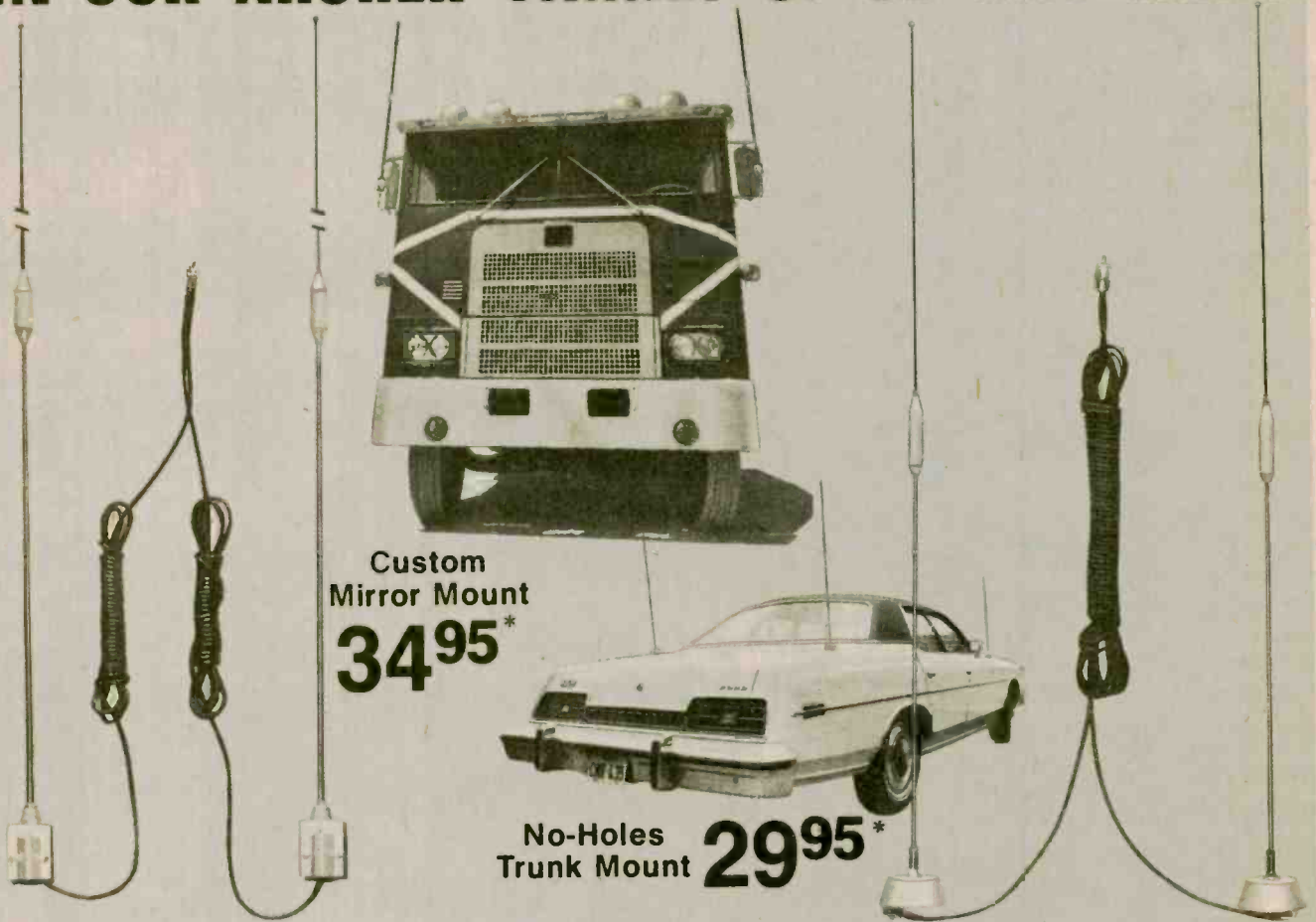
Corporation operating on this frequency. Best times to tune are between about 0100 and 0230. . . . 4,972—France Region 3, the new name for the old ORTF station located at Cayenne, French Guiana, is one South American you may be looking for. Listen for this one until 0105, when it signs off with the French national anthem. . . . 5,020—A nice bit of DX is the Solomon Islands Broadcasting Service. This voice from the Pacific can be heard from around 0700 until perhaps 0800 when some co-channel interference develops. . . . 5,995—*Vatican Radio* has a very short English language transmission, from 0100 to 0115. . . . 6,025—News and commentary in English from *Radio Portugal* can be found on this frequency starting at 0200. . . . 6,170—If you hear Arabic chanting on this channel sometime between 2000 and 2200, chances are you are listening to *Radio TV Marocaine*, with transmitter at Tangier, Morocco. . . . 7,170—Another of those exotic catches from the South Seas is *Radio Noumea*, from the French island of New Caledonia. This one can often be heard between about 0800 and sign off at 1100. . . . 7,295—In our "Tip Topper" section, the VOA relay station at Kavala, Greece was mentioned in passing. If you also want to tune this one, listen for the VOA's "Breakfast Show" in English at 0600. . . . 9,575—Italy's shortwave station, RAI, from Rome, can be heard about 0105 with English newscast. . . . 9,580—An African signal reported by a number of SWLs in recent months is *Radio Zambia*. You might listen in at 2000 for English programming. . . . 9,620—English news from Yugoslavia's *Radio Belgrade* can be logged on this frequency at 2200 until 2215. . . . 9,758—Though it still has been announcing its frequency as 9,745, here is where *Radio Baghdad*, Iraq, has been heard lately. It has an English language program beginning at 1930. . . . 11,745—Here is a very good bet for beginning SWLs. Listen for HCJB, the *Voice of the Andes*, at Quito, Ecuador. Try for its "Morning in the Mountains" program at 1300. . . . 11,825—Having already mentioned the Solomon Islands and New Caledonia, we can't skip over *Radio Tahiti*, which can be heard here around 0345 with island music. . . . 11,835—Uruguay is one of the tougher South American countries to hear. One possibility though is *Radio El Espectador* which broadcasts here in Spanish around 0030 to 0100 GMT. . . . 15,140—Here is an easy-to-hear European outlet, SBC, the Swiss Broadcasting Corporation. It programs in English at 1315. . . . 15,190—The Congo can be heard on this frequency between about 1900 and 2230 in French. Listen for the French IDs, "Radiodifusion Television Congolaise" or, "Ici Brazzaville." (Credits: Mark Connelly, MA; John Tuchscherer, WI; Richard Mitchell, CA; Ray Howath, IL; Dennis Dean, OH; Robert Zilmer, WI; John Shanley, PA; Ken Earhart, PA; Lauren Ware, VA; Alan Mayer, IL; Edward Becka, OH; Hadley Cress, VA; Richard Lucas, NY; Jack Conover, PA; Hobart Beal, WA; National Radio Club, Box 127,

(Continued on page 86)



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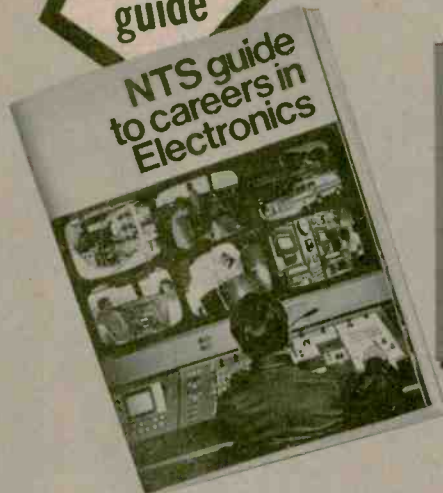
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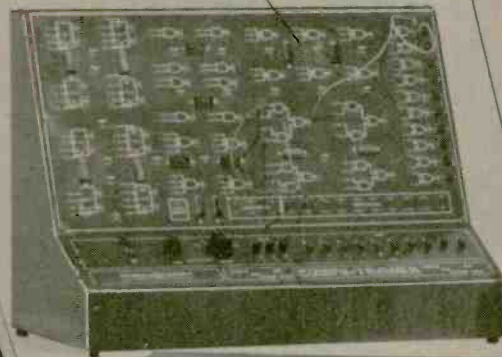
CIRCLE 32 ON READER SERVICE COUPON

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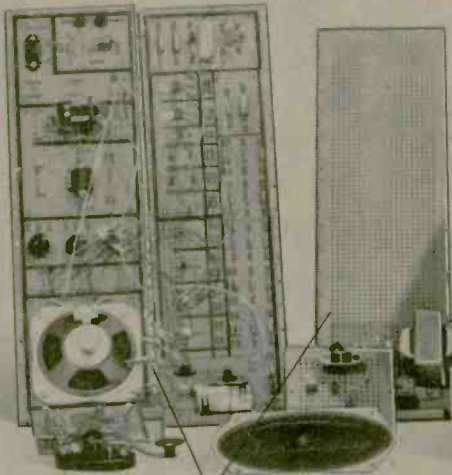
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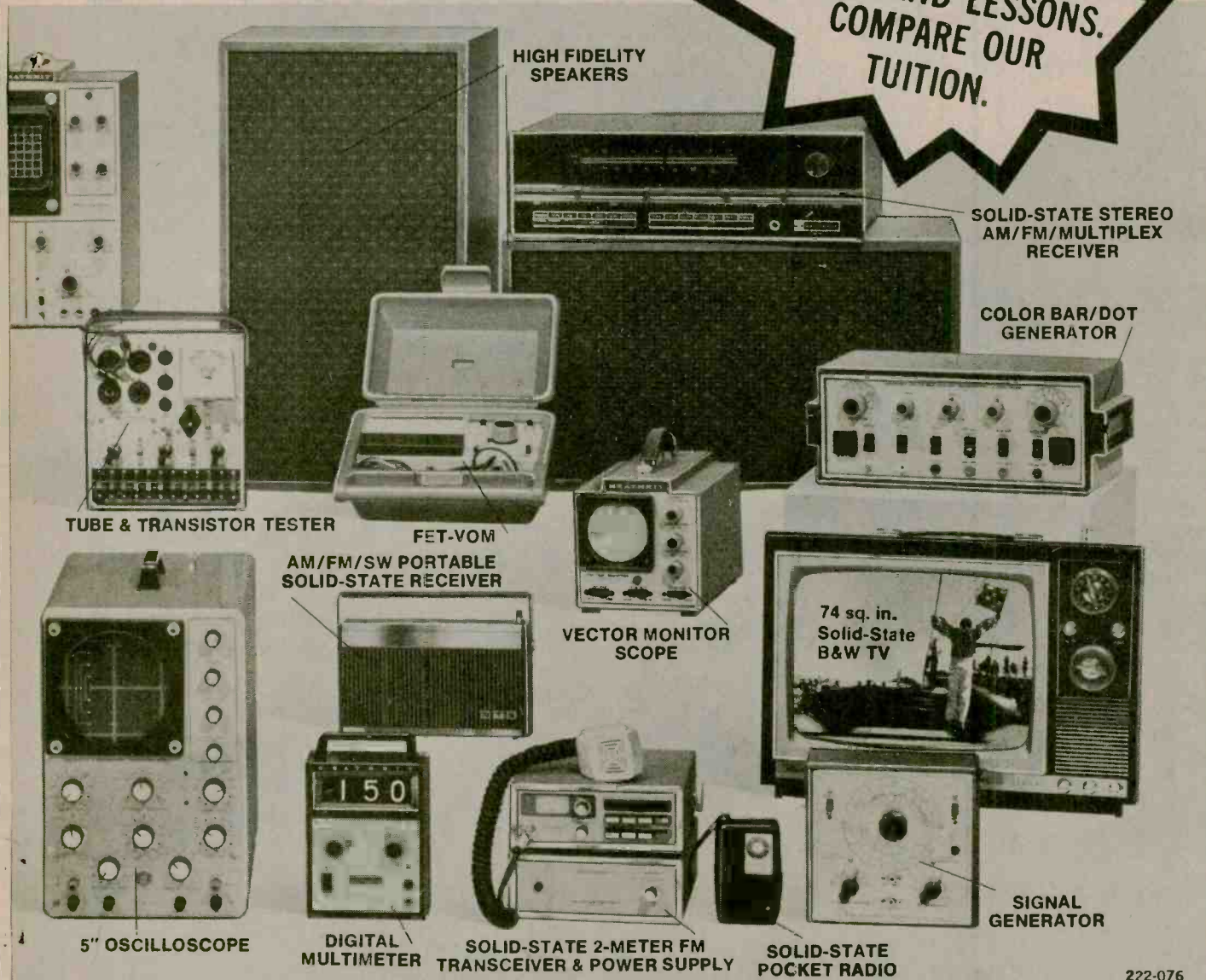
And even though you need an oscilloscope to perform their experiments, they don't provide it. You have to buy your own. And their course does not even include a Digital

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CIRCLE 21 ON READER SERVICE COUPON

□ ONE FINE DAY, when my life was still smooth and uncomplicated, the editor of **ELEMENTARY ELECTRONICS** called me on the phone and

said to me, "I think that you should get into CB radio." So I got.

That's the weird kind of relationship we have. When Polish Ham (that's my editor's CB handle) wants to find out what problems a newcomer to some area of radio or electronics might conceivably run into, he nudges me into action. He figures that if I muddle through on my own, just like any other novice, I will be willing to blab my goofs as well as my successes for the benefit of his readers. He's right, of course. We freelance writers have bills to pay, too.

I received no expert guidance from my knowledgeable editor, other than an offhand suggestion about what equipment I should consider using as a base station. After that he kept himself pretty much inaccessible for several months. I gained my knowledge the same way you do—by reading a few magazine articles and the **CB YEARBOOK**, and by trying to carefully follow installation directions provided with the equipment I bought. Despite all my advance research and planning,

# How I Got Started in CB Radio

**Here's how one beginner installed CB rigs in his car and home, with a few pratfalls along the way!**

by Jorma Hyytia, K2H5783

I managed to make enough interesting mistakes to justify Polish Ham's faith in my ability to discover some of CB's potential pitfalls, and I've lived to tell about them, too!

Lest you construe that fast remark a bit *negatory* (that's CB lingo for "negative"), let me say that setting up my CB system was fun, illuminating in some surprising ways, and all-in-all a success. Though I'm far from being a CB nut, I'll admit I would hate to have to give up the electronic umbilical cord that keeps me in contact with my home base when I'm tooling around town in my mobile-equipped four-wheeler.

*Talk About Chatter.* At times I still find it difficult to decide whether teenagers ever actually report emergencies. I found they can grunt, wheeze, and make other strange noises for half an hour or more without ever repeating themselves, and without uttering anything even remotely comprehensible to ordinary folk. I also discovered there is a twelve-year-old junior high school girl in town who imagines that she knows how to sound like a French cinematic sex kitten. She coos and gurgles to any male willing to listen, at all hours from 6:30 AM to midnight.

The true value of CB communication is most apparent when real emergency conditions arise, as during severe winter storms. The public service provided unfailingly by volunteer **REACT** organizations is impressive, to say the least. Also, time and again, I've seen drivers with mobile CB units stopping along highways to radio for tow trucks, police, or ambulances needed by other motorists. (Turn Page)

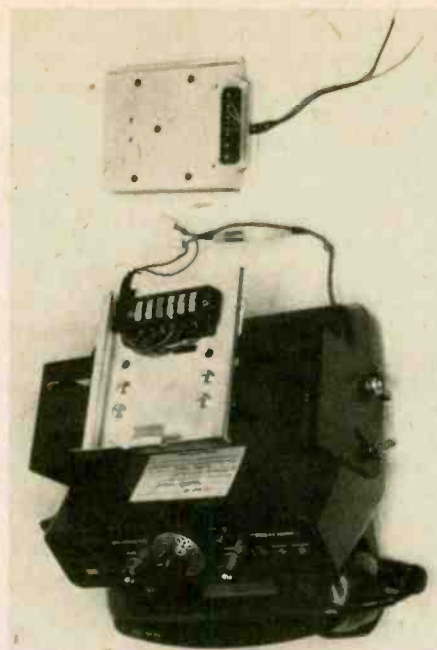


**Getting Started.** My first choices consisted of a popularly priced Realistic TRC-55 transceiver for use as a base station, a 5/8-wave omnidirectional antenna, and a 40-foot telescoping mast on which to mount the antenna. This package, purchased from Radio Shack in the U.S., costs just under three hundred bucks, plus taxes. There was an additional outlay for a connecting cable, according to the length needed.

For a mobile unit, I chose Realistic's TRC-56 rig, not because I knew beans about the quality of the electronics it contained (it was then so new that there were no published test reports), but because I could see definite advantages in the telephone type handset that is used for both talking and listening. Initially, my teenage son wanted a set with a regular microphone, but he fast became a handset convert. He discovered that he could ride in the car and listen privately to CB chatter that I would not tolerate on the loudspeaker. The loudspeaker can be on or off when the handset is in use.

Soon after I installed the mobile unit, I discovered an unexpected use for the handset. I was on the way home on a snowy afternoon when I spied a half dozen or so local juveniles waiting at a corner to peg ice balls at my car. As I approached, I picked up the handset and pretended to talk while running a cold eye over each foe. They were so stunned by the idea that I had a "telephone" with which to send information about their intended shenanigans that they just stood there, mouths open and ice balls in hand as I disappeared down the road. I exited laughing.

**What to Buy?** The right equipment for you isn't necessarily the kind I hap-



Half of the slide mount attaches to the set's mounting bracket with three or four screws. Slide contacts at rear are wired to the ground and plus 12-V leads of the set. Mating slide at right is bolted under car's dash.

pened to select. Pick what best meets your personal needs and pocketbook. However, I'll itemize my acquisitions in order to make the discussion that follows more meaningful.

Incidentally, I laid out \$179.95 for the TRC-56 and another \$11.95 for a mobile antenna. There were other expenses, but we will note those later on in context with specific installation problems.

**Getting The CB License.** Obtaining my FCC ticket took top priority because I just won't transmit without such legal sanction. Sure, the air waves are populated with dum-dums (so-called "bootleggers") who are too cheap to part with four bucks for a license that is good for five years and easier to obtain than a library card. Some bootleggers seek anonymity because they are sickies using language that, for obvious reasons, is forbidden by FCC. It's very juvenile and stupid, especially because the FCC is really cracking down on violators, even though you often don't read about such action in your local newspaper.

**It's Against the Law!** Illegal operation of CB equipment can get you up to a year in jail and up to a \$10,000 fine, though admittedly few judges impose such heavy sentences. Fines running up to \$500 and confiscation of equipment is more common, however, than you might think. Consider the ding-a-ling out on the west coast who

compounded his felony as an unlicensed operator by boosting his transmission power above legal limits with a linear amplifier—he got socked with a \$2,000 fine and a year in the jug! So send for your FCC license as soon as you latch onto the application form which comes with your new CB set. Send it out pronto because you will have to wait a month or more for your Glory Card because the FCC is being flooded with hundreds of thousands of applications every month. But don't fret. You can still have a good time, and learn how to operate, just by listening to other people broadcasting. Just don't thumb the transmit button on your mike until you have your license in hand—having mailed a check for \$4.00 to the FCC doesn't allow you to start transmitting.

As soon as your license application is in the mail, the next step is to start installing your equipment, and the first step in the installation process is locating your antenna.

**Antenna Location.** Locating my antenna was easy because there was just one really good place for it, on the end of the house, just above the garage roof. A ground location was out of the question because most of our land is either too heavily wooded, or too low for antenna erection. Fortunately, the highest point on the property is directly behind the house, so naturally I used that as my ground level reference from which to measure the maximum permissible height of 60 feet for the top of the antenna. In the end I actually dropped it a few feet lower than the maximum so there would be no question about my full compliance with FCC regulations.



The author slides his CB rig into place after plugging in the antenna lead on the rear of the set. Total installation (or removal) operation takes about four or five seconds, protects the set totally.



Tightening the cowl-mounted CB antenna. This location was chosen because it's easy to run lead-in cable from antenna to set.



Author mounted his base station with its antenna matcher in a custom-made cabinet. Underneath is his VHF police-fire scanner.

The lower section of the telescoping mast was separated from the rest of the assembly for mounting against the wall of the house. To mount it I used long U-bolts fashioned from  $\frac{3}{8}$ -inch diameter, threaded rod obtained at a local hardware store. The two legs of each U-bolt pass through the wall of the house, into the attic, where they straddle a two-by-four in the wall. Flat metal straps and nuts pull everything tight. The bolt holes drilled into the wall were caulked carefully. The bottom of the mast fits into a wood block with a hole drilled half way through it to protect the garage roof shingles from damage.

The other mast sections were dropped into the mounted lower section, the pre-assembled antenna was clamped in place and the end connector of the lead-in cable was screwed to the antenna connector. The coupling was weatherproofed by wrapping with electrical tape. I also used a spray-on material to weatherproof the vital connections.

Four guy wires of coated steel were fastened to the mast so they could later be run to anchor points located at ninety degree intervals. Turnbuckles were added to the guy wires to make tension adjustment easier. It was then a simple matter to run the mast up in sections while adding stand-offs to hold the coaxial lead-in cable away from the mast and to keep the cable from flopping about in a strong wind. The guy wires were fastened in place, and a heavy aluminum ground wire was run from the mast to a cold water pipe feeding an outside faucet. I managed the entire job alone without working up a sweat.

The RG-8U coaxial cable was run into the house through an attic louvre, then dropped down to the living room inside a partition. For short runs the less-expensive RG-58U cable is adequate, but I'm not one to take chances so I put out for the heavier stuff.

**I Thought I Was Smart!** A bright idea that fizzled on me shows why it's best to stick with straightforward installa-

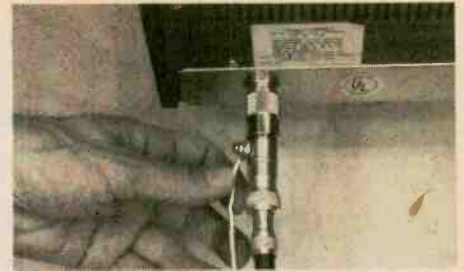
tion methods and no fancy new ideas of your own. Our CB base unit was to be placed on a shelf under a table next to my favorite chair. However, I could foresee that our teenager would want to make extended use of the CB rig just when I wanted to sit in my chair to watch some important TV program.

It seemed to me that the obvious simple solution was to run a branch coaxial cable to another room where the CB rig could be transferred when the family generation gap was about to be put under stress. This was easily accomplished by breaking into the coaxial cable, up in the attic, and adding a T-connection to accommodate the branch line.

When the time came for the big test, at first there seemed to be no problems. With the set turned on, we scanned the 23 channels in the hope of picking up at least a few signals. There were plenty, many coming in strongly enough to bounce the RF-S meter, which measures the strength of incoming signals, up in the 7 to 9 range. On one channel a housewife was nagging her husband to stop at the supermarket. Truckers were trading gossip about Smokey (highway police) on channel 19. The remaining twenty-one channels, including channel 11 which is for calling only, and channel 9 which has been designated for emergency use only, were in use by teenagers.

**Going On the Air.** Our first transmission attempt was less than a resounding success. When I finally thumbed the mike, my well-rehearsed FCC call letters firmly in mind, we saw the SWR meter needle jump close to the top of the scale. Now that's bad! Since the meter measures the relative amount of output energy *that comes back down to the CB set*, instead of joyfully leaping into space in search of other antennas, the meter reading should be as low as possible. A reading close to 1 would be phenomenal, a reading of 2 is good, but when the needle creeps past 3 it's time to start worrying about impedance mismatches. When the needle goes off the scale transistors can start popping. I've heard that when the mismatch is really bad, even the coaxial cable can start burning up.

I won't dwell on the agonizing and theorizing that followed. Finally, I remembered that branch antenna lead to the other room. You guessed it! When the branch lead was disconnected, the SWR meter dropped to a phenomenal 1.1—no kidding! It seems that our output signals kept getting curious about that dead end street, went to investigate, got confused, and came back home to the CB set. We can still make



On the back panel of base station the author ran a ground wire from a nearby pipe.

use of the branch circuit, but it calls for a quick trip up to the attic to switch the leads, which takes only seconds.

**The Car Installation.** It was easy to mount the mobile CB set under the car dash, using a mounting bracket supplied with the radio. The negative power lead from the set was grounded to the dash, and the hot lead, which was red, was run to the car fuse box where it was connected to the hot end of the regular car radio fuse holder.

Although I prefer the fuse box connection, because the power to the CB set is automatically cut off when the ignition switch is off, I experimented with a hot lead running directly to the car battery because this can sometimes eliminate some background noise. I observed no improvement, so the fuse box connection remains.

The best place for an antenna on our station wagon would have been in the middle of the roof, but this would have required drilling a hole into the bottom of our aluminum canoe which we frequently transport atop the car. This idea seemed to have little merit, so we opted for a top-loaded, cowl-

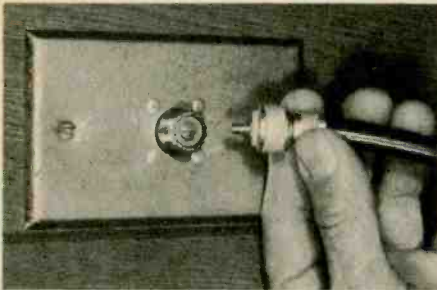


Blank electric wall socket plate was drilled to take UHF socket for high frequency coaxial cable. Single white wire on right side is separate ground.

## e/e GET STARTED IN CB

mounting antenna, mainly because it was so easy to feed the cable the short distance to the CB set.

As expected, we had to cope with receiving a lot of background noise interference with reception, caused by the car's ignition system. I tried all sorts of gizmos supposed to cure such noise problems. The best results were obtained with a small suppressor unit that I installed, in seconds, on the distributor. I also installed resistor type spark plugs, an alternator noise filter, and an ignition coil capacitor. I'm not sure just how much they help to suppress noise, but at least they did no harm, and the car runs as well as ever. Aside from the distributor suppressor, the best noise reducer turned out to be the "blinker" button built right into the front of our CB set.



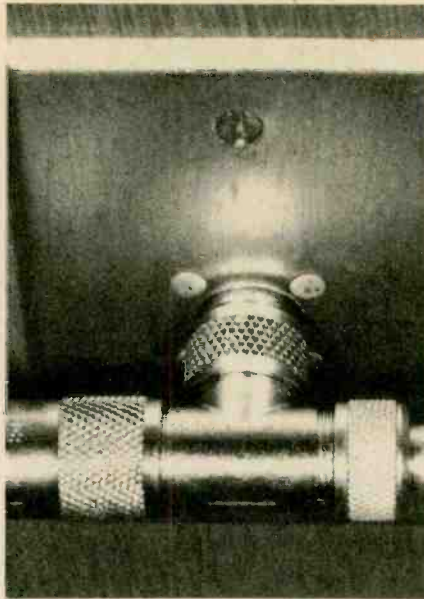
High quality UHF connectors ensure low-signal loss and ease inspection and repair.

Recalling the traumatic experience we had on the first attempt to transmit with the base-station CB unit, I pushed the mobile unit's mike button with crossed fingers. The needle indicating transmit power jumped to the upper section of the scale!

As I stared at the hastily-turned-off set, and wondered where to hunt for the trouble, a logical notion began to force its way into my consciousness. The base station has two meters, one to indicate *incoming* signal strength, the other to show *either* the SWR (standing wave ratio), or how much transmitting power is getting out to the antenna system.

However, the mobile unit has only one meter, with two scales indicated by the single needle. The top scale indicates the strength of incoming signals in S units. Good enough. The second scale, labeled *Power*, shows the relative power output of the transceiver.

Now one needle can't simultaneously point to a high RF-S reading and a low SWR reading, which is what you look for when using a two-meter sys-



T-adaptor at wall outlet of antenna cable permits use of two feed-off cables so that a scanner radio may be operated off the CB antenna. CB set works normally even when scanner is on at the same time.

tem. This particular meter is *supposed* to read a high power value instead of a low true SWR value when all is well. Now why can't the people who write instruction manuals *say* things like that? Anyway, subsequent transmission tests confirmed that we had a properly functioning two-way CB system after all.

**How to Foil Thieves.** The next problem arose while I sat in the local high school auditorium, one night, watching



Bottom of antenna mast fits into hole drilled part way through a wedge-shaped block protecting roof shingles. U-bolts pass through wall of house into attic. Note spacer block between the mast and wall to keep the mast vertical.

a fund-raising program. I got to thinking about that brand new CB set out there in the dark parking lot, and about all the news reports about CB mobile units being ripped out of cars by the thousands.

The next morning I bought a Radio Shack slide-out mount that permits speedy removal of the mobile unit for storage in a locked car trunk or in an even safer place like inside the coat you hold in your lap in a high school auditorium. This tension-easing accessory, costing only \$7.95, consists of two metal plates that make a series of elec-



Telescoping mast can be lowered in minutes without disconnecting guy wires, to bring the antenna within reach for maintenance and troubleshooting.

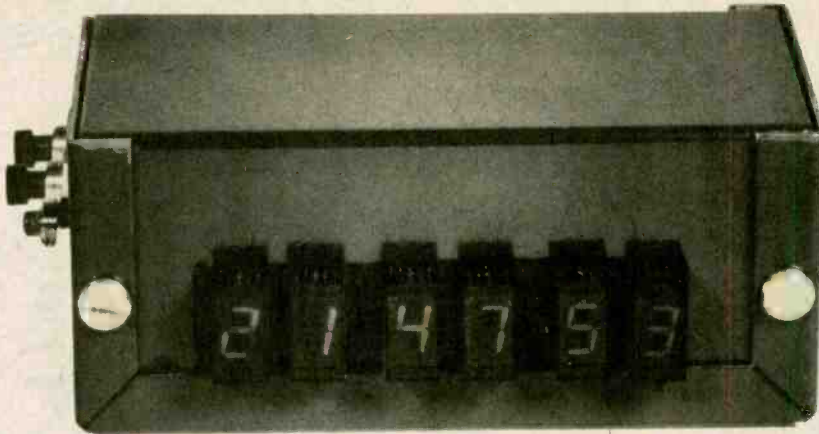
trical contacts when they are slid together in latching position. One plate bolts onto the CB set, and the set's two power leads connect to short wires attached to the plate's electrical contact block. The other plate bolts onto the underside of the car dash (another version can be floor-mounted), and the hot lead from the car fuse box and its associated ground lead connect to pre-attached wires coming off a second contact block. To mount the CB set, attach the antenna connector in the usual manner, then just slide one metal plate into the other. Electrical power connections are made automatically. Removal of the unit is just as easy.

**We Hit Another Snag.** My biggest goof came when everything was finally working perfectly, a couple of days after the editor finally reappeared and asked if I felt ready to write an article about how I went CB.

Although the system was working  
(Continued on page 82)



# CHIP-TOCK IS A TIP-TOP LED CLOCK



Six-digit LED readout mounts anywhere to show hour, minutes and seconds, in 12-hour or 24-hour format.

by Alex F. Burr

**E**LECTRONIC PROJECTS UNTIL A FEW YEARS AGO used only *analog* circuits—that is, the output was proportional to the input (another term for analog circuitry is *linear*). But now more and more devices and circuits are using digital techniques and circuitry, instead of the older analog methods. Anybody who wants to stay on top of what's happening in electronics today had better get familiar with digital components and design, and there's no better way to start than to build a simple digital device, learning digital basics the easy way.

One of the simplest projects you can build is a digital clock. The clock you can build from this article is called Chip-Tock. And while you're doing it you'll be working with the building blocks of digital computers; an MSI (medium scale integrated circuit), LED-display readout numerals, and transistor drivers for the readout digits.

One or two pleasant evenings of work is all it takes to assemble Chip-Tock, once you've gotten all the parts together and studied the diagrams and pictures thoroughly. When you've completed Chip-Tock you'll have a six-digit electronic clock operating from the AC power line, either in the usual 12-hour format, or if you prefer, as do the military, radio amateur operators (hams), and others, a 24-hour format. Chip-Tock will work either on the 60-Hz current which is most widely used, or on the 50-Hz power used elsewhere. The circuit diagram shows how few parts are used in addition to the chip, LEDs, and transistors. Actually additional parts in-

clude only switches—to make it easy to set the clock, or to stop it—a few capacitors and resistors (plus parts for the simple power supply. Power transformer T1 can be just about anything which supplies at least 200 milliamperes at 12-volts AC out of its secondary terminals. However if you can't find a transformer in your junk box the transformer in the Parts List is a good choice because it's so small, and it costs less than \$1.75.

**LED Readout Display.** Any of several seven-segment LED readouts may be used in Chip-Tock, depending on how far away you want to be able to read the time. However, the specified LED inserts directly into the printed circuit board shown in the Parts List, while you'd have to make up a hand-wired board for LEDs other than those specified.

You'll find the layout of the specified LED, Fairchild Semiconductor FND-70, at the lower left of the schematic diagram. Notice that each of the seven segments on the LED is designated by a letter, A through G, which is connected to pins numbered 1 through 10. Two pins 1 and 6, are set aside for common cathode connections. Any of ten digits can be displayed by applying current to two or more segments. For example, a "1" is lit up by connecting to B and C, a "6" is shown by connecting to A, C, D, E, F, and G, and "8" is obtained by lighting up all the segments (excepting, of course, the decimal point at the lower left of the numeral segments).

**It's a Baby Computer.** The heart of

Chip-Tock is IC1, National Semiconductor's MM5314 digital clock integrated circuit which has 24 pins. It's almost a small-scale, *special-purpose* computer which does only one job. Big computers, such as the IBM 370, are called *general-purpose* computers, because they can be programmed to do any of thousands of complex jobs. It's not necessary to know what goes on inside the chip, so long as we know what we have to put into it, and what we get out of it. Inside IC1 are dozens of tiny transistors, resistors and capacitors, already connected and just waiting for us to make the external connections.

**Inputs and Outputs.** The only signal input to Chip-Tock is at pin 16. Resistor R8 is used along with capacitor C2 to pick up a 60-Hz pulse signal from the AC power line (through T1). This 60-Hz signal connects to pin 16 of the clock chip. The circuits inside the chip count the pulses and divide them to get the signals for hours and minutes which control the display—the LED readout. If you're going to be using Chip-Tock in an area which has 50-Hz AC power, disconnect pin 11 from ground and leave it unconnected.

The signal outputs are on the right of the chip shown in the schematic diagram on pins 3 through 9 and 17 through 22. When the voltage on any of pins 3 through 9 is high (approximately 5 volts) the segment of the LED readout connected to that pin will light up. Pin 3 controls segment A, pin 4 segment B, and so on.

**Multiplexing the Readout.** If all the digits on Chip-Tock were kept lit up

# e/e CHIP-TOCK LED CLOCK

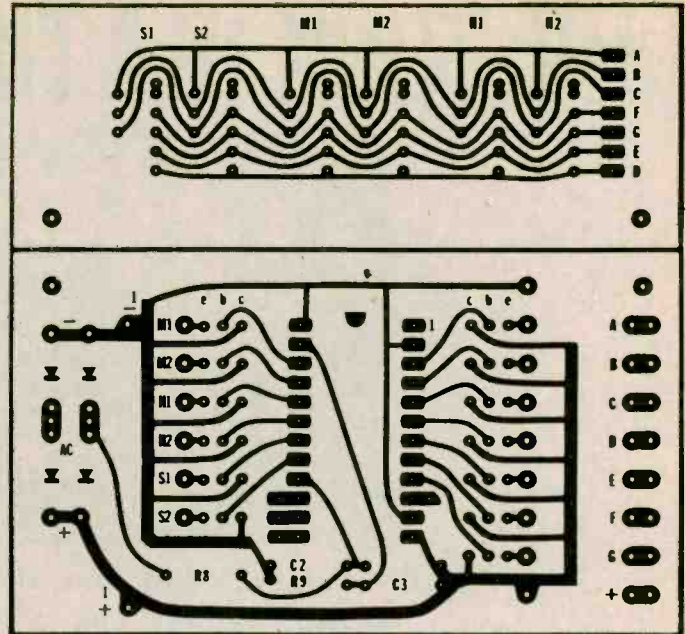
constantly it would take more circuit components, so a scheme called multiplexing is used. This multiplexing system has the LEDs lit up intermittently, but they go on and off so fast, one after another, that it looks to the human eye as though they are all on all of the time. The clock chip actually drives (through the transistor drivers) only one of the six LED display digits at any one time. Which LED is actually lit is determined by the voltage output at pins 17 through 22. These are switched about a thousand times a second, so there's no "flicker" to the eye and they all appear to be on at once.

The chip circuitry coordinates the segment-controlling pins (3 through 9) with the digit-driver pins (17-22) so that the desired number is formed on each of the six LEDs. Pin 17 controls the first (least significant) *seconds* numeral and pin 18 controls the other *seconds*. Pin 19 controls the first (least significant) *hours* numeral, while pin 20 works the other *hours*. Finally, pin 21 goes to the first *minutes* numeral, and pin 22 controls the other *minutes* one. This component-saving display technique is multiplexing.

The other pins on the IC have control functions. When pin 10 is grounded, the time is shown in the standard 12-hour format, but when it is left unconnected, the clock will run for 24 hours before it starts over again. Pins 11 and 2 are grounded, and pin 12 is connected to the DC supply. Pins 13, 14, and 15, marked *Time Set*, are used to set the clock, or to stop it and hold the display (so the actual time can catch up with the numbers shown). When pin 14 is grounded (by momentary action switch S2, labeled *Slow*) the clock will speed up, with the *minutes* indication speeding by in only seconds. If pin 15 is grounded (by switch S2, labeled *Fast*), the hours numerals change in just a few seconds. Once you've run the numerals a bit past the actual time you press switch S1, labeled *Hold*, and wait until the real time catches up to the LED-indicated time. Releasing the switch then lets the clock go ahead, telling the correct time. Pin 23 goes to an RC network which controls the multiplexing frequency. This frequency, roughly 1000 Hz, is not critical. Pins 1 and 24 are not used.

**Transistor Driver Switches.** The LEDs each require about 20 mA of current when they are lit, and this is more than the IC can handle. Therefore the IC outputs are used to switch tran-

Full-size foil pattern for Chip-Tock. Top part is for readout digits; may be separate from main circuit board.

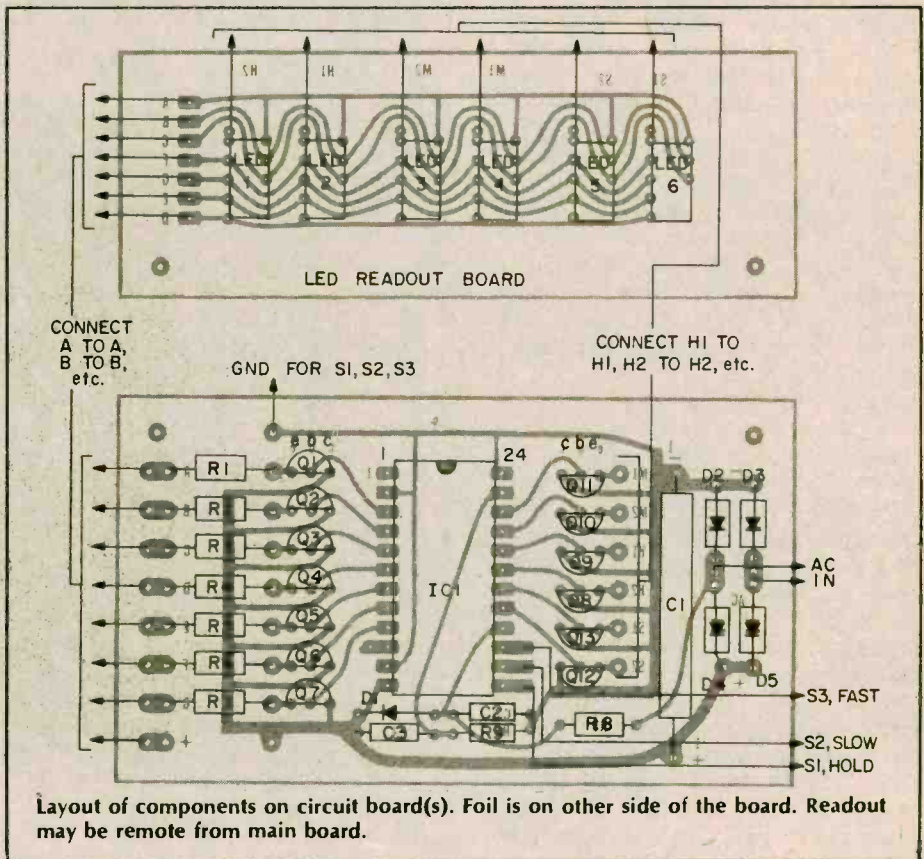


sistors Q1 through Q13 on or off, and these transistors, called drivers, are used as switches to control the current to the LEDs. There are seven NPN segment drivers, and six PNP drivers. The schematic diagram shows only two NPN and two PNP driver transistors, to keep the diagram uncluttered.

**Power Supply.** Chip-Tock uses a conventional power supply. It is a full-wave bridge rectifier type, with four rectifier diodes, connected so as to maxi-

mize the voltage and current from the secondary winding of the rather small power transformer. The bridge rectifier power circuit is widely used in modern transistor circuits. A full explanation of how it works can be found on pages 83 and 84 of *ELEMENTARY ELECTRONICS*, May/June 1975 issue.

**Building It.** Construction of Chip-Tock is straightforward and the layout and placement of parts is non-critical if you use perf-board construction. It is



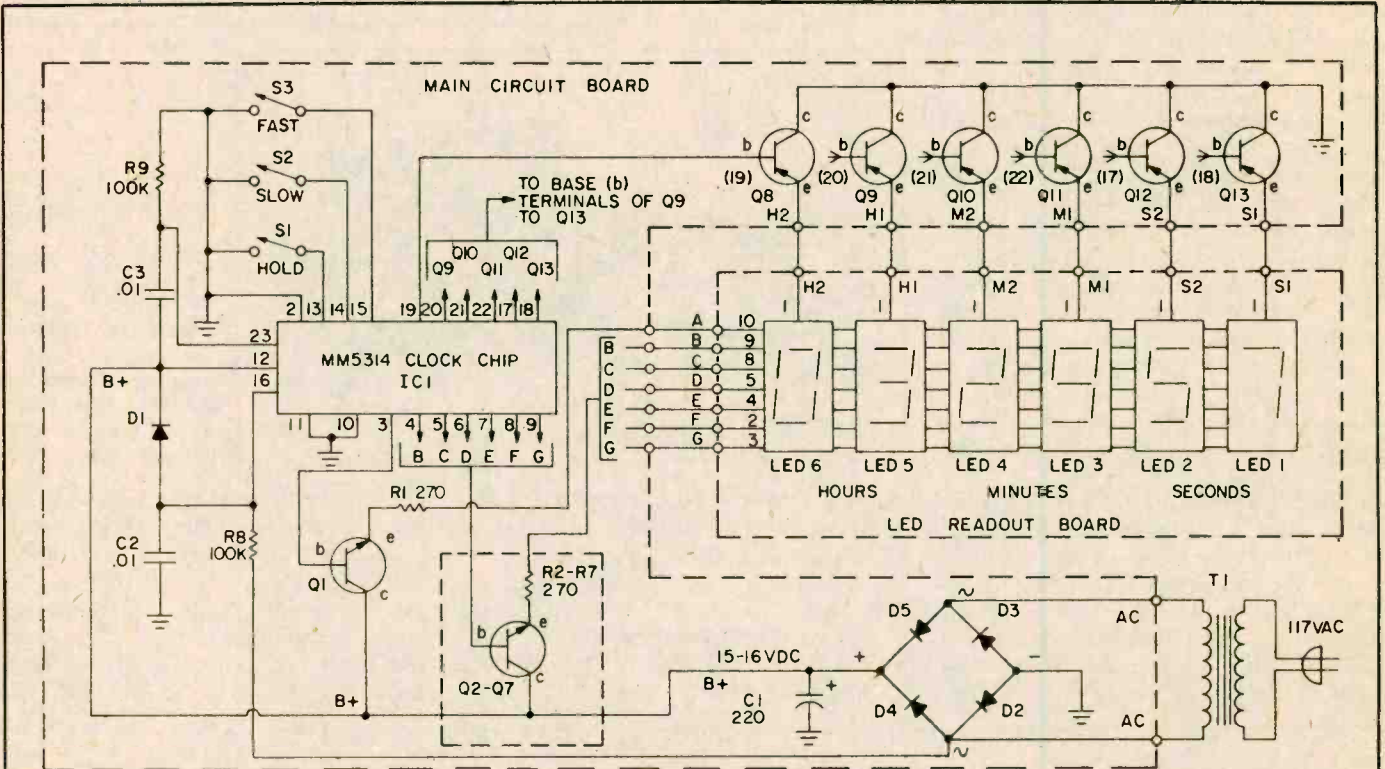
advisable however, particularly if this is one of your first projects, to use the printed circuit board shown in the Parts List. It will save you a great deal of time and effort.

The first thing you should do is get hold of the integrated circuit clock chip IC1, a Motorola MM5314, and the LEDs, which may not be generally available. Two good sources for these components are shown in the Parts

at the end of the Parts List.

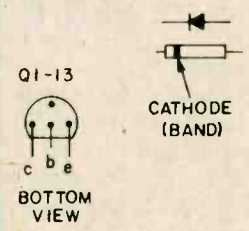
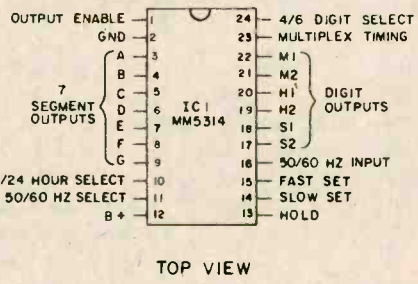
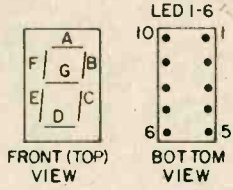
There is one thing you should be very careful about. This clock chip is an MOS device (metal oxide semiconductor), which requires care in handling to prevent damage. It should not be left anywhere near the project until you're finished. You should use an IC socket, and solder that to the board, plugging the IC into the socket only after all other work on the unit is completed. A

24-pin socket may not be readily available, but you can easily make use of the 28-pin kind which is easy to pick up. Just leave four socket holes unconnected. Again, don't let the IC get anywhere near your soldering iron. The iron you use should be one with a small tip, such as the Radio Shack 64-7020 25-watt, or their 30-watt unit (64-2068), if you prefer the "gun" grip to the pencil grip.



**NOTE:**

1. FOR 50HZ OPERATION REMOVE GROUND FROM PIN 11
2. FOR 12-HOUR OPERATION GROUND PIN 10
3. ALL CAPACITORS SHOWN IN  $\mu$ F
4. ALL RESISTORS IN OHMS



**CHIP-TOCK PARTS LIST**

- C1—220- $\mu$ F, 25 VDC, electrolytic capacitor (Radio Shack 272-956 or equiv.)
- C2, 3—0.01- $\mu$ F, capacitor, mylar, ceramic, or disc (Radio Shack 272-1065 or equiv.)
- D1—1N34 or 1N60 general-purpose diode, any small-signal diode will work (Radio Shack 276-821 or equiv.)
- D2-5—Miniature rectifier diode, 1A or more, 50 VDC or more (Radio Shack 296-1621, or 276-1101, or equiv.)
- IC1—National clock chip integrated circuit MM5314N—24-pin. See suppliers listed below.
- LED1-6—LED, common cathode (Fairchild FND-

- 70, numerals 0.25-in. high)
- Q1-7—NPN driver transistor 2N3904 (Radio Shack 276-2009 or equiv.)
- Q8-13—PNP driver transistor 2N4403 (Radio Shack 276-2021 or equiv.)
- R1-7—270-ohm resistors, 1/4- or 1/2-watt (Radio Shack 271-000 series or equiv.)
- R8, 9—100,000-ohm resistor. 1/4- or 1/2-watt (Radio Shack 271-036 or equiv.)
- S1-3—Normally-open, momentary-close miniature switches (Radio Shack 1547 or equiv.)
- T1—Power transformer 120 volts primary, about 15 volts secondary—voltage not critical (Radio Shack 273-1385 or equiv.)
- Misc.—IC socket, 24-pin. If not available, use

28-pin socket (Radio Shack 276-1997 or equiv.). Aluminum case (optional) 4-in. x 2 1/4-in. x 2 1/4-in. (Radio Shack 270-231 or equiv.)

IC1, the LED readout digits, and the printed circuit board are available from S.D. Sales Co., Box 28810, Dallas, TX 75228. In case of unavailability, they are also available (board slightly different) from Optoelectronics, Inc., Box 219, Hollywood, FL 33022. Larger LED readout digits are also available from Optoelectronics.

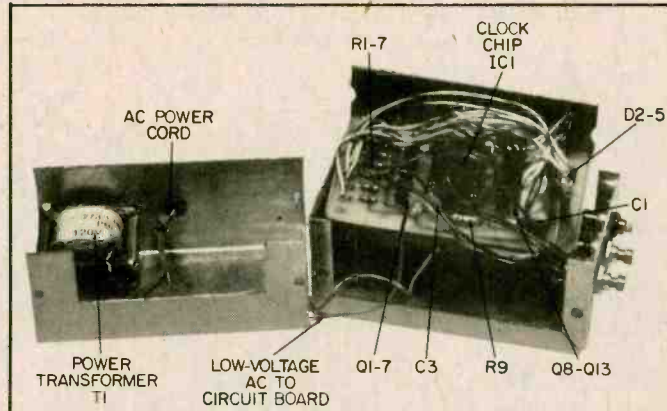
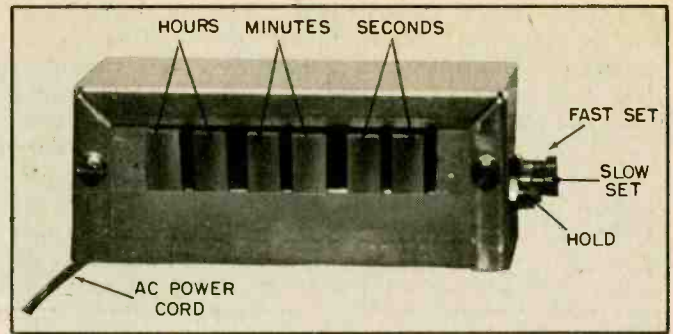
## e/e CHIP-TOCK LED CLOCK

There are two printed circuit boards—one for the LEDs and one for the main clock circuit. This arrangement provides flexibility because you can separate the two by up to several feet with just a few wires between them. If you decide to keep them together to keep size at a minimum, as shown in the photographs, that's okay too. The Parts List gives the author's cabinet size, but you can use any type you wish.

**Larger Readouts.** Some experienced constructors may wish to substitute larger LED digits on Chip-Tock, such as the Litronix DL 750 common-cathode units, which are 0.65-in. high (compared to 0.25-in. for the FND-70). These will work fine, but they require the following changes: (1) hard-wiring from the readout board to accommodate the wider spacing of the larger LEDs, and (2) wiring into the circuit is slightly different. Consult the technical data sheet supplied with the DL 747s.

**Trouble-shooting Hints.** In some areas, the AC power line generates transients (spikes, or large pulses of very short duration) which may cause Chip-Tock to run fast. In such cases, the addition of a 0.01 microfarad, 1.4 kilovolt (or more) capacitor to each side of the power transformer primary

**Finished Chip - Tock digital clock with push-buttons for setting at right. Make up your own case, even with readout remote from rest of clock.**



**Digital clock after assembly, just prior to securing case and plugging it in. Power transformer may be potted with any good epoxy.**

terminals to the building ground will filter out these transients.

If you have time errors caused by radio-frequency interference, connect a 0.01 disc capacitor (50 volts or more) across the terminals of switches S2 and across switch terminals S2 and S3.

**How Long Will It Take?** An experi-

enced constructor should take less than two hours to build Chip-Tock after the printed circuit board is available. If you're a beginner it might take as much as three or four hours, once you've got all the parts collected and you've studied the diagrams and this article. Good luck, and enjoy your Chip-Tock! ■

## THE PEN THAT TALKS TO COMPUTERS

□ A computer "pen" which lets people "talk" to computers has been developed by Dr. Hewitt Crane of the Stanford Research Institute, Menlo Park, California. The computer pen makes possible entry of hand-printed information, written on any ordinary paper forms, by anyone who can print characters by hand.

As the person prints, the computer recognizes the individual characters and stores them either for immediate display on a cathode-ray tube.

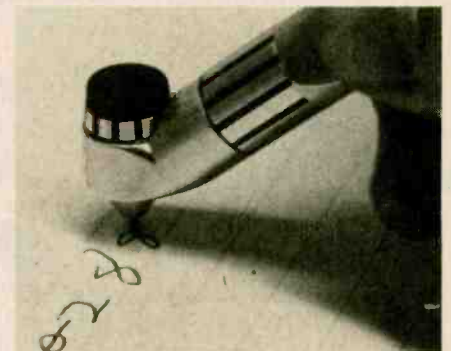


A small wire cable connects the pen to a computer terminal so the information can be entered into the computer, either nearby, or at any distance. As with other data processing terminals, many pens, even thousands if desired, can all be connected to the central computer. Of course it won't work with just any old computer—the pen must be wired to a computer programmed to receive the signals which are generated by the sensing circuitry in the pen while the user is printing the information.

The pen, which is now in production, has the capability of recording up to 16 characters—ten digits and six control symbols.

Easier to operate than a pocket calculator, the pen system eliminates key-punching and other keyboard-based procedures in data entry. It will greatly speed field data collection in many applications such as electric and gas meter

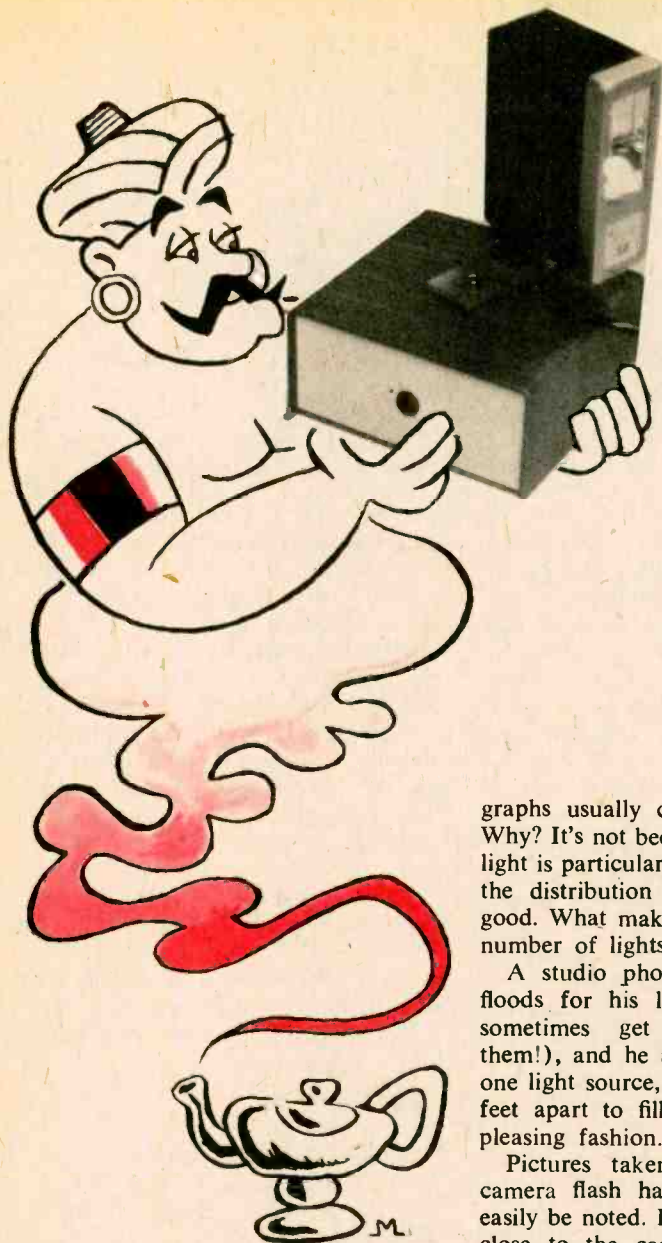
Even when the user prints his own style, the computer pen recognizes the numbers.



**Computer pen looks and feels much like a regular ballpoint. User must print.**

reading, and sales order entries by routemen delivering oil, milk, or almost anything else.

A major advantage of the pen system of data entry is that it eliminates a major source of human errors—the translation of written figures on the original source document by keypunch operators into punched cards or other computer-input material. Manufacturing firm for the computer pen is Xebec Systems, 566 San Xavier Ave., Sunnyvale, CA 94086. ■



# LET LIGHT/JINN SERVE UP SNAPPIER SNAPSHOTS

This cable-free slave flash uses only two resistors, one LASCR, one choke, and an optional diode bridge.

by C. R. Lewart

graphs usually come out second best. Why? It's not because the quality of the light is particularly inferior, but because the distribution of that light isn't as good. What makes the difference is the number of lights used.

A studio photographer uses photofloods for his lighting (those models sometimes get awfully hot under them!), and he always uses more than one light source, spaced at least several feet apart to fill in the shadows in a pleasing fashion.

Pictures taken with a single, on-camera flash have defects which can easily be noted. If you have subjects up close to the camera they often look washed-out or overexposed, and the shadows are usually harsh and too contrasty, particularly if the subject is near a wall or other large background. Automatic flash units, coming into wider

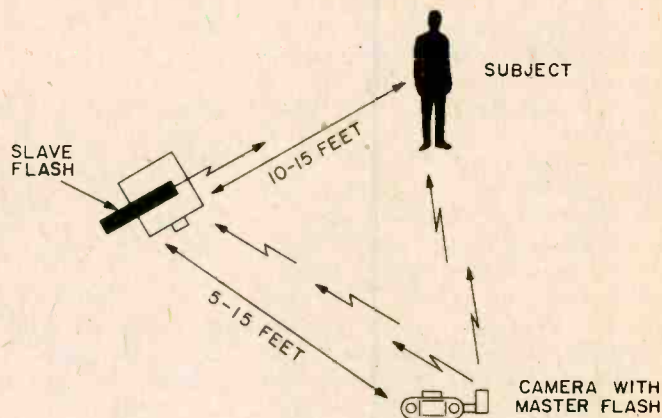
use now, can control some of these problems partially. But the automatic flash can't fill in the shadows it creates. Using bounce flash (aiming the flash at a white ceiling) provides more even illumination, although most on-camera flash units can't readily be aimed at the ceiling. And with bounce flash you must open the lens diaphragm to compensate for the lower overall light level. This decreases the depth of field, which can be another problem. Furthermore, bounce flash with color film can put the color of the ceiling or wall, if not white, into the subjects' faces. All in all, taking flash pictures with a single flash is something you'll learn to avoid wherever possible.

Adding just one more flash, if it's properly placed, will give you shadowless pictures, with greater depth, more modeling of subject's features, and

**G**REATLY IMPROVE your flash pictures by using the flashgun on your camera to control one or more "slave" flashes by means of our Light/Jinn—a magical genie which has no cables to the master flash, but triggers from the light of the camera flash—at your command. You can use two or more Light/Jinns at the same time, but the greatest improvement in your flash pictures will come with the addition of the first Light/Jinn to your regular on-camera flash. The time delay between the master and slave flashes is on the order of 1 millisecond (1/1000 sec) so that you can take pictures at the shortest exposure times your camera permits.

**Multiple Flash is Better.** If you compare most ordinary flash pictures to other shots taken with photofloods (high intensity incandescent lamps, such as are often used for motion pictures, as well as for professional still pictures) the single flashgun-illuminated photo-

Adding another flash at the side of subject improves pictures by wiping out harsh shadows. Slave flash triggers on light from camera flash.



clearer details. Or, in other words, your pictures will be a lot closer to studio photographs.

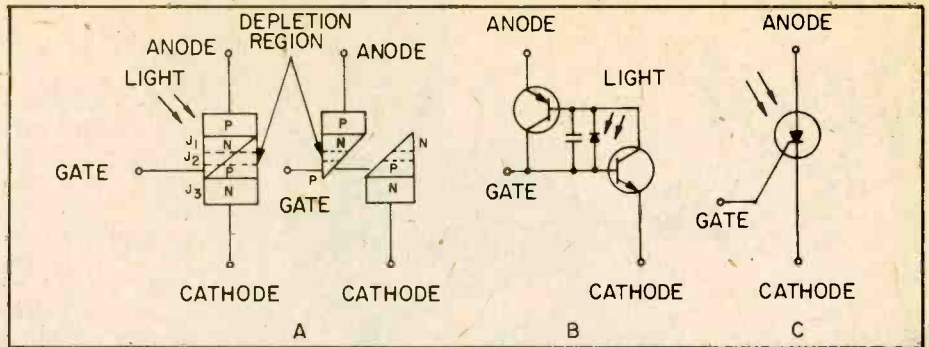
**Better Flash Shots.** To take such pictures you need one more flash unit and some way to support it, and of course some way to make it fire at the same time as the main flash. The first flash unit mounts in the usual way on the camera (or slightly off it, with an extending bar), while the second flash, which now becomes the "main" light (the primary source of illumination), is placed near the subject and inter-connected to flash at the same time as the first flash, in synchronism with the shutter opening.

The usual way to synchronize the two flashes with the shutter is to use a long connecting cord—if your camera or first flash has a receptacle for it (most do not).

**Get Rid of Cables.** Long cords can lead to problems. They can come loose at either end or both; they can be tripped over; and their length is either too long for most shots, or not long enough for some. But these problems can all be eliminated if you use a flash connected to the main unit by *light!* That's right. You can use the light from the first flash to set off the second one. It takes less than a millisecond (1/1000 of a second) for the second flash to fire. Since you'll be using a 125th or 250th of a second shutter opening, the camera will think both flashes go off at the same time, and the effect is exactly as though they do.

The project is simple to build and inexpensive—the basic parts cost less than \$5. Light/Jinn requires no power source; it "borrows" its energy from the flashgun it operates. It also is an improvement over many previously-described similar circuits, because Light/Jinn will not be triggered by even a strong beam of ambient light falling on its sensor. Only another flashgun, or direct sunlight can trigger it. In addition this project will familiarize you with one of the most modern optical semiconductor devices, the *Light Activated Silicon-Controlled Rectifier*, or LASCER for short. The unique properties of this device can lead you to other electro-optical projects which also can be built simply and inexpensively.

**What Is An LASCER?** Its tongue-twisting name, Light Activated Silicon Controlled Rectifier, explains its function. It is an SCR (silicon controlled recti-



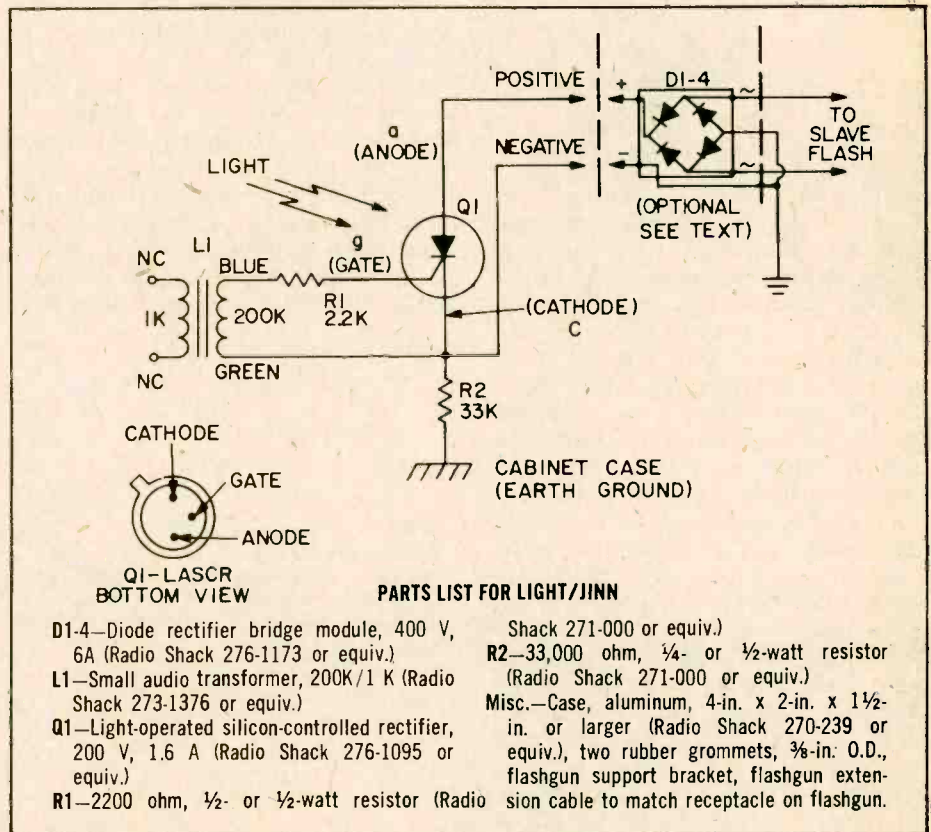
Operation of the LASCER (light-activated silicon-controlled rectifier) is shown above. It's equivalent to combined NPN and PNP transistors, as shown in A and B, above.

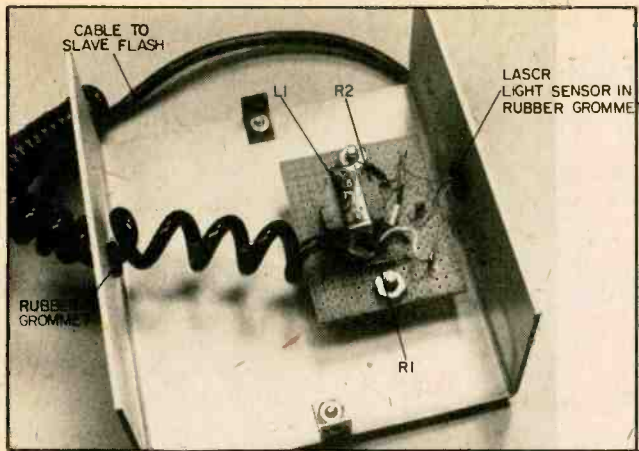
fier) operated by light falling on its sensitive area. The LASCER is the brain of our project, the understanding of which, though not essential for successful completion of the project, should nevertheless interest you.

Refer to the three small drawings (above the schematic diagram) marked A, B, and C, for a description of how the LASCER works. With positive voltage applied to the anode, junctions J1 and J3 are forward-biased, and they will conduct if sufficient free charge is present. Junction J2 is reverse-biased however, and it blocks current flow. Light entering the silicon creates free hole-electron pairs in the vicinity of the J2 depletion region which are then swept across J2. As light increases the current in the reverse-biased diode

will increase. The current gains of the NPN- and PNP-equivalent transistors also increase with current. At some point the current gain exceeds unity and the LASCER starts conducting.

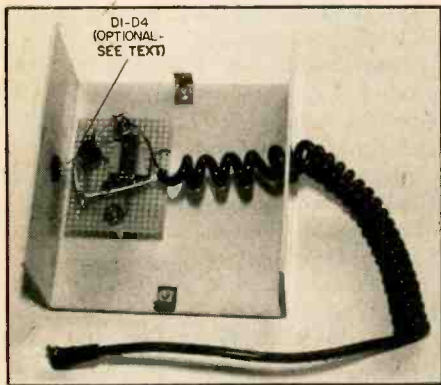
**Slave Flash Circuit.** The LASCER is sensitive both to visible and invisible light, and will normally trigger at as low as 200 foot-candles. To limit its response so it responds only to another flash, we put the inductance of a small audio choke L1, and resistor R1 between the gate and cathode terminals of the LASCER. This novel approach prevents the LASCER from being triggered even by strong ambient light. For steady ambient light the inductance of the transformer behaves like a very small resistor and prevents the LASCER from firing by bleeding the charge generated by





Light/Jinn with cover removed showing all the parts except optional diode bridge rectifier. Top cover has flash mount.

light directly to ground (the cathode). A sudden burst of light coming from an electronic or other flash makes the inductance of the transformer appear as a high resistance which causes the LASCR to conduct, triggering Light/Jinn. Finally, resistor R2 connects the circuit to the cabinet and lowers the



This photograph shows the unit including the diode bridge rectifier, which is needed if Light/Jinn will be used with flash units whose polarity is unknown.

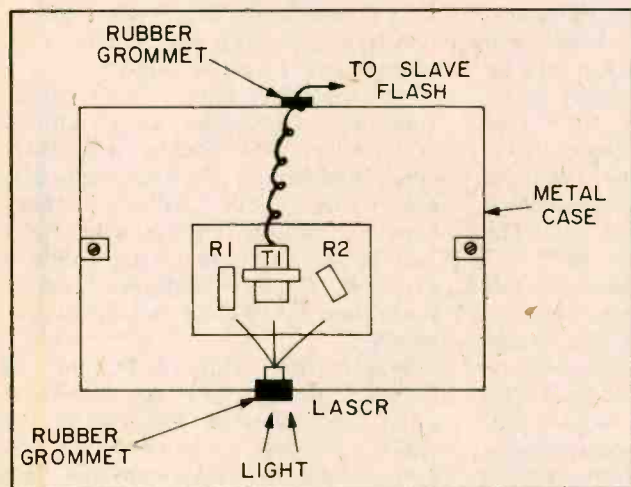
possibility of flashes caused by static electricity.

An inexpensive audio frequency choke is most readily obtained by using an

ordinary audio transformer and leaving the secondary unconnected.

**Construction.** Although the actual components of the simple circuit for Light/Jinn take very little space we selected a good-sized box (4-in. deep by 4½-in. wide by 2-in. high) to provide a substantial stand for the slave flash. A flash gun mounting shoe and flash gun extension cable can be obtained in most photo supply stores. Mount the flashgun shoe on top of the cabinet. Cut off and throw away the male jack on the flash gun extension cable and strip the two wires leading to the female jack. If the flash gun you are planning to use for Light/Jinn has a "hot" shoe you will not need the extension cable. You should now determine which wire is positive. In most, but not all, flash guns the positive is the one which leads to the inner part of the jack (the center lead). If you plan to use Light/Jinn with a slave flash whose polarity you do not know, add the bridge rectifier (labeled "optional") at the right hand of the schematic. Then the polarity does not matter.

**Using Light/Jinn.** Mount the second flash unit on Light/Jinn, connect it to the cable extension, and charge the gun from its built-in batteries (or AC). It



Drawing at left shows there is much spare space in the metal enclosure. This is because the box must be large enough to provide a substantial mounting base for the flash unit.

may flash once or twice by itself, but then it should stabilize. If it keeps going off spontaneously check the circuit for mistakes. If the wiring looks OK you may have to try another LASCR. This is because they have different sensitivities, and some trigger more easily than others.

For the best pictures set Light/Jinn five to ten feet to one side of the subject, with the sensor (LASCR mounted in rubber grommet) pointing directly at your camera, and Light/Jinn's flash unit pointing directly at the subject. Make sure that neither the slave flash nor its reflections are in the picture. Test the setting by looking in the camera viewer and releasing the master flash before taking a picture. If Light/Jinn does not go off, point the LASCR at the camera or move it closer. Light/Jinn can be set 10-15 feet away from the camera depending on the strength and direction of the master flash. If your camera has various flash settings (X, M, F) use the setting recommended for the master flash (X for electronic flash, M or F for flash bulbs).

The key to success in multiple flash photography is correct placement of the flash units. If you follow the basic rules for good studio photography you'll be able to take much improved flash photographs. The basic studio setup calls for just two lamps. In our setup the basic, on-camera flash becomes the "fill" light, and the second, added flash unit becomes the main light source. This is often called the *key* light, and its placement is critical to the production of a good photograph.

The key (off-camera) flash must be mounted on a chair, tripod, or something similar, such as a chair back or bookcase. If all else fails have a friend hold it for you. Putting this light high, and off to one side, about 45 degrees, will provide both depth and modeling. The on-camera flash, being much further away from the subject than the key flash, will be much weaker, and need not be considered when figuring the correct camera aperture.

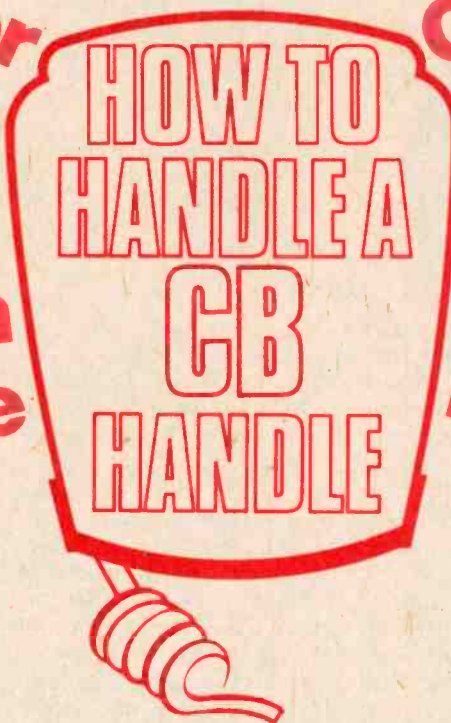
Since the key light is the only one that matters (in figuring the exposure) the calculation is quite straightforward. You just divide the number of feet from the key flash to the subject into the flash guide number. This gives the approximate *f* stop for the key flash mounted on Light/Jinn.

**Caution.** A charging flashgun may develop as high as 200 Volts, so keep the cabinet closed when the circuit is in operation. Also, do not get the flash gun close to your eyes, because when it is charged it may go off accidentally due to static electricity pulses.

By Sherman Wantz

# Happy Hooker Green Giant King Kong Gunga Din Daisy Mae

# Charlie Brown Country Girl Shady Lady Jack Sprat Little King



**“W**HO’VE I GOT THERE?” is a question that every active Class D Citizens Band operator must eventually answer. Translated into everyday language, that question simply asks, “To whom am I speaking?” Your response can reveal more about yourself than you perhaps realize.

For one thing, it can mark you as a person new to CB channels. If you in effect reply, “My name is John,” or, “I’m KEN 7608,” referring to the call sign issued to you by the Federal Communications Commission (FCC), you may confuse the CBER who asked the question. Call signs are difficult to understand on crowded CB channels and are almost impossible to remember.

“Who’ve I got there?” is a CBER’s customary way of asking, “What is your handle?” The usual response is, “You’ve got (*your CB handle*) here.” Of course, to some a handle is just a name, but for a CBER a handle is usually very special.

**Handle History.** Many years ago, the word “handle” referred to a person’s title—Mister, Judge, or Doctor, for example. As such, they were sometimes used alone, replacing their owners’ full names. Similarly, on most Citizens Band channels, handles replace names and usually substitute for call signs as well. You will find that, together with the sound of your voice, your speech pattern, and your particular vocabulary, your handle is an extension of your personality. It becomes *you* to those who meet you on the airwaves.

For that reason, you should be quite deliberate when you set about selecting your CB handle. Furthermore, you should not hesitate to exchange your present handle for one more comfortable or effective.

The primary purpose of your handle is to identify you to others. It should be distinctive. Admittedly, achieving distinction may be difficult since the FCC is currently issuing over 500,000 CB licenses each month, which is an awful lot of handles. However, with a little effort and ingenuity you should be able to come up with a unique handle that will distinguish you from other CBERs in your area.

One key point in choosing an effective CB handle is finding one that is easily recognized. Familiar terms or names will often be understood on crowded CB channels at times when unfamiliar ones might be missed. On CB radio, your surprising—or shocking—use of a familiar term as a handle will make it more likely that you will be remembered. Could you possibly forget a soft, breathy, feminine voice that whispers, “You’ve got the Happy Hooker here?” Or would you find it difficult to remember a deep, well modulated male voice that states assertively, “The handle here is Jack Armstrong?”

Now, let’s get to the heart of this handle business. How do you go about finding a suitable handle? The easiest way is to adopt a familiar name or term, preferably one that has some relevance to you as a person, to your job, or to your hobby. There are a number of categories you can use to begin your search, from which you can derive a whole slew of handles. All examples

given here are actual handles being used currently by U.S. CBERs.

**Find the Funnies.** Comic strips have produced perhaps more handles than any other category. There is something about associating yourself with a comic character that has universal appeal. Charlie Brown, Orphan Annie, Daisy Mae, Mickey Mouse, Little King, and Snoopy are examples.

Book titles such as Moby Dick, Ben Hur, The Saint or literary characters such as Macbeth, Gunga Din and King Arthur can also provide you with a distinctive, recognizable handle.

Perhaps the most easily recognized handles come from movies and television. From motion pictures: Sundance Kid, Godfather, James Bond, and Double-O-Seven. From television: Lonesome George, Hawkeye, Trapper John, Mister Lucky, and Bachelor Father. Don’t overlook TV and radio ads as potential sources. Gatorade, Big Mac, Jolly Green Giant, Tidy Bowl, Preparation H, and Hershey Bar are illustrative of popular ads used as handles.

Also consider: Sports (Stolen Base, Knockout, Gentleman Jim); objects (Cannonball, Dill Pickle, Big Ben); opera (Barber of Seville, Pagliacci); song titles (Bill Bailey, Yankee Doodle); nursery rhymes (Bo Peep, Jack Sprat); and common terms (White Elephant, Country Girl, Spoil Sport, Boss Man, Jay Walker and Speed Demon).

**Vice is Nice.** Handles that only a decade ago might have been considered a bit too suggestive for use on the nation’s airwaves are currently popular. Note these: Dirty Old Man, Jail Bait, Passion Fruit, Baby Maker, Bikini Watcher, and Shady Lady.



If a psychologist were to analyze CBers and the names they choose, he might conclude that some select handles to disparage themselves—reflecting what he might consider to be a negative self-image. Handles indicative of the self put-down variety are: Dum Dum, Eight Ball, Plain Jane, and Country Hick.

At the opposite end of the psychological spectrum are those who select handles that reflect a positive self-image such as: Spell Binder, Heart Breaker, Bright Eyes, and Lady Luck.

To stimulate conversation on the nation's interstate highways, the use of your home city or state's name in your handle will often prompt other CBers to ask where you live or work or to ask whether you know "old so-and-so." If you're looking for conversation to help keep you awake at the steering wheel of your car, such a handle could save your life.

Georgia Boy, Tennessee Traveler, California RV and Arizona Phantom are examples of handles that include state names. Dallas Delight and Dayton Nut identify the cities in which their owners live and work. Some CBers use two handles, one for local identification and another while they are traveling.

**Similar Sounds are Memorable.** Notice that CB handles usually contain two or more syllables and that most consist of two words. Many, too, take advantage of alliteration—two or more words having the same initial sound. Alliteration aids memory and adds novelty when used in handles. Examples: Baltimore Bomber, Woody Woodpecker, King Kong, and Ramblin' Rose. Puns (the use of words having similar sounds with different meanings, such as Georgia Kwacker and Bitter Half) or malaprops (the absurd misuse of words, such as Loan Arranger and Human Erase) often make interesting handles.

The ultimate handles are those that have clever, relevant, double meanings. A bread delivery truck driver who calls himself Doughboy is a case in point. Others are: a cross-country truck driver whose handle is Roadrunner; a Navy recruiter who calls himself Popeye; a detective whose handle is Sherlock Holmes; and a truck mechanic who uses the name Diesel Doctor.

Family handles are also in vogue. A husband who calls himself Stonecutter has a wife who refers to herself as Lady Stonecutter and a son who is known as Stone Chip.

**Regarding Registry.** There are several companies that will register your handle, promise not to authorize its use to another CBer in your county or state, and send you a colorful registration certificate. In addition, these companies will send you a directory that lists other  
(Continued at bottom of next page)

# CB Lingo II

## By the Bushel



**G**ET YOUR EARS ON, boulevard busters, cause here's the updated, super-expanded CB Lingo you've been modulating about. Mercy sakes, no sooner did our last list get in print than the land lines opened up and more CB lingo poured in. We got the cat by the tail and we're not letting go. The next time you let the channels roll and hear some bodacious lingo, break the ratchet jaws and get the meaning of the CB term you heard. Post it to the Polish Ham in care of ELEMENTARY ELECTRONICS, our home 20. Ten-four, good buddies, the good numbers on you. We gone.

Polish Ham, KGK3916

**Advertising**—A marked police car that has its lights turned on.

**Back Door**—Last vehicle (truck) in a string of three or more—all in contact with each other.

**Bean Store**—Restaurant or road stop where food is served.

**Bear**—Policeman.

**Bear Cave**—Police station or post on highway. Also Bear Den.

**Bear in the Air**—Police aircraft used to police highway traffic.

**Beat the Bushes**—"Front door" (lead vehicle) looks for Smokey by going fast enough to draw him out of hiding. See also "Shake the Leaves."

**Big 10-4**—Very much in agreement; "You said a mouthful!"

**Bodacious**—Good signal; clear transmission.

**Boulevard**—Highway.

**Break One-Oh**—"I want to talk (on Channel 10)." Also "Break 10."

**Breaker**—Station requesting a break.

**Brown Bottles**—Beer.

**Brush Your Teeth and Comb Your Hair**—Radar unit ahead.

**Bushels**—One-half-ton; a 20-ton load would be 40 bushels.

**Camera**—Police radar unit.

**Catch You on the Old Flip/Flop**—Catch you on the radio on a return trip.

**Charlie**—The FCC. Also, "Uncle Charlie."

**Check the Seatcovers**—Watch for a female driver with her skirt pulled up.

**Chicken Coop**—Highway truck weigh station.

**Chicken Inspector**—Weigh station inspector.

**Clean**—No Smokies around.

**Clear**—Communications completed or "We Gone."

**Comic Books**—Truckdrivers' log sheets or log books.

**Cotton Picker**—Cotton picker (instead of four-letter words on the air).

**County Mouny**—County sheriff or highway patrol.

**Cowboy Cadillac**—An El Camino or Ford Ranchero.

**Cut Some Z's**—Gef some sleep.

**Dew**—Light rain.

**Drop the Hammer**—Step on the gas.

**Ears**—Antennas or radios. See also "Smokey with Ears."

**Eatum-Up**—Roadside restaurant.

**Eighteen Wheeler**—Any semi-tractor trailer with any number of wheels.

**Eye-In-The-Sky**—Police aircraft or bear in the air.

**Evel Knievel**—Motorcycle rider.

**Fat Load**—Overload, more weight than local state laws allow.

**Feed the Bears**—Collect a ticket from Smokey.

**Fifty Dollar Lane**—Leftmost or passing lane.

**Five-Five-55**, the legal limit in most places.

**Flip-Flop**—Return trip, or "U" turn.

**Fluff-Stuff**—Snow.

(Continued at top of next page)

# e/e CB LINGO II

**Fly in the Sky**—Police aircraft.  
**Four**—Abbreviation of "10-4," meaning "OK."  
**Four Ten**—10-4, emphatically.  
**Four Wheeler**—Passenger car.  
**Front Door**—First vehicle (truck) in string of three or more trucks in radio contact.

**Good Numbers**—Best regards and good wishes or threes and eights.  
**Got Your Ears On?**—Are you listening to your CB radio?  
**Grass**—Side of the road or median strip.  
**Green Stamps**—Dollars.  
**Green Stamp Road**—Tollway.  
**Ground Clouds**—Fog.

**Haircut Palace**—Bridge or overpass with low clearance.  
**Hammer**—Accelerator or pedal.  
**Hammer Down**—Highballing; driving fast; pedal on metal.  
**Handle**—Nicknames used by CBers.  
**Harvey Wallbanger**—Reckless driver.  
**Holding On to Your Mud Flaps**—Driving right behind you.  
**Hole in the Wall**—Tunnel.  
**Home 20**—Where you live. Home town.

**In the Grass**—Parked or pulled over on the median strip.  
**Invitations**—Police traffic citations; tickets.

**John Barleycorn**—Hard liquor or drunk.

**Keep the Greasy Side Down and the Shiny Side Up**—Drive safely.  
**Keep Your Nose Between the Ditches and Smokey Out of Your Britches**—Drive safely and look out for speed traps and speeding fines.  
**Kenosha Cadillac**—Any car made by AMC.

**Land Line**—Telephone.  
**Let the Channel Roll**—Let others break in and use the channel.  
**Local Yokel**—City police.  
**Loose Board Walk**—Bumpy road.

**Mama Bear**—Policewoman.  
**Mercy**—Oh, wow! (Yes, truck drivers really do say this).  
**Mile Marker**—Milepost on interstate highways.

**Mix-Master**—Highway cloverleaf.  
**Modulate**—Talk.  
**Monfort Lane**—Passing lane.

**Nap Trap**—Rest area or motel.  
**Negatory**—No. Negative reply.

**On the Move**—Driving, moving.  
**On the Side**—Parked or pulled over on the shoulder or standing by and listening.  
**Other Half**—Wife (usually) or husband.

**Pickup-Up**—Light truck; pickup-truck.  
**Picture Taker**—Police radar unit. Same as "Camera."  
**Plain Wrapper**—Police car with no markings; unmarked car.  
**Polish Ham**—Your Editor, Julian Martin.  
**Portable Chicken Coop**—Portable truck scale.  
**Portable Parking Lot**—Auto carrier.  
**Post**—Milepost on interstate highways.  
**Pounds**—Number on S-meter (S-3 is three pounds, etc.).  
**Pregnant Roller Skate**—Volkswagen.  
**Pull the Big Switch**—To turn off the CB radio.  
**Put the Good Numbers on You**—Threes and eights; best regards, etc.

**Quisling**—A person who lets the Bears read this list.

**Radio**—A CB transceiver.  
**Rake the Leaves**—Back door or last vehicle in string, bringing up the rear.  
**Ratchet Jaw**—Nonstop talker.  
**Rest-Um-Up**—Roadside rest area.  
**Rig**—CB radio; tractor (double meaning).  
**Rocking Chair**—Vehicle that's between the front door and back door in a string of vehicles.  
**Roger**—Also Roger Ramjet. Passenger car going more than 20 mph over the limit.  
**Rolling Road Block**—Vehicle going under the speed limit and holding up traffic.  
**Rollerskate**—Small car.

**Sailboat Fuel**—Running empty.  
**Seatcovers**—Occupants of passenger car, usually attractive females.  
**Shake the Leaves**—Act as lead vehicle to decoy any Smokies out of hiding. See also "Beat the Bushes."  
**Six Wheeler**—Passenger car pulling a trailer.  
**Skating Rink**—Slippery road.  
**Smokey**—The police.  
**Smokey on Four Legs**—Mounted police (used in New York City and Chicago only).

**Smokey the Bear**—State Police Patrol (with or without a Smokey the Bear hat).  
**Smokey with Ears**—Police listening on CB.  
**Spy in the Sky**—Police aircraft.  
**Stack them Eights**—Best regards.  
**Super Skate**—High performance car, Corvette or other sports car.  
**Super Slab**—Major highway.  
**Sweeping Leaves**—Bringing up the rear. See also "Back Door," and "Raking the Leaves."

**Taking Pictures**—Police using radar.  
**Ten-four**—Affirmative.  
**Threes**—Best regards.  
**Thirty-weight**—Coffee.  
**Thirty Three**—10-33, This is an emergency.  
**Threes on You**—Best regards.  
**Threes and Eights**—Lots of best regards.  
**Tijuana Taxi**—Well marked police car.  
**Town**—Any city, regardless of size, i.e., New York town, Dallas town, Podunk town, etc.  
**Train Station**—Traffic court that fines everybody.  
**Truck 'em Easy**—Have a good trip.  
**Twenty**—Location (10-20).  
**Twisted Pair**—Telephone.  
**Two Way Radar**—Radar used from moving police car.  
**Two Wheeler**—Motorbike, motorcycle.  
**Twister**—Highway interchange.

**Uncle Charlie**—The FCC.

**VIP**—Can't talk, someone riding in car or cab.

**Wall to Wall**—Peg full-scale on S-meter.  
**Wall to Wall Bears**—High concentration of police with strict enforcement, traps, etc.  
**We Gone**—Stopping our sending, will listen.  
**Who Have I Got There?**—What's your handle? To whom am I speaking? See also "You've Got \_\_\_\_\_ Here."  
**Willy Weaver**—Drunk driver.  
**Window Washer**—Rainstorm.  
**Wrapper**—Color; "Blue wrapper" is a blue car, usually an unmarked police car.

**X-ray Machine**—Police radar.  
**XYL**—Wife. (Stands for ex-young lady).

**YL**—Young lady.  
**You've got \_\_\_\_\_ here.**—Response to "Who've I got there?" Insert your CB handle in the blank.

**Zodiac**—Highway sign.

## How to Handle a CB Handle

(Continued from page 53)

registered CBers. The directory shows your handle, full name, base station address, favorite CB channel monitored and (optionally) your FCC call sign.

Be aware, however, that no one is required to register a CB handle. Thus, even if your handle is registered with one of these companies, someone else may be either registered with another company or may be totally unregistered, and still be using the same handle as you.

Most CBers seldom use their call signs despite the fact that in failing to

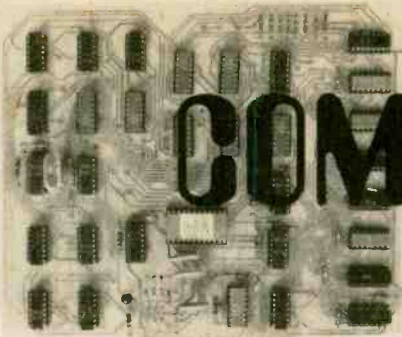
do so they violate Part 95 of FCC's Rules and Regulations and could subject themselves to stiff fines or other penalties.

Many do, however, try to comply with the spirit of the law by announcing their call sign at the time they sign-off with each station they contact or at the time they change channels to continue a conversation. Note, however, that this casual approach doesn't fully comply with the FCC Rules. According to Part 95 of the FCC Rules and Regulations (Section 95.95, Item c), every time you use your CB unit to transmit, you are required by law to transmit your assigned call sign at the beginning and at the end of each transmission or series of transmissions. During the period of

the contact, though, it's okay to use your handle exclusively.

**Wrapping It All Up.** In summary, to select a CB handle remember that two-syllable, familiar, relevant, preferably humorous terms or names with double meanings are best. The objective is to choose a handle that suits you and that is instantly recognizable. A handle you have to repeat or (worse) to spell for your listener should be discarded.

If, after you announce your handle on the air, the person you have contacted comes back, chuckles, and repeats your handle appreciatively—smile. You're entitled to a pat on the back. You have proved that you are among the growing number of CBers who have learned how to handle a handle. ■



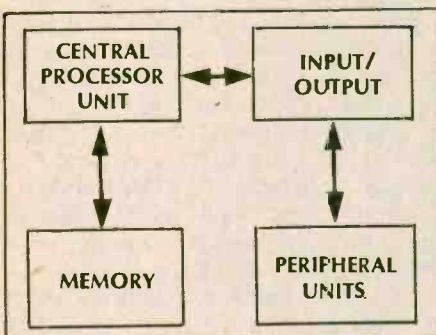
# COMPUTER READOUT

by Steve Gray, Computers Editor

## What's In a Computer Kit?

□ Welcome to Computer Readout, which will be a regular feature in *ELEMENTARY ELECTRONICS* from now on. We're going to cover the hobby micro-computer scene—computers, peripherals, programs, and applications. Right now let's take a look at just what a computer kit is.

**Block Diagram.** The simplest block diagram of any computer system consists of only four parts. The Central Processor Unit (CPU) "performs all



arithmetic calculations, makes all logical decisions, controls access to the computer by input and output devices, stores and retrieves data from the memory, and coordinates the orderly execution of a program," to quote from the manual for the MITS Altair 8800, a popular microcomputer kit we'll use as an example. The program is stored in memory. The computer communicates with the outside world through Input/Output interface circuits, one for each peripheral such as a printer, video (CRT) terminal, or Teletype.

In a microcomputer, the CPU consists of a microprocessor unit (MPU) and other integrated circuits, plus associated resistors, capacitors, etc. Although it's possible to put an entire microcomputer on a single integrated circuit, including CPU, memory and I/O, such an IC wouldn't allow for any flexibility at all. The CPU of the Altair 8800 is based on the Intel 8080 MPU, a 40-pin integrated circuit. Sixteen of those 40 pins are for addressing memory locations: that is, for selecting, one by one, any of up to 65,536 ( $2^{16}$ )

memory locations, either for reading what's in that location, or for putting either data or a program instruction into that location. Unless a program is designed to work entirely with data that's fed in from a peripheral, there will be data stored in memory along with instructions, as part of the program.

Eight of the 8080 pins are for data; the 8080 is an 8-bit microprocessor, as are most of the MPUs now on the market. Ten of the pins are for control signals, such as Reset, Interrupt, or Read/Write. Two pins are for connecting the clock (which synchronizes the computer circuits with each other), and the last four pins are power connections, for ground and +12, +5 and -5 volts.

**Inside the MPU.** The definition of a "microcomputer" is simply a computer that's built around a microprocessor, which contains the processing and control circuits. The 8080 MPU, for instance, contains an accumulator, which performs arithmetic and logical operations; an instruction decoder, which examines program instructions and determines what actions the computer will take for each; various registers, which

store information temporarily during execution of a program; and address decoders, which determine the location in memory where information will be retrieved or stored.

In the Altair 8800, the 8080 MPU takes up a space about  $\frac{3}{4}$ -inch wide and two inches long, on a printed-circuit board measuring 5 by 10 inches. To give you an idea of what needs to be added to an MPU to make a CPU, the CPU board contains—in addition to the 8080 MPU—17 ICs, 46 resistors, 12 capacitors, two zener diodes, and a 2.000-MHz crystal. Those added components constitute bus drivers, which buffer the address and data information and the control signals that enter or leave the CPU board. The 8080 CPU board also contains a crystal-controlled clock, and a logic circuit that generates one of the control signals, the Data Input Enable, to turn on the input data drivers.

**Display/Control Board.** In assembling the Display/Control board, which also measures 5 by 10 inches, you solder in 24 ICs, several dozen resistors and capacitors, 25 toggle switches, and 36 light-emitting diodes, or LEDs. Sixteen



CIRCLE 75 ON READER SERVICE COUPON

The 16 address switches across the middle of the MITS Altair 8800 are for selecting a memory location, and the 16 LEDs above those switches indicate the selected address. The eight rightmost switches are also for entering data into the selected address, and the eight additional LEDs at the top right show what's stored at that address.

# e/e COMPUTER READOUT

of the switches, and 16 LEDs, are for addressing memory; a switch whose toggle is up denotes a 1 bit. The eight Address switches at the right end of the row of 16 are also for entering data, along with 8 more LEDs (at the top right of the front panel). Of the remaining switches, one is for turning on the computer, and eight are for such controls as STOP/RUN, DEPOSIT/DEPOSIT NEXT, and EXAMINE/EXAMINE NEXT. The remaining 10 LEDs indicate various operating conditions.

**Programming.** Before we look at memory, let's take a look at programming, because how much memory you have will determine what kind of programming you can do.

Unlike analog circuits, which operate on the basis of *how much* signal is present, digital circuits recognize only the *On* or *Off* states, so the smallest component of a program is called a binary digit, or *bit* for short. Because the arithmetic circuits of a digital computer understand only zeroes and ones, they respond only to programs in *machine language*, which is made up of 0's and 1's. Here is a simple program that adds two numbers—in the 8080 MPU's machine language—stored in 14 successive memory locations, numbered 0 through 13:

```
00111010
10000000
00000000
01000111
00111010
10000001
```

```
00000000
10000000
00111010
10000010
00000000
11000011
00000000
00000000
```

The first computers, such as Eniac and Edvac, had to be programmed this way, which is quite tedious and error-prone. Today, to make programming easier and faster, the bit pattern is usually given in octal form (00111010 = 00 111 010 = 0 7 2), and the instructions are given *mnemonic* names, which are abbreviations that are easy to remember. For instance, the first instruction, which is 00111010 in binary and 072 in octal, is called LDA, defined as "load the accumulator with the contents of a specified memory address." The memory address takes up two *bytes* (groups of 8 bits) because the 8800 can address  $2^{16}$  memory locations.

Next, the program gives the "low-order" address: 10000000, or memory location 128; the "high-order" address follows and is, in this case, all zeroes. If we change to mnemonics and addresses, it will look like this:

STEP	MNEMONIC	BIT PATTERN	OCTAL EQUIV.
0	LDA	00 111 010	0 7 2
1	(address)	10 000 000	2 0 0
2	(address)	00 000 000	0 0 0
3	MOV	01 000 111	1 0 7
4	LDA	00 111 010	0 7 2
5	(address)	10 000 001	2 0 1
6	(address)	00 000 000	0 0 0
7	ADD	10 000 000	2 0 0
8	STA	00 111 010	0 7 2

```
9 (address) 10 000 010 2 0 2
10 (address) 00 000 000 0 0 0
11 JMP 11 000 011 3 0 3
12 (address) 00 000 000 0 0 0
13 (address) 00 000 000 0 0 0
```

Rearranging the program into just mnemonics and octal addresses (and remembering to store it in memory locations 0 through 13), it looks like this:

```
LDA 200 000
MOV
LDA 201 000
ADD
STA 202 000
JMP 000 000
```

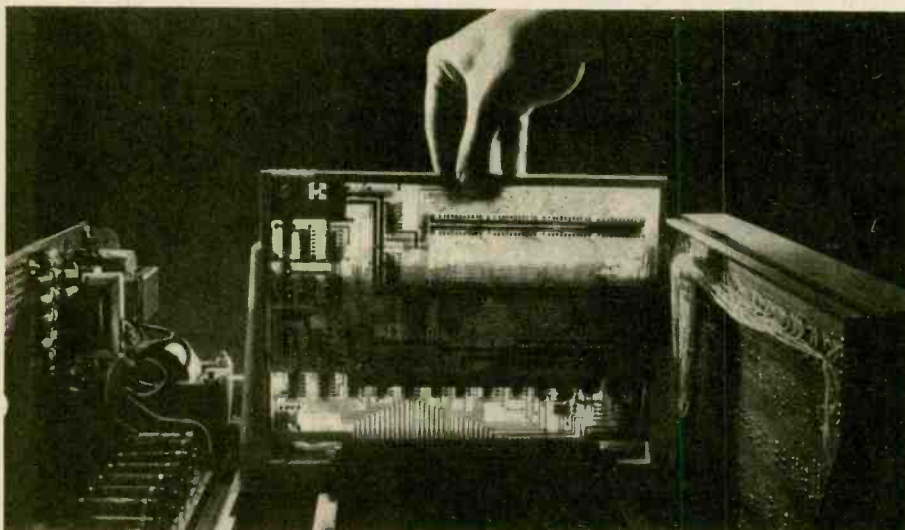
The addition program is now in *assembly language*. The Altair 8800 can understand this program only if you have obtained an *assembler* program from MITS. The assembler translates LDA to 00111010, 200 to 10000000, etc.

Here's what this program does: load the accumulator with the contents of memory address 128 (200 in octal), and move the contents of the accumulator to register B, using mnemonics LDA and MOV. Next, load the accumulator with the contents of memory address 129 (octal 201), and add register B to the accumulator, using LDA and ADD. Take the sum that's now in the accumulator and store it in memory location 130 (octal 202).

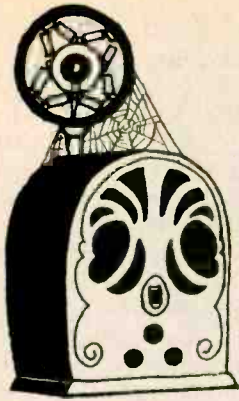
The program adds whatever is stored at address 128 to what's stored at 129, and puts the sum in 130. If you've already put a 6 and a 7 in those memory locations, the program adds them, and there will be a 13 in memory location 130.

**How to Run the Program.** When you turn on an Altair 8800, various front-panel LEDs light up to indicate whatever happens to be in memory at the location the computer settles on when the power comes on. By operating RESET, you prepare the computer to put information into (or see what's in) the first memory address, which is zero. If you're using machine language, you set the first instruction into memory by flipping the eight DATA/ADDRESS switches to 00 111 010. The switches are grouped in threes, to make it easier to set them. Actuating the DEPOSIT switch will load the first bit pattern into memory. Then enter the next byte into the DATA/ADDRESS switches and actuate the DEPOSIT NEXT switch, which means simply that you push the same DEPOSIT switch in the opposite direction, since this one switch controls both functions. The bit pattern will be auto-

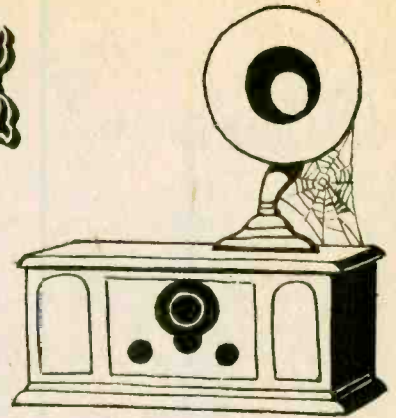
(Continued on page 88)



A view inside the Altair 8800 shows the power supply at left, a memory board being inserted on this side of the CPU board, and the front-panel control board at right.



# ANTIQUE RADIO CORNER



by James A. Fred

□ Hello out there in Radioland! Anyone interested in joining a radio collector club in the northwest corner of the United States may write to Arthur H. Redman, 9235 N. Kellog St., Portland, Oregon 97203. He sent me the First Anniversary Bulletin of The Northwest Vintage Radio Society. It is one of the finest club bulletins I have ever seen. There will be another AWA Southern Meet held at the Holiday Inn North, Winston-Salem, NC on July 9th to 11th. I plan on being there and look forward to meeting many of my readers.

**Antique Radio Bookends.** Several years ago I corresponded with several collectors who wanted to make a set of bookends using 2 large vacuum tubes. I had thought of it too, but didn't have the proper wood or the tools needed. Recently I received an advertisement through the mail from Holliday Woodworks, P.O. Box 548, Boerne, TX 78006. They offered a pair of unfinished cherry wood bookends. They seemed to be nicely shaped and looked like just what I wanted. The pair were priced

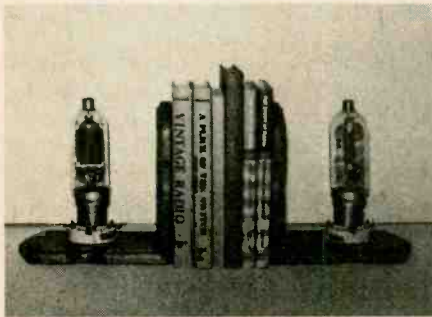
at \$8.00 plus \$1.00 for shipping.

The bookends came and I was very pleased with the design and quality of the wood. They were just a little larger than necessary for vacuum tubes since they were originally made to have HO gauge freight cars mounted on them. A light application of stain and two coats of urethane semi-glass varnish soon had them ready for mounting the tube sockets. In the photographs you can see two different versions. One with two very old 50-watt transmitting tubes, and the other with two more modern tetrode transmitting tubes. Another variation not shown has a 199 and a 201A tube on one end and two larger tubes on the other end. You may want to mount tuning condensers, telegraph keys, sounders, or other old radio and wireless items you may have.

**Crystal Radio Identified.** In the January-February 1976 issue of *ELEMENTARY ELECTRONICS*, at the top of page 62, is a photograph of a mystery crystal radio receiver. I received a letter from its owner, Marshall Howenstein of West

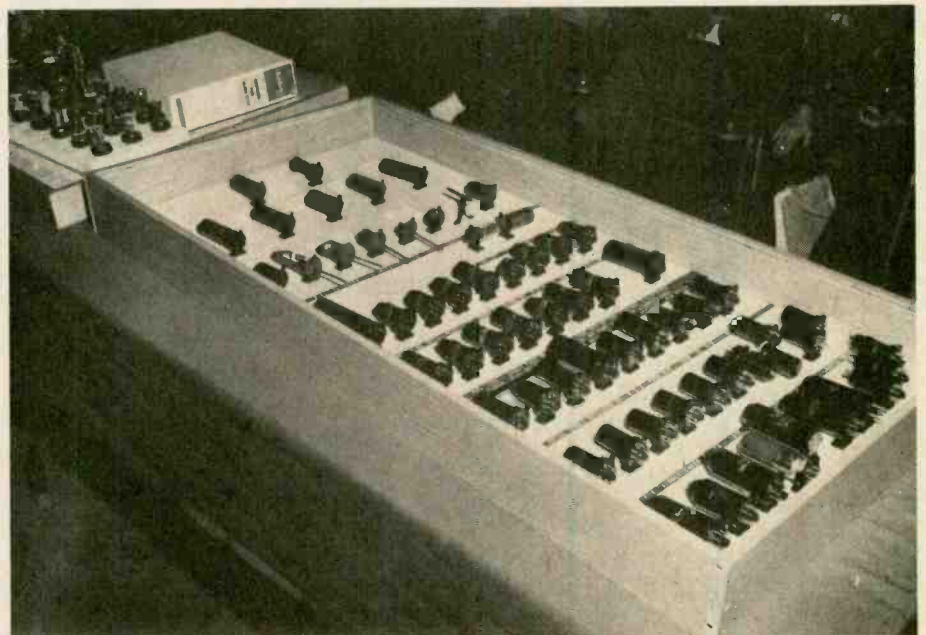
Lafayette, Indiana. Mr. Howenstein found the radio at an antique mart in Tennessee in the spring of 1975. It is British-made and is a long wave wireless receiver. It has binding posts for two sets of headphones. The case, which at first appeared to be rosewood or mahogany, is actually English walnut. Inside the case are two coils of wire with taps which can be coupled through switches for long wave broadcasts. The detector was a Galena crystal. Examination by experts have dated it as being pre-1921. With an adequate antenna and ground, Mr. Howenstein has received local stations. The set won first prize in its class at the IHRS 1975 summer meet held at Purdue University, West Lafayette, Indiana.

**Amplification Factor and Mutual Conductance.** Most collectors have read tube manuals and understand many of the tube characteristics listed such as filament voltage, plate voltage, screen grid voltage, filament current, plate current. However, the terms "Mutual Conductance," measured in micro-mhos,



You can use cherry wood bookends (source listed in column) with tube sockets and fairly recent transmitting tubes — these sockets and tubes cost a big \$1.50 at a recent Dayton Hamvention—or you can use older, harder-to-come-by receiving tubes.

At the Antique Wireless Association Fall Conference Patrick Dowd used this display to illustrate his talk on the development of the all-metal vacuum tube. These tubes came into use about 1935.



# e/e ANTIQUE RADIO CORNER

and "Amplification Factor," represented by the Greek symbol  $\mu$ , throw collectors for a loop.

The amplification factor of a tube depends on the spacing and size of the wires in the grid. It also varies directly as the distance between the plate and the cathode, and between the grid and the cathode. The tube manual usually lists amplification factors for audio amplifiers—triodes, and tetrodes. The amplification factor is a measure of the maximum amplification obtainable from the tube alone, and is determined mainly by the mechanical construction of the tube.

Both the plate resistance and the amplification factor of a vacuum tube affect its performance as an amplifier. Mutual conductance ( $G_m$ ) is the ratio of amplification factor to the plate resistance. Since conductance is exactly the opposite of resistance the unit of measure is a mho. Since a mho is too large a unit for common use, conductance is measured in micro-mhos. Usually RF amplifiers, converters, screen grid, pentode, and other multi-element tubes have their mutual conductance listed in the tube manual.

Mutual conductance is also expressed as the ratio of change in plate current to a change in grid voltage. In other words it is desirable to have a large change in plate current for a small change in grid voltage. In general the best type of a given tube has the largest value of mutual conductance. If you were to buy a tube tester the most desirable type would be one that measured the mutual conductance of all tubes (except diodes and rectifiers). The inexpensive types of tube testers only measure the ability of a vacuum tube filament to emit electrons. These tube testers are called "Emission Testers." An emission tester is fine for rectifiers and diodes, but are nearly useless for testing amplifier and multi-element tubes.

**Atwater Kent Books Now Available.** Just announced are three reprints of Atwater Kent radio instruction books. These books were originally published in 1924, 1925, and 1927. They explain how to operate, how to install, how to connect the batteries, and give hints on how to improve reception of all the Atwater Kent radios made during these years. In fact they cover nearly every battery radio Atwater Kent manufactured.

Volume 2, with 48 pages, was re-

printed by William Huntly of Coatesville, Indiana. The job of reprinting is an excellent one, and is better from a readability standpoint than the original. You may order a reprint of the Atwater Kent Radio Instruction Book, Volume 2 by sending \$6.00 to William Huntly, R 2, Coatesville, IN 46124. It is postpaid.

Volume 1, with 40 pages, and Volume 3, with 48 pages, have been reprinted by Antique Radio Press from negatives originally made by Alan Burch of Salt Lake City, Utah. You may order Volume 1 by sending \$4.00, and Volume 3 by sending \$5.00 to Antique Radio Press, P.O. Box 42, Rossville, IN 46065. Both will be sent postpaid.

Also just reprinted is the users manual for the Radiola III A radio receiver. It gives directions on how to hook-up and use the Radiola III A. It contains 16 pages and will sell for \$2.00 postpaid. It may also be ordered from Antique Radio Press at the above address. Later in the year there will be more reprints from the model 67 AK radio, Majestic models 71 and 72, Majestic models 91 and 92, an instruction book for Wards Airline Radio set, and *The Simplicity of Radio* by Powel Crosley Jr. These will all make valuable additions to your antique radio library.

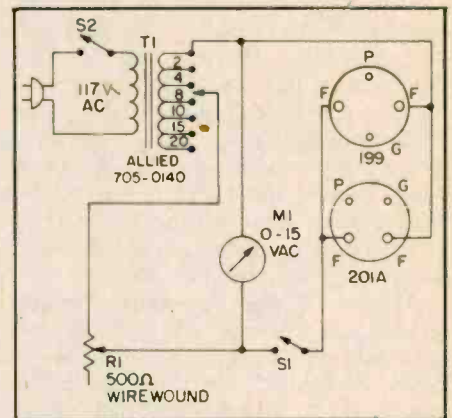
**Putting New Life Into Radio Tubes.** It often happens that an old vacuum tube will fail to operate properly although the filament is lighted. In this



Chip Meir, right, presents photograph of his grandfather, early radio maker Alfred Grebe, to the AWA. Secretary Bruce Kelley accepts the photo, which will be hung in the AWA museum.

case the trouble may be due to poor electron emission from the filament. The 201A tube and the 199 tube had a filament which was treated with thorium, a metal which emits electrons, when heated, at a much greater rate than tungsten or other metals. The old 201 tubes were not treated with this substance and cannot be reactivated.

The process of restoring Thorium treated tubes is very simple. The Thorium inside the filament is forced to the from the inner part of the filament is boiled out to the surface of the filament. In order to have the Thorium evenly distributed the tube must be baked also. This must take place at a lower temperature and therefore less voltage is applied to the filament.



This circuit can be used with the chart below to rejuvenate certain vacuum tubes.

	Boiling Time		Baking Time	
Radiotron	Volt.	Sec.	Volt.	Min.
UX, UV-199	10	30	4.5	10
UX, UV-201A	15	60	7.5	10
UX-120	10	60	4.5	10

All tubes cannot be restored. In many cases the filament will burn out in either surface of the filament by excessive heat. This process is called "boiling." To boil the 201A tube, 15 volts are necessary and the length of time is 60 seconds. For the 199 tube, 10 volts is required and the length of time is 30 seconds. The next step after the boiling is known as the "baking" process. The 201A tube must be baked for 10 minutes at 7.5 volts and the 199 tube must be baked for 10 minutes at 4.5 volts.

When the tube is boiled, the Thorium the boiling or baking process. However 8 out of 10 tubes can be returned to useful service and tests have shown that these tubes are just as good as new ones. At least nothing is lost if the tube does burn out because it was of no value anyway before you tried to rejuvenate it. ■

# 4-Channel Sound -- Alive and Well!

by Fred Petras



**After a temporary slowdown, sales of quadrasonic sound equipment are once again on the upswing.**

**F**or the past year or so any observer of the audio scene could hardly have failed to notice that four-channel sound has been getting something less than even-handed treatment from the hi-fi industry. And there's a reason for it: the industry has "rediscovered" stereo and has been enjoying another go-round with it, with high-powered, high-priced equipment, and making lots of money from it. It seems that many hi-fi buffs are not yet convinced of quadrasonic's merits, some prefer high-power stereo to low-power four-channel equipment, and some refuse to upset their house decor with the addition of two more speaker systems.

Now signs of a turnaround are appearing: quadrasonic is gaining new attention, on the heels of another "discovery"—while four-channel sound is not moving at the pace the industry expected it would, it has established itself as a solid part of the audio industry and is becoming more meaningful as the "gospel" spreads.

The public backed off from buying

four-channel equipment as the hi-fi industry began to lie low when it realized that the phonograph record/tape industries were not releasing quadrasonic records and tapes in sufficient quantities to satisfy consumer demand. In effect, a "which-came first"—chicken or egg, razor or blade—situation prevailed, with record/tape suppliers reluctant to put out four-channel releases for a relatively small number of prospective and actual users. As sales slipped the record/tape makers grew even more cautious.

Fortunately, the industries have now achieved a kind of peace, and all are forging ahead. Equipment producers are offering more four-channel gear; record/tape producers are stepping up their quadrasonic releases. And the broadcasting industry, ever alert to the public's tastes, is "in there," broadcasting more and more four-channel programs. In fact, some stations are on a 24-hour-a-day quadcasting schedule. All told, the future for four-channel sound is quite bright.

**Equipment Advances.** A lot has happened in the past year or two relative to four-channel equipment. In the early days, companies were more concerned with merely getting into four-channel production; they did not have marketing statistics to work with, and consequently, they made some boobos. Like making receivers with minuscule amounts of power in the belief that the consumer was more concerned with price than power. The low-powered sets flopped loudly, as attested to by hundreds of clearance sales of such units. Today, you need not settle for a five-watt-per-channel quadrasonic receiver; you can get them with 50 watts of power—enough to drive even the most inefficient speaker systems to ear-rattling volume.

Current four-channel receivers are also improved in a number of other respects over those of a year or two ago. Most contain more than a simple SQ matrix system, offering instead some form of logic decoding for better channel delineation and separation. Many of

## e/e 4-CHANNEL'S ALIVE

them contain built-in CD-4 demodulators, rather than merely offering a connection for auxiliary CD-4 units. Many contain sophisticated, updated QS matrix decoding circuits for optimum channel separation. In fact, there are a number of receivers offering the best of the three worlds of quadraphonic—logic SQ, built-in CD-4, and QS with Vario-Matrix—along with hefty power outputs.

**What's Available—Receivers.** Basic descriptions of some of the more desirable current and new four-channel equipment on sale at your local hi-fi emporium follow. By the time this appears in print there will be more. All receivers mentioned are tri-mode.

**Akai America:** A new receiver, the AS-1080DB, priced at about \$895, is a Dolby-equipped unit that delivers 40 watts per channel in quad, or 80 watts per channel in stereo operation. It has built-in CD-4 facilities, QS decoder and full-logic SQ decoder. A lower-priced model without Dolby and 20 watts per channel output in quad, the AS-1070, is about \$695.

**JVC America:** Four receivers, priced from about \$400 to \$800, in a range of 13 to 43 watts per channel, with the figures more than doubled in stereo operation. Each contains built-in CD-4 demodulator circuitry, plus "Matrix 1 and Matrix 2 decoder circuits to effectively decode any and all matrix-encoded 4-channel (and 2-channel) discs, tapes or FM 4-channel broadcasts." The two higher-priced models feature a "disc memory" that automatically switches the set from CD-4 to matrix operation. All but the lowest priced unit offer "S.E.A.," a form of equalization to "tune your listening room to compensate for irregular acoustics or to enhance the particular aspect of the music you like best."

**Kenwood:** Forty and 50 watts per channel output are available in the Ken-



Circle No. 31 On Reader Service Card

Heath's MODULUS system uses AN-2016 4-channel control center which works with MODULUS power amplifier modules, takes FM Dolby module AD-1504, SQ decoder module, and/or CD-4 demodulator module. 2-channel power amplifier modules at 35- or 60-watts/channel are used with the control center, which as a kit is available via mail at \$599.95.

wood KR-8840 and KR-9940, priced at about \$700 and \$975, respectively. Both units feature built-in CD-4 demodulator, SQ decoder with wave-matching logic and variable blend circuitry, plus RM (QS) decoder. The company claims that with the use of the variable blend circuit "it's almost impossible to distinguish between SQ and discrete playback," because of the improvement in center-front to center-back separation—by as much as 20 per cent.

**Lafayette Radio:** A plug-in module at an extra \$69.95 makes the firm's LR-5000 at \$600 a full-feature receiver capable of playing all three quadraphonic formats. For SQ, the set uses full-logic separation with variblend for widest possible separation. Power output is 35 watts per channel. A related model, LR-3000, priced at \$450, offers the same basic features but lower output—15 watts per channel.

**MX:** Two full-feature quad receivers, the MX1661 at \$700 and the MX1671 at \$800, offering 25 watts and 50 watts per channel output, respectively. SQ



Circle No. 60 On Reader Service Card

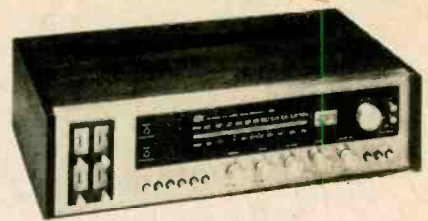
JVC four-channel receiver 4VR-5446X can deliver up to 21 watts/channel while it handles CD-4 discs and both of the matrix (SQ & QS) systems. Specially-flexible is the five-slider SEA equalization system. Unit also accepts remote balance control; \$649.95.

decoders in each are full-logic with variable blend.

**Onkyo:** Automatic mode-switching is a key feature of the TS-500, a full-feature unit priced at about \$750. The mode switch automatically brings into play the proper circuitry for decoding or demodulating the program material. A joystick control is offered for channel balancing functions. Power output is 20 watts per channel.

**Pioneer:** Two full-feature quadraphonic receivers, the QX-747 at about \$650 and the QX-949 at about \$750, offering 20 and 40 watts per channel output, respectively. The units have a pulsating indicator on the front panel that lets you view all four channel level adjustments simultaneously.

**Realistic (Radio Shack):** An "Audio-rotor" that "turns the sound" a full 360 degrees is a feature of the QTA-770, priced at \$600. It has a power output of 30 watts per channel. The set has built-in CD-4 and SQ facilities. In place of a QS decoder it offers "Quatravox," a four-channel synthesizer to make two-



Circle No. 65 On Reader Service Card

MX 1661 receiver has CD-4 demodulator, SQ logic and RM (QS) matrix decoders. Power output is 25 watts/channel; \$699.95.

channel stereo sound like four-channel. (QS records are played via the Quatravox or the SQ decoder.)

**Sansui:** Seventeen, 25 and 35 watts per channel output are offered in the QRX5001, 6001 and 7001, priced at about \$600, \$760, and \$880, respectively. The full-feature instruments feature a "Type-A, QS vario-matrix" for "boosting interchannel separation to a par with four-channel master tapes," in addition to built-in CD-4 and SQ facilities.

**Technics:** Sixteen watts per channel power is offered in the SA-8100X, a full-feature receiver priced at about \$650. A special aspect is provision for connecting two four-channel tape decks, with dubbing possible from one to the other. A third deck can be connected via the AUX terminal. Higher power—26 watts per channel—is offered in the firm's SA-8500X, priced about \$740. It has three tape monitors. Both sets permit hooking up two sets of four speakers.

### Other Quadraphonic Equipment.

If radio reception is not your bag and you wish to save money, you need not be limited to four-channel receivers. Several companies produce integrated four-channel amplifiers that can serve as the nucleus of a quadraphonic system. You'll find them in the JVC, Lafayette, Marantz, and Pioneer lines. They are priced from about \$280 to \$600. The units have built-in matrix circuits, but CD-4 capability is achieved only via the use of add-on demodulators. Additionally, Dynaco has a stereo



Circle No. 64 On Reader Service Card

The Pioneer QX-949 receiver functions in all 4-channel modes, including CD-4, RM and SQ, and supplies "enhanced" sound from stereo sources, for a four-channel effect at 40 watts per channel; \$749.95.





Circle No. 63 On Reader Service Card

From Sansui, the QRX-7001 receiver features a built-in vario-matrix chip for activating both QS and SQ decoders, plus a QS synthesizer and a CD-4 demodulator, at 140 rms watts total; \$879.95.

amplifier with a passive speaker matrix system that produces a quasi-quadraphonic sound from four-channel or stereo records: the SCA-80Q, priced at about \$299.

Four-channel preamplifiers are a rare item. My research revealed the existence of only one, the JVC, JP-V1000; available now in Japan, and tentatively scheduled for introduction in the United States sometime this year. However, a combination of four-channel preamp/two-channel amplifier is available from Marantz at about \$300, the 4C70. The unit can be combined with an existing two-channel stereo amp for full four-channel operation. It contains "Vari-Matrix," a synthesizer circuit that generates a four-channel effect from stereo and quadraphonic records. The set also has a matrix decoder "pocket" to house a decoder within the cabinet. The power output is 15 watts per channel.

If you insist on converting an existing stereo receiver or amplifier with tape-monitoring facilities to four-channel operation, there are still a couple of companies making conversion equipment. One is Lafayette Radio, with a 5-watt-per-channel rear-channel amplifier which features the basic SQ matrix at \$59.95, the LA-524. Sony in its SQA-2030 decoder/amp offers 18 watts per channel of rear channel amplification. This sophisticated device offers full-logic SQ decoding.

Should you already have an early-technology four-channel system and are dissatisfied with its separation qualities in the SQ mode, take heart. Sony is at your service with a logic-equipped SQ decoder to improve matters: the SQD-2070, at about \$100.

Four-channel equipment bought in the early days most likely did not have CD-4 facilities. This situation has been corrected in full, with several companies offering plug-in CD-4 modules. The demodulators range from \$130 to \$170. Some come with a four-channel pickup as part of a "package deal." Among companies making demodulators are JVC, Marantz, Magnavox, Panasonic, Technics, and Sansui.

What about record-playing equipment? Yes, it's available in the form of at least a dozen single-play turntables and a handful of automatic record changers. While much of this equipment is not labeled "four-channel" per se, it is of the high calibre needed to effectively play four-channel discs, and utilizes the proper type of wiring. Prices start at around \$100 and go on up past the \$500 mark. Some key brands are B&O, BSR, Empire, Dual, Glenburn, Kenwood, Lenco, Pioneer, Sony, Technics, Tannoy, Stanton, Yamaha, Thorens, Garrard, and Rotel.

Quadraphonic pickups have improved immensely in the recent past. They are widely available in at least 10 different brands and at a variety of prices ranging from \$40 to \$150. A few come already installed in some turntables and record changers. Some brands to check are: Audio Dynamics, Audio-Technica, B&O, Empire, Micro/Acoustics, Pickering, Stanton and Technics.

And what about tape equipment for four-channel use? There is none in cassette form. Why? Because Philips, originator of the cassette, will not grant licenses to producers of equipment who want to make quadraphonic cassettes equipment-utilizing only one side of a cassette. The width of a cassette tape is too narrow to accommodate four tracks in place of the two now used in stereo cassette recording.

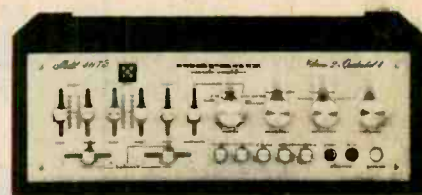
But in the reel format you'll find a nice selection. There are models that play four-channel but record only in stereo, while some models both record and play in four-channel and offer two-channel record/play facilities. This equipment is priced from \$330 in the Radio Shack/Realistic line, up to nearly \$3,000 in the Crown line. Other brands include Akai, Dokorder, JVC, Pioneer, Sony, and TEAC.

You'll also find a fair assortment of four-channel equipment in the cartridge format. There are recording and/or playback type home decks priced from \$60 to \$400. At least 10 companies



Circle No. 62 On Reader Service Card

Dynaco calls their SCA-80Q a "4-dimensional stereo control amplifier," which provides synthesized 4-channel sound from quad and stereo FM, tapes and records; \$299.00 wired, \$185.00 kit.



Circle No. 66 On Reader Service Card

Marantz 4070 is a 4-channel preamplifier and stereo power amplifier. It can also synthesize quadraphonic sound from stereo records. Requires extra stereo power amp.

offer them—Hitachi, Lafayette, Panasonic, Realistic, Sanyo, Sharp, Sony, Superscope, Technics, and Wollensak. Recording models come in simple "one-button" form for easy operation, on up to sophisticated Dolbyized units such as Wollensak's 8080 featuring fast forward control and digital time counter.

**Compacts.** If ear-rattling levels of sound are not your bag and you don't like making a lot of equipment decisions, you might consider buying a "compact"—modular four-channel system, packaged ready to go. All the work of selection is done for you and compacts can save you money as well. Such a system can sound surprisingly good, simply because the sound comes from four speaker systems and is therefore 'bigger,' more encompassing than sound from a similarly powered stereo rig.

Compact ensembles are featured in the Fisher, Hitachi, Magnavox, Miida, ElectroPhonic, Panasonic, Sanyo, Sony, Soundesign, Sylvania, and Zenith lines, among others. They are comprised of simple receiver/speaker combinations on up to receiver/tape/record combinations complete with speakers. Prices start at \$149.95 for a receiver/speakers combination in the Lafayette line, with some ensembles ranging past \$400, depending on power and features. Most of these outfits will provide basic four-channel sound. Few of them offer logic SQ, for instance, for top SQ decoding. Some of the higher-priced systems offer CD-4 capability, along with, of course, decoding circuits for the QS encoding approach. Some models don't provide for reproduction of all three systems. For instance, some models are touted as offering "discrete" sound; they do, but only in tape form. They do not contain a CD-4 demodulator for Quadradisc records; such discs will be reproduced through whatever matrix decoder is provided, with results unlike those obtainable if the record were played through the proper decoding system.

In addition to true four-channel com-  
(Continued on page 90)

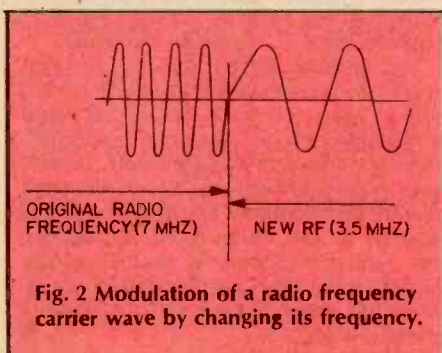
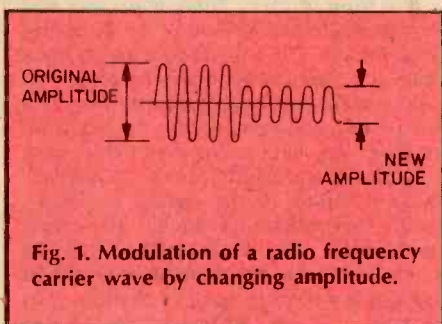
# MODULATION WITH FREQUENCY

FM Modulation is simple enough to investigate in depth at the hobby level—and for good measure, we toss in Phase Modulation

By Norman Crawford

IF YOU'RE A REGULAR READER OF ELEMENTARY ELECTRONICS you probably know *modulation* puts information (words, music, or other desired information) on a radio frequency carrier wave. You also know that messages can be sent by making *changes* in something, such as changes in smoke—smoke signals; changes in drum beats—"talking" jungle drums; changes in the number of lanterns in a church steeple,—Paul Revere's friend; or by changing *amplitude* of a carrier wave—amplitude modulation. But amplitude changes are not the only way a radio (carrier) wave may be changed to send messages. You also know that messages can be sent by changing the carrier's *frequency*—frequency modulation, or its *phase*—phase modulation. This article tells us how these two modulation methods carry the message, and describe simple electronic hardware for the purpose.

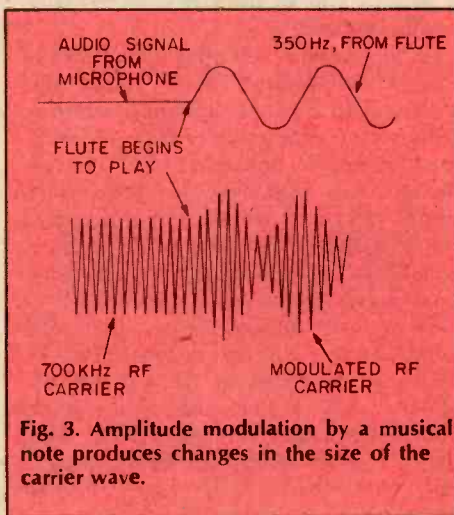
**Simple Changes for Simple Messages.** The simplest possible AM signal consists of a sudden shift in the *amplitude* of the carrier, as shown in Fig. 1. Similarly, the very simplest FM signal is



made by causing a sudden shift in the *frequency* of the carrier, as shown in Fig. 2.

Practical AM communication systems for speech and music make the carrier amplitude shift smoothly up and down, so that the tips of the carrier wave conform to the shape of the audio waveform. This is shown in Fig. 3. By this means the modulated radio frequency carrier wave conveys the audio (information) to a distant receiver. If this audio waveform were supplied to a FM transmitter, there wouldn't be any amplitude changes. Instead, the *frequency* itself (the radio frequency carrier wave) is pulled smoothly back and forth, higher and lower, in accordance with the audio signal, as shown in Fig. 4.

**The Walking Carrier.** If the audio frequency were low enough—say, for example one hertz (cycle-per-second) we could actually "see" the carrier moving back and forth—walking up and down on the dial of the receiver (if we constantly retuned the dial pointer correctly). This is shown in Fig. 5. Notice in that drawing that the back-and-forth motion of the carrier reproduces the original audio waveform (which happens to be a sine wave in this simple example). It's a one hertz back-and-forth motion. If we increase the audio frequency to 3 Hz, the carrier will "walk" rapidly back and forth at a 3-Hz

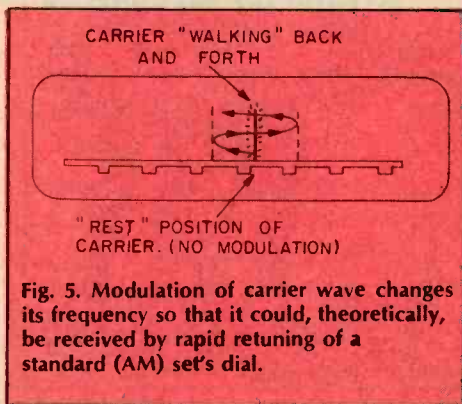
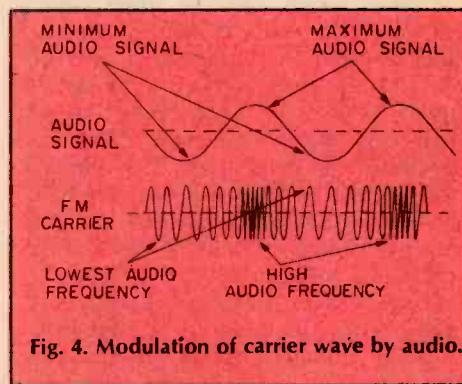


rate on the receiver's tuning dial.

But seeing the carrier move back and forth on a hypothetical tuning dial won't let us hear sound. How can we take this back-and-forth carrier motion and convert it back to the original audio wave?

**FM Detection Via an AM Detector.** Surprisingly enough, there is a way to use an ordinary AM envelope detector (very similar to the rectifier of a power supply) to make this conversion. To understand how this is done, we must first understand that the frequency-selecting circuits of a receiver—the circuits that allow us to listen to one station and exclude all others—normally give a sloping shape to the "window" through which the desired station is allowed to pass as shown in Fig. 6.

We all know from experience in tuning ordinary AM receivers that if we don't tune right on the station, the signal will sound weaker than it should.



This happens because the sloping edges of the frequency-selective window start chopping off (attenuating) the signal, as shown in Fig. 7.

But, what if the desired signal is an FM signal—walking back and forth on the dial—and we *deliberately* mistune so that the center of the “walk” is half-way down the slope? As you can see in Fig. 8, the back-and-forth carrier motion causes the signal to become alternately strong and weak—which is *amplitude modulation*! And, since the strengthening and weakening takes place at the audio rate, the slope of the frequency-selective circuit has converted the FM wave to an AM wave which may be detected with a simple AM detector! See Fig. 9. This is called *slope detection*, or *side-tuning detection*. It is *not* the most commonly-used FM-detection scheme, but its method forms the basis for more sophisticated FM-detecting techniques. If you understand slope detection, you will easily grasp the more elaborate arrangements found in textbooks and receiver schematic diagrams.

**Making FM.** Figure 10 shows a practical schematic diagram for an oscillator. If we were to build this oscillator and apply the correct voltages, it would generate a carrier which could be received on a nearby receiver. Its carrier would appear on the receiver dial at a place determined by the values we choose for inductor L and capacitor C.

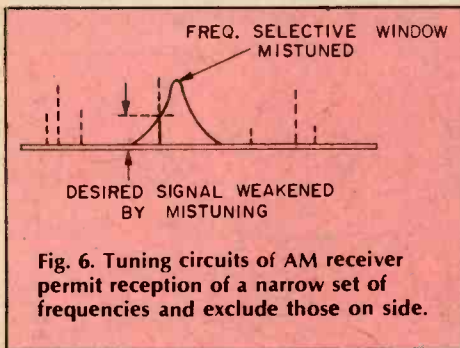


Fig. 6. Tuning circuits of AM receiver permit reception of a narrow set of frequencies and exclude those on side.

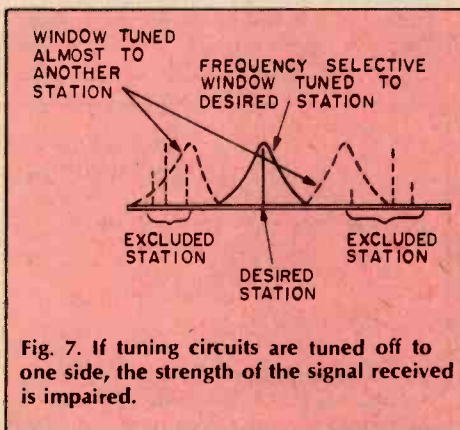


Fig. 7. If tuning circuits are tuned off to one side, the strength of the signal received is impaired.

If we vary either L or C, the carrier will shift to a new location on the dial. In the diagram, C is shown to be a variable capacitor. Shifting the value of C by turning the variable-capacitor knob will cause the carrier to appear at a new location on the receiver dial.

If we could attach a microphone's diaphragm to the variable-capacitor knob, as shown semi-schematically in Fig. 11, the sound waves striking the diaphragm would rock the capacitor back and forth rapidly, causing the received carrier to “walk” back and forth on the receiver dial—in short, the oscillator will be frequency-modulated.

Of course, no one makes an FM transmitter in such a crude mechanical fashion. In the first place, the amount of walk—the distance the carrier could deviate from its rest frequency—would be very small. In addition, the higher-pitched audio sounds couldn't possibly rock the capacitor, so no high notes would get through—the result would be very lo-fi.

There are a great many practical ways to build an FM transmitter, and a great many books which tell about them. One very simple, practical system uses *variable-capacity diodes*—a type of diode which actually can act as a capacitor whose value can be varied by applying a varying voltage to it. The system is shown in Fig. 12.

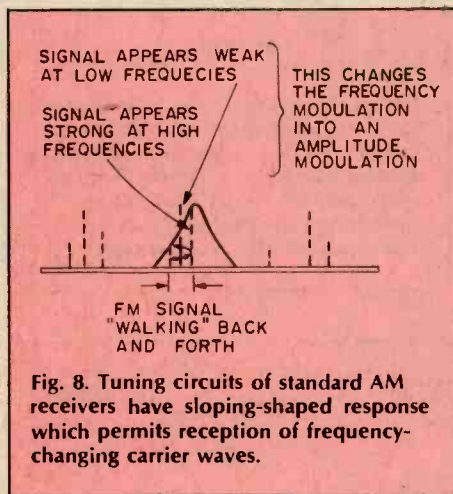


Fig. 8. Tuning circuits of standard AM receivers have sloping-shaped response which permits reception of frequency-changing carrier waves.

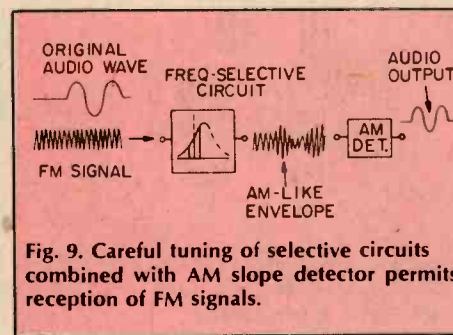


Fig. 9. Careful tuning of selective circuits combined with AM slope detector permits reception of FM signals.

The two diode symbols with variable capacitor symbols to indicate variability, are the variable-capacity diodes, also known as *varactors*. Their value varies according to the audio voltage fed to them. They produce the same effect as rocking a variable-capacitor knob with a microphone diaphragm, only they can respond to higher sounds, and can also walk (deviate) the carrier much farther.

**Modulation Without Limit.** In AM there is a limit to the loudness of the sound which an amplitude-modulated carrier can handle. We call this limit “100 per cent” modulation, and show its wave form in A of Fig. 13. A louder signal would cause *overmodulation*, and would look like B in Fig. 13, where the received signal can be seen to be distorted. Is there a corresponding limit for an FM wave? Where does “100% modulation” occur in FM?

There is no such limit on FM. We can “walk” (deviate) the carrier farther and farther from its rest position. The farther we deviate, the more the signal become immune to interferences from lightning disturbances, automobile ignition systems, and the like. However, the farther we deviate the carrier, the more channel space is gobbled up by the signal. The practical limit on FM, then, is set by how much channel space we are willing to trade in return for freedom from interference. A present-day FM broadcast station takes up many times the channel space of a standard AM broadcast station, and it is correspondingly more free of noise and interference.

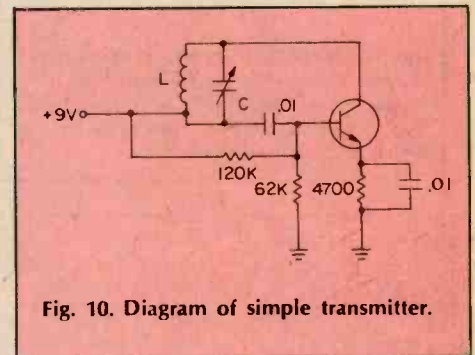


Fig. 10. Diagram of simple transmitter.

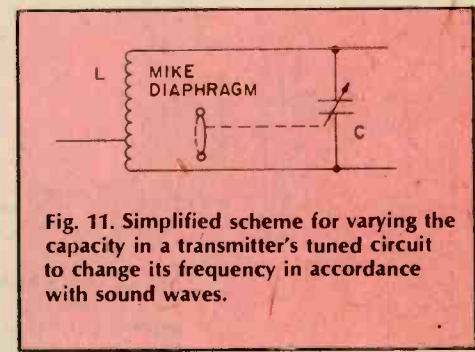


Fig. 11. Simplified scheme for varying the capacity in a transmitter's tuned circuit to change its frequency in accordance with sound waves.

**FM—Another View.** In Figure 5 we visualized FM resulting from a 1-Hz “audio” signal as a carrier shifting slowly back and forth around its rest (unmodulated) position. This is easily visualized for a 1-Hz signal, but what happens when we apply a flute sound at 700-Hz to an FM transmitter? We can, if we wish, think of a carrier buzzing rapidly back and forth at a 700-Hz rate. But this is rather awkward, and we find ourselves asking if there’s *another* way to visualize this signal. For example, does an FM signal have sidebands? Can we visualize FM as a *non-moving, non-walking* carrier surrounded by sidebands, just like AM?

Surprising as the idea may seem, it is true. We can visualize FM *either* as a carrier swinging back and forth at, say, a 700-Hz rate, *or* we can visualize it as a completely non-moving carrier, fixed at one frequency, but surrounded by sidebands.

Which picture is right? Either one, depending on what aspect of FM we are trying to understand. After all, *none* of these pictures of sidebands, carriers, and waveforms actually exist. They are merely ways to help us visual-

ize what’s happening to the electrons scurrying around in our circuits.

**Sidebands and FM.** Let us ask our flutist to play his 700-Hz tone into the microphone of an FM transmitter, while we watch what happens on our imaginary receiver dial which lights up wherever there’s a carrier or sideband. Before the flutist begins to play, we see the carrier sitting at its rest frequency (Fig. 14A), and as he begins to play—softly—we note that a side frequency appears on each side of the carrier, 700 Hz away—just as in AM (See Fig. 14B).

However, we note in B of Fig. 14 that the lower sideband is *inverted*—dangling below the base line. This signifies that its phase is inverted from the “normal” side frequency of an AM signal.

We can also see in B of Fig. 14 that the line representing the carrier becomes *shorter* as the flute begins to play, indicating that the carrier loses some of its strength (amplitude) as the sidebands *gain* amplitude. You might expect this, since the *total* amplitude doesn’t change in FM—remember Fig. 4

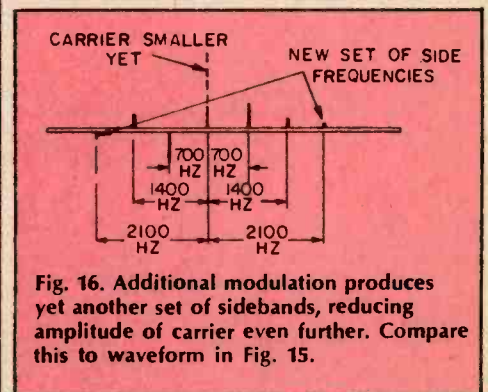
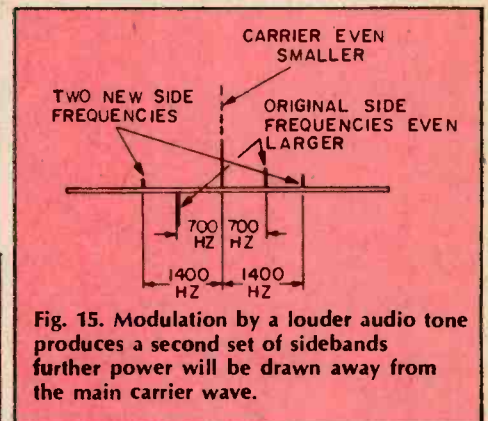
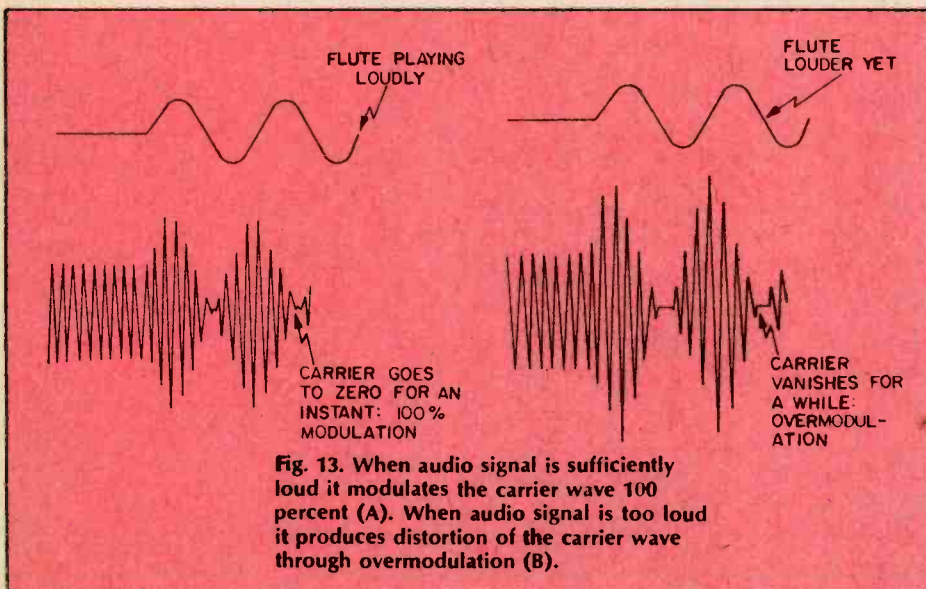
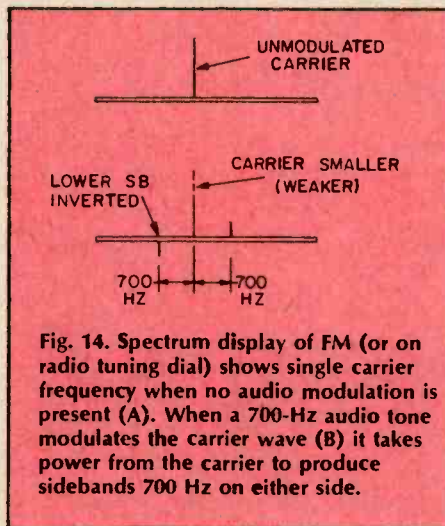
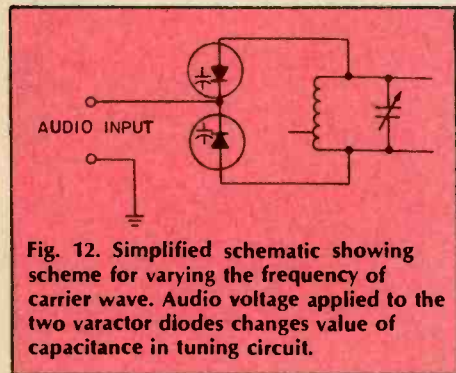
—so as one part (the sidebands) gets larger, the other part (the carrier) must get smaller.

**More Sidebands to Come!** But that’s not the whole story, yet. If we ask the flutist to play a little louder, we find that—as we might expect—the carrier line gets even shorter and the two side frequencies appear, at  $2 \times 700 = 1400$  Hz away from the carrier! See Fig. 15. As the flutist plays louder, the carrier gets even smaller, the side frequencies get even larger, and—another surprise—a *third* set of side frequencies appears at  $3 \times 700 = 2100$  Hz from the carrier! And, again, the lower side frequency of the pair is inverted. See Fig. 16.

How long can this go on, with sidebands multiplying like rabbits, and the carrier shrinking toward extinction? In our example, it’s limited only by how loudly the flutist can play—and, of course, we can add an amplifier to his flute and go on almost without limit, if we don’t mind gobbling up channel space. As the flutist plays louder and louder, we will get side frequencies at  $4 \times 700 = 2800$  Hz,  $5 \times 700 = 3500$  Hz,  $6 \times 700 = 4200$  Hz,  $7 \times 700 = 4900$  Hz, and so on. What’s more, the *odd* multiples— $3 \times 700$ ,  $5 \times 700$ ,  $7 \times 700$ , and so on—will have one of the pair upside down—dangling below the base line.

And the carrier? It can actually shrink to zero, and reappear *beneath* the baseline, indicating it has reversed its phase.

Do all the sidebands go on growing, without limit? Fortunately, no. By the time the carrier has shrunk to about half



its unmodulated size, the two sidebands closest to it stop growing and start shrinking. And, when the flute is so loud that the carrier has reversed and is dangling well below the baseline, the next set of sidebands—the ones 1400 Hz from the carrier—start shrinking. And shortly thereafter, the ones at 2100 Hz start shrinking. Sound complicated? Maybe a picture will help. Fig. 17 is a graph of the behavior of the carrier and two sets of sidebands, showing what happens as the flute plays louder and louder.

By tracing out the carrier line on the graph, you can see it shrink, vanish, invert, grow, shrink again, and vanish again, re-invert, and so on. Similarly, you can see the first two sets of side-

bands (700 Hz and 1400 Hz) going through the same sort of changes. For comparison, we have also sketched the graph for an AM case in Fig. 18, which shows the single set of sidebands growing to the 100 percent modulation point, which is the AM limit.

**Advantages of FM.** There is no question that FM is a more complex way of sending a message—at least so far as sidebands are concerned. But in return for this complexity, we obtain a signal which is more immune to such disturbances as lightning, electric motor sparking, and so on. In addition, two FM stations on the same frequency will not interfere with each other, because the FM receiver will receive only the stronger of the two—never both. This is a decided advantage, particularly for car radios.

**Phase Modulation.** In addition to amplitude and frequency modulation there are other methods of modulation. One of these, which is similar in many respects to FM, is phase modulation. This actually is a specialized form of FM, in which the changes in the frequency of the carrier wave occur briefly, as phase delays and phase advances, as shown in Figs. 19 and 20, respectively. These actually are the same as the frequency of the carrier being changed, momentarily.

Here, as you can see in Fig. 20, the distance Q between peaks at the point

of phase advance is smaller, indicating that, for an instant, the frequency became higher.

There are, then, two directions of phase change—one, a delay, which causes a momentary lower frequency, and the other, an advance, which causes a momentary higher frequency.

If a square wave, Fig. 21A, was fed to an FM transmitter it would modulate the carrier wave as shown in B of Fig. 21, and the output of the FM receiver would change only momentarily, and the output of an FM receiver converting this carrier to audio would resemble the waveform of Fig. 22C. However, by changing the detection system of the FM receiver to that of a phase-detecting system we could extract audio waveforms from the phase-modulated carrier identical with the original audio square wave. In other words, if we feed audio to an FM transmitter through an appropriate RC network, we have a PM transmitter, and if we receive this PM signal on an FM receiver to which we have added an inverse RC network, we have a PM receiver.

There are other methods of modulation more exotic than phase modulation, but they are not in widespread use at the hobby level at this time. The next time you tune in an FM station, you should have a better appreciation of the bouncing carriers and flickering

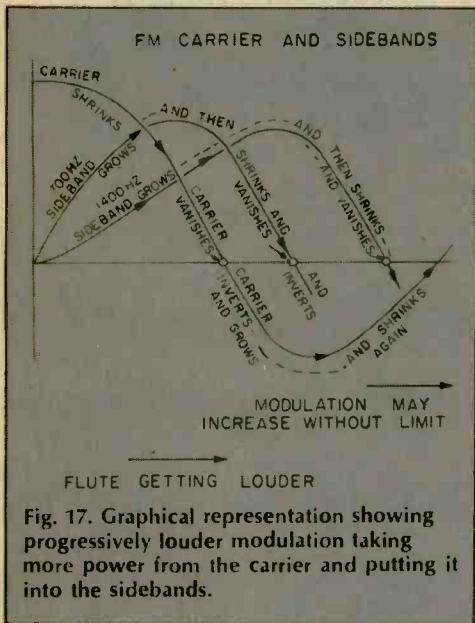


Fig. 17. Graphical representation showing progressively louder modulation taking more power from the carrier and putting it into the sidebands.

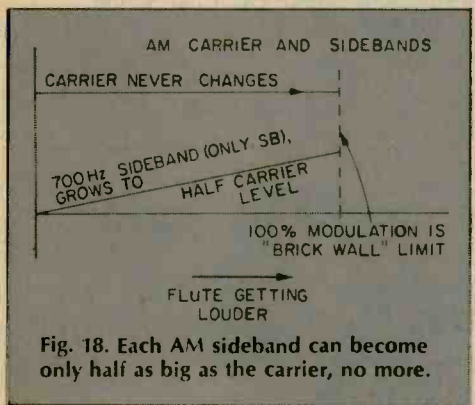


Fig. 18. Each AM sideband can become only half as big as the carrier, no more.

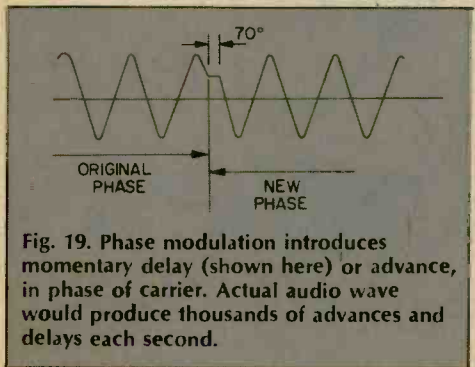


Fig. 19. Phase modulation introduces momentary delay (shown here) or advance, in phase of carrier. Actual audio wave would produce thousands of advances and delays each second.

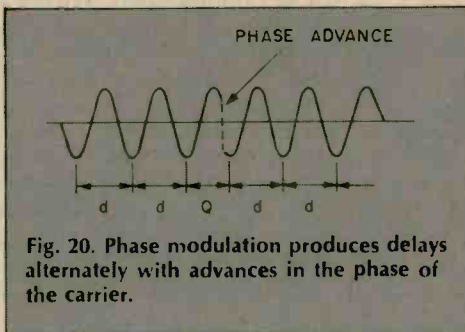


Fig. 20. Phase modulation produces delays alternately with advances in the phase of the carrier.

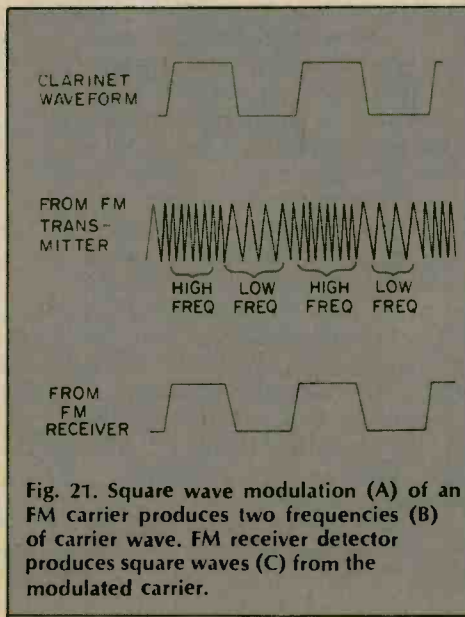


Fig. 21. Square wave modulation (A) of an FM carrier produces two frequencies (B) of carrier wave. FM receiver detector produces square waves (C) from the modulated carrier.

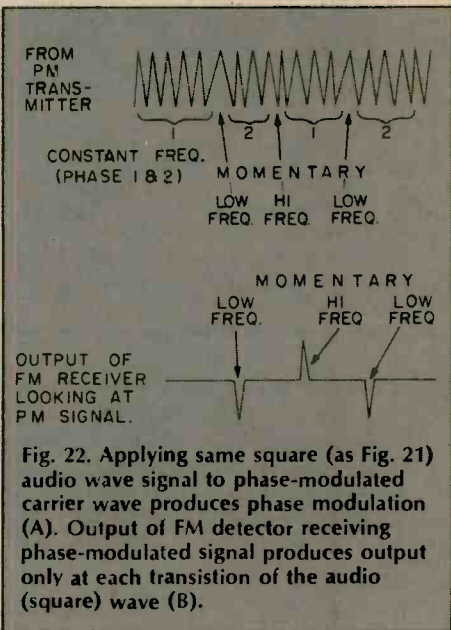


Fig. 22. Applying same square (as Fig. 21) audio wave signal to phase-modulated carrier wave produces phase modulation (A). Output of FM detector receiving phase-modulated signal produces output only at each transition of the audio (square) wave (B).

multiple sidebands that bring you the speech and music. And when you press the PTT switch on your CB rig, you'll have a better feel for the pulsating waveforms which dance from transmitter to receiver. When you flip the channels of your TV set . . . would you believe, it's not single-sideband, but one-and-a-third sidebands? And that's an interesting story, too, but a story for another day.



# CB NEW PRODUCTS



e/e puts together in one neat package some of the newest CB rigs, antennas and accessories for you to use in CB contacts this year!

**New CB Rig.** A new 23-channel, solid-state, Siltronix transceiver for mobile or marine CB use features variable RF gain control. Called the Mohawk, it has a full five watts of power input and includes an automatic noise limiter switch on the front panel. A high quality meter indicates relative output power on transmit and relative strength of received signal. A transmit indicator light is built into the meter. An external speaker jack is provided with a selector switch that permits the

speaker to be used either for public address or to monitor the receiver. Squelch and audio frequency gain controls are also included. Mohawk transceivers come complete with microphone, screw-on microphone connector, and mobile mounting bracket. Units operate with positive or negative ground. Retail price of the Mohawk AM transceiver is \$169.95. For further information, contact Siltronix, 330 Via El Centro, Oceanside, CA 92054.



CIRCLE 41 ON READER SERVICE COUPON



CIRCLE 43 ON READER SERVICE COUPON

**Remote Control CB Transceiver.** The Royce Model 1-606 remote-control 23-channel CB transceiver features the unique *Chan-L-Matic* system that allows the CBer to keep his eyes on the road. The user can switch channels automatically from a remote control switch on the microphone, as well as from the front panel by pushbutton or by the standard manual channel selector. Other features include: new microphone gain control for adjusting modulation capacity, full 3-stage RF noise blanker, large S-RF meter, fully variable receiver tone control, public address with pushbutton control, dual conversion receiver with ceramic filters, relay switching circuitry, and pushbutton power switch. The Model 1-606 also includes a unique protection circuit to minimize danger to the RF output transistors. If you have an open or short, or excessive SWR in your antenna a warning light flashes on the front panel and power is removed from the RF output transistor. Sells for \$249.95. For further information, write to Royce Electronics Corp., 1746 Levee Road, North Kansas City, MO 64116.

**CB-VOX Mike/Headphone.** Now there's a voice-operated, CB boom microphone complete with an automatic gain control headphone and designed for use with any mobile Citizens Band radio. The VOX-operated, CB Safety-Mike/Headphone made by Superex automatically keys transmission to the sound of the operator's voice. Extraneous sounds, though close by, are eliminated by the microphone's noise-cancelling design. The operator's hands never touch the microphone and response is instantaneous. A sensitivity control, engineered to compensate for variable conditions, is included in an easy-to-mount VOX-Box supplied with the mike/headphone combination. A remote control manual switch capable of overriding the automatic operation is also an integral part of the system. The VOX-operated unit features a featherweight cushioned headphone which may be worn for extended periods of time without fatigue. The headphone design incorporates a built-in gain control, level-limiting capability and special impedance-matched circuits for superior CB clarity. Suggested retail price for the system is \$100. Get all the facts by writing to Superex Electronics Corp., 151 Ludlow St., Yonkers, NY 10705.



CIRCLE 39 ON READER SERVICE COUPON

(Continued on page 73)

e/e CB NEW PRODUCTS



CIRCLE 45 ON READER SERVICE COUPON

**CB Under \$100** E. F. Johnson's new low-cost CB transceiver, the Messenger 121A, is for the penny pincher. Despite the radio's bargain price of \$99.95, it has many of the features found in Johnson's other CB radio models. Included are built-in automatic speech compression on transmit, and automatic noise limiting on receive. The new radio also features maximum power permitted by the FCC and easy push-button selection of up to five CB channels. (Crystals for the five channels desired are selected and purchased separately by the user.) It is supplied complete with microphone, mounting bracket, DC power cord, and built-in loudspeaker. An accessory power supply is available to convert the radio to 110-volt AC base station operation. The new Johnson Messenger 121A is U.S.-made and covered by Johnson's one-year parts and labor warranty. The warranty is honored at over 800 authorized Johnson service centers nationwide. Complete details on the Messenger 121A are available from Johnson CB radio dealers or by writing directly to E. F. Johnson Company, Waseca, MN 56093.

**Power Base Mike.** The new Power Base Mike from GC Electronics (Cat. No. 18-000) features easy connection for use in rigs with either relay or electronic switching, a built-in two stage amplifier that boosts modulation up to 50 times, a convenient "push-to-talk" bar on the front of the mike that can be locked into place for continuous transmission and a microphone output adjustment control. Using a standard 9-volt battery (battery life: average 200 to 300 transmitting hours), the mike is primarily designed for modern solid-state transceivers, but will greatly increase modulation of older tube-type transceivers as well. The mike specifications are: sensitivity: -40 dB (100 Hz); frequency response: 300 to 5000 Hz; impedance: 600 ohms; amplifier voltage gain: 0-15 dB; temperature range: -20°C to +60°C. It comes equipped with a 6-foot shielded coiled cord (1 shield and 3 conductors), and it sells for \$48.95. GC Electronics offers a complete line of CB accessories including test meters, microphones, connectors, cables, noise suppressors, and many others. Get their catalog by writing to GC Electronics, 400 South Wyman, Rockford, IL 61101.



CIRCLE 38 ON READER SERVICE COUPON



CIRCLE 44 ON READER SERVICE COUPON

**CB Rig with Digital Frequency Synthesis** All 23 CB channels are controlled by a single crystal in SBE's 26CB "Formula D" mobile AM transceiver through the use of digital frequency synthesis. The "Formula D" frequency synthesizer is comprised of a crystal-controlled master clock oscillator with phase-locked loop (PLL) and digital-counter divid-

ers. Thus, the compact 23-channel transceiver eliminates up to 14 crystals required in previous CB synthesizers. Among the front-panel controls of the high-technology "Formula D" are *audio tone*, *audio volume*, *delta tune* (to aid in reception of off-frequency signals), *distant/local* switch (to prevent receiver overload from strong nearby transmit-

ters), *squelch*, *automatic noise limiter*, and *Paging/Public Address* function switch. An illuminated front-panel meter reads both receiver "S" units and transmitter output power. The unit also offers choice of positive or negative ground. The receiver portion of the "Formula D" is designed around an ultra-sensitive double-conversion circuit with outstanding signal-to-noise ratio for better reception of weak signals. Audio output of 3.5 watts provides excellent sound levels in both receive and Paging/Public Address modes. The transceiver comes complete with dynamic microphone, coil cord with four-conductor plug, and mobile mounting bracket. Sells for \$229.95. For further information, write SBE, Dept. P, 220 Airport Blvd., Watsonville, CA 95076.



# Kathi's CB Carousel

by Kathi Martin, KGK3916

□ In the early days, CB manufacturers produced many legendary transceivers—models well ahead of their time both in performance and operating features. In recent years, however, there have been few substantial developments in CB gear. Overall performance has often been degraded in an effort to bring the price of mass-merchandized CB transceivers below the \$99.95 price level.

But this is changing in '76, and with the introduction of the Realistic TRC-57 AM/SSB transceiver by Radio Shack we have a model of such superlative performance and effective features it bids fair to become the legendary CB transceiver of the '70s. Its performance makes it the one others will have to equal or beat if they want to compete in the high-performance category.

Actually, the TRC-57 has so much that's new and unusual in circuit design I'm certain Radio Shack must have had one heck of a time getting the bugs out; but I have a production model, the same as you'd buy in a Radio Shack store, and I can't find any bugs left. All I can find is some of the best performance I've seen in a long, long time.

**Gingerbread Goodies.** Soon as I unpacked the TRC-57 *Navaho* (Navaho?—who picked that name?) I knew something was really different. First of all, the digital clock was a full electronic model with 7-segment readout devices that can be programmed for the 12 or 24-hour mode by simply flipping a switch on the rear apron. Typical of the thinking that went into the transceiver itself, the clock is programmed by three pushbutton switches on the front panel—not by a complex matrix of switches buried somewhere inside the cabinet. Press the *Fast* switch and the clock runs in minutes at extra high speed; when you get close to the time you want, you release the *Fast* switch and depress the *Slow* switch until the clock eases just past the right time. Then you press the *Hold* switch, which locks the displayed time. When you

hear the indicated time on your radio, or telephone, you release the *Hold* and the clock starts. That's the whole bit; you can calibrate the digital clock in less time than it takes to read this paragraph.

Next thing I spotted was two separate meters, one for received signal strength and relative power output, the other for SWR (standing wave ratio). More important than the SWR meter, the TRC-57 has a forward-facing speaker (which seems to be becoming a luxury lately), a front panel headphone jack, and wonder of wonders, mobile mounting brackets for what is essentially a

base transceiver.

Admittedly, all this is gingerbread, it still takes well-designed circuits to make a good transceiver, and that's where the TRC-57 really takes off.

**Getting to the Basics.** Let's start with the receiver section. The RF input appears to be conventional but closer inspection shows the antenna connection is tapped down for current drive of the input transistor; it takes one heck of a signal to cause the input protection diodes to conduct, so at normal operating levels there is no spurious signal output generated by the protec-

(Continued on page 90)



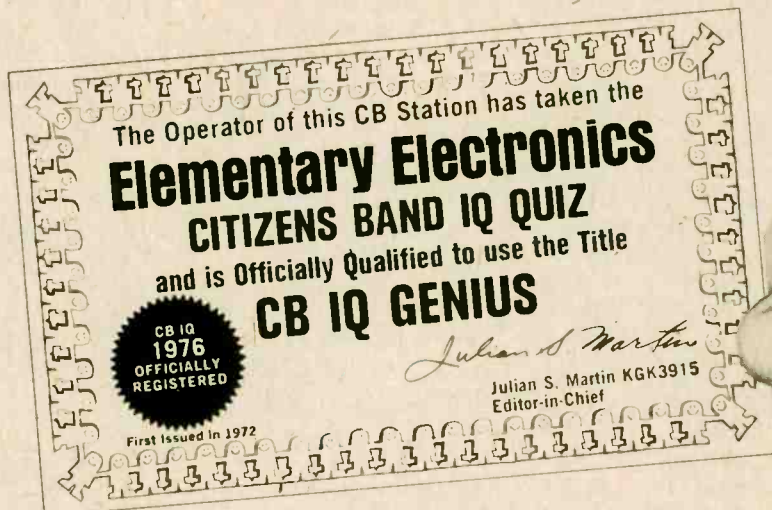
The TRC-57 has just about every important operating convenience as well as a digital clock. The SWR meter is a single-function meter so it provides continuous monitoring of the antenna system. The headphone jack is next to the mike jack, lets you connect a boom headset/microphone.



Sockets are provided for 115 VAC and 12-VDC power. A switch next to the 12 V socket programs the digital clock for 12- or 24-hour operation.



# WE DARE YOU TO TAKE THIS CB IQ QUIZ



## Prove to the Editor that you know and understand the Citizens Band Rules and Regulations and win a colorful CB IQ Genius Citation!

Okay, so you've been on the CB channels since 1958. You've 10-4ed through six different base station rigs not to mention mobiles. Not once did Uncle Charlie ever send you a nasty note. Big deal! That still does not prove you know the FCC Rules and Regs. Part 95.

If you were an ELEMENTARY ELECTRONICS reader in 1972, you are probably one of the many thousands who took our CB IQ Quiz and qualified for a CB IQ Genius Award. If not, you get another shot at it just like the Olympics—four years later.

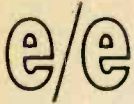
So why not test your CB knowledge and win a CB IQ QSL from e/e? Ol' buddy, we used up a lot of the alphabet in the last sentence, but what it means is ELEMENTARY ELECTRONICS will send you a congratulatory QSL card indicating that you successfully passed our Citizens Band IQ examination. No gimmicks, no fees, nothing much to do except take the test and if you get 36 to 40 correct answers, let us know about it by sending a letter with your score, a self-addressed, stamped business-size envelope and the top of your friendly CB dealer. It's that simple! Address all replies to: The Great CB IQ Quiz, ELEMENTARY ELECTRONICS, 229 Park Avenue

South, New York, New York 10003. Sorry, no self-addressed, stamped envelope, no QSL. Your letter must be postmarked on or before December 31, 1976. Caution: If you do not follow the instructions exactly, you won't get your CB IQ Genius Award in the return mail.

To take the test is simple. Just read the questions that follow and place a T or F in the adjacent boxes to indicate your answers—True or False. The answers to the quiz are upside down at the end of the quiz. Don't peek! Numbers after the answers refer to the applicable section in Part 95, FCC Rules and Regulations. You should have a copy. If not, pick up an issue of either the 1976 CB YEARBOOK or 1976 CB BUYERS GUIDE for \$1.50 at your favorite newsstand or check with the FCC field office near you. They'll tell you how to get a copy of Part 95.

Scoring is by the honor system. **We trust you!** A score of 36 to 40 correct answers makes you a CB genius, 30 to 35 means you're fit to continue operating your CB rig but some homework is required. Below 30, yank the fuses from your rig and dig deep into Part 95 until you can pass this quiz. Good luck and begin the quiz now!

- |  |  |   |
|--|--|---|
| <p><input type="checkbox"/> 1. An alien may hold a Class D Citizens Band license provided he has resided in the U.S. for five years.</p> <p><input type="checkbox"/> 2. A person must be 16 years of age or older to be eligible for a Class D license.</p> <p><input type="checkbox"/> 3. You may hold one Class D license for business use and one for</p> | <p>personal use.</p> <p><input type="checkbox"/> 4. Your station license renewal application should be sent to the FCC at least 60 days prior to the license expiration date.</p> <p><input type="checkbox"/> 5. You must take an oath in front of a Notary Public attesting to the facts contained in the CB license applica-</p> | <p>tion Form 505.</p> <p><input type="checkbox"/> 6. Your FCC Class D license will normally be issued for a period of 5 years.</p> <p><input type="checkbox"/> 7. If you want to add another transmitter (unit) to your network, thereby increasing the total number authorized by your license, you must first</p> |
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# We Dare You to Take This CB IQ Quiz

- obtain FCC approval.
- 8. Should you change your station location, cross out your old address on your CB license and neatly write or type in your new address.
  - 9. If the crystal manufacturer states that his designated crystal is a suitable type for replacement in your transmitter, you may make the substitution.
  - 10. If a resistor continues to burn out in your transmitter, you may substitute one of a higher value.
  - 11. The Rules refer to a "man-made structure" as any construction other than a tower, mast, or pole.
  - 12. The top of your Class D base station omnidirectional antenna must not be over 20 feet above a man-made structure or tower on which it is mounted.
  - 13. The only Class D radio channels that you may use for non-emergency communications with stations outside your own network are Channels 10, 11, 12, 13, 14, 15, and 23.
  - 14. The emergency call channel is Channel 9 and not Channel 11.
  - 15. If you see a tornado, you can report its existence and/or location on Channel 9.
  - 16. Do not depend on the Coast Guard to monitor emergency Channel 9.
  - 17. Only those external radio-frequency amplifiers suitable for commercial and amateur service may be used on the output terminals of CB transceivers.
  - 18. The frequency tolerance of a Class D CB transmitter is required to be no greater than .005 percent.
  - 19. You may use selective-call tone signals on all 23 channels.
  - 20. Should the FCC notify you that your CB mobile unit 4 was operating off frequency, you are required to shut down the station until the fault is corrected.
  - 21. If the FCC notifies you that one of your Class D transmitters is not operating properly, you must have a person holding an FCC first or second class commercial operator license make any required tests of or adjustments to the faulty transmitter.
  - 22. You may contact another Class D station for a report on how your new microphone sounds.
  - 23. You may not contact another Class D station for the purpose of requesting a QSL (confirmation) card.
  - 24. The FCC specifically prohibits your using obscene, indecent or profane words, language, or meaning while you are transmitting.
  - 25. You may communicate with Part 15 100-milliwatt walkie-talkies.
  - 26. You may not interfere with another station even though you know they are violating the Rules.
  - 27. You may not announce advertising or attempt to solicit the sale of your used mobile Class D rig.
  - 28. You may charge a nominal fee for calls you make for others using your Class D station.
  - 29. When you complete a 2½-minute contact on Channel 19, you may switch immediately to Channel 13 and finish the remaining portion of the 5-minute maximum talk period.
  - 30. If you have just completed a call and have begun your one minute of silence, you cannot answer a non-emergency call from another station, even if it is from one of your mobile units.
  - 31. All call signs for a Class D CB station issued by the FCC consists of three letters followed by four numbers.
  - 32. When you make your final transmission of a series, you are not required to give the call sign of the station you have contacted.
  - 33. You may file your Class D CB license with your other important papers or you may carry it with you in your wallet, if you wish.
  - 34. A photocopy or "stat" of your FCC Class D station license need not be posted with each of your mobile units.
  - 35. You are required to maintain a current copy of Part 95, Citizens Radio Service, FCC Rules and Regulations with your station records.
  - 36. You will not be permitted to operate your Class D mobile unit in states that border on Canada or Mexico.
  - 37. You are permitted to use Channel 9 for emergency marine traffic; sail boats and power craft are included.
  - 38. Civilian operated powered aircraft may not install and use CB radio.
  - 39. Under no condition may you operate a Class D station outside the United States unless you receive a permit from Canada or other foreign nation.
  - 40. Under no circumstances may you operate your Class D base station by remote control from another room or adjacent building.

(Continued on page 88)

station on all channels except Channel 9, 95.41(d)(1).  
 14. True. Channel 9 is limited to emergency communications for the protection of life and property and motorist assistance. However, if you can't raise anyone on Channel 9, or if you so elect, it is permissible to use any channel for emergency purposes. 95.41(d)(2) and 95.41(d)(3).  
 15. True. Fires, automobile collisions, flash floods, unsafe conditions to life and property and tornados may be reported on Channel 9. 95.41(d)(2)(ii) (Note).  
 16. True. The Coast Guard may or may not monitor Channel 9 in your area. Check with the local Coast Guard unit (page 88)

or use FCC Form 555-A. This form is now attached to new Class D licenses. 9. True. The crystals are usually purchased after the user specifies the manufacturer and model of the CB transmitter requiring the crystal substitution or replacement. 95.35(d)(4).  
 10. False. Transmitting equipment used by Class D stations may not be modified by the user. 95.35(d).  
 11. True. 95.37(c) (Note).  
 12. False. You can set your omnidirectional antenna's highest point up to 60 feet. Antennas with a directional ability are limited to 20 feet. 95.37(c).  
 13. False. This was the case a few years ago, but now you may conduct non-emergency communications with any

1. False. No alien may obtain a Class D Citizens Band license under any condition. 95.7.  
 2. False. The minimum age for a license of a Class D ticket is 18 years. 95.13(a).  
 3. False. You can hold only one license, but you may use it for business and personal use. 95.13(c).  
 4. True. 95.15(c).  
 5. False. Applications need not be signed under oath. Willful false statements are punishable by fine or imprisonment. 95.17(d).  
 6. True. 95.33.  
 7. True. 95.35(a)(1).  
 8. False. You must write immediately to the FCC, giving your old and new address. You can do this in letter form



# BASIC COURSE IN ELECTRICITY & ELECTRONICS

RECOMMENDED THEORY FOR ALL CB OPERATORS



This series is based on BASIC ELECTRICITY/ELECTRONICS, Vol. 1, published by HOWARD W. SAMS & CO., INC.

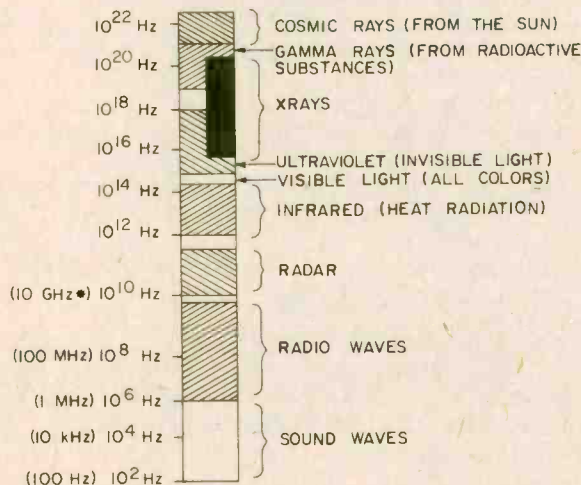
## HOW RADIO TRANSMITTERS WORK

**WHAT YOU WILL LEARN.** When you have finished reading this article you will have learned what the electromagnetic frequency spectrum is, what a radio transmitter is, how it develops a broadcasting signal, and how radio signals are transmitted through space. You will have learned that voice (or music) can be impressed on the radio (carrier) waves. In addition you will have become acquainted with the difference between amplitude modulation and frequency modulation of radio frequency transmissions.

### Electromagnetic Radiations

Energy that radiates from a source is said to be an **electromagnetic wave**. **Gamma rays**, which are given off by radioactive particles such as radium, uranium, or atomic-bomb fragments, are electromagnetic waves. **Cosmic rays** from the sun travel 93 million miles to the earth as electromagnetic waves. All electromagnetic waves, including light, radiated heat, and radio signals, travel through space at the rate of 186,000 miles per second.

### The Electromagnetic Spectrum



•GHZ = GIGAHERTZ

### The Electromagnetic Frequency Spectrum

Electromagnetic radiations differ from each other in terms of their frequencies measured in Hertz. (**Hertz**,

a term we now use which means cycles-per-second). The frequency of one of these kinds of radiation is the number of times a single cycle repeats itself in one second. An electromagnetic spectrum chart shows the relationship of these different radiations to each other.

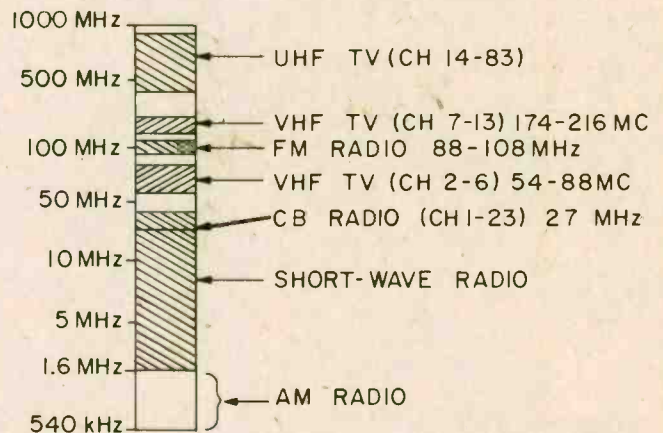
The chart shows that cosmic rays are radiated at a frequency of around  $10^{22}$  Hz (abbreviation for Hertz). (The number  $10^{22}$  is 1 followed by 22 zeroes, or ten-thousand, million, million, million Hz). At the lower end of the radio spectrum, the radiation frequency is under  $10^4$ , or ten thousand Hz.

### Assigned Broadcast Frequencies

The Federal Communications Commission (FCC) has assigned specific groups of frequencies to different types of communications transmissions. This is shown in an expansion of the radio-frequency portion of the spectrum in the right-hand chart.

Commercial transmitters (radio and television, for example) are assigned a transmitting frequency in the appropriate part of the radio-frequency spectrum. Transmitters broadcasting in the AM radio band, 535 kHz to 1,605 kHz, are required by law to be on their assigned frequency within plus or minus 20 Hz.

### The Radio-Frequency Spectrum



### QUESTIONS

1. Cosmic rays and radio waves are examples of \_\_\_\_\_.
2. Sound (is, is not) electromagnetic radiation.
3. Radio waves travel from the broadcast station to a receiving antenna at the rate of \_\_\_\_\_ miles per second.
4. \_\_\_\_\_ is the characteristic which distinguishes one electromagnetic wave from another.
5. Commercial radio transmissions are at a (higher,

lower) number of Hertz than television.

- Q6. A frequency of 1,000 kHz would be assigned to (commercial broadcasting, short-wave) radio.  
 Q7. CB radio is located (above, below) 30 MHz.

### ANSWERS

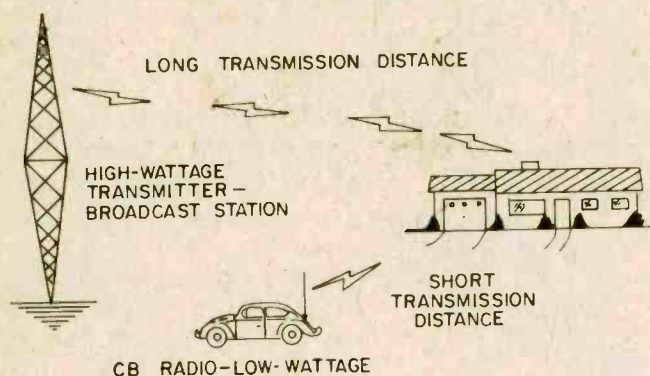
- A1. Cosmic rays and radio waves are examples of **electromagnetic radiations** (waves).  
 A2. Sound is **not** electromagnetic radiation. Remember? It is changing air pressure.  
 A3. Radio waves travel from the broadcast station to the receiving antenna at the rate of **186,000 miles** per second.  
 A4. **Frequency** is the characteristic which distinguishes one electromagnetic wave from another.  
 A5. Commercial radio transmissions are at a **lower** number of Hz than television.  
 A6. A frequency of 1,000 kHz would be assigned to **commercial broadcasting** radio. (1,000 kHz is equal to 1 mc.)  
 A7. The CB radio channels are **below** 30 MHz (27 MHz).

### RADIO TRANSMITTERS

The dial on your home radio receiver is marked off in numbers, probably from 550 to 1,600 kHz (marked 55 to 160 often). By rotating the tuning dial, you select the desired station. Since each local station broadcasts at a different frequency, you are able to select the one you desire. The dial setting indicates the **carrier frequency** of the station.

The channel numbers on CB transceivers (combined transmitter and receiver) may be any from "1" to "23." Some CB sets cover three or six channels, while many can operate on any of the 23 channels. The channel number selects the exact frequency near 27 MHz. Channel 9, for example, is 27.065 MHz, and channel 11 is 27.085 MHz.

### Transmission Power and Distance



### Transmitter Power

You have also noted that some stations come in stronger than others. The stronger stations broadcast at higher power (measured in **watts** or **kilowatts**) than the weaker. Or, if one of two stations broadcasting at equal power is stronger than the other, the stronger station is closer to your home.

The drawing shows two radio transmitters, one a powerful commercial broadcast station (AM broadcast stations generally transmit at least 250 watts, and no more than 50,000 watts), and the other a typical Citizens Band transmitter (limited to four watts). Even though the broadcast station is dozens, often hundreds

of miles from the receiver, its signal is able to reach across that distance. The CB transmitter, on the other hand, will only go a few miles. Many broadcast stations can be received no farther than 20 or 30 miles away (sometimes less, due to obstructing hills or buildings).

### Radio Frequency Carrier and Audio Frequencies

The frequency assigned to a broadcast station is called its **carrier frequency**. The transmitter and its antenna are designed and tuned to that specific frequency. As its name implies, the carrier frequency carries a reproduction of the sound originating in the studio. Actually, there are two frequencies that leave the transmitter, a **radio frequency** (carrier) and an **audio frequency** (sound). Audio frequencies are between 20 and 20,000 Hertz. The frequency range of most human ears, however, is usually no higher than 15,000 Hz.

### QUESTIONS

- Q8. A home radio receiver (can, cannot) be tuned to 1 megahertz.  
 Q9. 900,000 Hz (could, could not) be a carrier frequency of a commercial broadcast station.  
 Q10. The power of one transmitter, station A, is 5,000 watts. Transmitter B broadcasts 500 watts. Which transmitter will be receiveable at the greater distance?  
 Q11. Two broadcast stations are equally distant from your home. Assuming your receiver is OK, what could be a reason you could not receive one of them?  
 Q12. A human ear (can, cannot) hear a radio frequency.  
 Q13. A frequency of 600 kHz is classified as a (an) (audio, radio) frequency.  
 Q14. CB radio transmitters (can, cannot) transmit up to 15 watts of output power.

### ANSWERS

- A8. A home radio receiver **can** be tuned to 1 megahertz. One megahertz (1,000 Hz) is within the broadcast band.  
 A9. 900,000 Hertz **could** be a carrier frequency of a commercial broadcast station. It is the same as 900 kHz.  
 A10. **Station A**. It has much more power.  
 A11. **One station** is so weak in power it cannot transmit the distance.  
 A12. The human ear **cannot** hear a radio frequency.  
 A13. A frequency of 600 kHz is classified as a **radio** frequency.  
 A14. CB radio transmitters **cannot** transmit 15 watts output power (**limit is 4 watts**).

### A Basic Transmitter

The diagram below shows a **functional block diagram** of a typical radio transmitter. It is called a functional block diagram because each block is representative of a general electronic function and may include several circuits.

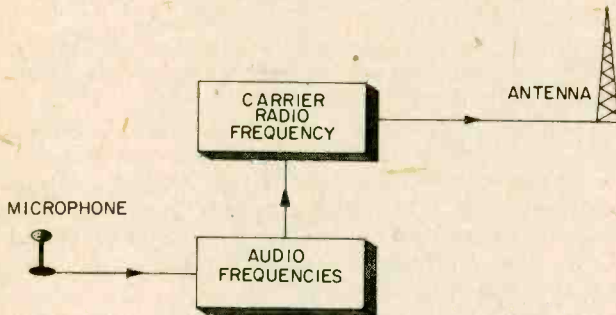
The arrowheads between blocks show the direction of signal flow. You can probably already read what the diagram reveals.

Sound enters the **microphone** and is fed to the audio-frequency (AF) section. The sound, because it is too weak for transmission purposes, is amplified (signal

amplitude is increased) and then passed to the RF carrier-frequency section.

**Carrier Frequency**—The specific radio frequency (RF) assigned to the transmitter is developed in the carrier-frequency block. Passing through several circuits, the RF signal is boosted in power (increased in amplitude) to the rated wattage output of the transmitter. Just before the RF carrier is fed to the antenna, the AF signal is superimposed on it. Waveforms developed in each block are shown below.

### Transmitter Functional Block Diagram



**Superimposing the Sound**—The process of superimposing audio on the carrier, as shown in this particular example, is called **amplitude modulation (AM)**. In amplitude modulation the audio frequency (varying at the changing rate of the original sound) is mixed with the carrier (a constant frequency) in a manner that causes that carrier **amplitude** to vary at the same rate as the audio. The carrier **frequency** remains unchanged.

### QUESTIONS

- Q16. The drawing here which shows circuit functions is called a (an) \_\_\_\_\_ diagram.
- Q17. Sound enters the AF amplifier section from a device called a (an) \_\_\_\_\_.
- Q18. \_\_\_\_\_ on a block diagram show the signal direction between blocks.
- Q19. Placing an audio frequency on an RF (radio frequency) carrier without changing the frequency is called \_\_\_\_\_.
- Q20. In CB radio the carrier frequencies are around \_\_\_\_\_ Hertz. The audio frequencies are between (20 & 15,000, 50 & 5,000) Hertz.

### ANSWERS

- A16. The drawing is called a **functional block** diagram.
- A17. Sound enters the AF section by way of a device called a **microphone**.
- A18. **Arrowheads** on a block diagram show the signal direction between blocks.
- A19. Placing AF on a carrier without changing the carrier frequency is called **amplitude modulation**.
- A20. In CB radio the carrier frequencies are around **27 MHz**. The audio frequencies are typically between **50 & 5,000** Hertz.

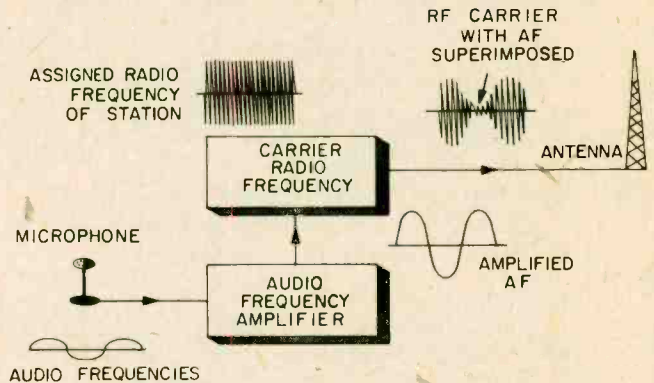
### Carrier-Frequency Circuits

A minimum number of RF carrier-frequency circuits are shown in the diagram below. An actual transmitter has many more circuits to attain the frequency stability and power required. The additional circuits are similar

to those shown, however.

**The Oscillator**—The purpose of the **oscillator** is to generate a stable RF signal. The resistance, inductance, and capacitance that make up its input circuit are such that they will not allow the transistor in the oscillator to amplify any other signal but that of the desired frequency. The stable-frequency, low-amplitude output of the oscillator is shown above.

### Transmitter Waveforms



**The Buffer**—This stage (another name for circuit) is sometimes called an **intermediate power amplifier**, or **frequency multiplier**. In most transmitters it performs three functions. As a **buffer**, the stage isolates the oscillator from the effects of the circuits which follow it. Without this isolation, stray signals may be fed back to the oscillator, causing it to operate at the wrong frequency. As an **amplifier**, the buffer increases the amplitude of the oscillator signal to a level that is between the desired transmitter output and the amplitude of the oscillator signal. In many transmitters, the buffer circuit **doubles** (or even **triples**) the frequency of the oscillator output. The oscillator may not be capable of generating the required high frequency by itself. In order to produce the assigned frequency, a transmitter may require several multiplier stages.

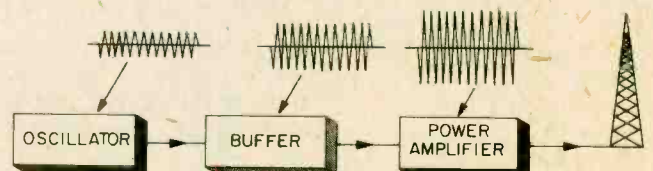
Most CB radio transmitters, until recently, used a doubler stage after the oscillator, which generated a 13.5 MHz signal.

**The Power Amplifier**—The purpose of the **power amplifier** is to increase the amplitude of the RF signal to the power (wattage) requirements of the station. Several stages of power amplification may be required to achieve this. Normally, the audio signal from the AF circuitry is fed to the final power amplifier and used to modulate the carrier.

### QUESTIONS

- Q21. A transmitter circuit which amplifies a signal and increases its frequency is called a(an) \_\_\_\_\_.

### Radio-Frequency Circuits

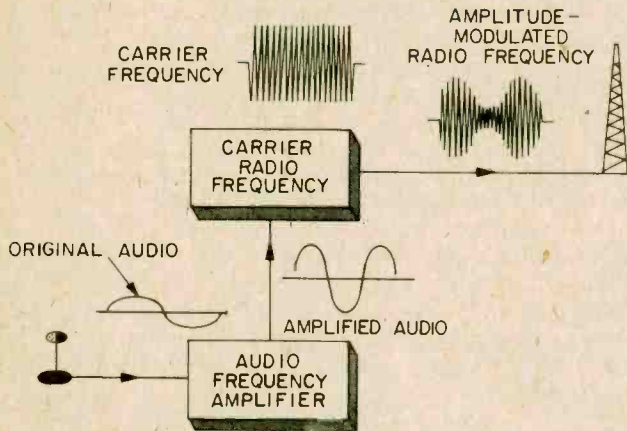


- Q22. A (an) \_\_\_\_\_ generates a signal which has a uniform frequency.
- Q23. \_\_\_\_\_ amplifier output is measured in watts.
- Q24. AF and RF are mixed in what stage?
- Q25. The carrier arrives at the antenna with its wave-form (amplitude, frequency) modulated.
- Q26. If a CB transmitter employed an oscillator which produced a basic radio frequency of 13.5 MHz, what kind of stage must be used after the oscillator to produce the required output radio frequency carrier of 27 MHz? (*tripler, doubler*).

### ANSWERS

- A21. A transmitter circuit which amplifies a signal and increases its frequency is called a **multiplier**.
- A22. An **oscillator** generates a signal which has a uniform frequency.
- A23. **Power** amplifier output is measured in watts.
- A24. AF and RF are mixed in the **final stage of the power amplifier**.
- A25. The carrier arrives at the antenna with its wave-form **amplitude** modulated.
- A26. To produce a CB radio frequency carrier of 27 MHz a 13.5 MHz oscillator would have to be followed by a **doubler** stage.

### Mixing Audio and Radio Frequencies

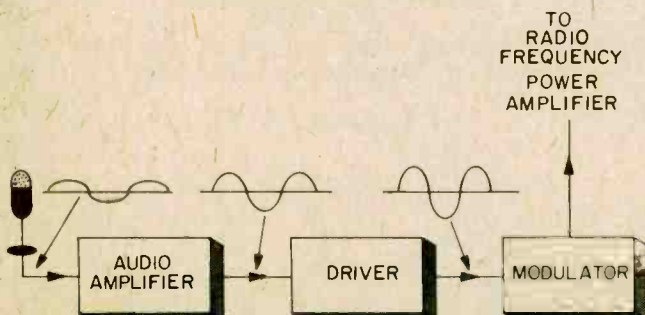


### Audio-Frequency Circuits

**The Microphone**—Regardless of the many different types of microphones that are available, even the best develop only a weak signal.

**The Audio Amplifier**—Although a single stage of audio amplification is sometimes all that is necessary, larger transmitters may have two, three, or more stages to obtain the desired undistorted level of amplitude.

### Audio-Frequency Circuits



**The Driver**—Like most circuits, the driver obtains its name from its purpose. The driver amplifies the AF to the voltage level required to “drive” the transistors of the modulator. The modulator transistors require large changes in signal amplitude to operate properly.

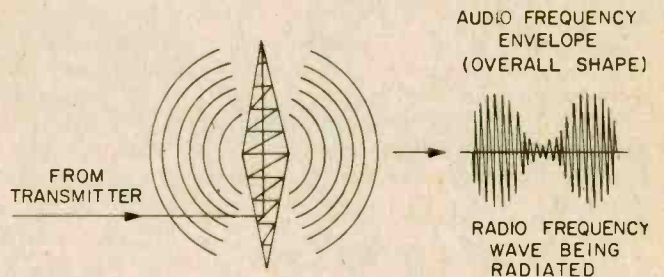
**The Modulator**—The modulator is a power amplifier quite similar to the final circuit of the carrier-frequency block. It amplifies the audio signal to a power level suitable for modulating (changing) the carrier power in the final power amplifier. Power output of the modulator is fairly close to half the power of the final carrier amplifier.

### Antennas

If all circuits are operating properly, an AM (amplitude-modulated) carrier is fed to the antenna and transmitted into the atmosphere.

Power is fed to the antenna in the form of both current and voltage. Voltage sets up an electric field along the length of the antenna. Current, in traveling through the antenna (a conductor), sets up a corresponding magnetic field. Both fields vary at the rate of the carrier frequency and at the amplitude and frequency of its audio envelope.

### Antenna Radiation



Both fields expand outward and collapse back to the antenna at the rate of the carrier frequency. The outermost waves continue through space and do not return to the antenna. This action is similar to dropping a pebble in a pool. The energy of the waves moves outward in ever-widening circles; the water, however, remains in place.

### QUESTIONS

- Q27. The weak output of a microphone is fed to one or more stages of \_\_\_\_\_ amplification.
- Q28. The output of even the best microphones (can, cannot) be fed directly to the modulator.
- Q29. The output of the \_\_\_\_\_ is connected to the carrier power amplifier.
- Q30. For proper modulation, the output of the modulator stage must be \_\_\_\_\_ that of the power amplifier.
- Q31. Carrier voltage develops a (an) \_\_\_\_\_ field and carrier current develops a (an) \_\_\_\_\_ field on the antenna.
- Q32. All of the energy in the antenna fields (does, does not) leave the antenna.

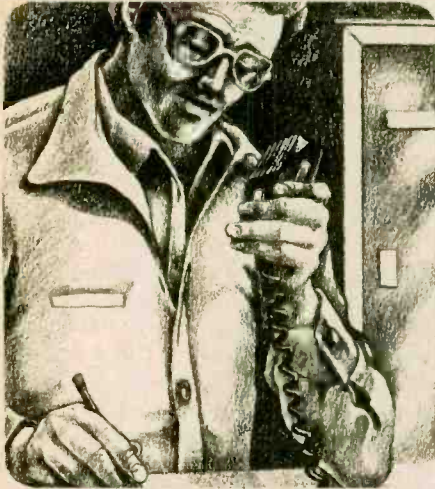
### ANSWERS

- A27. The weak output of a microphone is fed to one or more stages of **audio** amplification.
- A28. The output of even the best microphones **cannot**

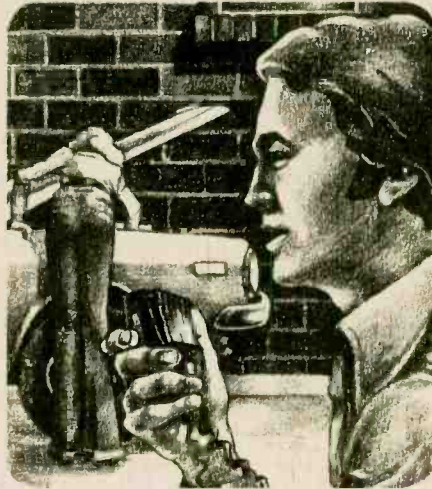
(Continued on page 84)

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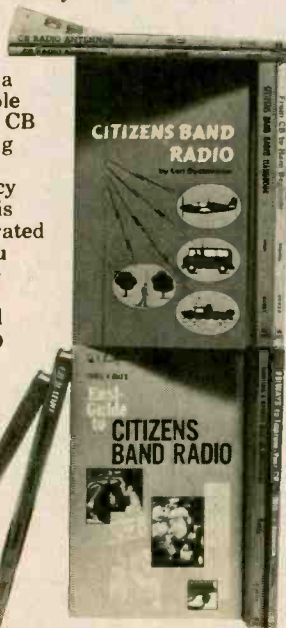
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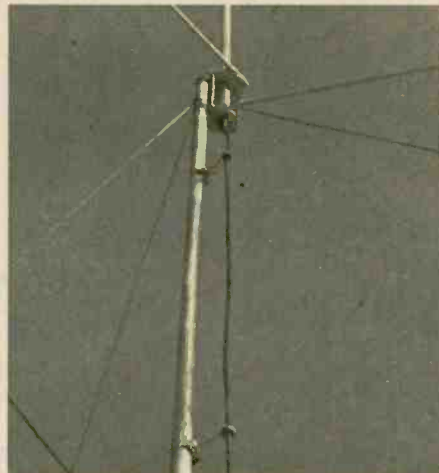
CIRCLE 14 ON READER SERVICE COUPON

## Get Started in CB

(Continued from page 44)

perfectly, I felt troubled by the way the eighteen inches of antenna cable protruded from our mahogany living room wall. Being under the table, it was quite unnoticeable. But if the table were ever relocated, the cable would dangle from the wall like a skinny, black snake. So I decided to install a more visually acceptable cable connector to keep my editor happy with the pictures I would send him.

After installation, I confidently checked the CB system. The SWR meter, which in this case is supposed to read low, was back up to around six again! I spent hours trying to find out what I had done wrong while installing that simple wall connection. All the while my teenage son kept munching cookies and suggesting that maybe the trouble was up in the antenna. No way! Nothing had been done to the antenna, and the problem appeared right after the wall connector had been installed.



Stand-offs keep antenna lead-in away from mast and from flapping in the wind. The coupling which attaches cable end to antenna should be weatherproofed.

To prove my point, I lugged the CB unit into the attic, disconnected the antenna cable at the T connection, and plugged in the CB set so that it was now attached to a stretch of cable leading directly to the antenna. I jabbed the mike button, and the SWR meter flopped down to an aggravatingly nice 1.5 reading. My son went in search of more cookies. I went back on the roof.

The connector attaching the cable to the antenna was now suspect, so I decoupled it, dried it with a portable hair dryer, then carefully weatherproofed the recoupled connection with a wad of caulking compound, plastic sheeting and electrical tape. The initial test showed an SWR reading that was still down in the 1 to 2 range. Moments

later, when the equipment was being put back in place, the meter needle started bouncing 'as if it had been connected to a Mexican jumping bean.

Up on the roof again, I had just completed tearing off the electrical tape, plastic sheeting and caulking compound when my eye wandered about ten inches higher along the antenna system and focused in disbelief on a plastic ring that was hanging at an angle on the lower part of the antenna. This ring is supposed to insulate the antenna from the mast. I can't imagine what happened to the three retaining nuts that were missing, but because the ring was clearly out of place, the antenna made momentary contact with the mast every time there was a slight breeze. Small wonder that the meter was going crazy; the antenna was being intermittently grounded to the mast. Replacement of the ring brought the SWR reading down to a nice, steady value just under 2. The addition of a ten-buck antenna matching unit brought the SWR back down, close to 1.

There never had been anything wrong with the wall cable connection. The antenna insulating ring just happened to drop out of place at the very time I chose to work on the wall connection. You figure the odds for or against such a coincidence. I have a bigger problem: figuring how to cope with a smug teenager who now thinks *he* is the hot-shot CB expert in the family.

The editors of ELEMENTARY ELECTRONICS are providing readers with a free booklet from the Electronics Industries Association (EIA) about CB radio. If you would like a copy, just fill out the coupon below, check the correct box, and send it in. Don't forget "Kathi's CB Notes" for straight info on how to get and fill out an FCC license application, and if you want to stay current on what's happening in CB, follow Kathi Martin's CB column in every issue of ELEMENTARY ELECTRONICS.

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ELEMENTARY ELECTRONICS  
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New York, N.Y. 10003

- Yes, I'd like to receive the EIA booklet about CB radio.
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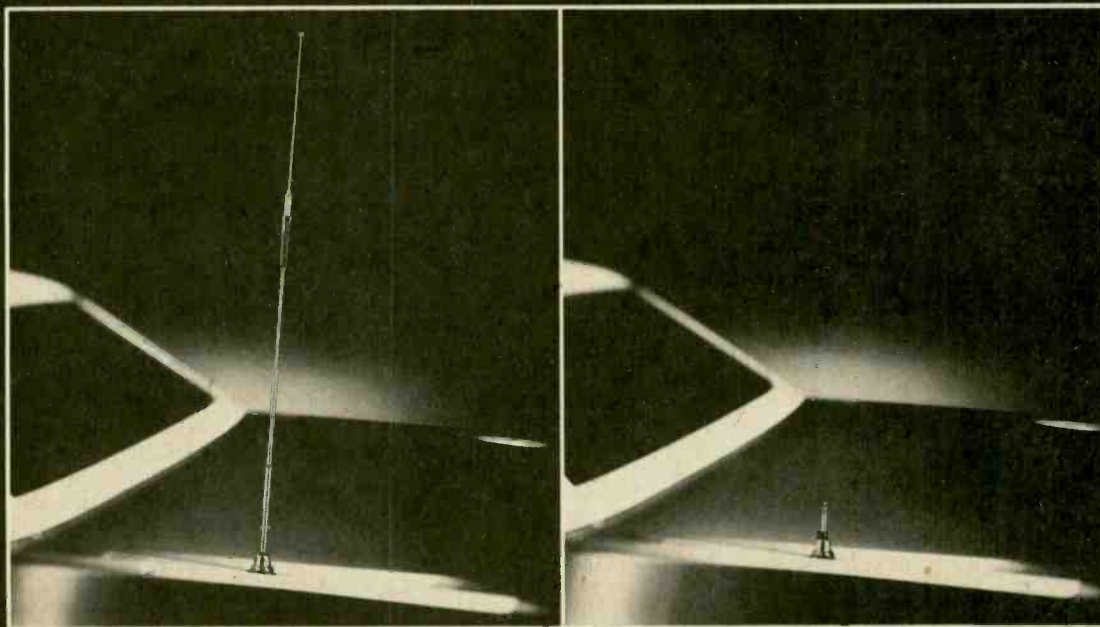
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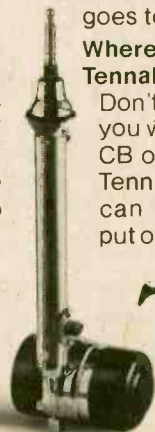
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CIRCLE 19 ON READER SERVICE COUPON

### Basic Course

(Continued from page 80)

be fed directly to the modulator. (Even the most powerful microphones develop a signal that is much too weak to drive the modulator.)

- A29. The output of the modulator is connected to the carrier power amplifier.
- A30. For proper modulation, the output of the modulator stage must be half that of the power amplifier.
- A31. Carrier voltage develops an electric field and carrier current develops a magnetic field on the antenna.
- A32. All of the energy in the antenna fields does not leave the antenna. (Only the outermost waves.)

#### WHAT YOU HAVE LEARNED

- Radiant energy is given off by electromagnetic waves. The electromagnetic spectrum includes cosmic rays, X rays, visible and invisible light, infrared, radar, as well as radio waves.
- A radio transmitter is a device that produces electromagnetic waves in the radio portion of the spectrum. Its essential functions are the development and amplification of a carrier frequency and modulating it with an amplified audio frequency. A specific carrier frequency is assigned to each radio station. The distance that the carrier, with its superimposed audio, travels is determined by the power that is developed in the final stage of the transmitter.
- Energy in the form of voltage and current is fed from the transmitter to an antenna. This sets up electric and magnetic fields around the antenna that expand and collapse at the frequency of the carrier. Part of the energy is in the form of electromagnetic radiations and is transmitted through the atmosphere. The farther it travels, the weaker the signal becomes. Learning basic CB radio theory is easy.

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15	5	150	5	1500	5
22	5	220	5	2200	5
33	5	330	5	3300	5
47	5	470	5	4700	5
68	5	680	5	6800	5
100	5	1000	5	10000	5
150	5	1500	5	15000	5
220	5	2200	5	22000	5
330	5	3300	5	33000	5
470	5	4700	5	47000	5
680	5	6800	5	68000	5
1000	5	10000	5	100000	5

#### RESISTOR ASSORTMENT

RES	QTY	RES	QTY	RES	QTY
10	5	100	5	1000	5
15	5	150	5	1500	5
22	5	220	5	2200	5
33	5	330	5	3300	5
47	5	470	5	4700	5
68	5	680	5	6800	5
100	5	1000	5	10000	5
150	5	1500	5	15000	5
220	5	2200	5	22000	5
330	5	3300	5	33000	5
470	5	4700	5	47000	5
680	5	6800	5	68000	5
1000	5	10000	5	100000	5

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This series is based on material appearing in Vol. 1 of the 5-volume set, BASIC ELECTRICITY / ELECTRONICS, published by Howard W. Sams & Co., Inc. @ \$22.50. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

### DIGITAL WRISTWATCH

(Continued from page 62)

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## DX Central Reporting

(Continued from page 34)

Boonton, NJ 07005; North American SW Association; Box 13, Liberty, IN 47353).

**Backtalk.** Taking a look in the mailbag we find a letter from Alar Anderson, Hopedale, MA, who has a question about an aeronautical weather station.

"I heard Shannon Air Radio on frequencies of 13,295 and 5,561 kHz around 0300 and 1800 GMT, with English weather reports for airports in Europe. How can I write to this station?"

Shannon Aeradio transmits VOLMET aeronautical weather data from Shannon Airport, Ireland, on frequencies of 2,889, 5,533, 8,833 and 13,312 kHz. The broadcasts begin on the hour and half hour. Address your report to Shannon Aeradio, EIP, Ballygirrein, Newmarket-on-Fergus, County Clare, Ireland.

"I would like all the information you could give me on ham operating," writes Jeff Kremis of Greenville, PA. "I'd appreciate any information you could give me an operating licenses."

Jeff, I'm afraid that DX Central Reporting doesn't get very involved in amateur radio, though some of our SWL read-

ers also are hams. There are a number of good magazines that deal exclusively with amateur radio interests. The ham's own organization is the American Radio Relay League (ARRL), headquartered at 225 Main Street, Newington, Connecticut 06111. ARRL publishes a small book titled "How to Become a Radio Amateur" (\$1.50 postpaid), which may be just what you are looking for, Jeff.

Here's a tip for those who like to tape record, on reel or cassette, the DX signals they hear on shortwave. It comes from Phillip Hamilton, Hickory, NC.

"If you would like a way to record from your receiver and eliminate background noise from the room, this will be of great help. I took my headphones and a telephone pickup coil that has a suction cup on it (Radio Shack sells them for \$1.49) and put them together. Actually I mounted the pickup coil (normally it is used to record telephone conversations) on a flat spot on my headphones. Plug the coil into your tape recorder. It will pick up the sound that comes through the headphones but not any conversation or noise in the room. It works great."

Thanks, Phillip, it is a good idea that works!

And that's about all the space for this month, gang. See you again soon. Meanwhile, keep DXing!

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## Bookmark

(Continued from page 30)



Hard cover  
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motive, marine, aeronautical and telephone systems and their special wiring requirements. Included among several other features is a glossary with straightforward explanations of commonly used electrical terms, measurement units, and standard symbols. Published by Prentice-Hall, Inc., Englewood Cliffs, NJ 07632.

## NEWSCAN

(Continued from page 26)

Most CB mobile rigs do not come equipped with a cigarette lighter plug to pick up the car's DC battery power. One can be obtained from any CB dealer or electronics parts store.

A citizens band radio is as easy to operate as a telephone. Merely flip the unit's selector knob to the desired channel and then push the button on the microphone to talk. Because of its many uses and its wide acceptance, CB radio has become the hottest item in the electronics market. As an established performer it is sure to become a permanent and progressively more important part of the American scene.

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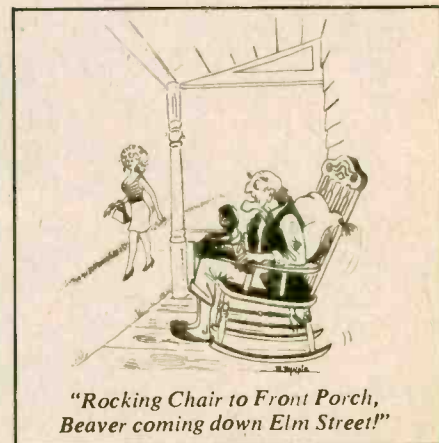


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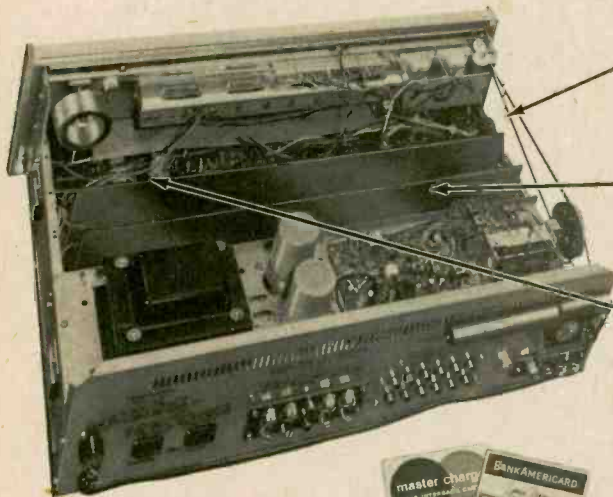
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 Hum and Noise (dB):  
 Phono 1, -60  
 Aux 1, -75

#### FM Tuner Specs

Sensitivity: 2.0  $\mu$ V IHF  
 S/N Ratio: 65 dB  
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## Year-round Fun!

## Computer Readout

(Continued from page 56)

matically loaded into the next sequential memory address, which is 1. After a dozen more settings of the switches and actuations of the DEPOSIT NEXT switch, the program is loaded.

If there isn't already data in locations 128 and 129, it can be entered by setting the DATA/ADDRESS switches to 10 000 000 and actuating EXAMINE. This will display the contents (if any) of memory address 128. You can load any desired number into this address by setting the DATA/ADDRESS switches, and actuating DEPOSIT to load it into memory. Note that the DATA/ADDRESS switches perform two functions: they first locate the desired address, and then can be used to load specific data into that address.

The JMP instruction jumps back to the first step in the program. As the Altair 8800 manual puts it, "Once the computer has executed the program, it will search its memory for something else to do. To maintain control of the CPU, we can end our program with a JMP instruction (followed by the memory address of the first instruction). The computer will "jump" back to the first instruction in the program and execute the program over and over again."

After the program is loaded, and the two numbers to be added are placed in

memory, the program can be run. First, actuate RESET to get back to address 0, where the program starts. Then press RUN. This program is so short that it's over before you can get your finger off the RUN switch; in fact, by then it's been run a great many times. Wait a second and actuate the STOP switch, which will stop the program somewhere in the middle of executing the program for the thousandth (or zillionth) time. To see the result of the addition, set the DATA/ADDRESS switches to the memory address where the sum is stored (10 000 010) and then actuate EXAMINE. The result will be shown on the DATA LEDs.

**For more information, data, and prices, write to the manufacturer listed below, or circle the number on the Reader Service Coupon.**

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**Next Issue.** In the next issue we'll look at the rest of what's in a computer kit, including memory, interfaces, and what it costs. In future issues we'll give detailed reports, all based on hands-on experience, on other hobby microcomputers (both kit and wired), and on a variety of peripherals. Join us, then, in the next issue of ELEMENTARY ELECTRONICS, to continue learning about the fascinating world of computers. ■

## CB IQ Quiz

(Continued from page 76)

in your area and local marinas. The Rules make no requirements for any public agency to monitor Channel 9. 95.41(d)(2)(ii)(Note).

17. *False.* Linear amplifiers of any type are not permitted. 95.44.

18. *True.* 95.45.

19. *True.* Selective-call tone signals are permitted but beepers for attracting attention are not. 95.47(d).

20. *True.* Only transmissions for necessary tests and adjustments may be made until the fault has been corrected. 95.53(a) and 95.53(b).

21. *True.* 95.53(c).

22. *True.* This is considered either personal or business activity and permitted. 95.81(a).

23. *False.* Requesting a QSL is considered personal activities and permitted. 95.81(a). Also, this type of communication is not banned by rule 95.83(a).

24. *True.* 95.83(a)(2).

25. *False.* 95.83(a)(3).

26. *True.* You may call the stations involved and inform them of their violation, or you may inform the FCC if they continue to violate the Rules. 95.83(a)(5).

27. *True.* 95.83(a)(9).

28. *False.* 95.83(a)(11).

29. *False.* At the conclusion of any call exchange, you must remain silent for at least one minute. The time limitation rule cannot be avoided by changing frequency. 95.91(b).

30. *True.* No exceptions to the one-minute silence rule may be made except for emergencies. 95.91(b).

31. *True.* 95.95(a).

32. *True.* You may give the other station's call sign as a courtesy. 95.95(c).

33. *True.* However, you are required to display a photocopy of your FCC license at each fixed station in your network. A note on the photocopy at your principal fixed station should state where you keep the original license. 95.101(a).

34. *True.* However, you must have a properly filled-out Transmitter Identification Card (FCC Form 452-C) or a metal plate or other durable substance

(Continued on page 94)

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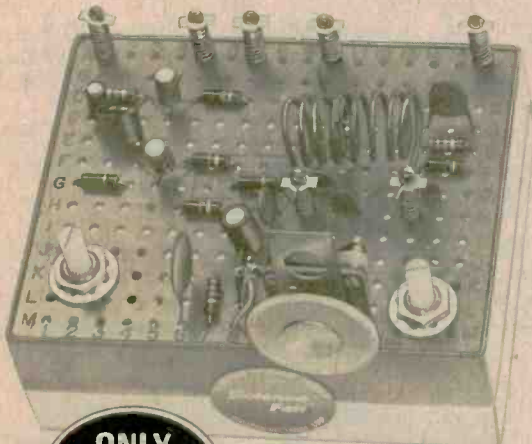


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### Kathi's CB Carousel

(Continued from page 74)

tion diodes. Nor will a strong signal on an adjacent channel cause receiver desensitization by the protection diodes, or spurious signal reception. This front end is clean as a whistle, even when the monitored station is barely above the noise level while the signal on the adjacent channel is pounding in from the next block. This is the first solid-state rig in a long time I've been able to measure for selectivity in terms of adjacent channel rejection rather than in terms of receiver desensitization. I measured AM sensitivity at 1  $\mu$ V for 10 dB S+N/N (signal plus noise-to-noise) and adjacent-channel rejection of 60 dB for AM—it just slices right through the adjacent-channel interference.

While we're looking at the front end we find a full side-chain noise blanker; actually a complete separate receiver used to punch holes in the first mixer's output wherever a noise pulse would be. This is the way noise blankers started out, and is the only circuit that justifies the description "noise blanker."

**Transmitter Traits.** Moving on to the transmitter, it delivered 3.6 watts AM output to a 50 ohm load, and just under 12 watts PEP in the SSB (single side-band) output.

The modulator circuit is outstanding. The compression works over a very wide range with minimal distortion (no clipping evident); in combination with 100% modulation limiting it puts out a wall-to-wall sound even when the signal is barely over the noise level. This is *talk* power at its best.

**Looking at the Guts.** If you take the cover off to see how things are put together you'll probably start wondering where the crystals are. If you look really hard you might find one crystal, for the TRC-57 uses a voltage-controlled, phase-locked oscillator with frequency control provided by a 10 MHz crystal working through a programmable divider. Unlike the usual CB transceiver, the channel selector doesn't select a crystal, or group of crystals. Instead the channel selector switch applies control voltages to a diode matrix, thereby causing the diodes to function as switches. The diode switches, in turn, program a digital counter/divider that locks the correct voltage controlled oscillator frequency to the reference crystal frequency.

Sockets are provided both for AC power and 12 VDC. Operation is the same for both power sources except

(Continued on page 94)

### 4-Channel's Alive

(Continued from page 61)

pacts, you'll run across some quasi four-channel outfits. These are essentially stereo models with a passive speaker matrix system that produces a four-channel *effect*. These models are sold with two speakers; the rear-channel speakers are optional extras. Such units can be bought with the idea of enabling you to sample four-channel sound, with a view to buying a true high quality four-channel rig later. You'll find them in the Channel Master, Magnavox, Panasonic, Realistic, Sanyo, Sharp, Superscope and Sylvania lines, among others. They are priced from \$89.95 (Realistic) for a receiver/two speakers combination, on up past \$200.

**Records, Tapes, Broadcasts.** As noted, a year or two ago there weren't very many records, tapes, and broadcasts to "feed" then-available four-channel equipment. Today things are immeasurably improved. By the time this



Circle No. 67  
On Reader Service Card

Lafayette LA-524 add-on unit has 4-channel SQ decoder and 2-channel amp at 5 watts/channel, with master gain control for all four channels of amplification; \$59.95.

appears in print, CBS Records will have released at least 300 SQ records. Some 20 other companies are also making them. Virtually all the SQ CBS records are also available in four-channel cartridge form. Some 60 stations encode their broadcasts in SQ. Over 300 radio stations are broadcasting SQ records.

Overall, there are some 350 CD-4 or Quadradiscs under at least 14 domestic brand names on sale in U.S. record stores. Counting foreign brands, there are over 1,000 such recordings. There is no broadcasting in the CD-4 format as yet, but there *may* be in a year or two. Hundreds of Q-8 tapes are available, from RCA as well as other companies.

In the QS format, some 800 record titles are available worldwide, with about 400 on U.S. record labels. Over 70 FM stations are broadcasting in QS. Many QS titles come in four-channel cartridge form. Summing up, we repeat, the word for four-channel sound is "GO!"



# LITERATURE LIBRARY

101. Get acquainted with the new *EICO* products, designed for the professional technician and electronics hobbyist. Included in brochure are 7 IC project kits, *EICO's* "Fonealds," security products and many varied kits.

102. *International Crystal* has a free catalog for experimenters (crystals, PC boards, transistor RF mixers & amps, and other comm. products).

103. See brochures on *Regency's* 1976 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service emergency broadcasts).

104. *Dynascan's* new *B & K* catalog features test equipment for industrial labs, schools, and TV servicing.

105. Before you build from scratch, check the *Fair Radio Sales* latest catalog for surplus gear.

106. Get *Antenna Specialists'* catalog of latest mobile antennas, test equipment, wattmeters, accessories.

107. Want a deluxe CB base station? Then get the specs on *Tram's* super CB rigs.

108. Compact is the word for *Xcelite's* 9 different sets of midjet screwdrivers and nutdrivers with "piggyback" handle to increase length and torque. A handy show case serves as a bench stand also.

110. *Turner* has two booklets on their Signal Kicker antennas. They give specifications and prices on their variety of CB base and mobile line. Construction details help in your choice.

111. *Midland Communications'* line of base, mobile and hand-held CB equipment, marine transceivers, scanning monitors, plus a sampling of accessories are covered in a colorful 18-page brochure.

112. The *EDI (Electronic Distributors, Inc.)* catalog is updated 5 times a year. It has an index of manufacturers literally from A to X (ADC to Xcelite). Whether you want to spend 29 cents for a pilot-light socket or \$699.95 for a stereo AM/FM receiver, you'll find it here.

113. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.

115. *Trigger Electronics* has a complete catalog of equipment for those in electronics. Included are kits, parts, ham gear, CB, hi fi and recording equipment.

116. Get the *Hustler* brochure illustrating their complete line of CB and monitor radio antennas.

117. *Teaberry's* new 6-page folder presents their 6 models of CB transceivers (base and mobile): 1 transceiver for marine-use, and 2 scanner models (the innovative "Crime Fighter" receiver and a pocket-size scanner).

118. CBers, *GC Electronic's* 8-page catalog offers the latest in CB accessories. There are base and mobile mikes; phone plugs; adaptors and connectors; antenna switchers and matchers; TV1 filters; automotive noise suppressor kits; SWR Power and FS meters, etc.

119. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1976 catalog. It has full-color photos and specification data on Golden Eagle, LTD and SST models, and on "Brownie," a dramatic new mini-mobile.

120. *Edmund Scientific's* new catalog contains over 4500 products that embrace many sciences and fields.

121. *Cornell Electronics'* "Imperial Thrift Tag Sale" Catalog features TV and radio tubes. You can also find almost anything in electronics.

122. *Radio Shack's* 1976 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.

123. Get *Lafayette Radio's* "new look" 1976 catalog with 260 pages of complete electronics equipment. It has larger pictures and easy-to-read type. Over 18,000 items cover hi-fi, CB, ham rigs, accessories, test equipment and tools.

127. There are *Avanti* antennas (mobile & base) for CB and scanner receivers, fully described and illustrated in a new 16-page full-color catalog.

128. A new free catalog is available from *McGee Radio*. It contains electronic product bargains.

129. Semiconductor Supermart is a new 1976 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

130. There are over 350 kits described in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo & 4-channel, hi-fi, etc.

131. *E. F. Johnson* offers their CB 2-way radio catalog to help you when you make the American vacation scene. A selection guide to the features of the various messenger models will aid you as you go through the book.

132. If you want courses in assembling your own TV kits, *National Schools* has 10 from which to choose. There is a plan for GIs.

133. Get the new free catalog from *Howard W. Sams*. It describes 100's of books for hobbyists and technicians—books on projects, basic electronics and related subjects.

134. *Sprague Products* has L.E.D. readouts for those who want to build electronic clocks, calculators, etc. Parts lists and helpful schematics are included.

135. The latest edition of *Tab Books'* catalog has an extensive listing of TV, radio and general servicing manuals.

137. *Pace* communications equipment covers 2-way radios for business, industrial and CB operations. Marine radiotelephones and scanning receivers are also in this 18-p. book.

138. *Shakespeare's* new pocket-size catalog lists and describes their full line of fiberglass CB antennas, mounts and accessories offered in 1976.

142. *Royce Electronics'* new full-color catalog updates information on their CB transceivers (base, mobile, handheld). It also describes new product lines—CB antennas and a VHF marine radiotelephone.

144. For a packetful of material, send for *SBE's* material on UHF and VHF scanners, CB mobile transceivers, walkie-talkies, slow-scan TV systems, marine-radios, two-way radios, and accessories.

145. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

150. Send for the free *NRI/McGraw Hill* 100-page color catalog detailing over 15 electronics courses. Courses cover TV-audio servicing, industrial and digital computer electronics, CB communications servicing, among others. G.I. Bill approved, courses are sold by mail.

152. Send for the new, free descriptive bulletin from *Finney Co.* It features the Finco line of VOM multi-testers (and accessories) for electronics hobbyists and service technicians.

153. *MFJ* offers a free catalog of amateur radio equipment—CW and SSB audio filters, electronic components, etc. Other lit. is free.

154. A government FCC License can help you qualify for a career in electronics. Send for Information from *Cleveland Institute of Electronics*.

155. New for CBers from *Anixter-Mark* is a colorful 4-page brochure detailing their line of base station and mobile antennas, including 6 models of the famous Mark Heliwhip.

156. Send for *Continental Specialties* new bread-boarding protostat devices. They vary in prices from a mini-budget kit at \$19.95. Featured is the new logic monitor, giving information on what it does, how it works, and how to use it.

157. *Dage Scientific Instruments* offers a 16-page booklet on how to build an electronic thermometer with control. Included is an introductory course on thermocouples, schematics and many applications.

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| <input type="checkbox"/> Electronics Technician     | <input type="checkbox"/> Construction Electrician   |
| <input type="checkbox"/> CB Radio                   | <input type="checkbox"/> Appliance Service & Repair |
| <input type="checkbox"/> Surveying & Mapping        | <input type="checkbox"/> Income Tax                 |
| <input type="checkbox"/> Diesel Mechanic            | <input type="checkbox"/> Motel/Restaurant Mgt.      |
| <input type="checkbox"/> Air Conditioning & Refrig. | <input type="checkbox"/> High School                |

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Telephone \_\_\_\_\_

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The ICS Center for Degree Studies is authorized by the Pennsylvania Department of Education to offer career programs leading to Associate in Specialized Business and Associate in Specialized Technology degrees.

Business Programs:

Engineering Technologies:

- |  |   |                                     |                                     |
|--|---|-------------------------------------|-------------------------------------|
| <input type="checkbox"/> Accounting      | <input type="checkbox"/> Business Mgt.  | <input type="checkbox"/> Civil      | <input type="checkbox"/> Electrical |
| <input type="checkbox"/> Industrial Mgt. | <input type="checkbox"/> Finance        | <input type="checkbox"/> Mechanical | <input type="checkbox"/> Chemical   |
| <input type="checkbox"/> Marketing Mgt.  | <input type="checkbox"/> Personnel Mgt. |                                     |                                     |

**VETERANS:** TAKEN FOR CAREER PURPOSES, ICS PROGRAMS QUALIFY FOR VA. BENEFITS.  
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## Read what these outstanding ICS graduates think of their training.



**Made head of department.** "With no experience, I was hired over several others, and quickly promoted to head of the air-conditioning service department. I owe it all to my ICS program."

— W. John Muirhead, Groton, Conn.



**Chance to use brains.** "As a switchboard operator I never got a chance to use my brains. So I began the ICS Accounting program. Now I'm internal accountant for a local company, and I love it."

— Ellen Garza, San Diego, Cal.



**His own boss at 26.** "I'm only 26, but thanks to ICS I'm a licensed electrician with my own contracting business. Without ICS I'd still be taking orders from everyone."

— Wm. DeMedio, Conshohocken, Pa.



**Starts Manufacturing Firm.** "With what I got from the ICS Engineering and Business Management programs, I have started my own company making parts for industry."

— Ron Jakubas, Jackson, Mich.

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Along with your Career Booklet, you’ll also receive a free Demonstration Lesson.

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More than 70 of America’s largest 100 corporations (including Bethlehem Steel, 3M, Union Carbide, Weyerhaeuser, and International Paper) use ICS training for their own employees.

## Earn a degree without going to college

And the ICS Center for Degree Studies is authorized by the Pennsylvania Department of Education to grant the Associate in Specialized Business degree in Accounting and Business Management, and the Associate in Specialized Technology degree in Civil, Mechanical, Electrical, and Chemical Engineering Technologies.

These degree programs are not mere stepping-stones to higher education nor are they primarily intended for transfer toward more advanced degrees. They are practical, career-oriented programs designed to help you reach your objectives without further academic training.

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Remember, it’s your life. You might as well make the most of it.

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**FOR A FREE CAREER BOOKLET & DEMO LESSON, CHECK BELOW.**

<input type="checkbox"/> Electrician	<input type="checkbox"/> Automotive Mechanics
<input type="checkbox"/> Engineering	<input type="checkbox"/> Business Management
<input type="checkbox"/> Accounting	<input type="checkbox"/> Civil Engineering
<input type="checkbox"/> Drafting	<input type="checkbox"/> Interior Decorating
<input type="checkbox"/> Electronics Technician	<input type="checkbox"/> Construction Electrician
<input type="checkbox"/> TV Service & Repair	<input type="checkbox"/> Appliance Service & Repair
<input type="checkbox"/> Surveying & Mapping	<input type="checkbox"/> Income Tax
<input type="checkbox"/> Diesel Mechanic	<input type="checkbox"/> Motel/Restaurant Mgt.
<input type="checkbox"/> Air Conditioning & Refrigeration	<input type="checkbox"/> Mechanical Engineering
	<input type="checkbox"/> High School

**EARN A DEGREE WITHOUT GOING TO COLLEGE**

<b>Business Programs:</b>		<b>Engineering Technologies:</b>	
<input type="checkbox"/> Accounting	<input type="checkbox"/> Civil	<input type="checkbox"/> Electrical	<input type="checkbox"/> Chemical
<input type="checkbox"/> Business Management	<input type="checkbox"/> Mechanical	<input type="checkbox"/> Chemical	

The ICS Center for Degree Studies is authorized by the Pennsylvania Department of Education to offer career programs at home leading to Associate in Specialized Business and Associate in Specialized Technology degrees. For more information, check the field of your choice above.

Name \_\_\_\_\_ Age \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

Phone \_\_\_\_\_

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