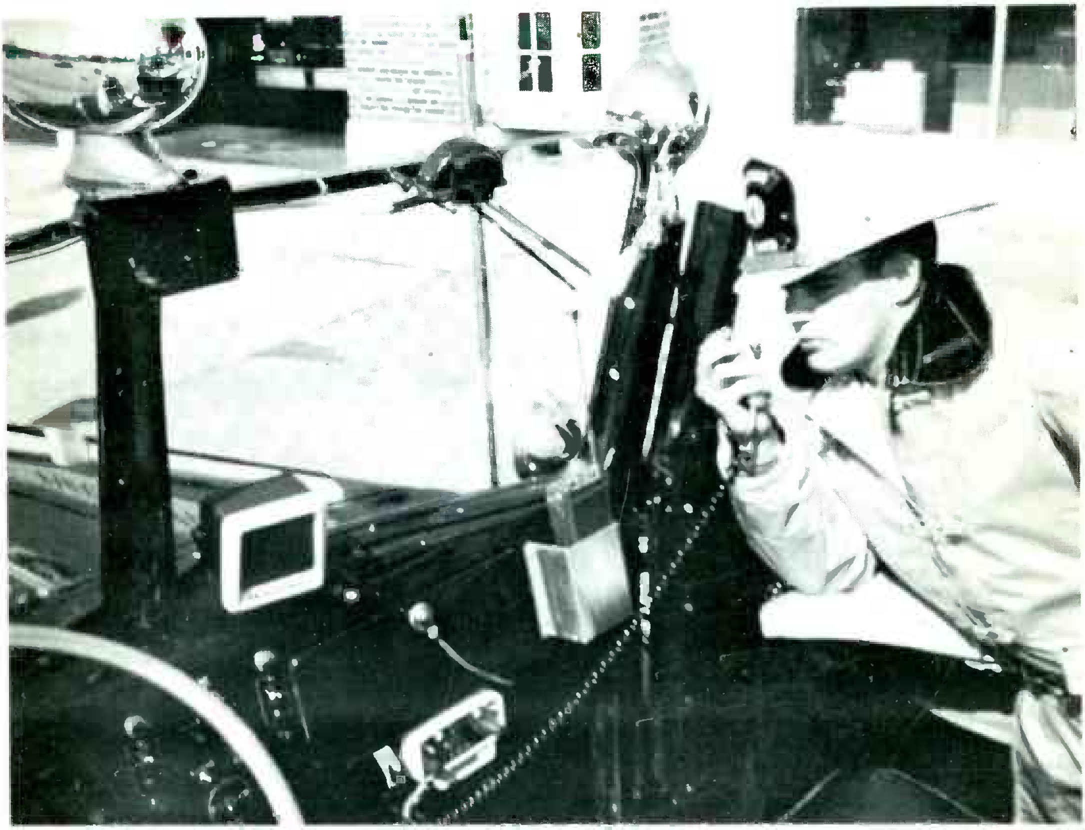
journal

March/April 1968 *35 Cents*



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MODULATION:
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Full crosshatch pattern
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A Brief Look At Integrated Circuits

By William F. Dunn

INTEGRATED CIRCUITS ARE FAST BECOMING AN IMPORTANT ADDITION TO THE FIELD OF COMMERCIAL ELECTRONIC EQUIPMENT

One of the newer developments that is beginning to find its way into commercial electronic equipment is the integrated circuit. The integrated circuit is a small unit that contains a number of circuit elements connected together in the one unit. Some integrated circuits resemble a transistor, but have many more leads than a transistor. Instead of a single transistor inside the unit, however, there are usually a number of transistors, often a number of diodes, and interconnecting leads which may provide direct connection or connections into which a certain amount of resistance has been introduced.

You will remember that semi-conductors are made by doping silicon or germanium with donor or acceptor-type impurities. When a semi-conductor is doped, the material, which in its pure state is a relatively poor conductor, becomes a comparatively good conductor. Thus by doping a piece of semi-conductor material with a donor-type impurity we can free electrons in the material so that the material will become a conductor. If we provide a path on a silicon chip and then control the number of donor impurities placed in that path, we can control the resistance of the path. This is how various resistances are created in the integrated circuit. On the other hand, by using a high concentration of donor impurities we can create a path with very little resistance so that, in effect, we have a direct connection.

In the type of integrated circuit found in commercial equipment, wide use is made of the differential amplifier. Therefore, if we are to understand how the integrated circuit works, we need to be familiar with the differential amplifier.

The Differential Amplifier

Fig. 1 is a schematic diagram of a basic differential amplifier. First, notice that two transistors are used; both are NPN transistors. PNP transistors or vacuum tubes could be used just as well, but in the integrated circuits manufactured to date, NPN transistors have been used and therefore we will use this type of transistor in our example.

Notice resistors R_1 and R_2. The sole purpose of these two resistors is to provide a forward bias for the transistor

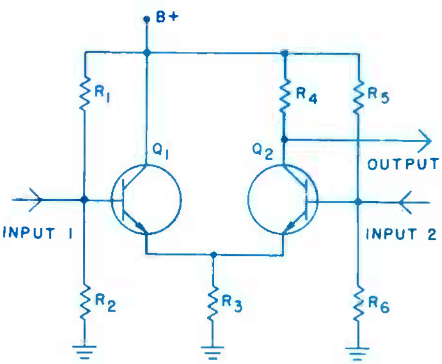


Fig. 1. Basic differential amplifier circuit.

Q_1. Resistors R_5 and R_6 are used to place a forward bias across the emitter-base junction of the transistor Q_2.

There are two inputs in the differential amplifier. Input 1 is connected to the base of Q_1 and input 2 is connected to the base of Q_2. Let's consider what happens when we feed in-phase signals of equal amplitude to the two inputs.

When the input signal drives the base of Q_1 in a positive direction, it will increase the forward bias across the emitter-base junction of Q_1 and tend to cause the current through the transistor to increase. This increase in current through Q_1 will result in an increase in current through R_3. The increased current through R_3 will drive the emitter of Q_2 in a positive direction. The in-phase signal applied to the base of Q_2 will drive the base in a positive direction. Since both the emitter and the base are moving in a positive direction, there will be very little voltage change across the emitter-base junction of Q_2. Hence there will be very little change in current flow through the transistor. This means there will be little or no change in current flow through R_4 and therefore there will be very little output produced.

Actually, the change in voltage across R_3 can't completely overcome the change in voltage on the base of Q_2. However, when the emitter swings in a positive direction, the net voltage between the emitter and collector of Q_2 decreases. This will reduce the voltage drop across both the transistor and R_4. This also helps to prevent any voltage change across R_4 due to the input signal fed to Q_2. The net result is that, with equal amplitude and in-phase signals fed to input 1 and input 2, there is practically no signal produced in the output.

On the other hand, if equal signals that are 180° out-of-phase are applied to the two inputs, we get maximum output from the differential amplifier. For example, suppose a positive-going signal is fed to input 1. This causes the current through Q_1 to increase and the voltage drop across R_3 will increase driving the emitter in a positive direction. At the same time, an equal signal which is 180° out-of-phase is fed to input 2. This drives the base in a negative direction. Hence we have the base going in a negative direction and the emitter going in a positive direction. Therefore we have a large reduction in the forward bias across the emitter-base junction of Q_2. This causes the current flow through Q_2 to drop substantially, which in turn causes the voltage drop across R_4 to drop. This change in voltage drop across R_4 will cause the output voltage to swing in a positive direction. The change in voltage at the collector of Q_2 will be far greater with the two signals fed into the transistors 180° out-of-phase than it would be if a signal was fed to only one of the two inputs.

Another way in which the differential amplifier can be used is by using only one input. To do this we might use input 1 and connect input 2 to ground insofar as the signal is concerned. This can be done by connecting a capacitor from the base of Q_2 to ground. With this arrangement, when the input signal drives the base of Q_1 in a positive direction, current through Q_1 increases, increasing the voltage drop across R_3. This reduces the forward bias across the emitter-base junction of Q_2 and causes the current through the transistor to decrease. When the current through the transistor decreases, the current through R_4 must also decrease, causing a decrease in the voltage drop across R_4. Therefore the voltage at the collector of Q_2 will increase, and the output voltage will swing in a positive direction. When the input signal applied to the base of Q_1 swings in a negative direction, the current through Q_1 will decrease and the voltage drop across R_3 will decrease. This in turn will cause the forward bias across the emitter-base junction of Q_2 to increase, increasing the current through both the transistor and R_4 so that the voltage drop across R_4 will increase. This will cause the voltage at the collector of Q_2 to swing in a negative direction.

Thus we could use a differential amplifier with two separate inputs or with one input grounded. When we use it with two separate inputs and signals that are equal and in phase, the output from the differential amplifier is essentially zero. If we use the two inputs and signals that are 180° out-of-phase, we will get a signal at the output of Q_2 that is amplified and 180° out-of-phase with the input signal fed to Q_2. On the other hand, if we connect the input of the second transistor at signal ground potential, then we will obtain an output at the second transistor that is in phase with the signal voltage applied to the first transistor.

Integrated Circuit Cases

Integrated circuits are made in a number of different types of cases which generally fall into one of the two configurations shown in Fig. 2. Notice the round IC in the photograph. This integrated circuit looks very much like a transistor, except it has many more leads coming from it. The number of leads depends on the integrated circuit, but usually it will have eight or more leads. The new CONAR Model 680 dot, cross-hatch, color-bar generator employs sixteen integrated circuits of this type, each of which has eight leads.

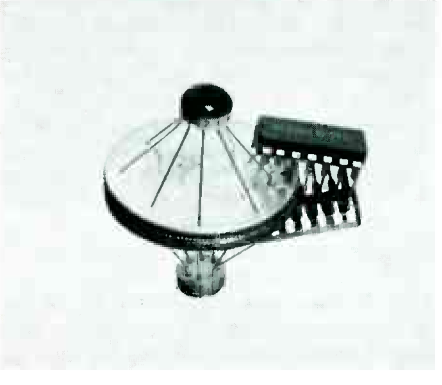


Fig.2. Typical integrated circuit.

The other general type of integrated circuit is the so-called flat pack. This integrated circuit is made in a rectangular form and has leads coming out of two sides. On some of these integrated circuits the leads on each side will be bent in a single row; on others there will be two rows of leads close to each side of the integrated circuit and then two rows of leads that are bent out somewhat further. This type of integrated circuit is easier to mount in a circuit board since the various leads are not so close together.

The shape of the integrated circuit has nothing to do with the way it works. Both the round and the flat pack can perform the same function. As a matter of fact, some integrated circuit types are available in both forms. The round type is generally smaller and more difficult to mount in the circuit board than the flat pack type, which is larger and easier to work with.

A Typical Circuit

There is no limit to the circuit configurations that can be produced using integrated circuits. However, one circuit that is quite widely used in TV receivers is shown in Fig. 3. This circuit is capable of performing the function of sound i-f amplifier, FM detector and AF amplifier. When used in this application it is usually designated by the schematic symbol shown in Fig. 4. Notice that in this case we do not draw the complete schematic of the integrated circuit, but rather we draw a functional diagram which shows the external connections to the integrated circuit and the basic functions which the integrated circuit is performing.

Now let's go back to the schematic diagram shown in Fig. 3 and study the integrated circuit in detail.

Circuit Description

In studying the schematic diagram of the integrated circuit, let's look at the two transistors Q_1 and Q_2. Notice that if we consider only these two transistors we

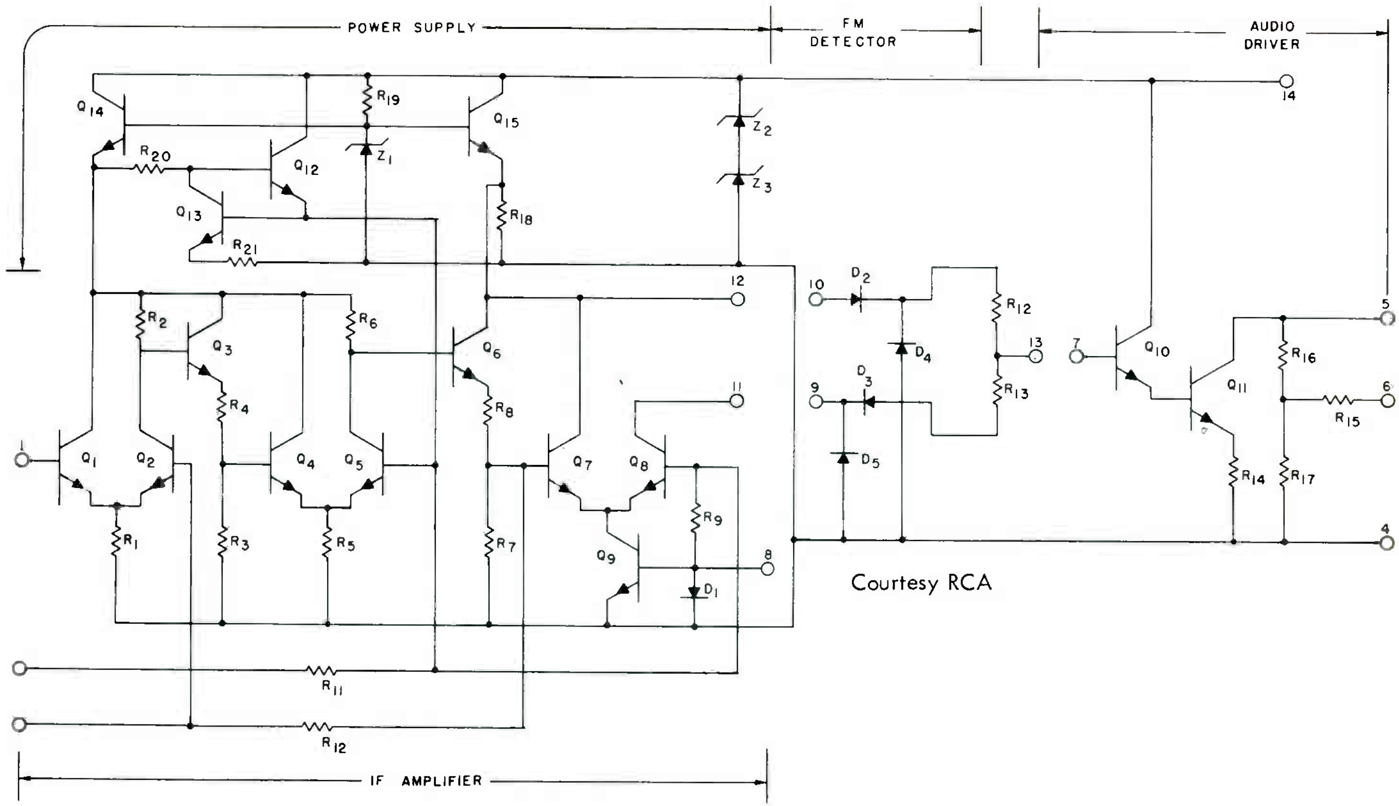


Fig. 3. Schematic diagram of the integrated circuit.

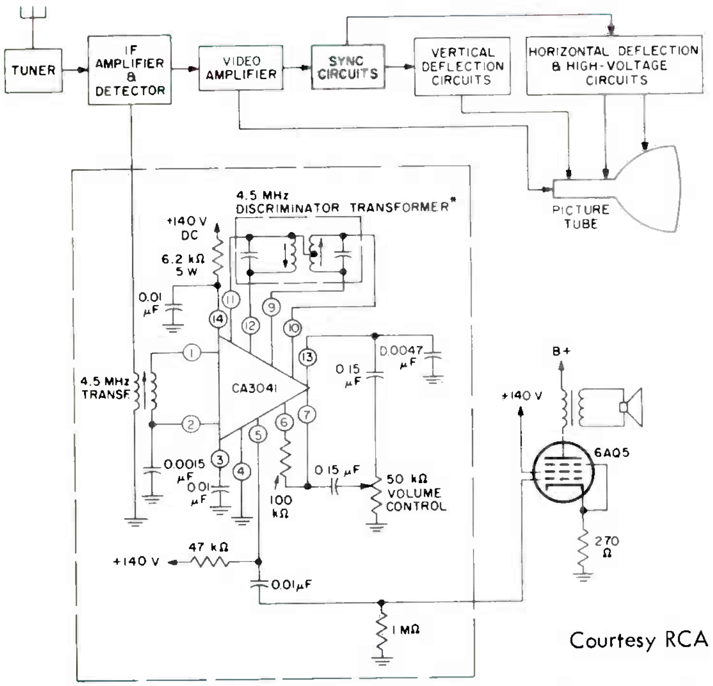


Fig. 4. Diagram of the sound system of a TV receiver using the integrated circuit.

have a differential amplifier. In operation terminal 3, which is the base of Q_2, is connected to ground through a suitable bypass capacitor. Thus we feed our input signal into terminal 1, which is connected to the base of Q_1. This signal will cause the voltage across R_1 to vary and hence vary the forward bias across the emitter-base junction of Q_2. This will cause the voltage across R_2 to vary and we will have an amplified voltage between the collector of Q_2 and ground.

The output from Q_2 is fed to the transistor Q_3. Notice that this transistor is connected as an emitter follower. This enables us to feed the signal over to Q_4, which is part of a second differential amplifier made up of Q_4 and Q_5, and at the same time maintain the proper base voltage on Q_4. By using the emitter-follower circuit we avoid the continual escalation of voltages which is obtained in cascade amplifiers that are direct-coupled.

The amplified signal is developed at the collector of Q_2 and fed to the base of Q_3. The voltage developed across R_3 is thus applied to the input of Q_4 and amplified by the differential amplifier consisting of Q_4 and Q_5. The varying current through R_6 will result in an amplified signal voltage at the collector of Q_5.

Now notice that the output from Q_5 is fed to the base of Q_6, which is another emitter-follower circuit. The signal voltage developed across R_7 is fed to the base of Q_7. Transistor Q_9 acts as the common resistor between the emitter of Q_7 and Q_8 and ground. The voltage across the emitter-base junction of this transistor is maintained constant by the forward biased diode, D_1. Thus an amplified signal current will be produced through Q_8 and fed to terminal 11 of the integrated circuit. Now if you'll refer to the functional diagram shown in Fig. 4, you'll see that terminal 11 is connected to the primary winding of the 4.5 megacycle discriminator transformer. Also, the primary winding is connected to terminal 12 which feeds the B-supply voltage to the collector of Q_8.

Thus we have the transistors Q_1, Q_2, Q_3, Q_4, Q_5, Q_6, Q_7, Q_8 and Q_9 as part of the sound i-f amplifier. One of the advantages of integrated circuits is that transistors and resistance elements are all on a relatively small piece of silicon. Thus any change in temperature that would upset the stability of the amplifier would probably change the temperature of the entire silicon chip. A temperature change in one circuit is balanced by a similar and equal change throughout the entire chip. Thus a gain will remain essentially constant.

The zener diodes of V_2 and V_3 are used to keep the overall input voltage to the integrated circuit constant. The zener diode Z_1 and the transistor Q_{14} maintain the voltage to the transistors Q_1, Q_2, Q_3, Q_4 and Q_5 constant. The transistors Q_{12} and Q_{13} are also part of the voltage-regulator circuit which maintains the input voltage and in particular the voltage to Q_6, Q_7 and Q_8 constant.

The FM Detector Circuit

If you refer to Fig. 4, you will see that the secondary of the 4.5 mc discriminator transformer is connected to terminals 9 and 10 of the integrated circuit. Looking back at Fig. 3 we see that terminals 9 and 10 connect to the diode network consisting of D_2, D_3, D_4 and D_5.

The two diodes D_4 and D_5 are back-biased; in other words, there is a reverse bias across these diodes at all times. These two diodes, instead of conducting, act as small capacitors. The diodes D_2 and D_3 are connected in the same way as the diodes in a ratio-detector circuit. Therefore these two diodes function as the detector while D_4 and D_5 function as the capacitors across the detector output. The detected output signal is taken from terminal 13 on the integrated circuit.

The Audio Circuit

There is no way that a volume control can be included as part of the integrated circuit, so the output signal from terminal 13 of the detector is fed through an external .15µf capacitor to the volume control. The volume control in turn feeds through a .1µf capacitor to terminal 7 of the integrated circuit which connects to the base of Q_{10}. Q_{10} is the first stage in the audio amplifier.

The schematic of the circuit for Q_{10} is shown in Fig. 5. Insofar as Q_{10} is concerned, the emitter-base circuit of Q_{11} acts like a resistance. The resistor network made up of R_{16}, R_{17} and R_{15} provides forward bias for the emitter-base junction of Q_{10}. The amplified signal developed at the emitter of Q_{10} is fed to the base of Q_{11}, causing Q_{11} to function like an amplifier, as shown in Fig. 6. Q_{10}, in addition to providing the audio driving signal for Q_{11}, acts as a resistance between terminal 14, the B+ input and the base of Q_{11} and provides forward bias for the emitter-base junction of Q_{11}. The amplified signal developed

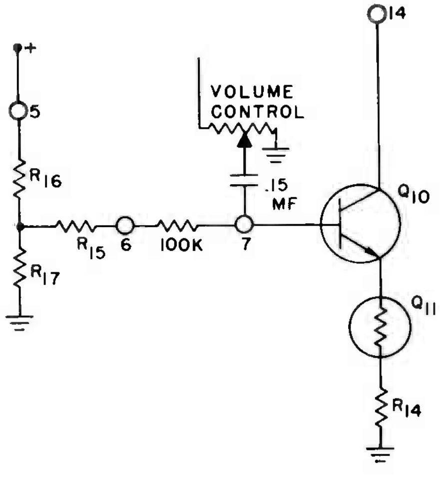


Fig. 5. Schematic for circuit for Q_{10}.

at the collector of Q_{11} is fed to terminal 5. Terminal 5 is connected through a .01µf capacitor to the grid of the output tube, a 6AQ5 tube.

Notice in Fig. 4 that there is a connection from terminal 6 through a 100K-ohm resistor back to terminal 7. If you'll look at Fig. 3 and Fig. 5, you'll see that terminal 6 connects to the junction of R_{16} and R_{17} through R_{15}. Part of the audio voltage developed at the output of Q_{11} is fed to terminal 6 and then through the external 100K resistor back to terminal 7, the input of the amplifier. This is a form of inverted feedback which is used to improve the fidelity of the circuit. Thus, in addition to providing forward bias for Q_{10}, this network also provides feedback.

If you'll examine the transistor amplifier consisting of Q_{10} and Q_{11}, you'll see that when the signal voltage swings the base of Q_7 positive, the current flowing through Q_{10} increases. This means that the voltage at the base of Q_{11} must swing in a positive direction. The positive-going signal at the base of Q_{11} will cause the current through Q_{11} to increase. The increased current through Q_{11} will cause the voltage drop across the 47K collector load resistor, shown in Fig. 6, to increase. This causes the voltage at the collector of Q_{11} to decrease and therefore the voltage at the junction of R_{16} and R17 will swing in a negative direction. Thus a negative feedback voltage is fed through R_{15} to terminal 6 and then through the external 100K resistor back to terminal 7 where it is degenerative.

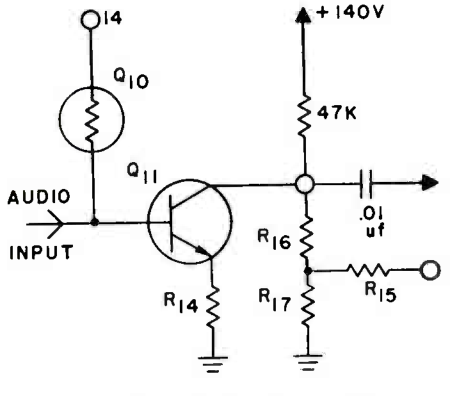


Fig. 6. Schematic for circuit of Q_{11}.

Conclusion

The integrated circuit we have discussed in this article is typical of the integrated circuits appearing in many late model television receivers. These integrated curcuits generally use differential amplifiers with emitter-followers used as couplers between the differential amplifiers. As pointed out previously, the emitter-followers are used to avoid the continued voltage build-up that would occur with direct-coupled amplifiers in cascade if some circuit, such as the emitter-follower, was not used.

When you encounter a receiver using an integrated circuit, you can generally break down the circuit into the various functions it must perform. If it is used in an application similar to the one we have just described, try to separate the portion of the integrated circuit that is used as the i-f amplifier, the portion used as the sound detector and the portion used as the audio amplifier. Also, remember that there will probably be a number of diodes and transistors used in the power supply part of the integrated circuit in order to maintain the voltages throughout the integrated circuit constant. By taking the circuits one at a time, you can usually break each one down into the various functions and then see how it works.

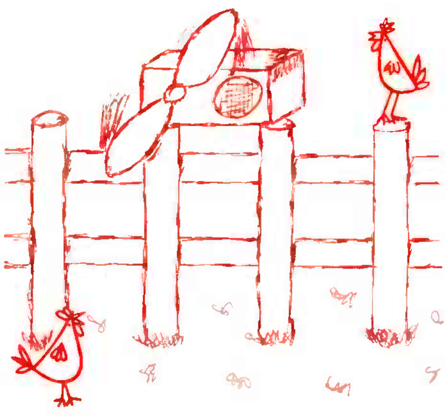
The problem of what to do with a defective integrated circuit comes up immediately. The first thing you have to do is to determine whether or not the defect is actually in the integrated circuit. This is why it is important to be able to break down the circuit into the various functions. If you know what the circuit is supposed to do, you can usually determine whether or not it's doing it. If the circuit, or part of it, is not operating properly, you have to determine whether the defect is due to a defect in the integrated circuit itself or due to a defect in one of the external components. Again, knowing how the integrated circuit is supposed to work will enable you to do this. Obviously, it is much easier to check the external components than to try to check each individual amplifier. For example, in the integrated circuit we discussed there would be no way to determine whether or not Q_1 and Q_2 are functioning correctly because there is no convenient external output from this differential amplifier. The signal feeds directly to the following emitter-follower and from there to the next differential amplifier. However, you can determine if the overall i-f amplifier is working correctly.

If your tests reveal that the trouble is not due to a defect in an external component but is due to a defect in the integrated circuit itself, the only thing you can do is replace the entire integrated circuit. Since there are an infinite number of circuit configurations that can be obtained with integrated circuits, and since minute variations in the circuit could cause a completely different performance in the receiver, the best choice is to obtain an exact duplicate replacement.

30 Years Ago

A new type of radio power had been developed by E. S. McDonald, then President of the Zenith Radio Corporation. It was intended for use particularly in areas where it would be difficult to have batteries recharged.

It was called "the windmill" and consisted of an airplane type propeller attached to a generator. As little as a six-mile wind would begin to charge the battery and because the generator had a "cutout" mechanism, even the strongest gale could not over-charge the battery.

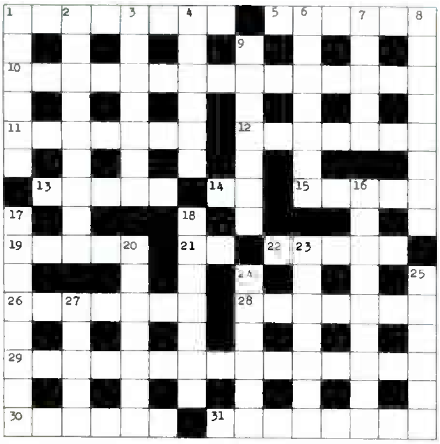


Radio reports of horse races proved almost disastrous to a certain barber in Sweden who had heavily backed a certain horse. So elated was the barber when news of his horse's victory flashed over the air that he gave a violent jerk, cutting off one of his fingers with the razor. The customer, thinking perhaps of his own neck, departed hastily.

A statue calls! The manager of a Chicago parking lot found a new use for an old statue and a public address system. The bronze figure of a medieval herald, nearly twelve feet high and weighing three tons, was wired for sound; motorists heard bellowing through his trumpet "calling all cars, calling all cars".

In quaint old Boston, it was unlawful to run a radio in any hotel lobby on Sunday without a special permit.

ELECTRONICS CROSSWORD PUZZLE



By Michael Kresila

(Solution on page 28)

ACROSS

1. Very severe.
5. Made up of atoms.
10. A device used to reduce voltage surges that might affect following parts. (2 words)
11. Having the ability to return to its original size, shape, or position.
12. The unit of heat energy in the metric system.
13. A unit of capacitance.
14. Opposite of out.
15. Card player's demand.
19. Put forth and circulate.
21. 16 ounces. (Abbrev.)
22. A mechanism designed to warn.
26. A bearing or range indication on a radar screen.
28. The electron - emitting electrode of an electron tube.
29. Transmission and reception of images or moving objects by means of radio waves traveling through space in different hues and luminance. (2 words)
30. A straight line that cuts a curve at two or more points.
31. Devices for radiating or receiving radio waves.

DOWN

1. Transmission lines.
2. Rays, of longer wavelength than visible light rays, which produce heat. (contraction)
3. The property of matter that tends to prevent motion, or resist a change of motion.
4. Two or more conductors for reception of radio waves, arranged so that the horizontal wires have little or no pickup.
6. A device used in regenerative circuits.
7. Used to measure and register integral electric quantity.
8. Movements of electrons through conductors.
9. In communication, the emission that takes place in between the code or when no code characters are being transmitted.
16. The rusting of metals by contact and chemical union with oxygen.
17. Capacitors formed by twisting two wires together.
18. Parts in proper position in relation to one another.
20. Term applied to one British version of a television camera tube.
23. An array of quartz crystals used to form a bandpass filter.
24. The surface of a cathode-ray tube upon which the visible pattern is produced.
25. A lawn game originally.
27. A keepsake or souvenir.

TODAY'S EFFICIENT FIREFIGHTERS

Go to Blazes With Electronics

By DONALD FLINN

With the constant increase of population and buildings in the past century, fire-fighting has had to become an efficient, coordinated operation and profession -- a long, long way from the first fire-alarm system placed in service in Boston, Mass. in 1863, consisting of a simple telegraph key, mounted in a protective covering, with the signal transmitted through telegraph wires.

Today the familiar red fire-alarm box, with no spot more than a few hundred feet from a location designated by a code number, has become commonplace. Transmitting an alarm is a simple operation, with the box's easily opened door and inside pull handle that automatically dispatches the alarm. (Unfortunately, the same ease of operation results in a number of false alarms. In Washington, D. C., for example, nearly one third of all fire alarms are false--a tremendous waste in time and cost of operating emergency equipment, plus the risk of injury of men responding to the alarm.)

One of the most vital factors in today's field of fire suppression thus becomes communications. The prompt, accurate receipt of an alarm, pinpointing of its

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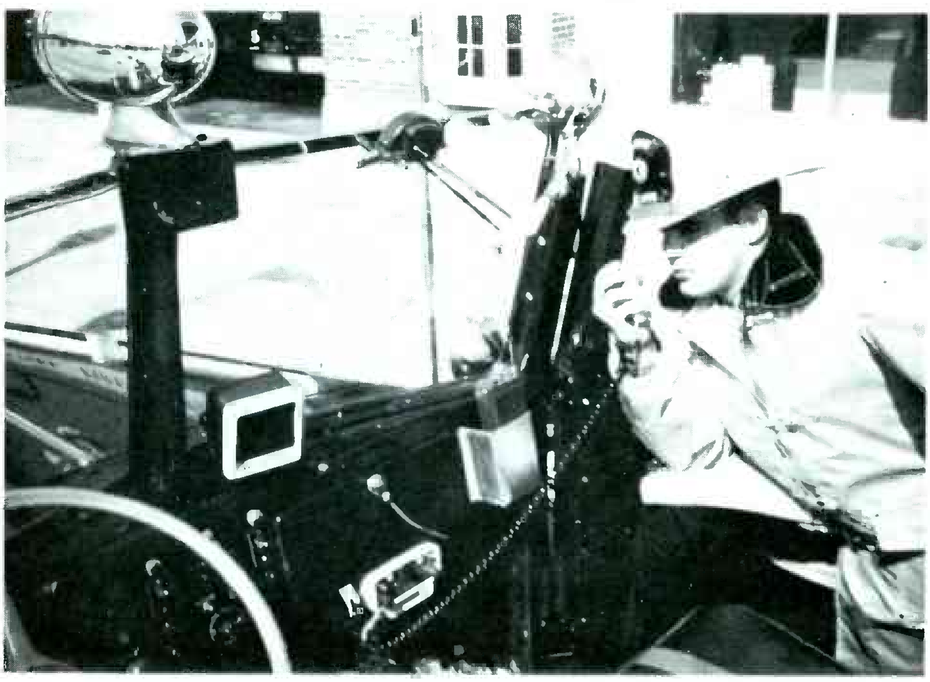
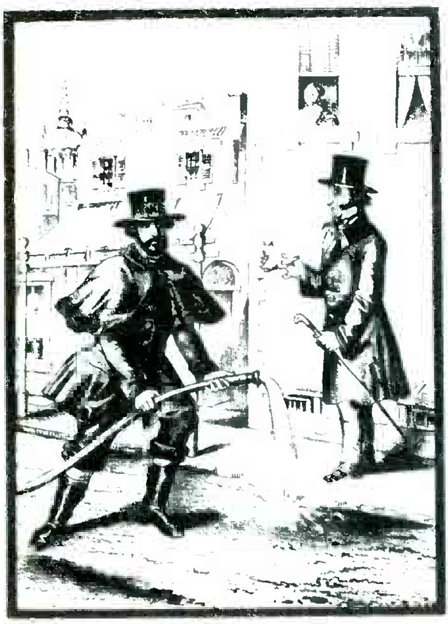
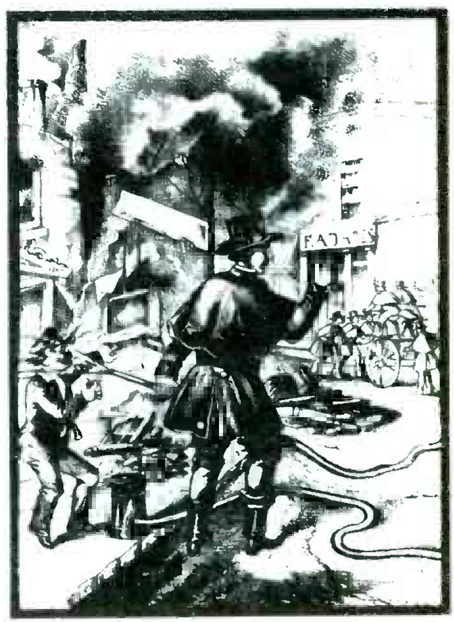



TOP LEFT, THE ALARM; RIGHT, GOING TO A FIRE; BOTTOM LEFT, NEAR A FIRE; RIGHT, AT A FIRE. 1858 ETCHINGS FROM LIBRARY OF CONGRESS.

locality, immediate alerting and dispatching of firemen and fire apparatus, further communications to handle unforeseen developments at the site--all this can become detailed and demanding, growing in intensity with the fire. Then, the fire extinguished, communications is still vital--to alert control headquarters that men and apparatus are available for the next call.

So naturally in recent years firefighters have been leaning more and more heavily on electronic devices for communications. This is especially important in alerting firemen--the U. S. ratio of fully paid firemen is only about 160,000 to a million volunteers (some of whom are partially paid on an "on call" basis).

Recent developments in the electronics field have aided in many facets of fire suppression. Even the street control boxes are using solid-state devices, including integrated circuits, to increase reliability and reduce maintenance costs. Solid-state transmitters, using either low-drain battery or solar battery power supplies, transmit radio signals up to 25 miles to the alarm receiving station. Some of these units also feature voice transmission, with acknowledgement to the sender, and the further utility of police communications. (Equipment standards for this type of alarm transmission are set forth in the National Fire Protection Association pamphlet No. 73-1967).

small fire, little water; big fire . . .

Alarms are received by diverse methods. Some communities utilize an individual fire station; others combine all emergency alarm controls and dispatch fire, rescue, or police squads as the situation dictates. The maintenance of reliable contacts has prompted many areas to organize central emergency communication facilities. In this way, one emergency telephone number covering a vast area, such as an entire country, can save valuable time in the transmission of the alarm and equipment to the proper area.

In 1964 approximately 320 center fire dispatching centers in at least 39 of the 50 states served thousands of organized fire departments. Of immeasurable value is the liaison with county, state, and federal agencies. In the growing metropolitan area of Washington, D. C., nearly 20 city, county, state, and federal fire units are united in a common link of one VHF frequency. Thus emergency apparatus may move freely between governmental jurisdictions on whatever level, always in constant radio contact of a control point.

mostly land-lines receive the alarms

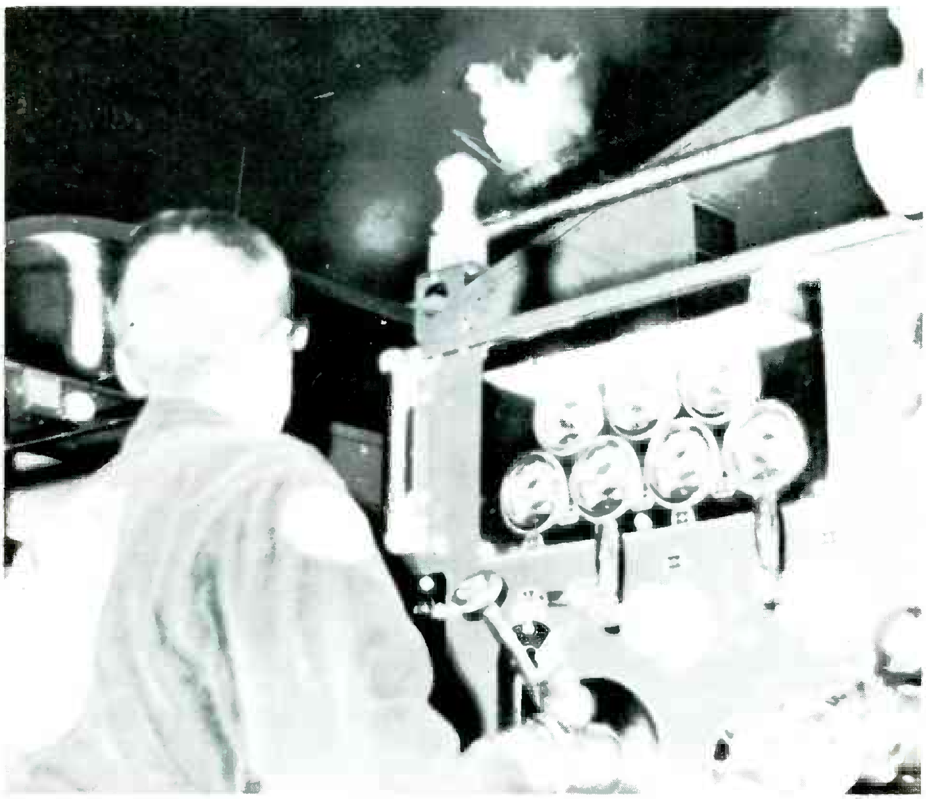
Not so involved are the methods of notifying individual fire stations after an alarm is received. Basically it's done by way of land-line, such as telephone or radio. The coded bell/tape systems also utilize land-lines in general, although some areas use coded horns to deliver the coded location of an emergency. Most departments use two or more systems to insure continuous operation regardless of situation, such as wires down due to storms, power failures, etc. As a backup, fire apparatus quite often will transmit by radio, such as "Engine 161 responding", "Truck 19 responding". A number of areas utilize the "10" signal for brevity, such as "10-8---ready for service". Then the arrival time of equipment: "Engine 161 on the scene."

'ground' site must be coordinated

Now we enter a third area of communications, the fire "ground" --location-- itself. The degree of communications needed at the ground is, of course, proportionate to the degree or area of fire involved. The old saying of small fire, little water, big fire, lots of water, applies here. The small fire may require just a few brief messages; the arrival of the apparatus, the degree of involvement and the type of occupancy, and the length of time the company will be on the scene comprise the bulk of the need. It would conclude with the notification that the apparatus was free for the next alarm, which possibly would be done by radio on the way back to the station.

Unfortunately, not all fires are small ones. In a fire situation where additional men and equipment are needed, the fire officer first of all must not be hampered by lack of adequate communications. When he appraises the situation, and radios "Chief 19 to headquarters, at 2121 Front St., five-story apartment, upper two floors involved; need second alarm and additional ladder truck", obviously the need must be met in a hurry for the saving of lives and property.

Coordination of command requires the use of multi-frequency radios; compact yet powerful bullhorns, portable radios, and loudspeaker devices attached to air



masks may be required. The latter must be sturdy, light, not harmed by smoky or wet atmospheres, and yet economical to purchase and maintain. Pretty tough requirements by anyone's standards! And yet, these requirements are being met and even exceeded by today's manufacturers. Here again the development and use of solid-state devices, integrated circuits, intermodulation rejection, improved microphones and easy installation through plug-in connectors reduce cost and improve quality.

Supplemental communication occurs through the use of sound-powered phones, intercoms between the operator of ladder truck's turntable and the man at the top. Walkie-talkie units on command frequencies, Citizen's Band units, and the use of mobile communications vans using telephones, teletype, radio, and yes, television are not uncommon.

Frequency utilization in itself is a complex subject. A survey conducted by the NFPA in 1964 showed the following: Of 80 emergency communication centers polled, 27 used frequencies from 154.07 to 154.43 mc; 31 from 46.06 to 46.5 mc; 13 from 33.54 to 33.98 mc; 4 from 153.77 to 153.83 mc, and 1 at 45.88 mc. This represents a nationwide coverage, with some duplication.

I'm certain the "hams" who read this will be familiar with the firefighter's complication, and the ham's freedom, of "skip" frequencies. I'm able to laugh

now at the problems the Silver Spring, Md. Fire Department had once with shrimp boats in the Gulf of Mexico, but at the time it was very frustrating.

The boats in a fleet would signal each other where the heaviest concentrations of shrimp were, and their signals would bounce over the horizon and surface layers of clouds, etc., to interfere with our frequency of 33.78 mc nearly two thousand miles away!

But in 1964, the control of our fire/rescue communications was assumed by the Montgomery county government, and gradually the operation was phased out from 33.78 mc to two-channel operation on the VHF 150 mc frequencies. For a period of about two-and-a-half years, simulcast broadcasts were on both high and low frequencies.

Many fire departments and Emergency Communications Centers (ECC) are now turning to the 450 mc frequency for operational reasons. Continued experience in this area will be necessary before complete data may be evaluated as to its practicality.

tone generators activate personnel

The fourth vital area of communications in fire suppression is the method of notifying volunteers. Rather than discuss the merits of the most common systems in use (sirens, horns, telephone, various group-alerting methods) let's talk about radio-alerting. The obvious method of monitoring the alarm and recognition when a member's department, or station, is responding to a call, becomes a problem when the volunteer is sleeping, working, or otherwise out of earshot. Here again electronics saves the day. Tone generators are used to activate specific, sympathetic internal buzzers or bells in receivers in a member's home, business, or office.

These tones may be used to activate specific individuals, chief officers, ambulance or rescue teams, drivers, or all members. The selection of the specific tone may be accomplished by the ECC, the individual fire station through a low-wattage transmitter, or some other source. This method is becoming increasingly popular. It means that only the needed individuals are alerted, as well as reducing the possibility of someone (needed) not hearing the vocal alarm, or of sleeping through the wail of the siren. The reduced use of the siren with this method has an additional benefit in improved public relations. It's a tremendous boost in solving some of our communications problems.

some communities combine controls

The fifth area of communications, of completion and ready-for-duty-again, was a coordinating measure badly needed. Before the development of constant two-way communications (and still in some communities), once the alarm was received and apparatus sent, the extent of damage, need for additional men or equipment, or help to another location could not be determined, in some areas, until the apparatus was returned to the fire station.

The methods of alerting had a curious side effect: the use of codes, alert tones, etc., led to development of a "language" that could override needless radio transmissions which caused confusion and sometimes concealed meaningful messages. In addition, standards for equipment manufacturers had to be developed. Maintenance of equipment, and its installation, had for years largely been hit-or-miss. Here professionals helped in establishing standards.

These standards are probably more complex than the layman realizes. In Montgomery County, for example, four base stations, connected by land-line, and a fifth connected by a 14-mile microwave radio relay, are operated from a central communications center. Selective use of the base station nearest the fire company or unit, communicating with the center, gives optimum reception at any time.

There are as well selective calling tone generators for the 25 fire stations and two rescue stations, plus telephone and teletype lines all operated from an underground, blast-proof center. All important internal equipment, such as pumps, generator, transmitters, and receivers, are shock-mounted. All connections to the outside, such as radio antenna cables, water mains, electrical power lines, etc., are flexible. In fact the main structure could move a foot without disrupting service!

There are approximately 175 radio-equipped fire vehicles with 35 full transistorized portable communicators. A status board indicates with colored lights either the availability, on call, out-of-service, or on-the-air situation of each vehicle. A full-time staff of four technicians maintains the equipment and makes other installations on a regular 40-hour-week basis. A duty technician is available any time for emergency service. In the past three years of service, the efficiency of the system has been evident. More than 27,000 calls for fire or rescue emergency were handled in 1966 alone.

Incidentally, for those of you who qualify, this type of servicing can be a rewarding and secure job. Merit-system protection, good pay and fringe benefits, mean a better-than-average career for the right man.

today's outre, tomorrow's routine

There is a sixth area of communications: future developments from ideas now undeveloped, or maybe on the planning board, or in experimental use. The most far-out thinking of today can easily be the operational procedure of tomorrow!

Closed-circuit television, for instance, is now being used for observing the overall fire situation from several vantage points, i.e., roofs of buildings adjacent to the fire, from helicopters, even the ends of aerial ladder trucks. This method of communications is finding increased usage, especially in the Far West, for forest fires or large brush fires. Here the helicopter serves as a mobile platform for the cameras.

In the area of training, CCTV is becoming an invaluable asset to fire-fighting instruction; newer fire stations and training centers are being built with an eye to the use of CCTV. TV cameras on ladder trucks, at great heights, demonstrate to personnel on the ground the results of their operations on the controls. (At the University of Maryland as far back as 1963 such demonstrations were among those offering special teaching techniques.) Recent civil disturbances point out anew the need for unmanned surveillance methods.

So what else is new?

Electronic devices so sensitive they detect a fire even before a visible flame is produced. Such detectors are sensitive to the ion particle change that occurs in combustible material when it is about to burst into open flame---giving the fire suppressors the extra moments needed to prevent a minor fire from becoming "the big one". These units are now in limited use. Infrared heat detectors, also now available, that "sniff" out concealed fires. Increased miniaturization of voice amplifiers in gas masks, allowing the fire officer to be more easily understood under fire conditions.

Electronic control of traffic signal devices. Present methods operate radio-controlled switches to override traffic lights; electronic computer units with special mapping receivers to give the most direct route, and to preselect traffic lights so the emergency apparatus has the green light. This is now controlled by individual emergency units.

Electronic warning devices on fire apparatus. With the present climate control in automobiles, the driver is often unable to hear approaching fire equipment.

Radios that transmit the readings of an electrocardiograph while en route to a hospital. These are in current use in Miami, Fla.

TV monitors in the vehicles of fire officers, for size-up of an emergency en route, so that men and equipment can best be placed for quick fire control.

In the offing, ultrasonic sound for the extinguishment of fire; lasers, intense beams of parallel light rays for detection systems.

All these and more are ahead. But only the trained and experienced technician will be able to cope with the complexities of the future. The fire service of today is willing to accept this challenge. Are you?

BY
STEVE
BAILEY

DEAR STEVE,

Please explain how a voltage tripler circuit works.

G. W., Mass.

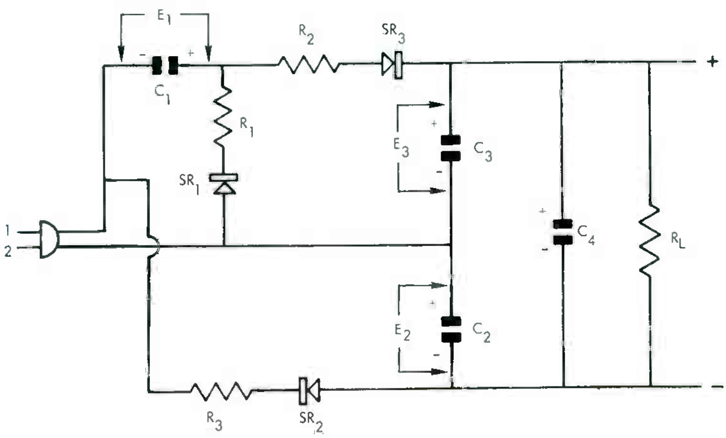
A basic voltage tripler circuit is shown in Fig. 1. Fundamentally, this circuit consists of a half-wave voltage doubler circuit and a half-wave rectifier circuit arranged so that the output voltage of one circuit is in series with the output voltage of the other. Thus, the total output voltage is approximately three times the applied voltage.

When the applied voltage has a polarity that makes terminal 1 negative and terminal 2 positive, electrons will flow into C_1, charging it to the peak value of the input voltage. The voltage across C_1 is identified as E_1. Electrons will flow away from C_1 through R_1 and SR_1 back to the positive side of the supply.

At the same time, part of the input current flows through R_3 and SR_2 into the negative side of C_2. C_2 will charge up to the peak value of the input voltage. The voltage across this capacitor is identified as E_2. Electrons will continue to flow from the positive side of C_2 back to the positive side of the supply.

During the next half-cycle, the polarity of the input voltage will reverse, making terminal 1 positive and terminal 2 negative. Voltage E_1 is now in series with the applied ac. Therefore, it will add its potential to the peak value of the input voltage. Electrons flow into the negative side

Figure 1



of C_3 and away from the positive side through SR_3, R_2, C_1 and the ac source in series. Thus E_3 receives a charge equal to the peak value of the applied ac voltage plus E_1, making E_3 equal to approximately twice the peak value of the applied voltage.

Since C_2 and C_3 are connected in series, their voltages will add. The voltage across C_2 is equal to the peak of the applied voltage and the voltage across C_3 is equal to twice the peak of the applied voltage. Thus, the sum of these voltages will be equal to three times the applied voltage. This will be the total voltage impressed across C_4 and thus supplied to the load.

DEAR STEVE,

Lesson B105 discusses the thermistor, a special type of resistor whose value varies with changes in temperature. Is the change in resistance proportional to the change in temperature?

D. J., Canada

A thermistor is a nonlinear device whose exact value at any given time depends upon its temperature. Of course, to know how a certain type of thermistor will operate, we must know its characteristics. This information is given by the manufacturer.

For example, the manufacturer will provide a chart which enables you to find the resistance at various given temperatures. A typical chart with the characteristic curve of an average thermistor is shown in Fig. 2. This shows, for example, that the resistance of the thermistor is 9 ohms at 25° centigrade. At double that temperature, the resistance is 4 ohms. At half the original temperature (12.5° C), the resistance is about 10.7Ω. Thus, changes in temperature will not necessarily result in proportional changes in resistance. The characteristic curve should always be consulted to determine the resistance at any given temperature level.

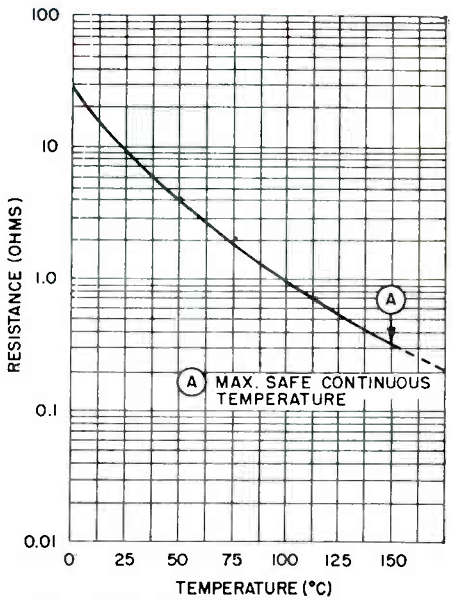


FIG. 2. Resistance-temperature curves of a typical thermistor.

DEAR STEVE,

At the present time, I am studying the power formulas given in lesson B105. Can you give me assistance on these?

F. J., Mo.

The power formulas should not be difficult to understand; you have already been introduced to the idea of using a formula to find an unknown value when you studied Ohm's Law. Then you were given three formulas to find these unknown values. You are also given three power formulas, but any one of the three can be used to find a single unknown value, namely power.

The formula you use depends on what values you are already given. If you are given voltage and resistance, you use the formula $P = \frac{E^2}{R}$. The formula $P = I^2 \times R$ is used when you know the current and resistance. If you know the voltage and current, you use the formula $P = EI$.

Below, I have shown how each formula is used. The values used are E = 10V, R = 50Ω and I = .2 amps. When these values appear in a circuit, the power developed across the resistance will be 2 watts. Notice that no matter which formula is used, the power always comes out the same.

$$P = \frac{E^2}{R}$$

$$E^2 = 10 \times 10 = 100$$

$$R = 50\Omega$$

$$P = \frac{100}{50}$$

$$P = 2 \text{ watts}$$

$$P = I^2 \times R$$

$$I^2 = .2 \times .2 = .04$$

$$R = 50\Omega$$

$$P = .04 \times 50$$

$$P = 2 \text{ watts}$$

$$P = E \times I$$

$$E = 10V$$

$$I = .2 \text{ amp}$$

$$P = 10 \times .2$$

$$P = 2 \text{ watts}$$

DEAR STEVE,

I have often seen the term "loading" used in reference to making measurements with a VOM. Can you tell me what this refers to?

L. M., Calif.

First of all, let me remind you of another term you have seen before: load. It means, as you know, that a device that will draw correct current and consume power is connected to a circuit.

Keeping this definition in mind, it follows that the word "loading" refers to something that is drawing current and power from a circuit. A VOM can alter the characteristics of a circuit under test, especially if its impedance is near the impedance of the circuit being tested. In this case, the voltmeter may serve as a parallel path for current, and thus reduce the actual current flow in the circuit it is connected across.

Effectively, the impedance of the circuit is decreased because of this. When this happens, we say that the VOM is loading the circuit. Of course, measurements taken under these conditions cannot be considered accurate. The best way to avoid this type of trouble is to use a VTVM in your service work. Most VTVMs have an internal impedance of between 10 and 15 megohms, which is greater than the internal impedance of most VOMs. This is why a VOM causes circuit loading much more frequently than a VTVM.

DEAR STEVE,

What is the meaning of the term "rms"?

J. B., Md.

The term "rms" is an abbreviation for the phrase "root-mean-square." This is used to describe the effective value of an alternating current that corresponds to the direct current value that will produce the same heating effect.

The effective, or rms, value can be calculated by taking the square root of all instantaneous values, squaring the result, finding the average or "mean", and then finding the square root of the mean. The rms value for the sine wave can be found by multiplying the peak value of an ac voltage or current by .707. If you know the rms value, you can find the peak value by multiplying the rms value by 1.41.

One important thing to notice is that the terms "rms" and "effective" can be used
(Continued on page 24)

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For outstanding grades throughout their NRI course of study, the following November and December graduates received Certificates of Distinction along with their NRI Electronics Diplomas.

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IM

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City & State ________________ How long at this address? ________

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Business Address ________________ How Long Employed? ________

If in business for self, what business? ________ How Long? ________

Bank Account with ________________ Savings ☐ Checking ☐

CREDIT REFERENCE (Give 2 Merchants, Firms or Finance Companies with whom you have or have had accounts.

Credit Acct. with ________________ Highest Credit ________
(Name) (Address)

Credit Acct. with ________________ Highest Credit ________
(Name) (Address)

(Communications--cont. from P. 21)
interchangeably. Also, it is important to remember that readings obtained with an ac voltmeter are the effective values. Typical ac voltages given on a schematic are also expressed as rms or effective values.

DEAR STEVE,

In lesson B106, we are given the formula $Q = \frac{X_L}{R}$ for determining the Q of a coil. It is mentioned that at high frequencies R may increase. I thought that resistance was not affected by frequency. Will you clear this up?

R. D., Wash., D. C.

To begin with, there are actually two types of resistance that must be taken into consideration. The first is the actual dc resistance of the wire used to wind the coil. This will offer a slight amount of opposition to any direct current flowing through the coil. The second type of resistance is the rf or ac resistance. At most frequencies this is equivalent to the dc resistance.

In the formula for Q, the resistance referred to is the ac resistance. At most frequencies, this can be considered to be equivalent to the dc resistance. However, at extremely high frequencies we have what is known as the "skin effect". This is a phenomenon that occurs when the electrons flowing through the wire tend to shift their path of travel from the center of the wire to close to the surface of the wire. This restricts the area available for the current to flow and thus effectively increases the resistance. This effect increases with further increases in frequency. This is primarily a factor at extremely high frequencies and is normally taken into consideration only for design purposes.

Hertz or Cycles

THE EXPRESSION 'CYCLES PER SECOND' NOW CHANGED TO 'HERTZ' TO HONOR A GERMAN PHYSICIST

For many years we have used the expression cycles per second, kilocycles per second and megacycles per second to describe the frequency of repetitive waves. For example, a sine wave is a repetitive waveform; it simply repeats itself over and over again. The frequency of the power line voltage, which is a sine wave, is 60 cycles per second.

In place of the expression, cycles per second, a new term, the Hertz, is now being used. Hertz was a physicist who many years ago studied radio wave propagation. No unit in electricity has been named after him and hence the term Hertz was designated as an honor to him and also as a unit of frequency measurement. One Hertz is equal to one cycle per second. 60 Hertz is equal to 60 cycles per second. We usually abbreviate the word Hertz Hz, thus instead of writing the power-line frequency as 60 cps we can write it as 60 Hz.

In addition to the unit Hertz we have the kilohertz and the megahertz. The kilohertz is abbreviated KHz and is equal to 1000 cycles per second or 1 kilocycle per second. The term megahertz is usually abbreviated, MHz and is equal to 100,000,000 cycles per second or 1 megacycle per second.

Notice that the term Hertz not only identifies the number of cycles, but also the time as one second. Thus to properly describe the power line frequency we can say 60 Hz, but if we use cycles, we must say 60 cycles per second.

You'll find the term cycles per second, kilocycles per second and megacycles per second used in all the older text books and magazines. Even some later text books still use these units. However, the general trend is toward adopting the new terms Hz, MHz and KHz. Since you need to be familiar with both sets of units, we will use both in the following lessons. It will be worthwhile to take time now to memorize the equivalents.

1 Hertz (Hz) = 1 cycle per second (1 cps)

1 Kilohertz (KHz) = 1 kilocycle per second (1 kc ps)

1 Megahertz (MHz) = 1 megacycle per second (1 mc ps)

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HUMBLE OIL & REFINING CO., Marine Dept., Box 1512, Houston, Texas 77701
TEXACO OIL CO., Marine Dept., Box 1028, Port Arthur, Texas 77640
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DIRECTORY OF ALUMNI CHAPTERS

DETROIT CHAPTER meets 8:00 P. M., 2nd Friday of each month, St. Andrews Hall, 431 E. Congress St., Detroit. Chairman: James Kelley, 1140 Livernois, Detroit, Mich., VI-14972.

FLINT (SAGINAW VALLEY) CHAPTER meets 8:00 P. M., 2nd Wednesday of each month at Andrew Jobbagy's Shop, G-5507 S. Saginaw Rd., Flint. Chairman: Clyde Morrissett, 514 Gorton Ct., Flint, Mich., 235-3074.

HAGERSTOWN (CUMBERLAND VALLEY) CHAPTER meets 7:30 P. M., 2nd Tuesday of each month at George Fulk's Radio-TV Service Shop, Boonsboro, Md. Chairman: Robert McHenry, RR2, Kearneysville, W. Va. 25430.

LOS ANGELES CHAPTER meets 8:00 P. M., 2nd and last Saturday of each month, at Chairman Eugene DeCaussin's Radio-TV Shop, 4912 Fountain Ave., L. A., Calif., NO 4-3455.

NEW ORLEANS CHAPTER meets 8:00 P. M., 2nd Tuesday of each month at Galjour's TV, 809 N. Broad St., New Orleans, La. Chairman: Herman Blackford, 5301 Tschoupitoulas St., New Orleans, La.

NEW YORK CITY CHAPTER meets 8:30 P. M., 1st and 3rd Thursday of each month, St. Marks Community Center, 12 St. Marks Pl., New York City. Chairman: Samuel Antman, 1669 45th St., Brooklyn, N. Y.

NORTH JERSEY CHAPTER meets 8:00 P. M., last Friday of each month, Players Club, Washington Square (1/2 block west of Washington and Kearney Avenues), Kearney, N. J. Chairman: William Colton, 191 Prospect Ave., N. Arlington, N. J.

PHILADELPHIA-CAMDEN CHAPTER meets 8:00 P. M., 2nd and 4th Monday of each month, K of C Hall, Tulip and Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore Ave., Philadelphia, Pa.

PITTSBURGH CHAPTER meets 8:00 P. M., 1st Thursday of each month, 436 Forbes Ave., Pittsburgh. Chairman: James Wheeler, 1436 Riverview Dr., Verona, Pa. 15147.

SAN ANTONIO (ALAMO) CHAPTER meets 7:00 P. M., 4th Friday of each month, Beethoven Home, 422 Pereida, San Antonio. Chairman: Sam Stinebaugh, 318 Early Trail, San Antonio, Texas.

SAN FRANCISCO CHAPTER meets 8:00 P. M., 2nd Wednesday of each month, at the home of J. Arthur Ragsdale, 1526 27th Ave., San Francisco. Chairman: Isaiah Randolph, 523 Ivy St., San Francisco, Calif.

SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8:00 P.M., last Wednesday of each month at home of John Alves, 57 Allen Blvd, Swansea, Mass. Chairman: Walter Adamiec, 109 Taunton St., Middleboro, Mass.

SPRINGFIELD (MASS.) CHAPTER meets 7:00 P. M., last Saturday of each month at shop of Norman Charest, 74 Redfern Dr., Springfield, Mass. Chairman: Br. Bernard Frey, 254 Bridge, St., Springfield, Mass.

Solution to Crossword Puzzle

Alumni News

John Pirrung	President
Franklin Lucas	Vice-Pres.
James J. Kelley	Vice-Pres.
Arthur Howard	Vice-Pres.
E. J. Meyer	Vice-Pres.
T. E. Rose	Exec. Sec.

DETROIT CHAPTER is proud of their chairman James Kelly. Jim was elected to one of the Vice-Presidential positions in the recent National Elections. He has served as Chairman of the Detroit Chapter for the past eight years, and his new position is well-earned. Congratulations, Jim!

Here's Jim Kelly, one of the new NRIAA Vice-Presidents, as he was sworn into office by Asa Belton.

John Nagy, one of the Chapter's active members, gave a lesson on Grayhill Switch Terminology, and led a question and answer period after his enlightening talk.

At the next meeting Gill Sager, another Chapter member, brought in a portable TV set that had a reduced picture and raster. Out came the NRI oscilloscope and the VTVM, and together the members worked at troubleshooting the receiver.

Plans have been made to continue a study of transistors so that the members will be more familiar with solid-state servicing.

Flint Chapter Works On Something Old, Something New

FLINT (SAGINAW VALLEY) CHAPTER held a discussion on Color TV set up without the use of a color bar generator. They found that it wasn't really so difficult, after all.

Andrew Jobbagy and Clyde Morrissett gave a demonstration of early day servicing. They used a 1026 Atwater Kent Radio.

Jim Windom called the Chapter's attention to the change in receiver tube pricing. Price checking is in order or money will be lost on some of those repair jobs.

L.A. Chapter Shares Troubles, Viewpoints

LOS ANGELES CHAPTER members know a good chairman when they have one. They re-elected Gene DeCaussin as their Chapter Chairman. Gene owns his own Radio-TV Shop on Fountain Avenue in Los Angeles and is very active in the Chapter. Congratulations, Gene!

Also to be congratulated are Bob Belew, who was re-elected Vice-Chairman; Gerry Dougherty, who was elected secretary to take the place of Fred Travis who decided to resign to take care of his folks; and Kenneth Kellogg, who was re-elected Treasurer.

Jack Greenberg, the Chapter's newest member, brought in his TV set and together the members analyzed its trouble -- a bad picture tube and power supply filter.

At the next meeting there was a lively discussion about the antenna business. The general opinion was that it is an excellent field for young men with ambition and a knowledge of antennas.

New York Chapter Has Speakers Galore

NEW YORK CHAPTER has certainly been busy these past few months. First they had their elections. The results were: Samuel Antman, Chairman; Albert Bimstein, Executive Chairman; Sylvester N. Carter, First Vice-Chairman; Franklin Lucas, Second Vice-Chairman; Roy DaSilva, Treasurer; and Joseph Bradley, Jr. will continue as Secretary. Frank Lucas was also elected to one of the Vice-Presidential positions in the recent National Elections. Congratulations, gentlemen!

Then they were visited by Tom Nolan, a prominent member of the NRI technical staff, who discussed and demonstrated the NRI Color TV. He divided his discussion into two parts; first he explained the tuner and i-f sections and the Horizontal output and High-Voltage sections and then he covered the Convergence and Chroma section. Mr. Nolan went through all the adjustments several times and explained the need for each one. For most of the group his talk represented new material, so it was quite a slice of knowledge for one evening. Roy DaSilva brought in his tape recorder and Joseph Pagan brought a reel of good tape, so the New York Chapter now has a permanent record of Mr. Nolan's talk.

Then the Chapter was visited by Mr. A. Russell Thompson, of the New York Telephone Company, who gave an interesting and often amusing talk supported with colored slides on the subject of Expo '67.

For their next meeting the Chapter was entertained by their own Vice-Chairman, Pete Carter, who spoke on the internal workings and biasing of transistors. Sam Antman, the Chairman, then demonstrated how, with the aid of two capacitors, a transistor radio could be used to signal trace another set.

North Jersey Continues Study of Transistor Board

NORTH JERSEY CHAPTER held their elections and the following men are to be congratulated for being voted into office: William E. Colton, Chairman; Franklin Lucas, Vice-Chairman; Harry Weitz, Secretary; and William Whitely, Treasurer.

The Chapter continued its study of the transistor board. The Chairman, William Colton gave a very interesting lecture

Harry Weitz, of the North Jersey Chapter, using the vtvm on the demonstration board.

using the instruction manual. He started with the main features in preliminary troubleshooting, such as visual inspection, points to check the voltage input, and points to check current readings which are very important in transistor troubleshooting. The secretary brought in a tough dog set, and the members spent the rest of the evening troubleshooting it.

At the next meeting, Harry Weitz and Bill Colton teamed up to discuss short cuts for problems, the use of simple instruments, IC circuits, and the use of transistors in the future. Afterwards, there was a question and answer session.

Philly-Camden Chapter Hears Talk on Color TV

PHILADELPHIA-CAMDEN CHAPTER has added another member to its ranks. He is Ed Suplee of Wilmington, Delaware. Welcome to the Chapter, Ed!

Ted Rose and Tom Nolan, of the NRI staff, visited the Chapter recently. Tom demonstrated the new NRI Color TV, gave a talk on its circuits and explained the basic differences between black-and-white and color receivers. A question and answer period followed, then all the members enjoyed their usual sauerkraut and hot dogs with all the trimmings.

The Chapter members are making good progress in their Color TV class. We

Ted Rose, left, and Tom Nolan at the Philadelphia-Camden Chapter.

hear that Norman Roton is doing a terrific job as instructor. They now have a good RCA set to use for demonstrations and practice. Pretty soon the whole Chapter will be doing color!

Pittsburgh Chapter Visited by Mr. Howard and Mr. Harvey

PITTSBURGH CHAPTER held their elections for 1968. The men elected were: James Wheeler, Chairman; Joe Burnellis, Vice-Chairman; William Sames, Treasurer; Howard Tate, Corresponding Secretary; and George McElwain, Recording Secretary. Congratulations, gentlemen!

Officers of the Pittsburgh Chapter are: bottom row, left to right; Mr. Wheeler, Mr. Burnelis, Mr. McElwain, Mr. Sames; top row; Mr. Kelly (director), Mr. Tate, Mr. Lundy and Mr. Benes (directors).

Mr. Howard and Mr. Harvey, representatives from the Motorola factory, visited the Chapter to discuss the Motorola transistor Color TV. The program was excellent. A few of the members missed it due to -5° temperature, but those who were there thoroughly enjoyed it.

San Francisco Chapter Studies the B and K Analyzer

SAN FRANCISCO CHAPTER member Harold Jenkins has been leading informative discussions about the B and K Analyzer. At one meeting he connected the analyzer to the vertical section of a TV receiver and showed the results. Then, at the next meeting, he substituted a new vertical blocking oscillator transformer into the TV receiver to demonstrate the results.

The Chapter plans to continue working on the vertical oscillator and output section.

Busy Springfield Chapter Welcomes Guest Speakers, New Members

SPRINGFIELD (MASS.) CHAPTER has had a number of visitors lately. At one meeting two science and electronics instructors came to speak to the members.

Art Zavarella, on the right, and Norman Forest with the charts and machines they brought when they spoke to the Springfield Chapter.

In Memoriam

Mr. Anthony S. Kania, Oneonta, N.Y.
Mr. J. H. Hunter, Columbus, Ohio
Mr. L. M. Holland, Philadelphia, Pa.
Mr. Charles H. Colquitt, Detroit, Mich.
Mr. R. J. Salm, Montoursville, Pa.
Mr. E. J. Brophy, Jersey City, N.J.
Mr. Richard M. Miles, Loyal, Wisc.
Mr. G. Proctor, Jr., Mooresville, N.C.
Mr. C. R. Slack, Frederick, Md.

Art Zaverella, from Westfield State College, gave an interesting talk on the theory of the oscilloscope, accompanied by his own charts.

Norman Forest, from Technical High School in Springfield, brought demonstration scopes and audio generators from the school to show the members the machines in action and what can be done with them.

At a later meeting, Tom Nolan, from NRI, gave an unforgettable lecture on the CONAR Color TV. All the members present enjoyed the lecture and learned a great deal about dealing with color.

Two new members were presented to the Chapter: Joseph Gregory and Robert Niquette. Welcome, gentlemen!

All the members of the Springfield Chapter were throughly entertained by Tom Nolan when he came to speak on the CONAR Color TV.

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SPECIFICATIONS

Picture Size
18" diagonal measure. 180 square inches of viewing area.

Tube, Transistor and Diode Complement
21 tubes, 20 diodes and 3 transistors. Includes 3 compactrons. Picture tube type RE19FMP22.

Tuners
Prealigned VHF tuner and transistor UHF tuner. Tunes Channels 2 through 83.

Video I-F Amplifier
Two stages. Uses high transconductance tubes and preset coils.

Video Amplifier
Three stages. D.C. coupled.

Sound Circuit
4.5 mc amplifier. Uses quadrature detector and beam power output stage.

High Voltage
22,000 volts, regulated.

Focus
Electrostatic with separate high voltage supply.

Loudspeaker
Front mounted oval type.

Front Controls
VHF tuner, UHF tuner, tint, color, horizontal hold, contrast, brightness, on-off and volume.

Dimensions
25" wide
19" deep
15¼" high

Cabinet
Wood grained vinyl clad steel.

Weight
Under 75 lbs.

Power-Requirements
120 VAC 60 cps—275 watts

Easier to build because it's designed for learning!

CONAR maintains its extraordinary leadership pace with another first—the all new Custom 600 Color TV Receiver Kit. Here's the first and only color receiver kit on the market engineered especially for learning. This means you'll find the Custom 600 tops for simplicity of design and ease of building. The Custom 600 is not a copy of an existing receiver "broken down" for rebuilding. It has been designed by CONAR engineers from the chassis up to provide the kit builder with a superb color instrument which will give years and years of enjoyment.

Its functional, modular design, combined with the knowledge you gain from building, will make it simple to make any needed repairs—and we're willing to bet you'll make mighty few, for the Custom 600 is the work of a project team selected from among our own engineers, technical writers and editors who spent literally years on engineering, design and testing.

The Custom 600 uses printed circuit boards for fast, easy assembly and every component is of first quality. Its design incorporates the latest advances in the art of color receiver construction. In addition to 21 tubes, this all-channel receiver incorporates a transistor UHF tuner, transistor noise cancellation circuit and sixteen solid-state diodes. The low voltage power supply contains three silicon rectifiers. Everything, but everything, is supplied. There is absolutely nothing extra for you to buy. The attractive bronze-toned cabinet with wood tone accents will enhance any room in your home. The receiver even includes separate gun killer switches which you will build in to aid you later in making maintenance and servicing easier and more convenient, and a built-in cross hatch generator makes it easier for you to adjust convergence so that you get true-to-life color.

Total learning design gives you a receiver kit with many circuit operations readily observable through easy-to-get-at test points of novel design. All hardware is engineered for accessibility. More important, circuitry not normally requiring maintenance is deliberately made accessible. No matter that you're not taking formal electronic training—just building the kit will give you enough experience so that you need never call a service man. Basically this is the same kit used to train NRI students.

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