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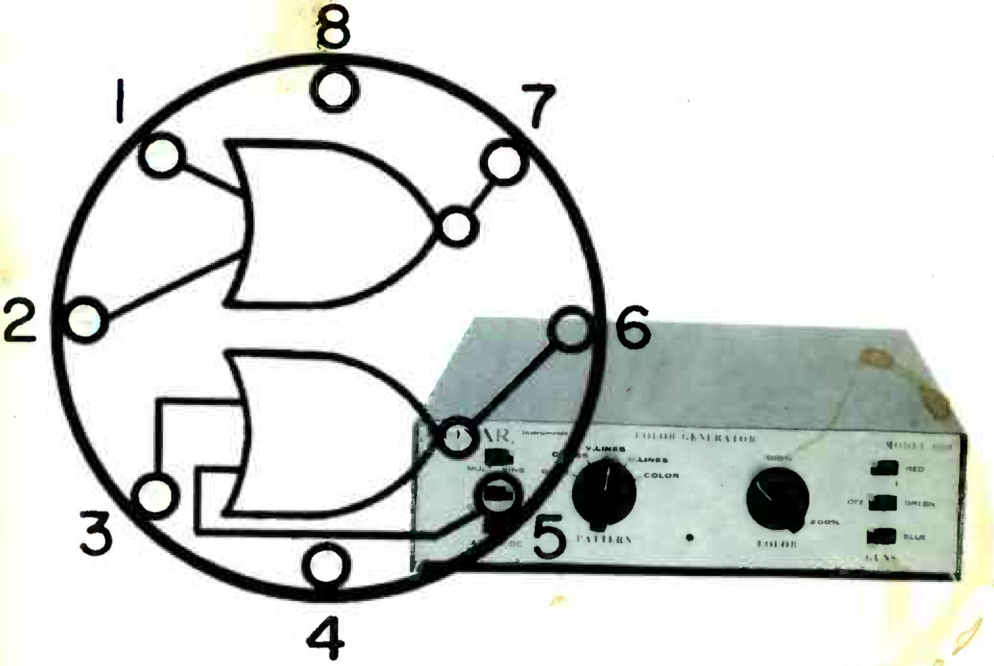

IN THIS ISSUE

CONAR Introduces:

Integrated Circuits in the NEW Model 680 Color Generator

Homeowner-Hobbyist Professional...Test It, Fix It Yourself And Save!

CONAR

Appliance Tester

COMPLETE INSTRUCTIONS INCLUDED

Tests Fans, Lamps, Refrigerators, Washers, Toasters, Clocks, More

For troubleshooting all household appliances — refrigerators, toasters, fans, lamps, clocks, washers, etc. A versatile, labor-saving instrument for the repair shop, the Model 200's amazingly easy operation makes it perfect for home use too. Test-proven in over 12,000 shops and homes.

Quickly, **accurately** pinpoints what's causing the trouble. Measures the actual consumption of any operating appliance, tests for proper voltage up to 300V. Locates house wiring defects, checks for open circuits, faulty connections, and "shorts."

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Ideal for testing electrical systems in automobiles, too: checks generators, distributors, starter motors and brake light switches —just a few of the jobs it will do.

Uses two precision double-jeweled meters and 1% precision resistors. Top-quality 30" alligator clip test leads come with it at no additional cost. Rugged yet good-looking fabric covered wood cabinet adds to the professional appearance. The cabinet has a carrying handle and removable lid—plus extra space for storing small tools, fuses, etc.

KIT Stock No. 200UK — $24^{50}

WIRED Stock No. 200WT — $32^{50}

SPECIFICATIONS

METERS: Double-jeweled D'Arsonval type, 0-1 ma and 15 amp special scales

VOLTAGES RANGES: 0-150 AC, 0-300 AC

OHMS RANGES: 0-1000, 0-10,000 ohms

AMMETER RANGES: 0-15 amp (direct line plug in panel)

BATTERY: 1.5 volt "D" cell for ohms circuit

CONTROLS: 6-position switch for volts-ohms; ohms adjust potentiometer

OVERLOAD PROTECTOR: 15 amp fuse

DIMENSIONS: 7½" x 7½" x 3½"

POWER SOURCE: 110-120 volts, 60 cycle AC

ACTUAL WEIGHT & SHIPPING WEIGHT: 5 lbs., shipped parcel post insured.

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30 Years Ago

In National Radio News

Radio has stepped into the breach! For the first time in Radio history, network stations, regardless of affiliation, joined in a nationwide hook-up and stayed on the air for 24 hours straight to fight the Great Flood of 1937. For the first time, a governor of a state spoke on an emergency telephone line in an appeal for aid from the nation. He was Gov. A. B. Chandler of Kentucky, speaking from the guardhouse of the engulfed and evacuated old Frankfort Prison where he had directed work of rescuing more than 2,700 imprisoned men.

Radio station CKCL of Toronto, Ontario placed on the air a spiritualistic seance lasting an hour and a half. During the broadcast, conducted by a world-famed medium, voices presumably from spirits were clearly heard, and weird blue lights were seen traveling around the studio walls...so say the reports.

Talking planes made Arabs behave! Powerful loudspeakers on British airplanes were replacing cavalry and guns in the desert regions of Iraq. Voices from the sky proved more effective than the use of force!

The Television Division of the Don Lee Broadcasting System staged a noteworthy demonstration when, for the first time, the "sound" phase of a newsreel was broadcasted over KHJ, the "sight" portion over W6XAO, simultaneously, with the united sight and sound picked up at a private residence 3-1/2 miles from both transmitters. The demonstration was given as a feature at a special joint meeting of the Los Angeles section of the Institute of Radio Engineers and the Institute of Electrical Engineers.

ALBERT MILLARD
Pacoima, Calif.

"I am working for Litton Industries in Quality Assurance-I am now a leadman in Electronic Test inspection and earn more than $8,000 a year.

"The NRI course helped me understand the circuits I have to work with and increased my knowledge of electronics."

CECIL RASNAKE
Hampton, Va

"After completing my NRI training, I was employed by the Newport News Shipbuilding & Drydock Corp. as an electronics technician, working with some of the very latest equipment for use on Atomic Submarines. Later I was transferred to Electronic Maintenance, giving me a wider range--thanks to NRI, I earned a promotion."

JOHN M. ELWELL
San Jose, Calif.

"I found the NRI Electronics Course to be exactly as advertised. Lessons, kits, and service were beyond reproach. While in the midst of the course I got my first job in the field, writing electronics maintenance manuals for General Dynamics Astronautics. I also began servicing radios, TV receivers and other home-entertainment equipment. Since then, I have worked as an electronics technical writer for the Ampex Corp., and I am now writing documentations for diagnostic programs used to help service IBM systems. I have earned over $10,000 during the past year."

Television Test Equipment: A Modern Color Generator

BY EDWARD B. BEACH

To be able to successfully compete in today's TV servicing field a person must have:

(1) Technical competence
(2) Quality test equipment
(3) Experience

NRI training will prepare a person for number ONE above, and numbers ONE and TWO together, plus some time and patience, will produce number THREE automatically.

It used to be, some years ago, that all the test equipment a person needed to service TV was a good vtvm and an oscilloscope (plus a tube tester for the customer!). Now, however, in addition to the old faithful vtvm and scope, one must have a color generator to service and align the ever increasing number of color receivers on the market, plus lots of numbers ONE and THREE above. New sets as well as old have to be converged and aligned before they are ready for the customer.

There are many good makes and models of TV color generators on the market today. Most produce the desired convergence and color patterns. Many use transistors. Some have special video features. Others don't. Some operate from batteries. Some operate from ac. Until now, no commercially available color generator offered so many quality features in a single instrument as the new CONAR Model 680 Color Generator.

This unit offers:

(1) Digital integrated circuits.
(2) FOUR crystal controlled oscillators.
(3) Battery OR ac operation.
(4) NINE video patterns to speed convergence adjustments.
(5) Small size and weight for portability.
(6) All printed circuit construction.
(7) Kit or wired construction.
(8) Two simple alignment procedures.

Before describing the CONAR 680 in more detail, let us first give a brief look at the topic mentioned in (1) above-digital integrated circuits. Both digital and linear integrated circuits are terms that are fairly new to most service technicians but which will be as commonplace as "sync" and "vtvm" tomorrow.

MAKING TRANSISTORS AND INTEGRATED CIRCUITS

Technical advances in the art and science of semiconductor manufacturing was probably the single largest contribution to the rapid development of the integrated circuit. Continuing advances have improved the quality and yield of these integrated circuits to such an extent that prices have dropped and they are now practical to incorporate into low volume, low-priced consumer products (such as TV receivers, FM tuners and receivers, and now color generators).

The Planar Process.

The planar process is essentially a multi-step photolithographic masking process in which individual transistors (or ICs) are formed on a slice of semiconductor material. The process begins with a single crystal of semiconductor material (usually N type silicon). The slice, or wafer, is coated with a thin film of photo-resist material and exposed through a photographic negative to form the base area image as shown in Fig. 2. Multiple photographic tech-

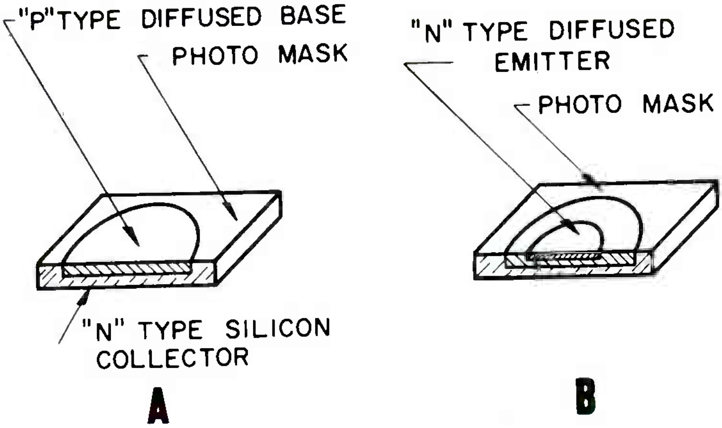


Fig. 1. Forming base (A) and emitter (B) in the planar process.

niques are used so that hundreds (400 to 1000) of transistors are formed at one time on a single wafer.

Next the image is developed and the base area is left exposed while the collector area is protected by the photo-resist. The masked wafer is then subjected to diffusion by a gaseous P type material to form the base. After diffusion, the photo resist is scrubbed off and a new coating put on the entire wafer.

The emitter image is then exposed photographically with the new negative carefully aligned with the already formed base areas. Developing the emitter image exposes a portion of the base area which is next diffused with N type material to form the emitter. (See Fig. 1). Finally the wafer is scrubbed and sliced up into individual transistors, each of which is then mounted on a "header" (usually by soldering) and leads attached to the emitter and base.

A little thought will show that by this multi-step photographic process, complete circuits can be formed almost as easily as individual transistors. Resistors and conductors can easily be formed. Capacitors and inductors are a bit more complex and take up quite a bit of "real estate" on the wafer, and are thus avoided whenever possible in making ICs.

Resistors are made simply by laying down areas of semiconductor material. Conductors are produced by a metalization process (in masked areas of the wafer) in which some metal, such as aluminum, is evaporated onto the wafer. Two metalized layers separated by silicon dioxide make a small capacitor. Diodes are as easy to make as resistors or transistors. For this reason, the final configuration of an IC may appear more complex, electrically, than necessary to perform a given function such as with discrete component "conventional" RCL-transistor circuits.

DIGITAL AND LINEAR CIRCUITS

Although ICs can be made to form almost any of the usual electronic circuits, there are certain circuits which are more suited to integration than others. As noted earlier, fabrication of diodes, transistors and resistors is a fairly simple process whereas capacitors and inductors are somewhat more difficult. Also, it is not practical to "grade" transistor characteristics within an IC. That is, all transistors of the same type formed on an IC wafer will have the same electrical characteristics - Beta, cutoff frequency, switching time, power dissipation, etc.

For these reasons, the first ICs made,

and by far the majority manufactured today, were for use in digital switching circuits used in computers and control equipment. In these applications, the transistors and diodes act as gates or switches which are required to be either "on" or "off". They are generally required to have small switching times (in the nanosecond or 10^{-9} sec. range) in order not to introduce delay to the signals. In these applications the uniform non-graded IC transistor characteristics are an asset.

The other broad class of IC is the linear circuit, used mainly as operational amplifiers, rf amplifiers, i-f amplifiers and audio amplifiers. Although no more complex electrically than some digital ICs, linear ICs require much more closely controlled resistor and transistor parameters and rely heavily upon external feedback and stabilizing components for their linear operation.

Although linear IC technology is advancing at a very rapid rate, the digital ICs still represent a large majority of the ICs being manufactured today, and were selected to be used in the Conar 680 Color Generator.

LOGIC SCHEMES-RTL

The actual types of switching or digital circuitry employed in ICs fall into several broad classifications called "logic schemes". The subject of logic schemes is a study in itself and will not be investigated here at this point in any detail. We will, instead, look at the type of digital logic used in the CONAR 680 - the Resistor Transistor Logic or RTL.

RTL Gates.

The basic configuration of an RTL gate is shown schematically in Fig. 2. Quite simply, this circuit consists of two (or more) common emitter transistor amplifiers sharing a common collector load resistor. Each transistor has a current limiting base resistor in series with the input lead.

Assuming that both inputs of Fig. 2 are

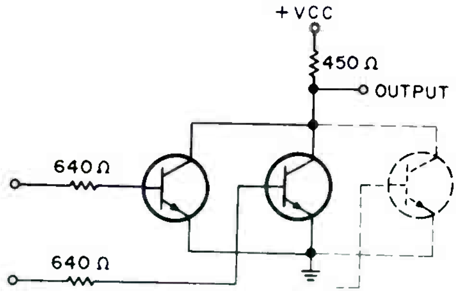


Fig. 2. RTL gate circuit.

either open circuited or connected to the emitter (grounded), and a collector supply voltage V_{CC} is present, then the output voltage at the collector(s) is approximately V_{CC} volts since neither transistor is conducting (very small leakage currents assumed).

The dissipation in either transistor is extremely low under these conditions because of the low transistor currents. Typically, with 3.0 volts supply voltage and a 1.0 microampere collector current for each transistor, the total dissipation is a mere 6.0 microwatts!

Now if either input is returned to a positive voltage of from 1.0 to 3.0 volts, the corresponding transistor will be driven into saturation. The collector voltage will drop to the value of about 0.3 volts. The collector current is set by the collector load resistor (450 ohms) and will be approximately: $(3.0 - 0.3) \div 450$ which is 0.006 amps or 6 ma. This will result in a transistor dissipation of: 0.3×0.006, which is 0.0018 watts or 1.8 mw, still a very low value. This is one of the attractions of the RTL logic scheme - low dissipation under all conditions.

Notice that the output voltage drops to almost zero (0.3V) when EITHER input is raised to a positive level. When one transistor is saturated by a positive input, the condition of the other input is unimportant, since under no circumstances can its condition affect the output. Thus this circuit can be defined as a two-input NOR gate (NOT - OR) in symbolic logic terms. This means that if input One OR input Two is positive, the output is NOT at a high positive level.

This circuit could also be called a NAND gate (NOT - AND) in symbolic logic terms if we say the output is at a high positive level when input One AND input Two are both NOT at a positive level (zero).

If we define any positive voltage between 1.0 and 3.0 volts as a logical ONE (1), and any voltage below 1.0 volt as a logical ZERO (0), then zeros at all inputs result in a one at the output. A one on any input will result in a zero at the output. These are the only conditions we need concern ourselves with in investigating the behavior of RTL circuits. Keep these thoughts in mind as we continue.

Fig. 3. NOR/NAND gate logical symbol.

A convenient (and conventional) symbol is used in digital circles to represent the NOR/NAND gate just described, and is shown in Fig. 3. Each input is a line going into the curved portion of the "bullet", and the output line is on the right at the point of the bullet. The small circle at the output indicates inversion of the output (making the gate a NOR gate). The collector supply voltage and ground connections are usually omitted for clarity unless special connections are made which make these terminals necessary.

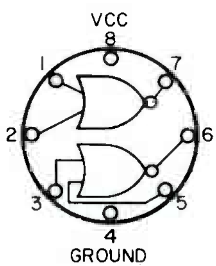


Fig. 4. Basing of 914 dual 2-input gate.

Fig. 5. Type 914 IC (left); TO5 transistor (right).

The RTL ICs used in the Conar 680 are type 914 dual two input NOR gates, each containing two of the two input circuits just discussed. Fig. 4 shows the lead arrangement of the eight-lead 914 IC. A total of 16 such devices are used in the Model 680, amounting to 64 transistors and 96 resistors! To give you an idea of the size of the 914, Fig. 5 shows one in comparison to a conventional transistor in a TO5 case. Only four separate transistors are used, three as crystal oscillators (sound carrier, offset color subcarrier and rf carrier) and one as a power supply regulator.

Block Diagram.

Before looking at the individual circuits of the Model 680, let us examine the overall block diagram as shown in Fig. 6. The various timing signals are produced by the 189 kc crystal oscillator, IC1, and the chain of six dividers. The 189 kc oscillator is unusual in that it (1) uses an IC, and (2) produces complementary square wave outputs (complementary means two outputs are available, 180° out-of-phase). One of the 189 kc outputs drives the divider chain, IC2, IC3, IC4, IC5, IC6, and IC7, as shown to provide three useful output pulses - 15,750 cps, 900 cps and 60 cps. The 15,750 cps and 60 cps outputs of the divider chain are shaped by IC8 and IC9 to form horizontal and vertical sync AND blanking pulses which are fed to the video mixer, IC10.

Assuming for the moment that S2 is in the position shown in Fig. 6 (M is for "multiple"), we will now see how the convergence patterns - dots, crosshatch,

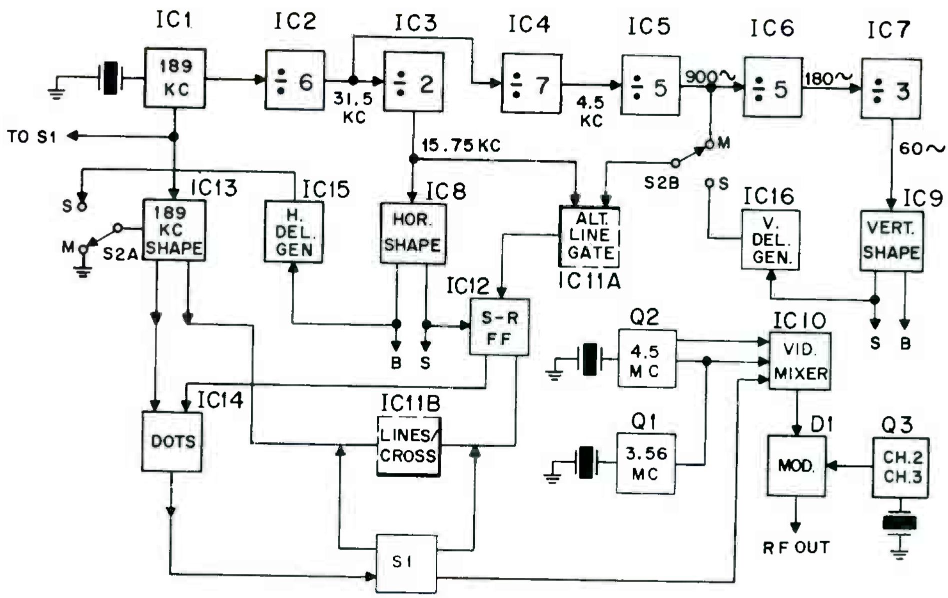


Fig. 6. Block diagram of the CONAR Model 680 Color Generator.

horizontal lines and vertical lines - are produced.

To be able to produce horizontal lines and dots exactly one scanning line thick, two special gates - IC11A and IC12 are used. IC12 is a SET-RESET flip-flop which is SET by the pulse from the Alternate Line Gate, IC11A, and RESET by the horizontal sync pulse from IC8. In operation, 900 cps pulses and 15,750 cps pulses are fed to IC11A which will produce an output pulse ONLY when the two input pulses coincide.

Because of the interlaced relationship of the two applied signals to IC11A, there will be only 450 simultaneous occurrences a second, so the output of IC11A will consist of a series of 450 cps pulses coinciding exactly with the start of a horizontal scanning line. These pulses SET the flip-flop, IC12, and the next horizontal sync pulse, at the END of the horizontal scanning line, RESETS the flip-flop so that the output if IC12 is a series of complementary pulses EXACTLY ONE HORIZONTAL PERIOD IN DURATION, OCCURRING AT A 450 CPS RATE. No adjustments are required of these digital circuits to make them produce the desired output pulses.

IC13 is another shaping circuit which produces narrow complementary 189 kc pulses used for dots and vertical lines. The outputs of IC12 and IC13 are fed to IC11B and IC14 to produce the desired convergence patterns as selected by S1. IC11B is connected as an OR gate which basically combines the 450 cps and 189 kc signals to produce a crosshatch pattern. By removing the 189 kc signal and grounding its input, the output of IC11B is horizontal lines only. Similarly, by removing the 450 cps signal and grounding its input, the output is vertical lines.

IC14 is an AND gate which is also fed 189 kc and 450 cps pulses. The result is to produce an output pulse only at the intersection of the crosshatch grid, when the 189 kc and 450 cps pulses occur simultaneously. The output of IC14 is also fed via S1 to the video mixer, IC10.

For generation of color bars, a 189 kc square wave from IC1 is sent to the video mixer IC10 via S1. At the same time, the 3.56 mc crystal oscillator, Q1, is switched on and also fed to the video mixer. The 4.5 mc sound carrier, Q2, can be switched on in any position of S1 to add a 4.5 mc sound carrier to the composite video signal. This oscillator may be used to adjust sound traps in the color receiver.

Switch S2 provides an additional four functions for the convergence functions of the Model 680. When this switch is placed in the S position, the action of the 189 kc shaper and Alternate Line Gate are modified to produce SINGLE functions as selected by S1: a single dot in the center of the screen, a single cross in the center of the screen, a single vertical line or a single horizontal line. These functions greatly simplify setting static convergence, centering, and central dynamic convergence adjustments (by eliminating lines or dots which otherwise might confuse the operator making the adjustments).

When S2 is in the S position, the following actions take place:

The 189 kc shaper is converted into a gate circuit which is fed pulses from a 15,750 cps delay generator, IC15. This delay generator is driven by the horizontal blanking pulse from IC8 and is adjusted to produce an output pulse one half a scanning line after the blanking pulse, in the center of the scanning line. This pulse allows only the 189 kc pulse that occurs in the center of the horizontal scanning line to be generated and fed to the dot and crosshatch/line gates.

A 60 cps delay generator, IC16, is similarly driven by the vertical sync pulse from IC9 to produce a single output pulse that occurs midway between the vertical sync pulses. That is, half way down the screen on the receiver. This delayed 60 cps pulse is fed to the Alternate Line Gate instead of the 900 cps pulse (via S2), resulting in a single horizontal line occurring at the center of the receiver screen, produced by flip-flop IC12.

The two delay generators may be adjusted to move the single dot/cross/line pattern to positions other than the center of the receiver screen if desired. However, the adjustments are best made once and left alone to aid in locating the center of the screen for centering adjustment purposes.

A crystal-controlled overtone carrier oscillator, Q3 (channel 2 or 3 available on order from CONAR), produces a highly accurate rf carrier for the modulator, D1, a forward biased silicon diode. Exact carrier frequency is very important in a color generator because an improperly placed carrier can lead to complete loss of the color signal or, perhaps worse, a shift in the phase of the color subcarrier in the receiver resulting in the production of incorrect colors.

By using a crystal controlled carrier oscillator (as the television stations do) you are assured that the rf carrier is exactly on 55.25 mc or 61.25 mc, and that if the receiver is properly adjusted the colors will be truly represented on the screen.

Power Supply.

Not shown in the block diagram of Fig. 6 is the power supply for the Model 680. Both battery and ac operation are provided in the power supply section of the 680. This is practical because of the low power requirements, less than one watt at 6V dc. On ac, a full-wave rectifier is used whose output is stabilized at approximately 6V by a Zener diode and transistor electronic filter shown in Fig. 7. This combination provides good regulation of the output voltage for line voltage variations from 100V to 140V ac.

For battery operation, the regulator section of the power supply is bypassed and four series connected D cells are connected directly to the 6V line. Under intermittent duty conditions a set of batteries should give 40 or 50 hours service. Heavy duty cells will last much longer; however they are not really necessary.

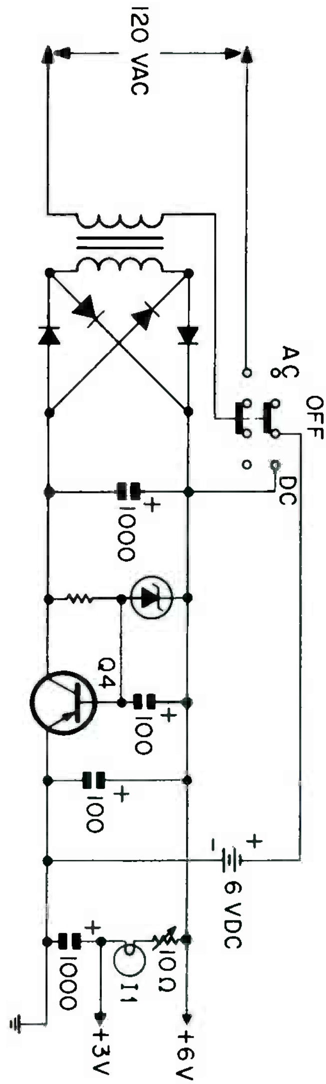


Fig. 7. Model 680 power supply.

The integrated circuits require a nominal 3.0 volts for their operation, while the three crystal oscillators operate from the 6V supply. Since the 3.0V load is a constant load, it can be very simply obtained by dropping the regulated 6V supply with a dropping resistor. As shown in Fig. 7, this dropping resistor combines a potentiometer (10 ohms) and a pilot lamp, I1. Using the lamp for a dropping resistor gives us a "free" pilot lamp on both ac and dc operation. The potentiometer allows compensation of the 3V supply for aging of the batteries, and is called a "stability" control for the dividers in the timing chain of the Model 680.

MODEL 680 CIRCUITS

The dual two-input type 914 RTL gate is used in a number of different configurations in the CONAR 680 color generator. In this section we shall examine a few of the various ways in which it is used.

Inverter.

Consider first a simple inverter connection as shown in Fig. 8, using one-

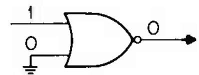


Fig. 8. Half a 914 connected as an inverter.

half of a 914 gate. Here, a "one" at the input (positive voltage) produces a "zero" (approximately zero voltage) at the output and vice versa. Thus the input signal is inverted. Notice that when used as an inverter, one of the two input leads is grounded (has a permanent "zero") so one of the two transistors in the gate is not used.

Shapers.

A simple extension of the inverter circuit will produce the shaper circuit shown in Fig. 9. Again, one input is grounded

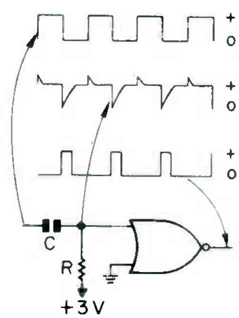


Fig. 9. Half a 914 connected as a shaper.

while the second is connected through resistor R to the 3-volt line, making the output normally "zero". Applying a pulse input signal through capacitor C has the following effects:

(1) If R and C are of the correct size

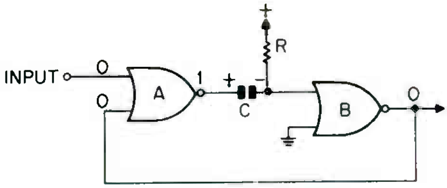


Fig. 10. Monostable multivibrator.

the pulse train is differentiated (spiked).

(2) Positive spikes have no effect since the gate is already saturated.

(3) Negative spikes turn the gate off, producing narrow, positive going pulses at the output as shown.

By proper choice of R and C values, a pulse train can be narrowed to produce uniform positive going output pulses. This circuit is used to produce the horizontal and vertical sync (narrow) and blanking (wider) pulses as well as the narrow 189 kc pulses.

Monostable MV Dividers.

The shaper circuit just described combined with the other half of the 914 gate is used in the monostable multivibrator of Fig. 10 that is used in all the divider stages and the two delay generators.

With no input to A, stage B is saturated, producing a "zero" which is in turn fed back to stage A whose output is thus a "one" since both its inputs are "zeros". Capacitor C is charged as shown since the "one" at the output of A will be higher than the "one" at the input of B. A positive pulse applied to the input of A will produce a "zero" at its output. Capacitor C will discharge through R making the input to B go negative ("zero").

The output of B then goes to "one", holding A saturated until C has discharged sufficiently to allow the voltage at the input to B to go positive once more. During this interval, it does not matter what goes on at the other input to A since the output from B will keep the gate closed to further inputs.

Thus two, three, four, or more pulses may be applied to A while C is discharging. The result is B (and A) produces a single pulse for several input pulses, the exact number being determined by R and C. Thus frequency division is produced. Notice that only one RC network is required instead of the two in a conventional free-running multivibrator.

When C has discharged, the input to B goes positive and its output goes to zero. Assuming the other input to A is also zero at this time, C is charged quickly to the polarity shown through the collector resistor of A and the base resistor of B (not shown here, but equal roughly to 1 k).

Set-Reset Flip-Flop.

The set-reset flip-flop used to generate horizontal lines is shown in Fig. 11. This is a very simple flip-flop and is often referred to as a "latch". The output of A is fed to one input of B while the output of B is fed to one input of A as shown.

With the "ones" and "zeros" as shown in Fig. 11, the second input to A can be either a one or a zero and nothing will happen at the output due to the one at the other input of A. If, however, a one is applied to the second input of B with the latch as shown in Fig. 11, the output of B goes to zero and with two zeros at the input of A, its output goes to one, latching the output of B at zero. Now the situation is reversed and the second input to B can be a one or a zero and the latch will not flip. Thus the latch will respond to alternate ones applied to the two inputs and will ignore any other inputs.

The 189 kc crystal oscillator is a modi-

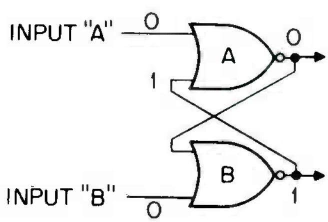


Fig. 11. Set-reset flip-flop.

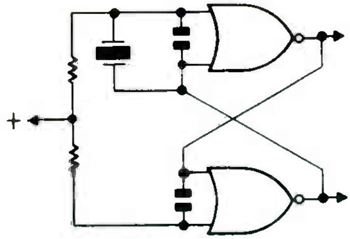


Fig. 12. A 189 kc oscillator.

fication of the latch and is shown in Fig. 12. The crystal operates in the series resonant mode in this circuit.

AND Gate.

The circuit for the alternate line gate is shown in Fig. 13 and uses one half of a 914 dual gate. 900 cps and 15,750 cps pulses are applied through differentiation networks to the two inputs of the gate. Normally, with both inputs returned to the 3V supply through R1 and R2, the output of the gate is low (zero). Negative spikes will tend to bring the gate out of saturation; however this will not occur except when both inputs have a negative spike simultaneously. Since 15,750 cps is exactly 17-1/2 times 900 cps, this occurrence will take place every 35 horizontal lines. Since there are 262-1/2 lines in each field (1/60th of a second) the gate will produce 7-1/2 pulses (262-1/2 ÷ 35) each field. With the interlacing of the two fields, the total of 15 pulses will be generated every frame, offset by 17-1/2 lines.

Video Mixer.

The video mixer uses a rather unusual arrangement and is shown in Fig. 14. The 914 dual gate is used in this circuit

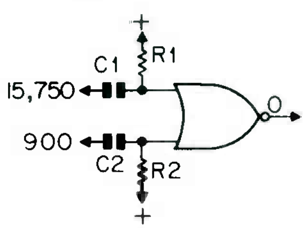


Fig. 13. Alternate line AND gate.

as a three input common collector (emitter follower) mixer in which sync signals are fed to two inputs while either horizontal blanking or 189 kc square-wave signals are fed to the third input. Vertical blanking and video signals are resistively mixed at the emitter load resistor as shown.

Sync and blanking signals are positive going pulses. The sync pulses drive the IC into heavy saturation so that any signal resistively mixed at the emitter and occurring at the same time as the sync signals will cause no effect at all, thus assuring solid sync at all times. With S1 in the convergence pattern positions (all except "color"), reduced level horizontal blanking pulses are also applied

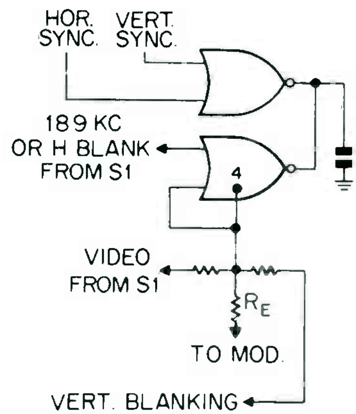


Fig. 14. Video mixer.

to the IC mixer to eliminate video pulses during horizontal retrace. A scope waveform showing two horizontal lines is in Fig. 15.

With S1 set to the "color" position, horizontal blanking is fed to the emitter, and acts like a video signal. The 189 kc square wave is fed to the base of the IC formerly fed by horizontal blanking, and in addition to allowing the color carrier to pass as a video signal, it places a notch on the "back porch" of the horizontal blanking pulse, which will also accept color information to act as a color burst as actually transmitted by the TV station.

Fig. 15. Video waveform at mixer output.

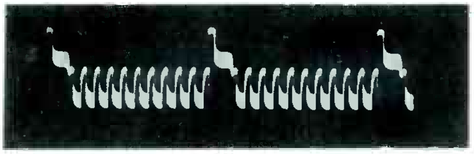


Fig. 16. Color bar video waveform at mixer output.

The resulting composite video signal, shown in Fig. 16, is almost identical to a received color signal so that the receiver chroma operation can truly be checked by the color bar pattern generated by the Model 680.

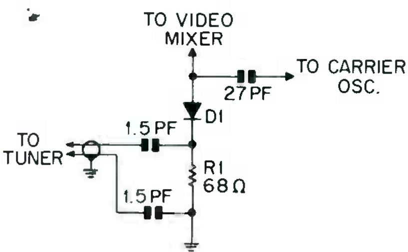


Fig. 17. Diode modulator.

Diode Modulator.

The modulator circuit is shown in Fig. 17. D1 is the modulator diode and is directly connected to the video mixer load resistor of Fig. 14. The 68-ohm resistor is the diode load resistor. Video mixer current forward biases D1 to a linear operating point while rf from the carrier oscillator switches D1 on and off to produce modulated rf across R1. Output is taken from R1 via the two 1.5 pf capacitors.

These capacitors reduce the nominal 2-volt signal to a more useful level of 10,000 to 50,000 microvolts suitable for application to the TV tuner. At the same time they provide effective isolation so that the generator is safe for use with transformerless receivers as well as with transformer operated sets.

The sound oscillator and color subcarrier oscillators are conventional common collector (hot emitter) Pierce crystal oscillators and will not be described in detail. One feature of the color oscillator worth noting is a phase adjustment capacitor to provide exact adjustment of the offset color subcarrier oscillator phase for exact color reproduction.

CONSTRUCTION, ADJUSTMENT, AND OPERATION

All parts except the power transformer, switches, batteries, color control and one resistor and one capacitor are mounted on a 6" × 9" printed circuit board. This type of construction assures uniformity from one generator to another and makes "wiring" the kit a relatively fast job. The circuit board is mounted on a frame which is hinged to the top of a 10" × 3" × 8" chassis as shown in Fig. 18. (this figure as well as Fig. 19 are photos of hand-made prototype models. Production models differ slightly in parts position from these two figures.) The hinged circuit board makes it easy to connect the leads from the panel controls to the circuit board and at the same time gives instant access to the batteries.

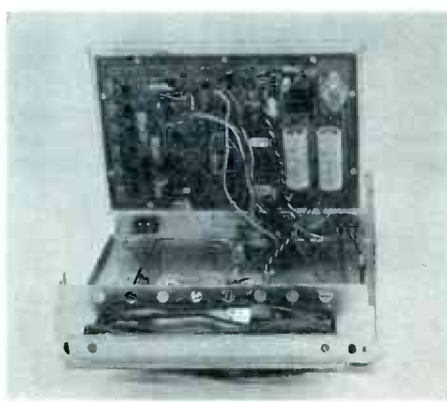


Fig. 18. Rear of CONAR Model 680 Color Generator with circuit board raised.

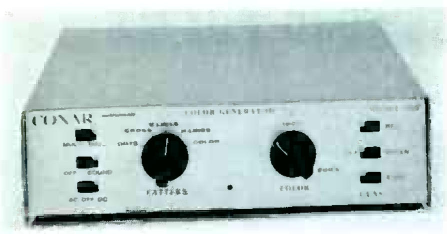


Fig. 19. Front of CONAR Model 680.

A handle on the rear of the chassis provides a convenient place to store the leads (rf output, gun killer and ac line cord) when carrying the generator or when it is not in use. The 10-ohm stability control is also located on the rear of the chassis. The line cord is a detachable TV interlock type you can remove if desired. It also serves as a handy "cheater" should you misplace your regular one - the 680 doesn't really need it! Rubber feet on the bottom of the chassis protect the finish of TV receivers the 680 may be placed on.

Fig. 19 shows the locations of the various controls on the front panel. The three slide switches on the right side are the gun killer switches. The knob to the left of these switches is the color amplitude control, and the knob to its left is the function switch, S1.

The upper slide switch on the left is the MULTIPLE - SINGLE function switch for the first four positions of S1. The middle switch turns the 4.5 mc sound carrier on and off, and the three position switch at the bottom is the power switch - ac "on" to the left, center "off" and dc "on" to the right.

The only adjustments needed for the complete Model 680 are the six monostable multivibrator dividers and the two delay generators. Two procedures for initial adjustment are given in the assembly manual - one using the TV receiver itself, and the other using an oscilloscope. After setting the stability control for a supply voltage of 3.0V dc, it is a simple matter to adjust the dividers for the correct division ratios: 6,2,7,5,5 and 3. Once adjusted, these dividers are quite stable, being subject only to variations in battery voltage. A slight compensation with the stability control will lock all signals rock steady until the battery voltage drops below approximately 5.4V. Then you need new batteries. (Severe changes in temperature might also call for stability adjustment on ac operation. This is much easier, however, than a long wait while the generator "settles down".)

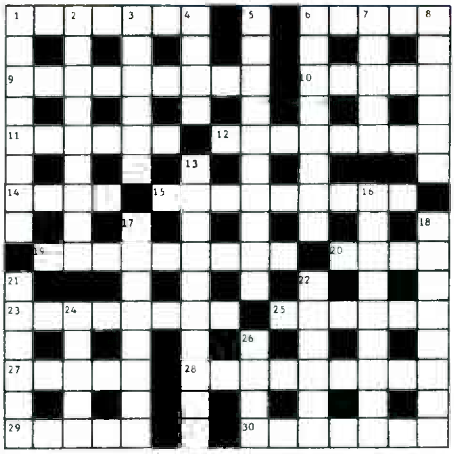
To operate the Model 680, simply connect the rf connector to the vhf antenna terminals of the receiver and set the channel selector to the correct channel (2 or 3). Attach the lead-piercing gun killer clips to the CRT grids and ground, and turn on the 680 and the receiver.

In use, the 680 is like most other color generators and should be operated in accordance with the alignment instructions of the receiver you are servicing. Usually you begin with purity and static convergence adjustments, so set the function switch to DOTS (single or multiple) and make these adjustments. Switching to CROSSHATCH (or LINES) lets you go ahead with the dynamic convergence adjustments. Finally, check chroma circuit operation by switching to COLOR. The fourth bar from the left on the screen should be magenta if the receiver is set for normal operation (afpc, tint, color killer, etc.).

CONCLUSIONS

The CONAR Model 680 Color Generator represents the finest generator with the most modern, up-to-date features available on the market today - both kit and factory wired. No generator made today offers so many fine features: four crystal-controlled oscillators - all digital circuitry using computer type integrated circuits - battery or ac operation as standard - nine switch-selected patterns - TV station quality composite video signals, including "back porch" color burst - all at low CONAR quality prices.

ELECTRONICS CROSSWORD PUZZLE



By Michael Kresila

ACROSS

1. The movement of electrons through a conductor.
6. Unit of power gain or loss using the system of logarithms as its base.
9. Tube producing frequency modulation.
10. Up or down movements of a TV camera.
11. An electromechanical transducer that transforms an electrical input into a mechanical output, such as in the recording medium.
12. Causes improper reductions of sound or images.
14. A sound sensation having a pitch.
15. Devices for obtaining radio waves.
19. Indicator of readings of gauges involving electrical transmission between points.
20. Slang for ammunitions.
23. An oscillator whose output frequency and amplitude are variable.
25. The arched upper surface of the human foot.
27. To set over again.
28. To register or place on a list (variable).
29. Acoustic radar.
30. Relating to calculation by numerical methods or discrete units.

DOWN

1. The ratio of the charge stored in a capacitor to the voltage producing the charge.
2. The part of impedance offered to the flow of ac by the inductance or capacity of a part or circuit.
3. Banished or expelled.
4. A decimal prefix designated by the symbol T.
5. Unit equal to 100th of a meter.
6. Oscillating antenna feed for producing a deflection of the beam in which the plane of polarization remains fixed.
7. A relay with a permanent magnet that centers the armature.
8. A material used to protect the desired portions of the printed circuit from the action of the etchant.
13. Transmission and reception of images or moving objects by means of radio waves traveling through space or over wires.
16. Abating for a time or at intervals.
17. An amplifying station used to boost the volume on long telephone lines.
18. Where the sick and injured are given treatment.
21. A beginning or onset.
22. A system on which the performance of measurements gives information about class of mathmatical problems.
24. Let up.
26. Excessively dry.

SOLUTION TO PUZZLE
ON PAGE 21

MODERN MARVEL COMBINES FEATURES OF TRANSISTORS AND VACUUM TUBES

By WILLIAM F. DUNN

The theory of the field-effect transistor was evolved before that of the transistor itself, in the late forties. Oddly enough, it has only been used extensively commercially in the last two or three years.

You CAN be sure that the FET is going to be used widely in the future; it offers the advantages of the transistor, along with many of the characteristics of the vacuum tube. It's to your advantage to understand how it works.

In the field-effect transistor we have a current path, and we can control the current in this path just as effectively as the grid of a tube controls the cathode plate current. Like the grid, the control element in the field-effect transistor does not draw current from the source. Let's see how this effect, so remarkable for a solid-state device, is accomplished.

One type of field-effect transistor can be made by taking a piece of N-type material, as shown in Fig. 1. If the negative terminal of a battery is connected to one end of the material and the positive side of the terminal to the other end, electrons will flow through the material as shown.

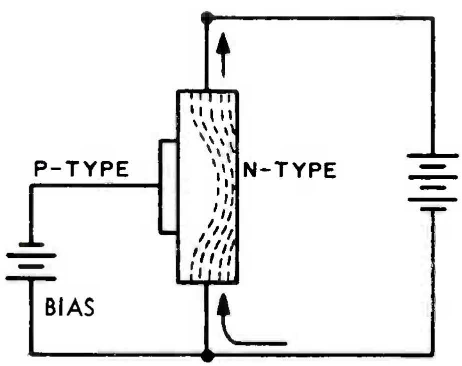


Fig. 1. Drawing showing the basic operation of a field-effect transistor.

If we attach a piece of P-type material to one side so that a PN junction is formed and then place a negative voltage on the P-type material, as shown in Fig. 2, there will be no current flow across the junction, because the battery biases the junction in such a way that electrons cannot flow from the N-type material to the P-type material.

Nor can holes flow from the P-type material to the N-type material. However, the negative voltage applied to the P-type material sets up a field in the N-type material. This field opposes the electrons flowing through the N-type material, and forces them to move over to one side so that the electron movement follows the path shown in Fig. 1.

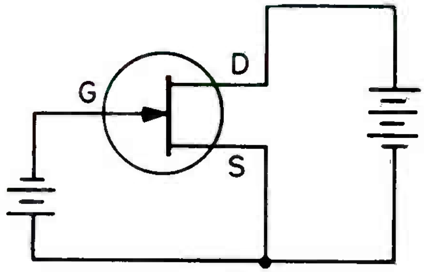


Fig. 2. Schematic representation of the circuit shown in Fig. 1.

The negative voltage applied to the P-type material has the effect of increasing the resistance of the N-type material in the area in which the field is affected. It forms a depletion layer around the junction, so there will be no free electrons in the N-type material near the junction.

If the negative bias voltage is made high enough, it is able to prevent the flow of electrons through the N-type material entirely, so that the current flow will be cut off. We call this voltage, where the bias voltage is high enough to stop the flow of current through the N-type material, the "pinch-off" voltage. The N-type material is referred to as a channel, and the P-type material as a gate. This type of transistor is called a "junction field-effect transistor".

The schematic representation of the circuit shown in Fig. 1 is shown in Fig. 2. Notice that the end of the N-type channel, at which the electrons from the battery enter, is called the "source". The other end, the end from which the electrons leave and flow to the positive terminal of the battery, is called the "drain". The P-type material is called the gate, as we mentioned previously. The transistor is called a field-effect transistor because it is the field produced by the bias voltage applied to the gate that controls the flow of current through the channel.

This particular type of transistor is called a junction transistor because a junction is formed between the P and N-type materials. It is called an N channel transistor because the material in the channel through which current flows has been treated in such a way as to produce an N-type semiconductor material.

Thus the complete name for this type of transistor is an N-channel, junction-gate, field-effect transistor. We usually abbreviate field-effect transistor FET, so you will see that this type of transistor is abbreviated JFET to indicate it is a junction gate type.

An amplifier using a field-effect transistor of this type is shown in Fig. 3. In this circuit we have eliminated the bias battery by means of a resistor connected between the negative terminal of the battery and the source. This resistor might be compared to the cathode-bias resistor in a triode vacuum tube am-

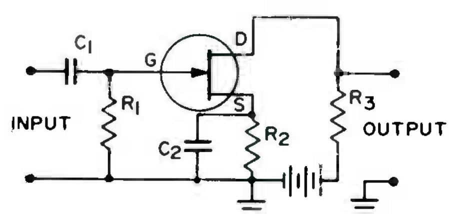


Fig. 3. An amplifier using an N-channel junction-gate FET.

plifier stage. In the amplifier circuit, electrons flow from the negative terminal of the battery through the resistor R_2 to the source. In so doing they set up a voltage drop across R_2 having a polarity such that the source is positive with respect to ground. Since the gate connects back to ground through R_1, the gate will be at ground potential and this will make the source positive with respect to the gate, or in other words, the gate negative with respect to the source. Therefore none of the electrons in the N channel will flow to the gate, because the gate is negative.

Electrons will flow through the N channel to the drain and then through the load resistor R_3 back to the positive terminal of the battery. As the input voltage applied across the input terminals causes the voltage between the gate and the source to vary, the current flow from the source to the drain will vary because the controlling action of the gate on the current through the channel depends upon the voltage between the gate and the source.

Thus we have a varying current, which will vary as the input signal varies, flowing from the source to the drain of the transistor and through the load resistor R_3. This varying voltage flowing through R_3 will produce an amplified signal voltage across R_3.

It is interesting to note the similarity between the circuit shown in Fig. 3 and a triode amplifier. When the input signal swings the gate in a positive direction, current flowing through the transistor will increase; this will cause the voltage drop across R_3 to increase and therefore the voltage between the drain and ground will decrease. Thus a positive-going signal applied to the gate will cause a negative-going signal at the drain; this transistor inverts the signal phase just as the triode vacuum tube amplifier stage does.

P Channel JFET.

It is possible to make a P-channel junction-gate field-effect transistor by using a P-type material between the source and drain. The gate is then made of an N-type material. The bias polarity is reversed so that once again the PN junction is biased and no current flows across the junction.

A schematic diagram of an amplifier using a P-channel junction-gate effect is shown in Fig. 4. Notice the schematic symbol for the P-channel unit; we have turned the direction of the arrow around just as we did to distinguish between NPN and PNP transistors. Also notice that in this circuit the battery polarity is reversed. This is because the carriers in the channel in the P-channel unit will be holes. The positive terminal of the battery which connects to the source through

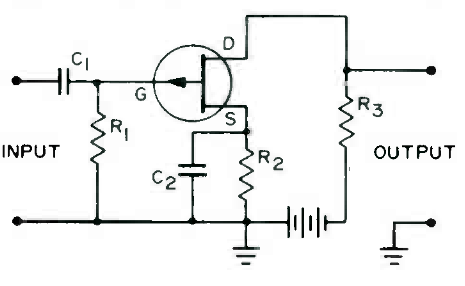


Fig. 4. An amplifier using a P-channel junction-gate FET.

R_2 repels the holes and they travel through the channel to the drain where they are attracted by the negative potential connected to the drain.

Meanwhile, holes arriving at the drain terminal are filled by electrons which flow from the negative terminal of the battery through R_3 to the drain. At the same time, the positive terminal of the battery attracts electrons from the source, creating new holes. These electrons flow from the source through R_2 to the positive terminal of the battery.

The operation of the P-channel junction-gate effect is the same as with the N-channel unit, except that in one case the majority carriers are electrons, and in the other case they are holes.

In discussing the action of the junction-gate field-effect transistor, we often refer to the reverse bias across the junction creating a depletion layer in the conducting channel. In the case of an N-channel unit, the negative voltage on the P-type gate will repel electrons at the junction so that the electrons have been depleted from that area around the junction. The higher the negative voltage the further the electrons are depleted in the area around the junction.

As we pointed out previously, if the voltage is made high enough, all of the electrons will be depleted, so that there will be no current flow through the channel. The transistor is referred to as a depletion-type transistor because the bias depletes the number of majority carriers from the channel around the junction region. Remember what we mean by a depletion type of FET; you'll see later there is another type.

THE INSULATED GATE FIELD-EFFECT TRANSISTOR

The transistors we have been discussing so far are called junction-gate field-effect transistors. There is another type of field-effect transistor that is called an insulated-gate field-effect transistor. We usually abbreviate this IGFET.

In the insulated-gate field-effect transistor, the gate is completely insulated from the channel by a thin insulating material. For example, a very thin piece of glass might be placed between the conducting channel and the gate. Thus there is no actual junction formed between the semiconductor materials in the channel and the gate. In an N-channel, insulated-gate field-effect transistor, construction such as shown in Fig. 5 is often used. Here we have an N-channel between the source and drain. The substrate on which the channel material is mounted is P-type material and the gate is

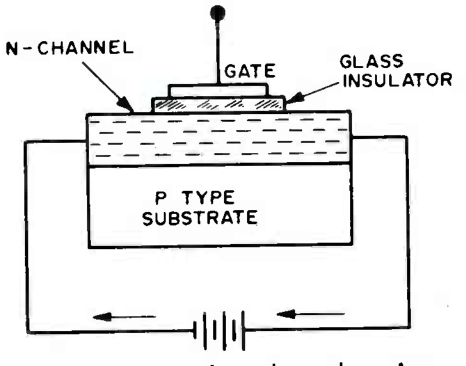


Fig. 5. Current flow through an insulated-gate, N-channel field-effect transistor with no bias applied.

placed along the channel as shown in the figure. The thin layer of glass prevents any actual contact between the channel and the gate.

In operation, as shown in Fig. 6, the source and the substrate are connected to the negative terminal of the battery and the drain is connected to the positive terminal. This will permit current to flow from the negative terminal of the battery to the source, through the channel to the drain and then back to the positive terminal of the battery.

When a negative voltage is applied to the gate, it has the effect of repelling electrons away from the gate as before. In addition, the negative potential applied to the gate attracts holes in the P-type material so that the width of the channel is reduced.

Thus the current flow through the channel is restricted by the narrowing of the channel. In effect, the resistance of the channel is increased. We refer to this type of channel as a depletion channel. The transistor is called an insulated-gate field-effect transistor and it is also referred to as a depletion type because the flow of current through

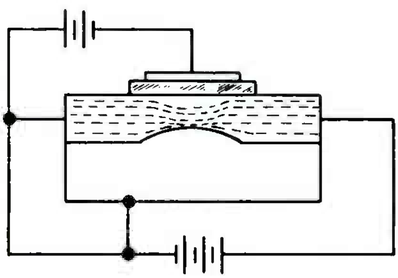


Fig. 6. Current flow through an N-channel IGFET with bias applied.

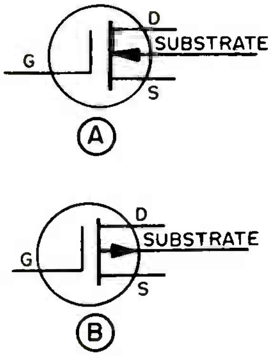


Fig. 7. Insulated-gate field-effect transistors. (A) The schematic symbol for an N-channel unit; (B) the symbol for a P-channel unit.

the transistor is controlled by producing a depletion layer in the channel, as in the case of the junction transistors discussed previously.

Both N-channel and P-channel IGFET's are manufactured. The schematic symbols used to represent the two different types are shown in Fig. 7A and B. In A, we have shown the symbol used for an N-channel type, and in B the schematic symbol used for a P-channel type. In operation, the units perform in essentially the same way as the junction-gate units with the exception that there will be no current flow at all from the channel to the gate or from the gate to the channel. In the JFET, there may be very small leakage current across the junction. However, a JFET has a high input resistance because this leakage current is low. The IGFET has an even higher input resistance because there is no current flow at all from the gate to the channel or from the channel to the gate. Thus the input resistance of an IGFET is almost infinite.

Enhancement Type.

So far the field-effect transistors we have been discussing are all what are known as depletion types. In the depletion type of FET, the channel is formed and a bias is placed on the gate so as to reduce the size or width of the channel. In the enhancement type of field-effect transistor, there is no channel present until the bias is applied to the gate.

Thus, there is no current flow from the source to the drain through the transistor, unless there is a bias applied to the gate. The polarity of the bias applied to the gate is reversed from what it is in the depletion type, and this bias forms the channel through which current can flow. The operation of the units is the same as with the depletion type with the single exception of the reverse bias. In other words, in the case of an N-channel enhancement-type field-effect transistor, instead of placing a negative bias on the gate to reduce the width of the channel, as we do in the depletion-type transistor, in the enhancement-type we place a positive bias on the gate and produce the N-channel.

The enhancement-type field-effect transistor is always an insulated gate type. In the case of a junction FET, if we produced an enhancement type, we would have current flow across the junction because the voltage required to produce the channel would forward-bias the junction. However, in the insulated-gate FET, no current can flow across the junction because we have an insulating material between the gate and the channel. Thus we can put any type of bias we want, either forward or reverse bias, on the gate and we still will not get a current flow from the gate to the channel or from the channel to the gate.

The schematic symbol of an N-type IGFET of the enhancement type is shown in Fig. 8A. Notice that we have indicated there is no channel by breaking the channel into three parts. When the correct bias is applied to the gate, an N-channel between the source and the drain will be formed. The schematic symbol for the P-type unit is shown in Fig. 8B.

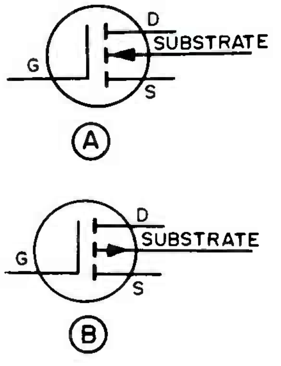


Fig. 8. The schematic symbols for the enhancement type of IGFET's. (A) An N-channel unit; (B) a P-channel unit.

The operation of the enhancement-type IGFET is basically the same as with the depletion type. It could be used in a circuit similar to the circuits shown in Figs. 3 and 4.

One of the problems with IGFET's is the very high resistance between the gate and the channel. In shipping these units the manufacturer usually wraps the leads in tin foil to keep them connected together. If he doesn't do this, static charges can build up on the gate because of the very high resistance between the gate and the channel. These static charges may become high enough to actually puncture the insulation between the gate and the channel and thus ruin the unit.

In soldering a IGFET into a circuit, there might be enough leakage from the power line through the tip of your soldering iron to ruin the FET. To prevent this from happening, ground leads should be used on the various connections to the transistor and these leads should be left in place until the transistor is installed in the circuit. Once the transistor is soldered in place, you do not have to be concerned about static charges destroying the unit, because the resistance in the circuit will be low enough to prevent static changes from building up to a high enough value to destroy the transistor.

Field-effect transistors are finding their way into commercial equipment; therefore you should be sure you understand how they work. Review the sections on field-effect transistors several times if necessary because you can be sure they are going to be widely used in the future. They offer the advantages of the transistor along with many of the advantages of the vacuum tube.

In Memoriam

Since the last issue of the Journal we have received word that the following members of the Alumni Association have passed away. We extend the sympathy of the Alumni Association to their families.

Mr. Harry Voorhoeve, North Vancouver, British Columbia, Canada

Mr. Arthur Custer, Milan, Mo.

Mr. Peter Cherba, Swartz Creek, Mich.

Mr. Edward Hutson, Muskegon, Mich.

Mr. John Nunez, Del Paso Heights, Calif.

Mr. Wilson Yeun, Calgary, Alberta, Canada

Mr. Walter Clemons, Shillington, Pa.

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TV SERVICEMEN NEEDED IN MOST RCA FACTORY SERVICE BRANCHES. TECHNICAL SCHOOL TRAINING ESSENTIAL. WE PREFER BLACK/WHITE AND COLOR SERVICE EXPERIENCE. APPLY AT NEAREST RCA BRANCH OR WRITE TO

W. R. Speck
RCA Service Co.
Cherry Hill, New Jersey

BY
STEVE
BAILEY

DEAR STEVE,

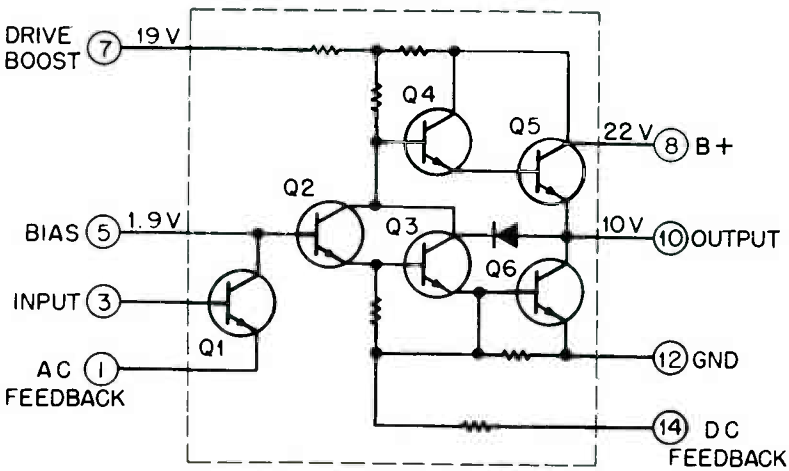
What is an "IC"?

J. L., Ill.

The abbreviation "IC" stands for Integrated Circuit. This is a new electronic component that contains such parts as transistors, resistors, and capacitors which are encased in a modular body. The parts are connected together internally to form a complete circuit. Leads are connected to various points in the circuit and brought out of the module to be connected to input, output, and voltage supply circuits. Thus, a small module about the size of a mica capacitor can be used to replace a complete standard circuit. The design problems that formerly prevented this component from receiving commercial application have been solved and it is now appearing in television receivers and stereo equipment.

Shown is an equivalent diagram of an IC manufactured by G. E. It is actually a 6-transistor, 1-watt amplifier used in a portable phonograph made by G. E. The distortion rating of the amplifier is only 5%. Physically, it is about .7" long, .3" wide and .2" thick.

Watch future issues of the Journal for further information on this part and equipment using it.



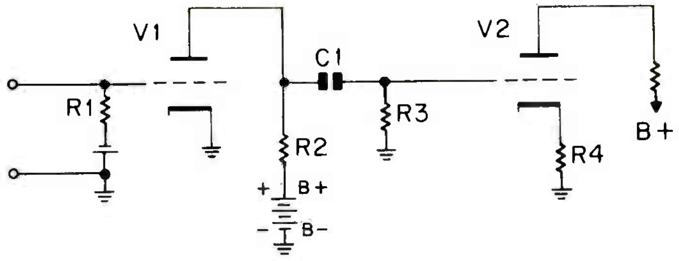


Figure 1.

DEAR STEVE,

How is the AC signal at the plate of an amplifier coupled to the grid of the following stage?

W. A., Ill.

To see how this is done, refer to Fig. 1, a diagram of a two-stage, RC-coupled amplifier. When no signal is applied to the input of V1, plate current will flow through the tube and R2, producing a voltage drop across each. The plate to cathode voltage V1 is equal to the B supply voltage minus the drop across R2.

When a signal is applied across R1, the grid of V1 will be made less negative and then more negative. When the grid is less negative, the plate current increases, the voltage across R2 increases, and the plate-to-cathode voltage decreases. When the grid is made more negative the plate current is reduced and the voltage drop across R2 is reduced, resulting in an increase in plate-to-cathode voltage.

Thus, with an ac signal voltage across R1, we have large variations in plate-to-cathode voltage. These dc voltage variations are the amplified signal.

With no signal received, the plate voltage of V1 is constant. C1 charges up to this voltage, through the B supply, R2 and R3. With C1 fully charged to the plate-to-cathode voltage no current is flowing through R3 and there is no voltage across this resistor.

When the signal applied to the grid of V1 makes the plate-to-cathode voltage increase, C1 must charge up to this higher value. This is accomplished by electrons flowing from B-, through R3, and into the right-hand plate of C1. An equal number of electrons flow out of the left-hand plate of C1. The electrons flowing through R3 make its grid end positive compared to ground. Remember that the end of a resistor at which electrons enter is always negative with respect to the end at which they leave.

When the signal fed to the grid of V1 reverses and reduces the plate-to-cathode voltage, C1 must discharge to this lower voltage. Electrons flow out of the right-hand plate of C1, through R3 to the chassis and an equal number flow into the left-hand plate. Note the directions of current flow through R3 is opposite to that occuring during charge of this capacitor. Now the grid end of R3 is negative compared to ground. Thus we have the enlarged ac signal across R3, where it is fed to the input of V2.

DEAR STEVE,

How is the input signal to a grounded cathode amplifier reversed in phase 180° at the plate?

S. L. B., Washington, D. C.

To explain how this occurs, I can refer again to Fig. 1 which shows a two-stage amplifier. Remember that the dc voltage drop across the plate to cathode of V1 varies with changes in the input signal. When the input signal moves in a positive direction, plate current increases, thus increasing the voltage drop across

R2. This voltage drop subtracts from the B+ voltage, thus reducing the plate-to-cathode voltage. So, while the input voltage goes in a positive direction, the plate voltage decreases or moves in a negative direction. One important thing to remember here is that the output voltage is the ac variation in the plate-to-cathode voltage.

During the next half-cycle, the grid-to-cathode input voltage will move in a negative direction. This tends to reduce the plate current, thus reducing the voltage drop across R2. The plate-to-cathode voltage will now increase or move in a more positive direction. This is due to the voltage drop across R2 subtracting less from the B+ voltage, thus increasing the drop across V1.

DEAR STEVE,

Lesson 8 says that in a series-resonant circuit, a high LC ratio is required to obtain a sharp resonant curve. A low LC ratio will do the same thing in a parallel-resonant circuit. Why does the LC ratio affect the selectivity of these circuits?

J. S., Ala.

The LC ratio in a series resonant circuit must be high to obtain a sharp resonant curve. The reason for this is that at frequencies off resonance, the impedance of a high LC ratio will change substantially for any given change in frequency. Thus the line current will be sharply reduced. This gives a steeper slope on both sides of the resonance curve. As the LC ratio is reduced, the impedance change off resonance will become more gradual, thus causing a more gradual change in the circuit current and a broader resonance curve. This means that the higher LC ratio in a series-resonant circuit gives a sharper curve and better selectivity.

With a parallel-resonant circuit, we have an opposite situation. A low LC ratio will give a sharper resonant curve and better selectivity. A parallel resonant circuit acts like a high resistance at resonance. Thus, the current drawn from the generator or source is low. Off resonance, the circuit will act like the part having the lowest reactance. With a high LC ratio, the reactance of either part will still be high. Thus, it will take a drastic change in frequency to cause a large change in circuit current. This gives a broad resonant curve and poor selectivity.

With a low LC ratio, a change in frequency off resonance will result in a low reactance of the parallel-resonant circuit. Thus, the circuit current will increase rapidly, resulting in a sharp resonant curve and better selectivity.

DEAR STEVE,

What happens to the resistance of conductors at low temperatures?

B. N., Mexico

Scientists have found through experimentation that many metals used for conductors of electricity lose almost all resistance at certain low temperatures. They seem to maintain a constant resistance until a certain point known as the transition point is reached. This transition point is at various temperature levels for different metals. Oddly enough, the best electrical conductors such as gold, silver and copper do not exhibit as great "superconductivity" characteristics as many other types of metals.

One practical feature of this discovery is the possibility that currents, once set in motion, will not require the application of constant power. This means that greater power can be developed from smaller generating sources. At present, the Cryogenics Laboratory of the National Bureau of Standards and Bell Telephone Laboratories, among others, are conducting experiments to develop practical applications for this discovery.

NRI HONORS PROGRAM AWARDS

During the months of May and June, 1967, the following NRI graduates received, with their NRI electronics diplomas, Certificates of Distinction under the NRI Honors Program for outstanding grades throughout their NRI training.

WITH HIGHEST HONORS

Esdras Bouchard, Laval Des Rapides, Can.
Gordon M. Brinton, Seattle, Wash.
Robert W. Cove, Ashland, Mass.
David A. Guerin, APO New York
James J. Hankins, Nutley, N.J.
Robert A. MacLeay, Jr., Northfield, Minn.
Lawrence W. Speicher, Norfolk, Nebr.
Kenneth Vaughn, Union City, Tenn.

WITH HIGH HONORS

Richard H. Auge, Tacoma, Wash.
Daniel L. Balog, Woodbridge, N.J.
Joe Edd Boaz, Heber Springs, Ark.
Lawrence E. Boellhoff, APO New York
Gene E. Boone, Williamstown, W. Va.
John Gerald Boylan, Sedalia, Mo.
Robert H. Bright, Pittsburgh, Pa.
George D. Brown, Pontiac, Mich.
John W. Buchanan, Sylnar, Calif.
James P. Cason, Morrow, Ga.
Rialto M. Christensen, Balboa, Canal Zone
Phillip D. Deem, Alexandria, Va.
Donald G. Dunn, Berkeley, Calif.
John L. Durr, Springfield, Ohio
Hector Eastman, San Fernando, Trinidad
Raymond Etchepare, Los Angeles, Calif.
Charles Ewing, Clinton-Sherman AFB, Okla.
Champ E. Ford, Warfield, Ky.
John H. Friedmann, Stamford, N.Y.
Grady George, McAllen, Texas
John S. Greeley, Hamden, Conn.
William H. Herran, III, Texas City, Texas
Dean R. Hoy, Loring AFB, Maine
John L. Huffman, Rapid City, S. Dak.
Raymond G. Jacobson, Affton, Mo.
Virgil R. Jeude, Lancaster, Pa.
Robert S. Joseph, Natchez, Miss.
Huey P. Kleinpeter, Plaquemine, La.
George E. Komar, Bayonne, N.J.
Lawrence LaFlair, Hutchinson AFS, Kans.
Albert L. Martin, APO San Francisco
Douglas A. Marty, Milford, Iowa
Urbano Mayorquin, Union City, N.J.
Bill J. McMahon, Valley Stream, N.Y.
Richard L. Miller, Marion, Ill.
Roland E. Misner, Battle Creek, Mich.
Norman Morton, Washington, D.C.
William Newman, Campobello, N.B., Can.
Donald E. Nicholas, Kellers Church, Pa.
Mario D. Pantophlet, St. Croix, V.I.
Eugene F. Prentler, Lansing, Mich.
Charles N. Price, Charlotte, N.C.
Durphy J. Primeaux, Port Arthur, Texas
Thomas G. Pritchard, Midland, Mich.
Dean A. Reed, Springfield, Oreg.
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Joe Alfred Sain, Lurton, Ark.
Peter Sawrenko, Saskatoon, Sask., Can.
Gregory F. Shaw, Santa Ana, Calif.
John M. Shekleton, Danielson, Conn.
Ventry Wade Smith, Chesapeake, Va.
Richard N. Steinmetz, Tiffin, Ohio
Hollis M. Suber, Moultrie, Ga.
Jack N. Thorpe, Pocatello, Idaho
William T. Tupy, East Detroit, Mich.
Norman D. Vance, APO New York
Robert E. Wade, Claude, Texas
Edward H.C. Weiler, Garden City, N.J.
Vergal A. Winn, Sidney, Nebr.
Roy S. Woodard, St. Vital, Man., Can.
Fred Lorentz Zabel, Minneapolis, Minn.
A.C. Ziemkiewicz, Toledo, Ohio

WITH HONORS

David W. Alcorn, FPO New York
John W. Baldwin, Minneapolis, Minn.
LeRoy Barnhart, Chicora, Pa.
Mabrey Barrier, Elgin, Texas
Robert E. Brick, Harwick, Pa.
Morris Bruce, Middlesboro, Ky.
Richard O. Bryant, Fresno, Calif.
Lesley Cannegieter, St. Maarten, Neth.
Ronald L. Church, Sinnemahoning, Pa.
Russell Conklin, Paterson, N.J.
Jerry E. Cook, Decatur, Ga.
Ellis E. Covan, Pawtucket, R.I.
Robert Crampton, Virginia Beach, Va.
Linburn Crouse, Bridgewater, N.S., Can.
Leonard C. Decker, Berlin, N.J.
John V. DiSalvo, Buffalo, N.Y.
James E. Doyle, Mexico, Mo.
Coyt Early, Corbin, Ky.
Fred J. Franko, Bronx, N.Y.
Eugene Goodson, San Clemente, Calif.
Kurt Gunther, Dumont, N.J.
Herman M. Guzik, Buffalo, N.Y.
Roger B. Hall, Fort Meade, Md.
Raemond Hellbusch, Idaho Falls, Idaho
David E. Herrmann, Bellevue, Nebr.
William J. Howell, Nashville, Tenn.
Bela J. Johnson, Jr., District Heights, Md.
Clifford A. Jones, Endicott, N.Y.
Edgar Kargo, Riverside, Calif.
Clyde Kasten, Uniontown, Mo.
Kenneth L. Kelly, Topeka, Kans.
Fred Warren Kragler, Aberdeen, Ohio
Tom W. Lambert, III, Cle Elum, Wash.
William L. Lawton, Rockville, Md.
Darrell W. Liebolt, Minot, N. Dak.
John N. Mann, Newton Falls, Ohio

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Alumni News

DEADLINE FOR NOMINATIONS EXTENDED

Our face is very red. A combination of circumstances, including a Post Office Department embargo on second-class mail due to the railroad strike, delayed our mailing the July-August issue until late in July -- much too late for many members to send in their nomination ballots by the July 25 deadline.

We had no choice but to extend the deadline for nominations to September 25 and the deadline for election ballots to November 25. So please send in your nomination ballot (on Page 22 of the July-August issue) to reach NRI by September 25.

Mention was made in the last issue that of the current officers only Harvey Morris of the Philadelphia-Camden Chapter is eligible for re-election as a National Officer. But another member of his chapter, the chairman, John Pirrung, is also deserving of the honor. In fact, such recognition is long overdue.

Remember: Mail your ballot well before November 25.

DETROIT MARKS YEAR'S END WITH A FISH DINNER

DETROIT CHAPTER held its final meeting of the 1966-1967 season on June 8. It celebrated the occasion with its customary fish dinner. One member, John Korpalski, could not attend because he was on a diet and would not trust himself to refrain from fish-eating when everyone else was. John Nagy, upon hearing that shrimp would be on the menu, said nothing would stand in his way, that "the only thing" he likes "better than a big dish of shrimp is two big dishes of shrimp."

Detroit Chapter Chairman Jim Kelley conducts a demonstration at a chapter meeting.

The only business transacted at this meeting was the election of officers for the 1967-1968 season. National Headquarters has been promised a list of these officers in time to include them in the next issue.

Another point of interest at this meeting was the introduction of Mr. Berus as the newest member of the chapter. Welcome, Mr. Berus!

SERVICE SYMPOSIUM HELPS LOS ANGELES

LOS ANGELES CHAPTER devoted the first part of its meeting to a service symposium in which members took turns developing their diagnostic abilities in locating and correcting defects in various pieces of equipment. Some of the highlights were a Silvertone television receiver on which Chairman Gene De Caussin demonstrated troubleshooting procedures used to pinpoint the defect to the horizontal section.

In a dead transistor set, members saw how to make a stage-by-stage check to localize the defective stage. Here the defect was found to be in the phone jack switch, a fairly weak point in such receivers. Also a defective scope was serviced with the aid of another scope in good working condition.

All agreed that this was a very interesting and profitable meeting. Following a movie entitled "Safety 1st, 2nd, and 3rd", doughnuts, apple pie and beverages were served by members' wives.

TRANSISTOR DEMONSTRATIONS HIGHLIGHT NEW YORK MEET

NEW YORK CITY CHAPTER has three new members: Messrs. Anthony C. Adams, Victor del Prado, and David Cohen. Glad to welcome you among the membership, gentlemen!

Willie Foggie and Jim Eaddy gave a stimulating talk on various faults they run across in their work and adjustments that have to be made in setting up Color TV sets.

Joseph Bradley reviewed some of the principles of transistor biasing and the reasons behind them. Sam Antman did a masterful job of using a Conar Tuned Signal Tracer on the Transistor Demonstration Board. Unfortunately, Dave Spitzer's regular signal tracer was indisposed, so a comparison of the two instruments could not be made.

For the last meeting of the 1966-1967 season the chapter's old friend Mr. Thompson of the New York Telephone Company returned, with a film and talk entitled "Communications in the Future," which proved to be both interesting and instructive. After this stimulating talk, the members enjoyed coffee and cake and a session of good-fellowship before splitting up for the summer. Meetings will resume on September 7.

NEW MEMBERS WELCOMED BY NEW JERSEY CHAPTER

NORTH JERSEY CHAPTER welcomed two new members, Edward Tuite and George Fee. The Chapter spent a good part of this meeting in extending its welcome and hospitality to these two members and also to visitors to the Chapter. All new members and recent visitors were invited to bring in any problem they needed help with. This proved to be very helpful to two students with their NRI lessons. Everyone responded to this challenge. One visitor had a set that played and then stopped. All other troubles were normal, everyday TV defects, such as sound in the picture, lines in raster.

The Chapter plans to purchase a transistor breadboard for demonstration purposes.

Representatives of the Bell Telephone Company are expected to be on the program of the September 29 meeting.

PHILLY-CAMDEN CHAPTER NEEDS A COLOR TV SET

PHILADELPHIA-CAMDEN CHAPTER has been trying to get hold of a secondhand Color TV set or some facsimile that can be used for members to practice on, but has found that the prices are, in Secretary Jules Cohen's words, "ridiculous." A color set was required for the program scheduled for the last regular meeting of the 1966-1967 season on June 30, but one was not available so movies were shown instead, courtesy of the Bell Telephone Company.

It would be a welcome gesture if someone or some organization was to donate a second-hand Color TV set to the chapter or offer a set at a price the chapter could afford to pay. Does anybody know of such a possibility?

OPTICAL MASER EXPLAINED FOR PITTSBURGH CHAPTER

PITTSBURGH CHAPTER members thoroughly enjoyed a program on the optical maser conducted by Mr. J. R. Rohleder, Supervisor of Information, Bell Telephone Company. Mr. Rohleder showed how the beam of light generated by the maser can carry conversation over great distances, theoretically vaporize objects in space, remove tumors and even perform the delicate operation of repairing a detached retina.

The optical maser amplifies light waves in the same way that electronic devices amplify radio waves. It produces an intense narrow beam of 400 trillion waves per second. It is a spot of light the size of a fingernail but brighter than the center of the sun.

In this demonstration Mr. Rohleder's voice was carried over this beam of light. "The maser's beam", Mr. Rohleder said," is capable of carrying a billion telephone circuits and a million television channels, as well as radio and data processing material." He demonstrated how the light can be sent underground by means of wave guides to avoid attenuation by the atmosphere. It can send power directly from the earth to the moon for use in construction and exploration. It will be able to carry great chunks of information back and forth between satellites and planets many light years apart. It will also make possible underwater communications between submarines for the first time.

SPRINGFIELD REVIEWS TRANSISTOR TECHNIQUES

SPRINGFIELD (MASS.) CHAPTER used its Transistor Radio Demonstration Board to review all the techniques described in the instruction manual on the

COLOR TV TRAINING TOPIC OF TOUR

There has never been a tour of greater importance to the NRIAA chapters than the one J. B. Straughn and Ted Rose will make this season. Mr. Straughn will tell the members all about NRI's New Color TV Training and will demonstrate the new Color TV Training Kits designed specifically for training purposes.

For the last several years servicemen have been searching desperately for complete and thorough training for Color TV Servicing. NRI now has the answer to that urgent demand.

As student or graduate -- and regardless of whether you are a member of a local Chapter of the NRI Alumni Association -- you will be cordially welcome at these meetings. Bring a friend with you if you like.

Here is the schedule of visits :

CHAPTER	DATE
Southeastern Mass.	September 27
Detroit	October 13
Hagerstown	November 9
Philadelphia-Camden	November 13
Springfield (Mass.)	December 6
New York City	December 7
New Orleans	April 9
North Jersey	April 26
Pittsburgh	May 9

servicing of transistorized equipment when the complaint is a dead receiver. The group went through the converter test in detail but found that results did not jibe with the theory in the manual. After consultation among the members it was decided that the impedance of the meter was not enough to permit it to measure the ac voltage in the oscillator tank circuit. (Note from J. B. Straughn: The NRI Model 211 or 2W VTVM can measure the oscillator tank voltage in a transistor receiver.)
Both signal injection and signal tracing techniques were demonstrated. For the latter a transistor receiver was modified so that it could be used as a signal tracer. Like several other chapters, meetings were suspended in July and August but will be resumed in September.

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. VI-1-4972.

Flint (Saginaw Valley) Chapter meets 8:00 P.M., 2nd Wednesday of each month at shop of Andrew Jobbagy, G-5507 S. Saginaw Rd., Flint. Chairman: Clyde Morrissett, 514 Gorton Ct., Flint. 235-3074.

Hagerstown (Cumberland Valley) Chapter meets 7:30 P.M., 2nd Thursday 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.

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

New York City Chapter meets 8:30 P.M., 1st & 3rd Thursday of each month, St. Marks Community Center, 12 St. Marks Place, N.Y.C. Chairman: Samuel Antman, 1669 45th St., Brooklyn.

North Jersey Chapter meets 8:00 P.M., last Friday of each month, Players Club, Washington Square (1/2 block west of Washington & Kearney Avenues), Kearney. Chairman: George Schopmeier, 935-C River Road. New Milford.

Philadelphia-Camden Chapter meets 8:00 P.M., 2nd & 4th Monday of each month, K of C Hall, Tulip & Tyson Sts., Philadelphia. Chairman: John Pirrung, 2923 Longshore Avenue, Philadelphia.

Pittsburgh Chapter meets 8:00 P.M., 1st Thursday of each month, 436 Forbes Ave., Pittsburgh. Chairman: Joseph Burnelis, 2268 Whited St., Pittsburgh.

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.

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

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

Springfield (Mass.) Chapter meets 7:00 P.M., last Saturday of each month at shop of Norman Charest, 74 Redfern Drive, Springfield. Chairman: Joseph Gaze, 68 Worthen St., Springfield.

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TRANSISTOR TESTER. Model 650 .... $34.95 Checks low and medium power transistors of the junction type. Checks Beta and ICO with an accuracy heretofore found only in laboratory type instruments. Test Lead ..... #7545 $1.20	**Beta**: 0-10, 0-50, 0-250, (F.S.) **ICO**: 0-100 μa	**Beta**: ±3%; with 250, 255, 260± 5%; with 261 and 270±4% **ICO**: ±1%; with 260±3% F.S.; with 261 and 270±2% F.S.
DC VTVM. Model 651 .... $39.95 Ideal for general VTVM applications and transistorized circuitry. (Design and servicing) High sensitivity with laboratory type DC Coverage (10 ranges) offers higher accuracy of reading. Ground Lead ..... #7547 $1.20	**Voltage**: 0-.5/0-1.0/0-2.5/0-5.0/ 0-10/0-25/0-50/0-100/0-250/ 0-500 **Input Impedance**: Greater than 10 megΩ all ranges	±1%; with 250, 255, 260 ±3% F.S.; with 261 and 270 ±2% F.S.
TEMP. TESTER. Model 652 .... $39.95 Three lead hook-up. Ideal for production and engineering spot temperature measurements, servicing of heating and refrigeration devices, and for general type measurements. Normally supplied with °F scale; can be supplied with °C scale for **$1.95** additional.	—50°F to +100°F; +100°F to +250°F Three lead positions provided **Sensing Element**: Thermistor	±2° with 250, 255, 260, 261 and 270
AC AMMETER. Model 653 .... $22.95 Ideal for government engineering and testing, Commercial engineering and testing, Industrial applications, general servicing, electrical installations and servicing.	0-0.25/0-1/0-2.5/0-12.5/0-25 amps **Frequency Range**: 50 to 3000 cycles	±2%; with 250, 255, 260, 261, 270 ±3% F.S.
BATTERY TESTER. Model 656 .... $22.95 Checks all radio and hearing aid batteries up to 90 volts at the manufacturer's recommended load, or any external load.	Up to 90 volts	±1%; with 250, 255, 260 ±3% F.S.; with 261 or 270 ±2% F.S.
DC AMMETER. Model 661 .... $24.95 Multi-range, excellent accuracy of reading. Applications; automotive accessories (servicing), automotive electrical system, DC supplies, industrial (DC control systems—welding, heavy current rectifiers, etc.).	0-1/0-2.5/0-5/0-10/0-25 Amperes DC	±.5%; with 250, 255, 260 ±2% F.S.; with 261 or 270 ±1.5% F.S.

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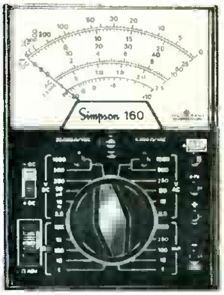
Simpson model 160 VOM



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