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Analyzing Sylvania Superset Two, part 6

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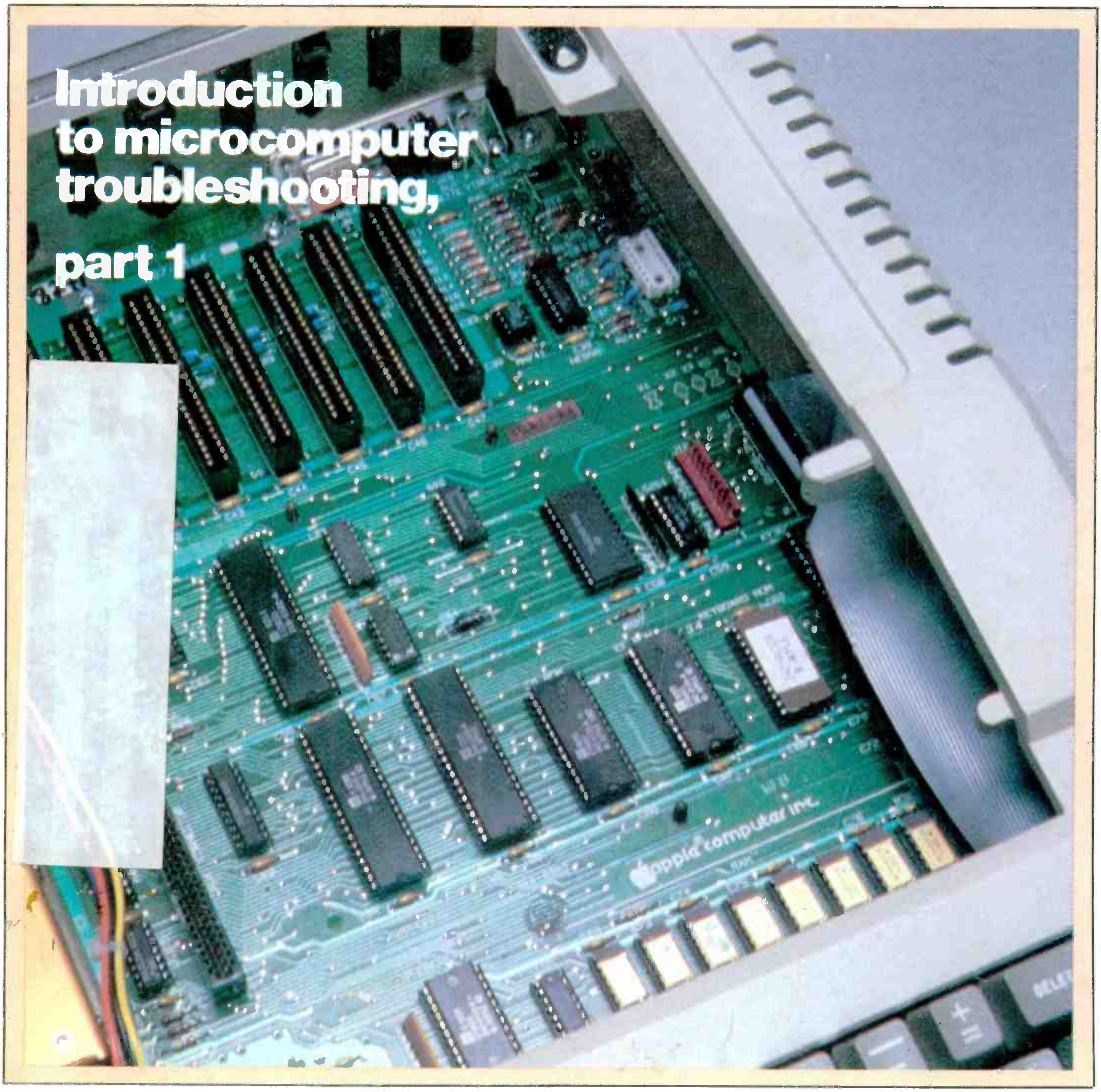

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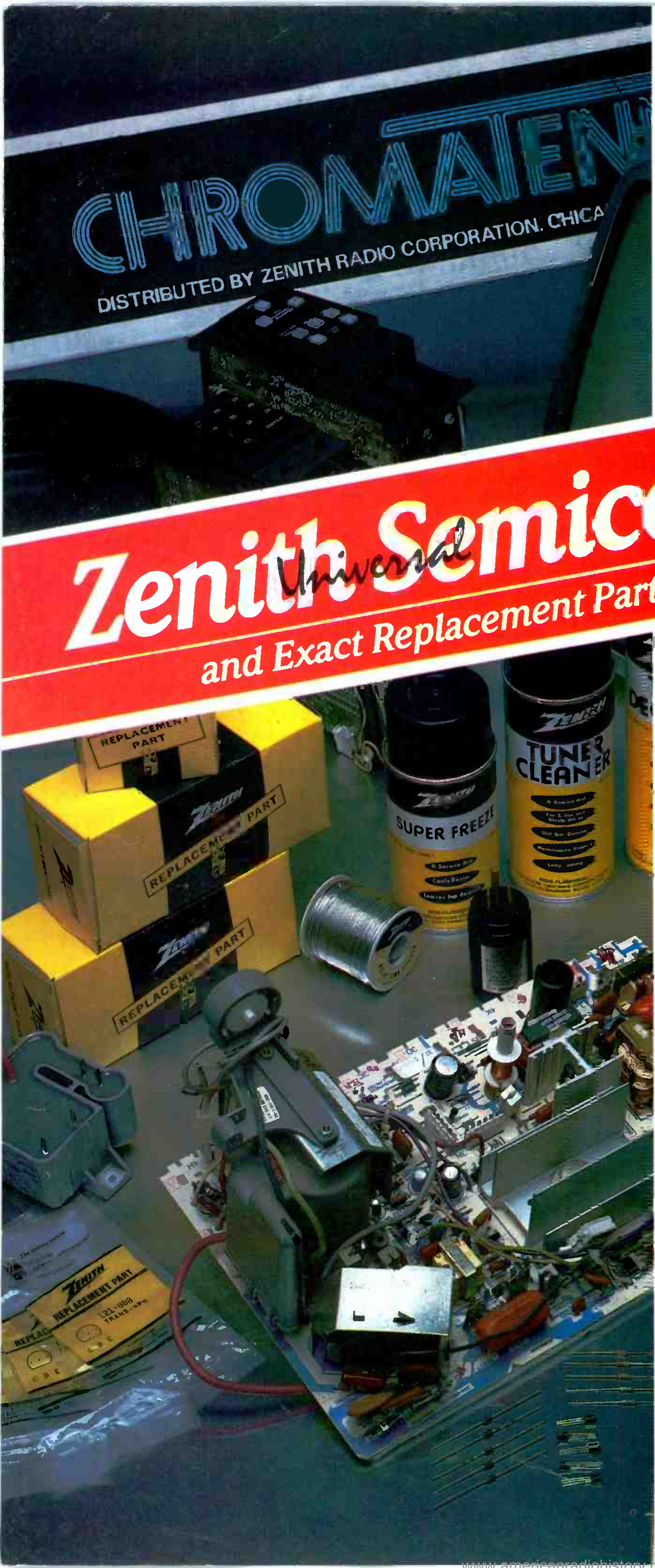

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ELECTRONIC Servicing & Technology

Volume 5, No. 11 November 1985

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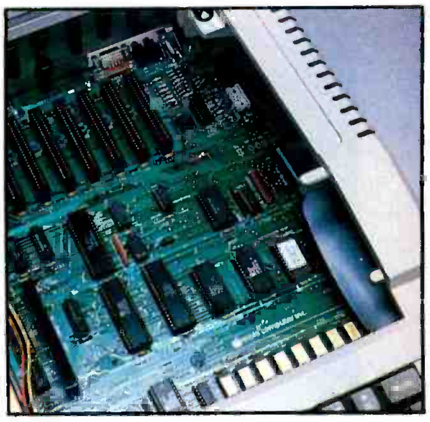

The circuitry of this personal computer is less complex than that of most televisions. TV technicians easily transfer their logical approach to computer repair. *(Photo courtesy of Apple Computer, Inc.)*

Because Osae Kamada, Hitachi chief engineer, theorized that the number of crystal boundaries in copper cable correlated to imperfect sound reproduction, linear-crystal/oxygen-free audio-visual cable has been introduced.

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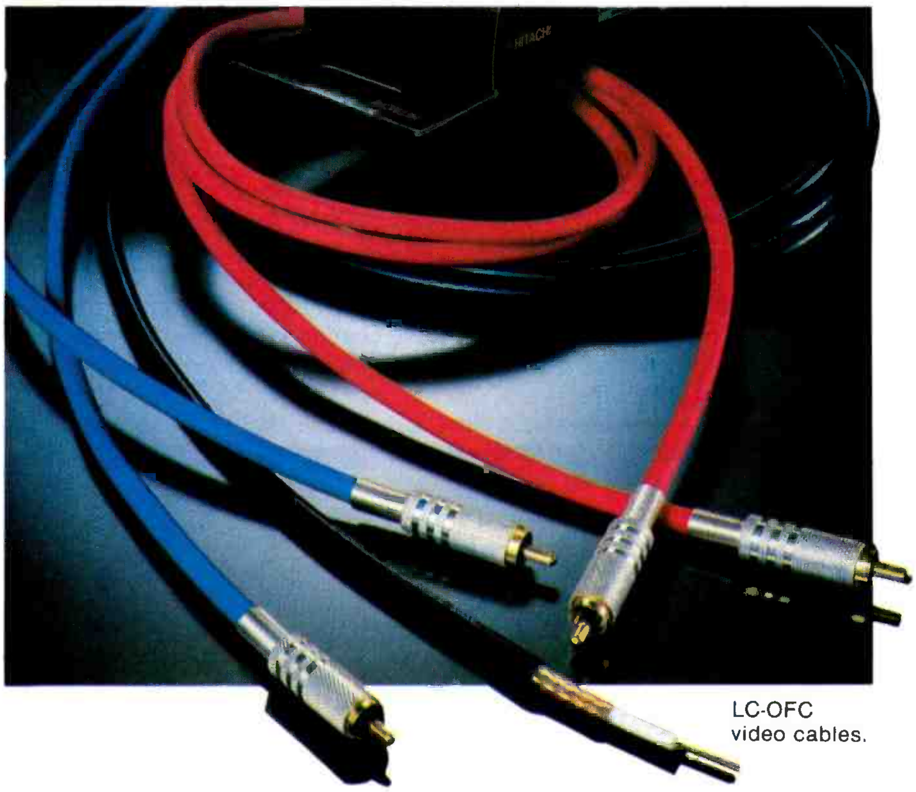
Technology

New audio-video cable promises superior reproduction quality

So many exciting things have been happening in consumer electronics: microcomputers in all kinds of products, stereo audio for television, compact digital audio discs to name a few. But there are some areas of electronics that seem so ordinary, so pedestrian, that you don't expect to see announcements of advancements or breakthroughs.

What, for example, could be more ordinary than the copper wire that connects a stereo amplifier to the speakers, or for that matter, the shielded cable that connects the turntable or tape deck to the pre-amp. I mean, there's not much chance of seeing any advances in that, is there? Wrong.



LC-OFC video cables.

A new cable using *linear-crystal/oxygen-free copper* (LC-OFC), a recent breakthrough in audio-video technology, recently has been introduced by Hitachi Cable, Inc. Linear-crystal cable provides dramatically lower distortion and reduced signal loss compared to conventional cable, claims the manufacturer. One Japanese critic is said to proclaim that using the new cable makes a difference equivalent to upgrading a full level in loudspeaker quality.

Developed by Hitachi engineers in Japan, LC-OFC cable makes use of recent research on the crystals found in the copper used to make electrical cable. Scientists suspected that a major source of distortion and signal loss lay in the boundaries between crystals, which act as a gap the electrical impulses have to cross. One way to minimize the problem, they reasoned, was simply to reduce the number of crystals.

To do this, they developed a technique that produces oversize copper crystals called, logically enough, *giant crystals*. Then they devised an extrusion process that stretches the giant crystals until they're thousands of times longer than usual.

What results are *linear-crystals* (LC). Whereas ordinary copper cable might have 50,000 crystal boundaries per meter, LC cable has only 20. Fewer boundaries for a signal to cross, according to the manufacturer, means less distortion.

LC-OFC cable also makes use of a purer grade of copper, known as *oxygen-free copper* (OFC). Ordinary copper contains an impurity called copper oxide. This forms barriers between the copper crystals, making distortion and signal loss even worse. Oxygen-free copper contains only one-hundredth the amount of oxygen that ordinary copper has.

Another improvement incorporated into LC-OFC cable is *elasto memory conductor*. Electrical energy sets off tiny vibrations when it passes through a cable. These vibrations can drain off signal energy and cause distortion. To prevent this, each linear crystal cable is tightly wrapped in polyolefin *memory* tape, dampening any vibration.

LC-OFC cable is said to be particularly effective when used to connect all the components in a stereo or video system, not just the speakers. Using LC-OFC just to connect the amplifier with a tape deck makes a noticeable difference, proponents say.

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Editorial

One small step, one giant leap

The history of electricity and electronics includes a lot of experimentation with new materials: improving existing materials and finding new materials to do the job. For example, in the early days, much of the insulation was Bakelite, glass, varnished fabric, paper. As the technology advanced, thermoplastics began to take on many of the insulation tasks. Experimentation with germanium and silicon led to the revolution that replaced vacuum tubes in electronic circuits with far more reliable solid-state components. Work with phenolic resins resulted in printed circuit boards, changing the way wiring is handled in many instances. Even the formulation of recording tapes has changed and now consumers have a wide choice of tape types to choose from for various types of recording. Light-emitting diodes and liquid crystals have changed the way information about the status of an electronics product is displayed.

Recently two developments were announced that are destined, each in its own way, to change the world of electronics. One of these developments is in an area that seems so pedestrian that you wouldn't expect to see significant innovation at this point, and the other is so advanced it's almost unbelievable.

Well, who would have thought they'd improve on cables for stereo? I mean, wire's wire, right? Apparently not, as revealed in an article in the Technology department in this month's **ES&T**. Metallurgists have recently studied the structure of the copper used in ordinary copper wire and found that its characteristics could be improved. They found a way to remove all of the oxygen, existing in the wire in the form of copper oxide, that interferes with the transmission of the audio signal. They also have managed to increase the size greatly of the individual copper crystals in the wire. This reduces the number of crystals in the wire accordingly, reducing the number of crystal-to-crystal transitions that the signal must make. The net result of all this, claims the manufacturer, is an improvement in audio system performance equivalent to one level of upgrade of components.

In contrast to this already commercially available technological advance, another advance in materials technology still in the earliest stages is molecular electronics. According to a newsletter published by "Boardroom Reports," this marriage of electronics and biotechnology will use tiny organic molecules as components in extremely fast, minuscule electronic circuits. The newsletter implies that the future fruits of this new technology could include supercomputers the size of a paperback novel, truly intelligent robot systems and electronic vision for the blind. According to the newsletter "even skeptics can envision commercial products on the market in two to five years."

Thus is progress made in the field of electronics: a minor innovation here, an incredible breakthrough there.

Nils Conrad Persson

ELECTRONIC Servicing & Technology

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Ultrawide viewing angle, rear projection TV screen

An ultrawide viewing angle, low color shift screen has been developed. Other significant features are high resolution capability and good contrast in ambient light. The screen is composed of a lenticular array with contiguous black stripes, a bulk diffuser and a Fresnel lens.

Most rear projection TV (PTV) systems use a 2-piece screen in which the front piece incorporates a linear lenticular array that distributes light horizontally, and an array of black stripes that increase the image contrast by reducing the ambient room light reflections. The lenticular array is on the inside surface on the front piece and the black stripes are on the outside surface. The registration between the black stripes and the lenticular array must be controlled with high accuracy so that the TV picture is unaffected by the presence of the stripes. The rear piece of the screen is composed of a Fresnel lens that directs the light toward the viewing audience and a diffuser that is incorporated into the screen for vertical spreading. The amount of horizontal and vertical spreading defines the dimensions of the audience space.

Although the optical performance of these PTV screens is adequate, with the Fresnel lens it has been improved in terms of the size of the audience space, color shift and resolution.

Lenticular array

A computer program was written to predict the optical performance of different lenticular profiles. The program predicts light distribution and color shift. An optimal lenticular profile was designed that is based on reflective/refractive optics. Due to total internal reflection, the side portions of each lenticular element reflects light away from contiguous black stripes and toward the tip of the element. Because of the shape of the tip, the light is refracted into the viewing area at very high angles. Large plastic models of individual elements were constructed. The lenticular shape that produced the best results was manufactured with a pitch of 0.3mm. Experimental tests confirmed the computer program's predictions of ultrawide angle light distribution and minimal color shift.

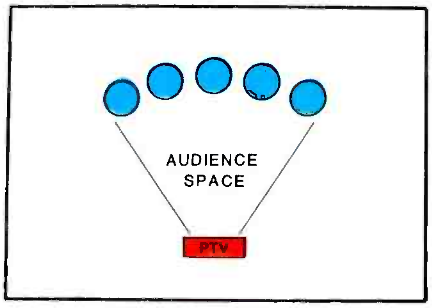

Figure 1. PTV with conventional black stripe screen.

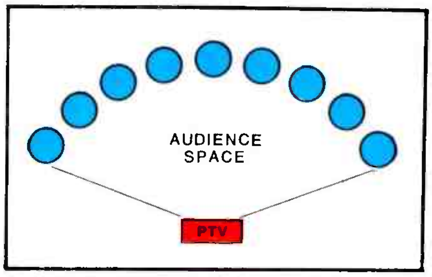

Figure 2. PTV with ultrawide viewing angle screen.

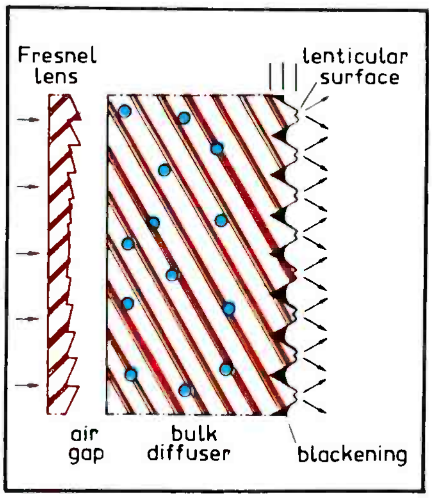

Figure 3. Schematic of ultrawide viewing angle screen.

Black stripes

Novel approaches to applying the black stripes have been developed and used to manufacture prototype screens. Demonstrations show that the stripes improve contrast without affecting light distribution. The stripes are durable and can be cleaned.

Diffuser

There are two types of diffusers; diffusers formed on a surface and diffusers incorporated within the bulk material. Bulk diffusers are used in the new screen because they yield higher resolution. A method of analyzing bulk diffusers was developed so that they could be designed for high efficiency and resolution.

Fresnel lens

The performance of Fresnel lenses of different configurations was studied with the use of a computer model. A configuration was chosen that yields high efficiency and good off-axis performance. The facets of the Fresnel lens were designed to eliminate artifacts that result from the Fresnel lens being illuminated by three CRTs (two of which are off-axis).

Overall screen considerations

Because two of the surfaces of the screen are planar, the screen could be redesigned as a 1- piece screen. This would significantly reduce the corner illuminations. The most important attributes of this new rear projection TV screen are the perception of uniform brightness and minimal color shift throughout the 180° horizontal viewing angle.

This article was based on a paper presented by engineers of North American Philips Corporation. ES&T

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Analyzing the Sylvania Superset Two

By Carl Babcoke, CET

Solid-state switching of input stereo signals, electronic volume, balance, bass and treble controls using dc voltages, and details of the stereo power amplifiers with muting are some of the subjects discussed in this last article of the series.

We waited until the last minute to cover the stereo-audio system in Sylvania Superset Two (lower left) model RXS198WA with 19C4-03AA chassis, in the hope that television *stereo* audio could be heard and evaluated. Unfortunately, no stereo TV audio has been broadcast as yet in this area. The changeover to stereo at the stations is extensive and expensive, involving not only replacement of audio switching and mixing facilities but also complete replacement of the aural (sound) transmitter in some cases. Understandably, the stations are reluctant to pay such a high price until the number of stereo TV receivers has increased. On the other hand, TV shoppers are reluctant to spend a larger amount for a television with a stereo decoder when none of the stations are broadcasting stereo in their area. Of course, owners of stereo VCRs now can begin to use the new stereo-ready receiver/monitors (that have incoming video and audio jacks) to watch many taped movies with stereo sound, without waiting for reluctant local stations to modernize.

This final article of the series examines the Sylvania Superset Two stereo audio system in detail.

In/out audio switching

A switching-type integrated circuit (IC1 in Figure 1) selects either external stereo audio or the internally produced TV stereo audio as input signals for the internal amplifiers and their speakers. On the audio-video/input-output board, the switching voltages at J23-1 and J23-2 are the same as the video-switching control voltages described in part five, October 1985 **ES&T**. These *high* and *low* switching voltages come from the A-V *on/off* switch under the front-panel door. When one voltage is high (about +12V) the other is zero and vice versa.

Four RCA-type female phono sockets for the audio in and out signals are located on the jack panel (top, left). When conventional TV audio is selected by the A/V switch, the left-channel TV audio enters the audio-video/input-output (AVIO) board at cable plug PD2-3, while the right-channel TV audio enters at PD2-5.

The *out* position of the A-V push-button places a +12V *high* at J23-2 that closes IC1 internal switches A and D, allowing TV sound to reach Q22 and Q24, the audio emitter followers. Output signals from the Q22 and Q24 emitters are sent through J201-3 and J201-6 to the power amplifier (Figure 2).

Simultaneously, the zero-voltage *low* at J23-1 opens IC1 internal switches B and C, thus preventing any sound (or hum and noise) entering the left and right audio input jacks J4 and J6 from reaching Q22 and Q24.

When the AV-I/O switch under the panel door is pushed *in* to the A/V position, the J23-2 *low* opens IC1 internal switches A and D, preventing the receiver's audio

Sylvania Superset-Two model RXS198WA (with a 19C4-03AA chassis) is a color-TV/monitor with a jack panel and RF switching for connecting videocassette recorders, audiocassette recorders, video games and other accessories. Audio from these external sources can be reproduced in stereo when connected to the receiver by shielded cables. A decoder is included to provide stereo sound for TV programs that are broadcast in stereo. The two speakers are not attached to the cabinet, but they can be placed wherever the customer desires. When proper buttons are pushed, the time and the TV channel in use are displayed in the picture.

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signals from reaching Q22, Q24 and the power amplifier.

At the same time, the J23-2 *high* closes IC1 internal switches B and C, feeding any audio signals at input jacks J4 and J6 to Q22 and Q24, where they eventually are heard in the stereo speakers.

In other words, IC1 has four single-pole/solid-state switches that are wired externally so they act as two single-pole/double-throw switches to select which two audio inputs are heard, and which two are blocked.

A gain control is provided on the jack panel for control of the external video signal entering J2 (see part five, October), and dual gain control (see Figure 1) is included to control the right and left audio-input signals entering at J4 and J6. The dual control should be turned fully clockwise (maximum volume) for most input signals, such as those from VCRs and audiocassette decks. However, some compact audiodisc players have up to 2V rms of output signal. This is more than double the usual level of other accessories, so if overload distortion is heard, reduce the adjustment of VR4, the input-level audio control.

Audio for external uses

In Figure 1, notice that the TV stereo sound signals entering at PD2-3 and PD2-5 also are connected directly to J3 and J5 TV audio-output jacks. Therefore, television stereo or monaural *sound is available from J3 and J5 at all times* when the receiver is turned on and the tuner has been

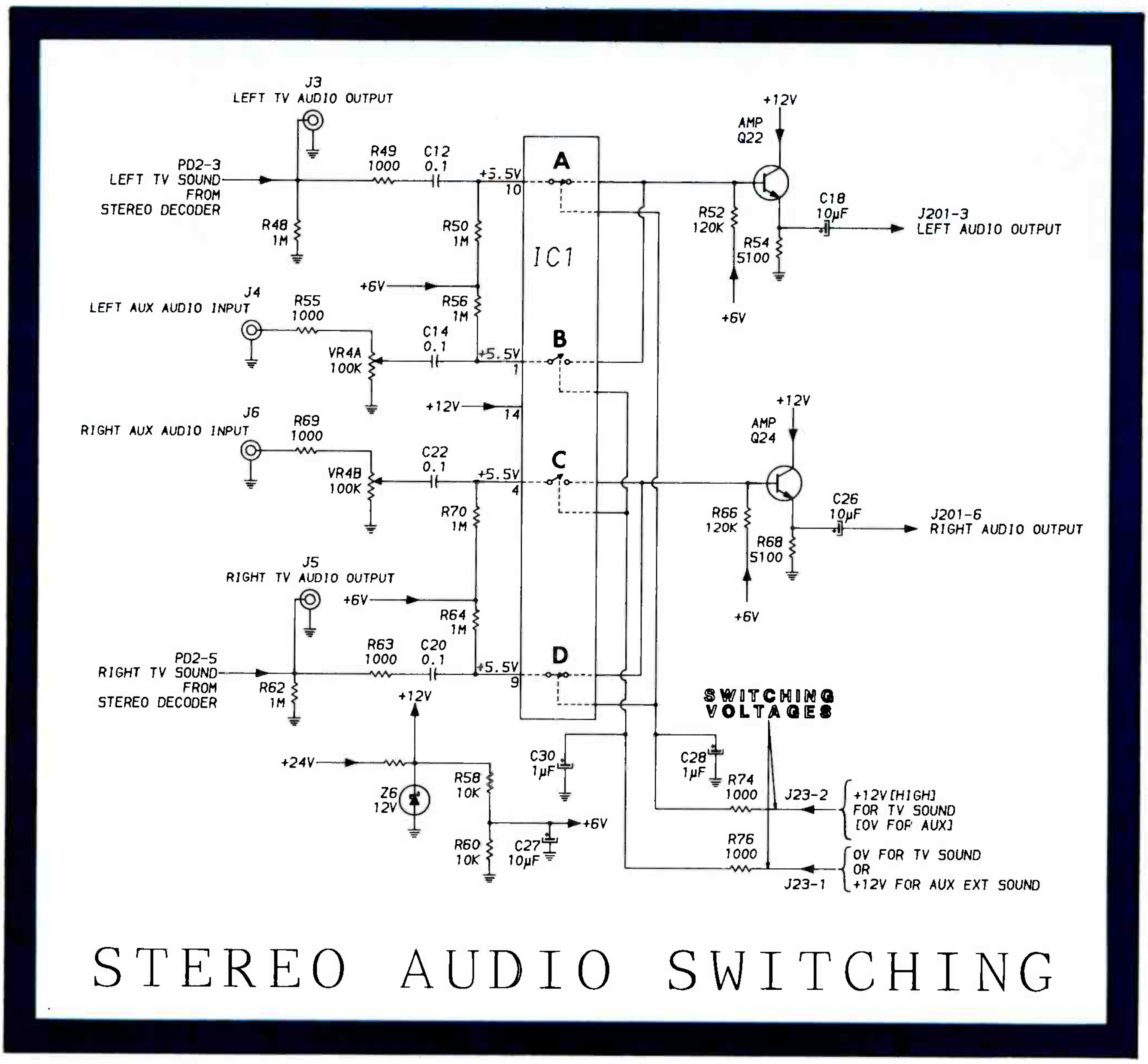

Figure 1. Solid-state switches inside IC1 select stereo-TV audio or external stereo audio and send those signals via buffer transistors to the power amplifiers. Switching operates according to the dc voltages at J23-1 and J23-2. Notice that the audio from the TV tuner, IFs and detector always is available at output jacks J4 and J6. Dual gain-control VR4 allows external audio signals that are too high in amplitude to be reduced as needed.

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THE MARK III

HV CIRCUIT SCANNER

★ Checks the horiz output circuit for open / shorts,
★ Checks the flyback, yoke, PC, and HV mult,
★ Checks all scan derived B + sources,
★ Checks all circuits that rely on scan derived B + voltage,
★ Checks for open safety capacitor,
★ Checks the emitter circuit of the horiz output,

THEN,

★ Provided the green normal light is lit, the Mark III will safely power up the TV set so that **you** can "look" for open circuits by examining the picture on the CRT.
★ Circumvents all start up and horiz drive related shut down circuits.

APPLICATIONS: The Mark III will analyze the horiz, flyback, hi-voltage, scan derived B + sources, yoke, pin cushion, HV multiplier circuits in any TV set that employs either an **NPN** transistor or a single **SCR** for its horiz output device. This applies to any age, any model, any chassis, any brand - - - including Sony.

In brief, the "test" function scans for shorts, the "run" function permits you to observe any "open" circuits via the symptoms that appear in the CRT screen.

HOOK - UP: Simply remove the set's horiz output device and replace it with the scanner's interface plug. No wires to disconnect, no other connections required (not even a ground connection).

MISTAKE PROOF: No damage will result if an error is made during hook up. The scanner simply won't turn on until the error is corrected.

PUSH THE TEST BUTTON Just one of the four lights will lite.

RED OPEN LIGHT means the emitter circuit of the horiz output stage is open (no ground path).

YELLOW SHORT LIGHT means the flyback primary, HV multiplier, vertical output, horiz driver, and R-B-G color output stages are **not** shorted. Instead, a circuit that normally draws a small amount of current is shorted (i.e. the tuner, IF, AGC, video chroma, matrix, vertical or horiz oscillator).

RED SHORT LIGHT means either the flyback, the HV multiplier, the vertical output, horiz driver or one of the **R-B-G** output transistors is shorted.

GREEN NORMAL LIGHT means the TV set's entire flyback circuit is totally free of shorts. It also means that it is safe to power up the TV set with the "run" button so that you can look for open circuits by observing the symptoms on the CRT screen.

FEATURES: All **start up** circuits and all horiz drive related **shut down** circuits are automatically circumvented by the Mark III during all test and run functions. During the test function all flyback secondary output is limited to approx 80% of normal. 2nd anode voltage is limited to approx 5 KV.

This means all circuits that are not shorted will have some 80% of their normal B + voltage during the "test" phase. It also means that any shorted circuit will have zero DC volts on it. This feature makes any short easy to isolate.

The MARK III sells for only $595.00

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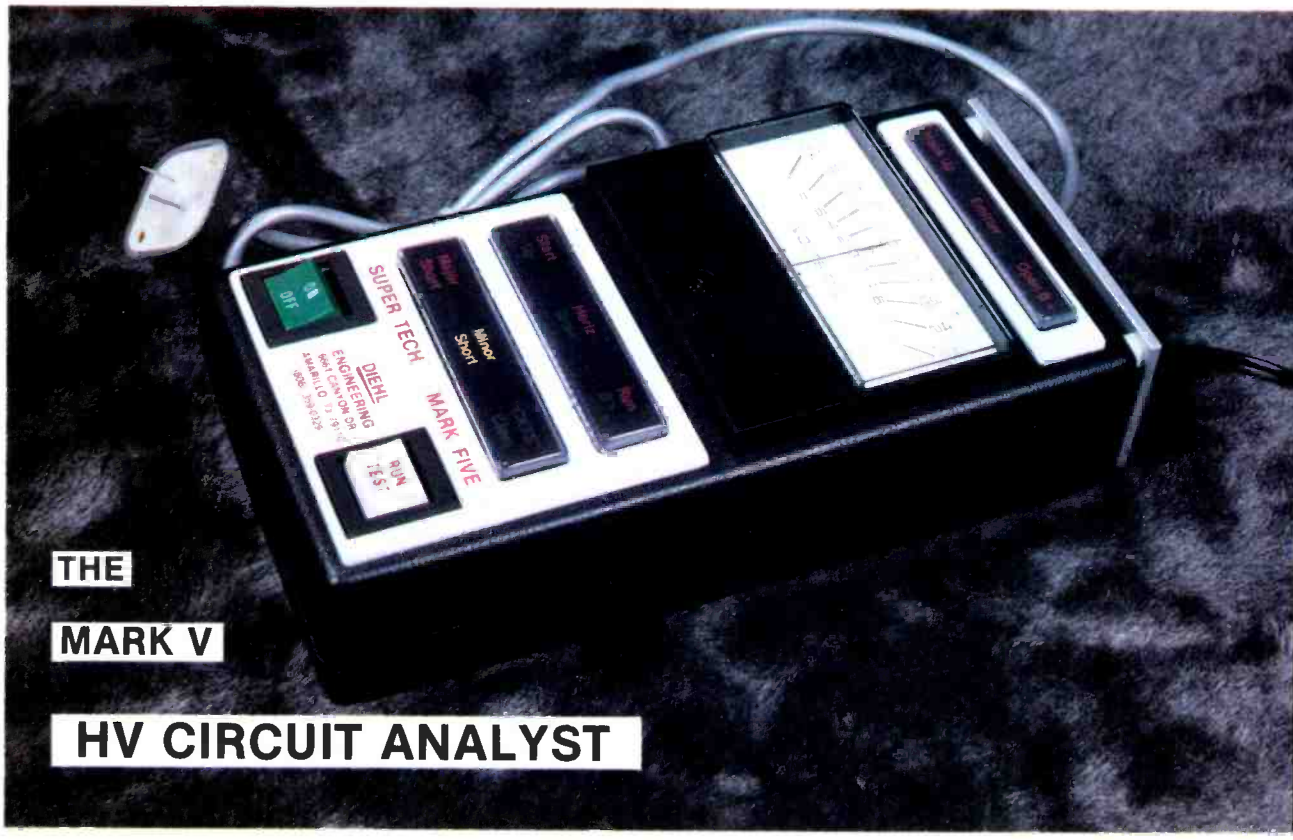

A M A Z I N G

- ★ Checks the horiz output stage for opens / shorts,
- ★ Checks flyback, yoke, PC, and HV mult,
- ★ Checks all scan derived B+ sources,
- ★ Checks for open safety capacitors
- ★ Checks for open ground path for horiz output stage
- ★ Checks for open primary LV supply,
- ★ Checks for error in interface connections,
- ★ Checks for proper LV regulation,
- ★ Checks for proper start up circuit operation,
- ★ Checks for shorted horiz driver transistor,
- ★ Checks the operation of the horiz osc / driver circuits,
- ★ Checks B+ "run" supply for the horiz osc / driver circuits,
- ★ Checks all circuits in the TV set that rely on scan derived B+,
- ★ Automatically circumvents all start up circuits and horiz drive related shut down circuits.

HOOK UP: (Identical to Mark III)

OPERATION: Turn the Mark V on, turn the TV set on, then, simply look at the lights.

RED "HOOK UP" LIGHT means that you have made an error in hook up. No damage has been done, correct the problem then continue.

RED "EMITTER" LIGHT means that the ground path for horiz output stage is open. Correct the problem then continue.

RED "B+ OPEN" LIGHT means that the primary LV supply in the TV set is open. Correct the problem then continue.

No "top row lights" equals normal.

Look at the middle row of lights

RED "START UP" LIGHT means that the start up circuit in the TV set is not working (no start up pulse).

GREEN "START UP" LIGHT means the start up circuit in the TV set is working normally. Yes, it is 100% accurate. Even on Zenith's single pulse start up circuit !

RED "HORIZ DRIVE" LIGHT with a green start up light means that the horiz driver transistor in the TV is shorted (E to C).

GREEN HORIZ DRIVE LIGHT means that the horiz oscillator and driver circuits are operational.

READ THE DC VOLTAGE METER THEN,

PUSH THE TEST BUTTON

If the meter comes up to, or, falls back to, factory specified DC collector voltage, the LV regulator circuit is working. If it fails to do so, it is not working!

RED "B+ RUN" LIGHT means that the B+ source that normally keeps the horiz osc / driver circuits running after the start up B+ pulse has been consumed has become open.

GREEN "B+ RUN" LIGHT means that the B+ resupply voltage (scan derived) is being provided. All is normal if all three lights are now green.

The scan circuit short detector in the Mark V is identical in all ways to that which is used in the Mark III. Operation is also identical. Both units are virtually indestructable when simple directions are followed. Both units carry a full year's warranty against defects in materials and workmanship (parts and labor). Either unit can be easily repaired by almost any technician in his own shop.

If the green "circuits clear" light is now lit

It is now safe to push the "run" button and examine the symptoms that appear on the CRT screen, for the purpose of isolating any "open" circuits.

Except for hook up and CRT filament warm up time, this test can easily be completed in two to five seconds!

The Mark V sells for only $995.00

Stop losing money on start up / shut down scan derived B+ problems; order your Mark V today!

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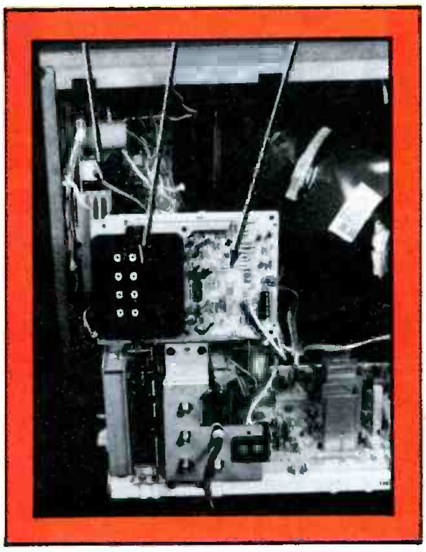


RCA-type female sockets of the jack panel are connected directly to the audio-video/input-output board where the internal/external switching is performed. Audio signals from the AVIO board are sent to the power amplifier board. Location of the power amplifier is shown by the arrow at left. The center arrow points to the jack panel, and the right arrow indicates the AVIO board.

adjusted previously to a channel that has good TV video and audio.

For example, if you have channel 5 tuned in with good picture and sound, and then operate the A/V switch under the front-panel door (lower right) to select external audio and video, a VCR (or other source of audio and video) can be connected to the jack panel. A picture from that video will be on the screen and the accompanying stereo sound can be heard through the Sylvania speakers. But the channel-5 video still is present at jack panel J1 while the stereo or mono TV audio appears at jack panel J3 and J5. These signals can be used externally by other equipment, if desired.

Notice that the J3/J5 audio does not pass through the tone-control stages or any other function of IC201. The receiver volume, tone, balance and muting functions do not affect the J3/J5 audio. Therefore, there will be a brief burst of noise each time a new station is selected because no muting is provided. This is normal.

The stereo power amplifier

Right and left audio outputs from the switching IC on the AVIO board are sent through cables to the power-amplifier board (top, right) that is mounted on the cabinet wall. The complete schematic in Figure 2 is remarkably simple in some respects but complicated in others. Examples of simplification are the *bass, treble* and *balance* controls. These controls operate by dc voltages applied to IC201, resulting in far fewer components compared to systems based on discrete components. At the other extreme are switching and muting transistors whose purposes are obscure.

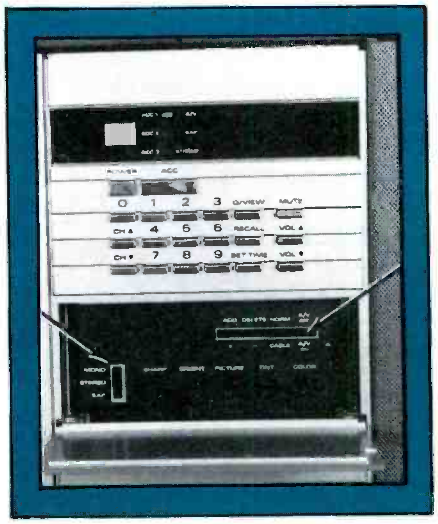
As shown in the Figure 2 schematic, the right-channel audio enters at J201-6 and travels to pin 4 of IC201. Between those two points are an isolation resistor (R201), a R211/R213 voltage divider to reduce the signal level and a C209 coupling capacitor. Similarly, the left-channel audio from J201-1 goes through R200, R212/R214 and C210 to IC201 pin 15.

FET Q206 is connected between the right and left audio signals following R201 and R200. When the MONO/STEREO/SAP switch (under the front-panel door) is moved to the MONO (monaural) position, 0V is applied to the gate of P-channel J-FET Q-206. This zero voltage is maximum bias for Q206 and it produces minimum resistance inside Q206 between source and drain, which are connected to the two stereo audio voltages. Therefore, the J-FET's low resistance blends both input signals together, forming a monaural signal.

The MONO/STEREO/SAP switch contacts are open for stereo and SAP (separate audio program), applying almost +8V to the Q206 gate. This is cut-off bias for the J-FET, producing a virtually open circuit between drain and source, so the two stereo signals are not blended, but remain separate. During SAP operation, another audio program (brought on a separate subcarrier) will be heard from both speakers.

Volume control for both audio channels is produced by the dc voltage at IC201 pin 1. Push-buttons on the remote unit and the receiver's front panel can be pressed to increment and decrement a counter that produces 64 steps of dc pulse duty cycle at pin 25 of IC1002 on the tuner-control board. These pulses are filtered to obtain pure dc voltage between zero for minimum volume to +3.8V for maximum volume that is applied to J201-1, the R234/R235 voltage divider and the C203 filter capacitor before it reaches IC201 pin 1 (which is the place to check the dc voltage if the volume does not vary properly). Also, the muting dc voltage is added to this volume-control voltage on the tuner-control board during channel changes and when the mute channel is pressed.

Notice that the balance, bass and treble controls do not handle audio signals. Instead, each control supplies an adjustable dc voltage between +3.7V and zero to a pin of IC201. No explanations have been published (to my knowledge) about this method, but it appears the capacitors and resistors at IC201 pins 13 and 14, 5 and 6, and 7 and 12 are the resistance/capacitance components for the various high-pass and low-pass filters. Then the dc voltages from the controls vary the gains of internal transistors to produce the response curve changes. The 0.22μF capacitors from pins 17, 9, 10 and 16 to ground are there to remove hum and horizontal-sweep signals from the circuit; they have nothing to do with the tone controls otherwise.



Location of the *MONO/STEREO/SAP* switch under the front-panel door is shown by the left arrow, while the arrow at the right points to the audio/video (A/V) push-button.

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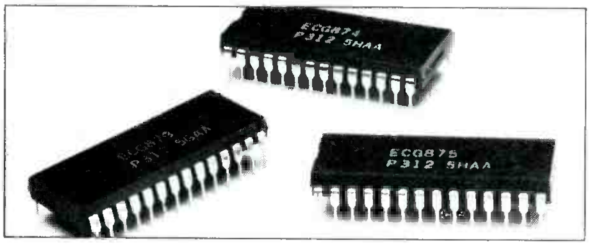

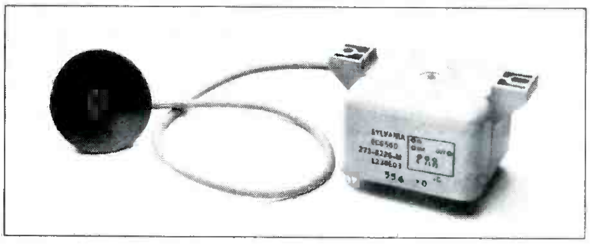

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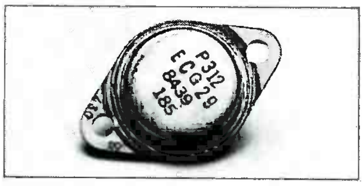

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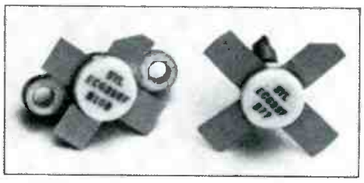

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Following amplification and volume-control/muting functions of both stereo signals, the processed signals emerge from IC201 at pin 8 for the right channel and pin 11 for the left channel. Between the IC201 pins and the input pins of the power integrated circuits that drive the speakers are several components. The right-channel signal first passes through coupling capacitor C221, then through R229 (with R301 as the other half of a 6dB loss pad) and finally through coupling capacitor C305 to the IC301 input pin 5. Other components perform the same functions for the left-channel output signal that finally reaches IC302 pin 5.

Large coupling capacitors (1,000μF of C315 and C316) bring the amplified audio from pin 9 of each power IC to the speaker (the other speaker lead is grounded). Several electrolytic capacitors around IC301 and IC302 have been omitted from Figure 2 schematic for simplicity. Use a complete schematic when servicing the am-

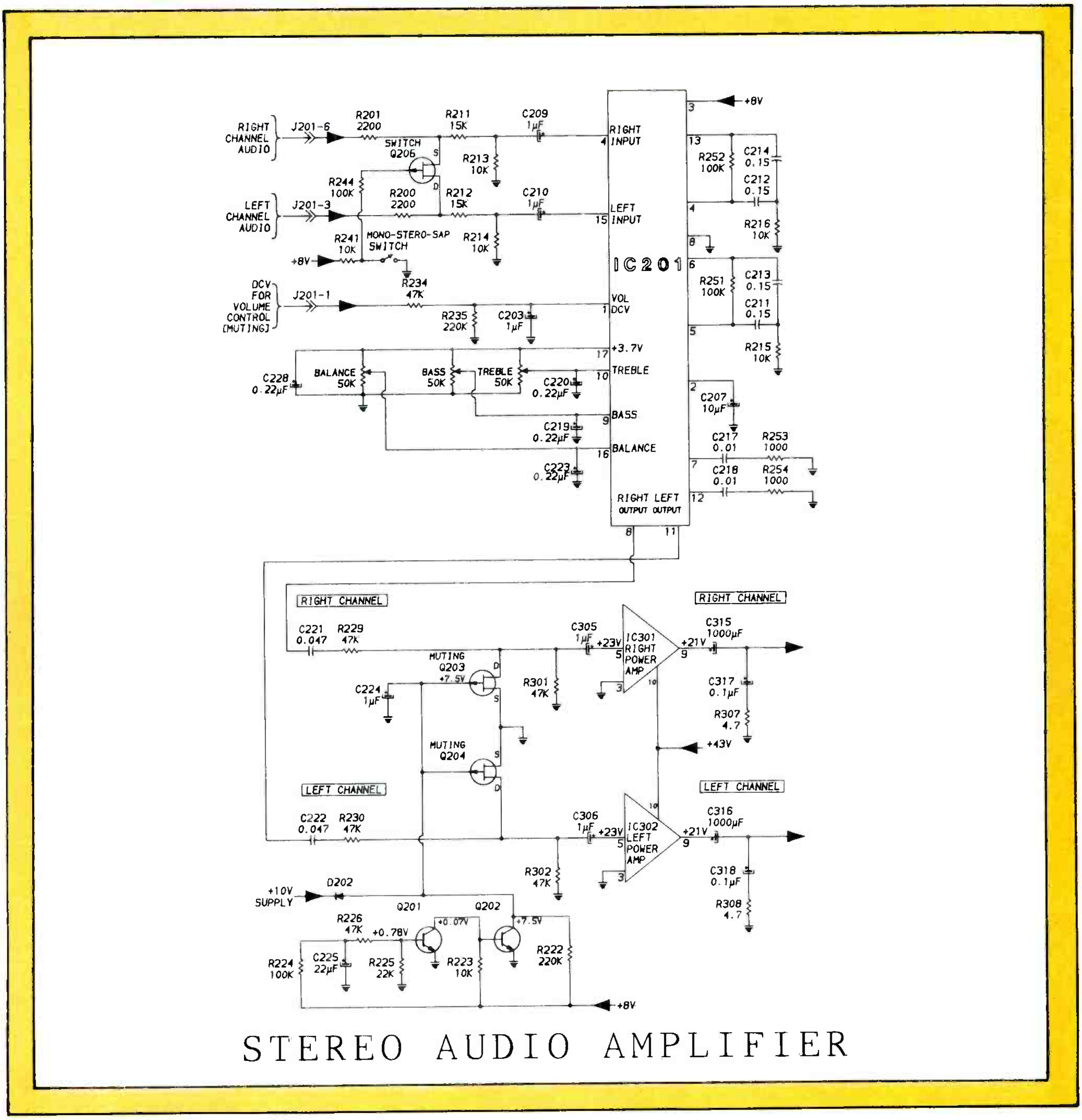

Figure 2. Amplification is provided by IC201, IC301 and IC302. FET Q206 acts as a switch to connect together the two audio inputs for monaural operation. FET's Q203 and Q204 act as switches to ground the signal inputs of IC301 and IC301 output IC s for muting. Transistors Q201 and Q202 provide time delay that limits the muting to the first half-second or so after power is applied. D202 and the + 10V supply act to bleed C224 almost instantly at turn-off, to provide muting immediately following power-off. Another type of muting is performed during station selection by the tuner-control circuit. It mutes by adding a voltage to the volume-control voltage that is brought to IC201 pin 1.

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plifier. Do not remove the phase-compensation filter at each output (C317/R307 and C318/R308) during tests because inaudible oscillaton at an ultrasonic frequency can be produced.

Muting circuits

Nothing has been written so far about Q203, Q204, Q201 and Q202 because they have nothing to do with the signal and power amplification. Although Q203 and Q204 are identified as *muting* transistors, they have no connection with the muting (described previously) that eliminates noise during station selections. Instead, they are part of a function that removes any thumps or pops that otherwise might occur during power-up and power-down times, while Q201 and Q202 control the time the sound is dead at the beginning of power-up.

Q203 and Q204 J-FETs operate as shorting switches to connect the two audio signals to ground when their gate-to-source voltage is near zero. When +7.5V is applied to the two gates, both FETs are cut off and act as open circuits that do not affect the audio signals at their drains. Those are the two conditions; no in-between conditions are allowed.

Transistors Q201 and Q202 provide a near zero gate voltage for Q203 and Q204 (which removes the input signals from the power ICs) for less than one second after ac power is switched *on*. In other words, after the power switch is pushed, almost a second goes by before any sound can be heard in the two speakers. Also, the sound level rises slowly enough to eliminate switching clicks. The effect is pleasant to the ear.

This time delay is produced primarily by R224 and C225 (with R226/R225 and the Q201 base current draining some current from C225). None of the other base and collector voltages for Q201 and Q202 are applied gradually, but rise in step with the power-supply voltage.

When power is switched *on*, the Q201 base has zero dc voltage, so it is cut off and its collector does not affect the base bias of Q202. Therefore, Q202 has saturation forward bias, and the resulting high collector current through R222 reduces the Q202 collector voltage to almost zero (less than +0.1V). Of course, this voltage is connected to the gates of J-FET's Q203 and Q204, forcing them to conduct strongly and thus eliminate all signals, hum, clicks or thumps that otherwise might be there and heard in the speakers.

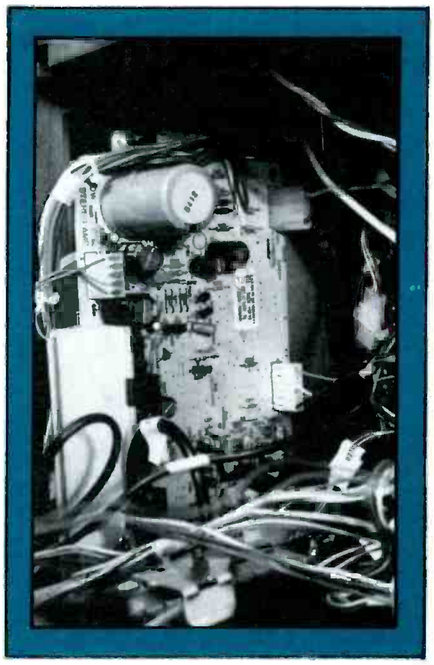
After sufficient positive voltage has built up in timing capacitor C225, the Q201 base has saturation bias that forces the Q201 collector to draw a large current that reduces the collector voltage to almost zero, and with it the Q202 base voltage. Without a forward bias at its base, Q202 cannot conduct so its collector rises to about +7.5V (almost supply voltage). This increases the gate voltage of Q203 and Q204 to cut-off bias. At this time, any audio signals coming from IC201 will reach the output ICs and be heard in the speakers.

No explanation has been made yet for D202 and the +10V high-ripple voltage supply. Neither appears to have any useful purpose. These components are added to mute the signals to the output ICs *after* the receiver is switched *off*.

The D202 anode is connected to both FET gates, that in turn are bypassed by a 1μF capacitor and supplied with dc voltage by 220k R222 from the +8V supply. Therefore, the long time constant prevents any rapid change of gate voltage when the receiver power is switched *off*.

By contrast, the +10V supply uses half-wave-rectified power with minimum filtering via a 10μF capacitor and only one 1,500Ω resistor for a load. The +10V supply decreases to zero almost instantly when the receiver power is switched off.

Because the +7.5V gate voltage decreases slowly while the +10V supply voltage at the cathode of D202 decreases very rapidly when power is switched *off*, D202 quickly changes from reverse bias to forward bias and its current forms a low-resistance short between the 1,500Ω supply bleeder resistor and C224 (which bypasses the J-FET gates). Thus C224 is discharged quickly and the gates voltage drops to zero, eliminating all thumps, clicks or pops that originate in stages prior to the output ICs.



Most of the power-amplifier board is shown, although the bottom is obscured by cables. The white rectangle at the left is the heat sink for the output ICs.

Therefore, the Q203/Q204 muting operates to eliminate various noises during these two times: during the first half-second after power is switched *on;* and for a short time after the ac power is switched *off*.

Stereo speakers

Two matching speakers are supplied with Sylvania model RX-S198WA. They are not fastened to the receiver cabinet, but have the same height and matching walnut grain as the receiver. Therefore, they can be placed closely adjacent to the right and left sides for the appearance of a wide table model. Or they can be placed on the floor or elsewhere within the limits of the wire (about 9 feet) on each speaker. Enhanced stereo effect can be obtained if the speakers are separated more widely.

Each speaker baffle contains two 4-inch woofers and one cone-type tweeter (page 14) along with sufficient fiber glass to dampen most internal multiple reflections. The cabinet is sturdy and heavy for its size with a removable back. A bass-reflex round vent is placed in the cabinet's bottom.

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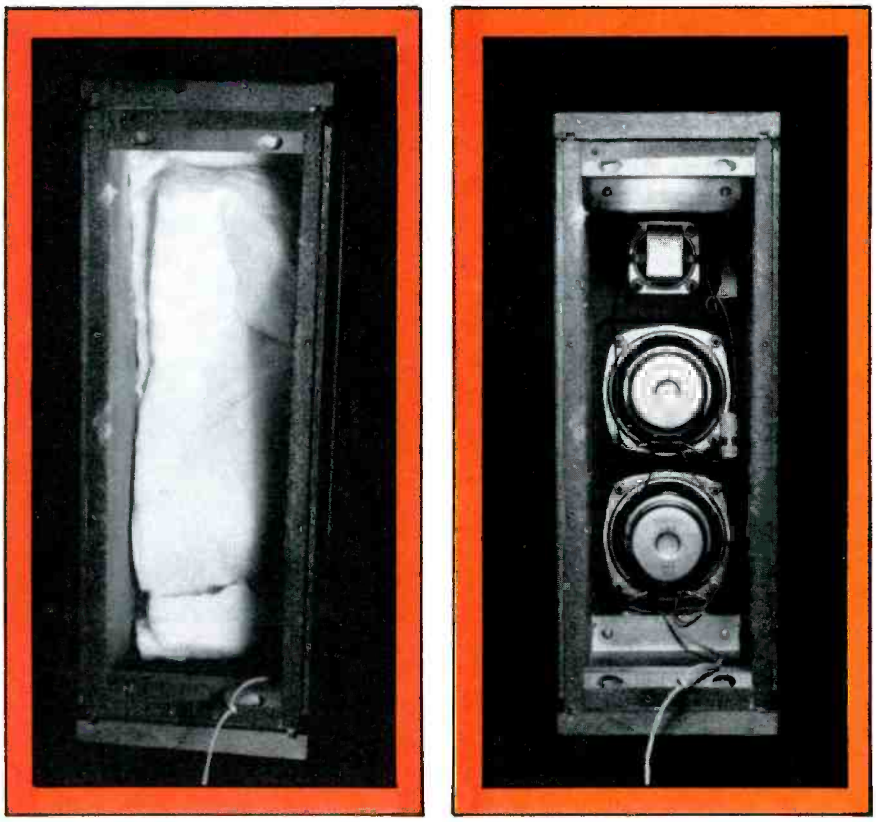
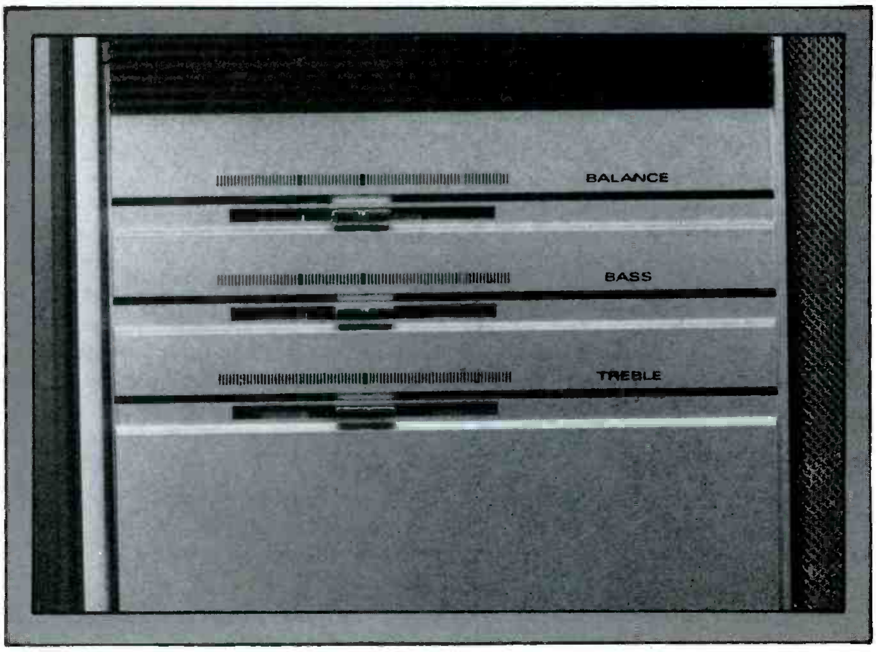


Two woofers of about 4-inch diameter and a cone-type tweeter are in each speaker cabinet. (A) when the back is removed, nothing can be seen except the fiberglass batting that minimizes internal sound reflections. (B) With the fiber glass removed, the three speakers can be seen inside the cabinet.



For the balance, bass and treble controls, neutral position is obtained with the dent in the bar knob vertically aligned with the black calibration line above it. Operations of the bass and treble controls are critical around the center or neutral position because the controls do not have a center tap on the element. Instead, it appears the boost and cut operations are in opposition at the center, making the point of cancellation very critical.

Frequency response of the speakers was not measured, but listening tests with sine waves showed fair bass response down to nearly 60Hz, which is good for such small speakers.

Amplifier tests

Power output and frequency response tests were made on the two amplifiers, by connecting the audio generator to the external-audio input plugs and load resistors with a decibel meter to the speaker-output jacks.

Sylvania rates the power output as 7W per channel. My tests of one channel at a time showed 8.4W across 8.3Ω for one channel and 8W across 8.4Ω for the other at 400Hz. This exceeding of the specifications is all the more unusual if compared to the old days when all amplifiers having two 6L6 tubes were *rated* at 35W, although most of them checked out at 18W to 21W on sine waves before clipping!

Frequency responses were tested very extensively because this was the first circuit I had examined that used dc voltages to produce changes of frequency response. Table 1, page 15, shows frequency response listings for six different adjustments of the tone and volume controls. These three controls are not center-tapped, so it is difficult to find the precise center of each one's operation. For example, the bass potentiomenter gives bass increase (boost) when moved to the right from the center position, or bass decrease (cut) when moved to the left from the center (see lower left). But the point giving flattest response is very difficult to find. Deviations of only 1/6-inch change the response enough to show on a dB meter reading, while moving the bar knob ¼-inch changes the response noticeably to my ear.

Another discovery from the measurements was that the circuit partially corrects the Fletcher-Munson equal-loudness contours. When the amplitude of music or multifrequency sounds is decreased, human ears become less sensitive to the bass frequencies and somewhat less sensitive to the extreme treble frequencies. The

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ALL READINGS IN DECIBELS

Frequencies	Low Gain for Fletcher-Munson	High Gain for Flat	HF Down	HF Boost	Bass Down	Bass Boost
20Hz	−1	−8.4	−8.5	−8.4	−38	+6
40Hz	+7	−0.9	−1.1	+0.9	−31	+16
60Hz	+9	+1.5	+1.4	+1.4	−22	+17.4
80Hz	+9	+2.0	+1.9	+2.1	−17.4	+14.8
100Hz	+8.1	+2.2	+2.1	+2.2	−14	+12.4
200Hz	+4.6	+1.6	+1.6	+1.8	−7.8	+6.8
400Hz	+1.8	+0.6	+0.6	+0.6	−3.5	+2.6
1000Hz	+0.2	+0.2	0.5	+0.4	−0.8	+0.6
2kHz	0	+0.3	−1.5	+1.3	−0.3	+0.2
4kHz	+0.2	+0.4	−4.2	+3.2	+0.2	+0.5
8kHz	+0.2	+0.3	−8.5	+6.6	+0.2	+0.4
12kHz	−0.7	−0.4	−11.3	+7.7	−0.5	−0.4
16kHz	−1.8	−1.2	−13.5	+7.5	−1.5	−1.3

19C4 AUDIO RESPONSES

Table 1. These are the six frequency response curves according to the test conditions stated.

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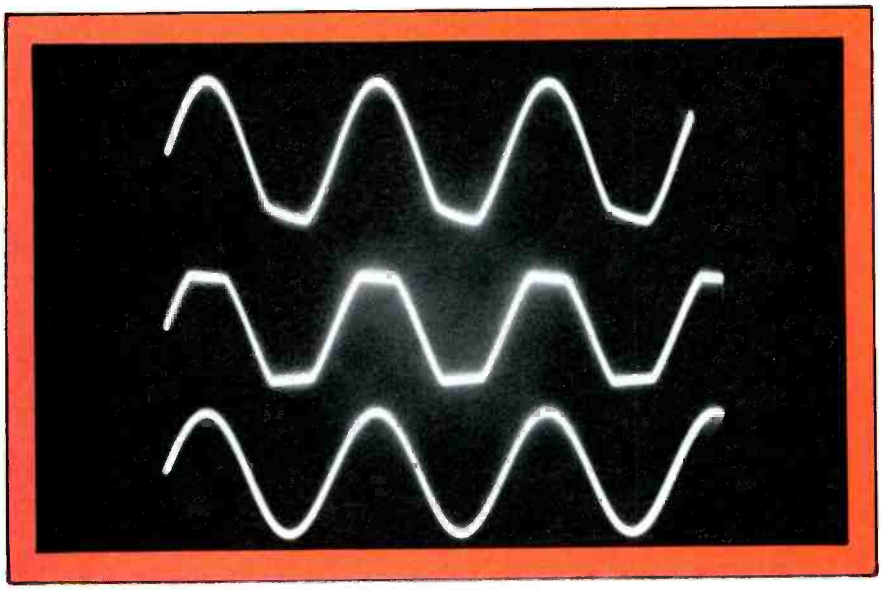

The top scope trace shows the output at the speaker plug (across an 8Ω load resistor) when the amplitude of sine waves at the input jack was too high, and the receiver volume was reduced electronically, causing clipping in the IC201 VCA.

At the center is correct symmetrical clipping of positive and negative peaks when the generator signal was reduced to about 1V rms and the TV electronic volume control was adjusted for excessive gain. This waveform is normal under the circumstances. The bottom trace shows excellent sine waves obtained from the previous clipped ones by slightly reducing the electronic volume-control gain.

effect becomes more pronounced as the volume progressively becomes weaker. Some hi-fi equipment provides partial correction with a *loudness* control. The Sylvania Superset Two audio system gives increasing bass boost as the volume is decreased with the up/down buttons. At unity gain, a very low volume where the input signal voltage equals the speaker voltage, the low frequencies were boosted +7dB at 80Hz, +6.5dB at 60Hz and +6.1dB at 40Hz. However, no treble boost was measured.

When the up/down buttons were used to give higher gain in IC201 this Fletcher-Munson bass boost was eliminated and the conventional frequency response curves were made. Adjustments of treble (high frequencies) were moderate. Maximum change occurred at 16kHz for a boost of +8.7dB and a maximum cut of −12.3dB, for a total treble adjustment range of 21dB. At 4kHz the boost was +2.8dB and the cut was −4.6dB.

By contrast, the bass control gave a much higher change from +12.8dB to −19.4 at 80Hz for a total range of 32.2dB, and a +15.9dB maximum to a −20.5dB minimum at 60Hz for a total range of 36.4dB.

No instrument tests were made of the balance-control operation. Listening tests showed it operated smoothly, giving equal volume to both channels at the center mark, and it reduced the other channel to near inaudibility when moved to one extreme giving full volume to that channel.

Comments about the audio system

Many operating and listening tests were conducted on this Sylvania Superset Two television/monitor. An audiocassette deck was connected by two pairs of shielded cables. The audio of several television programs was recorded and played back over the television audio system. Also, several prerecorded music tapes were played to evaluate the audio quality with stereo music.

Both high-fidelity and conventional sound tracks from a VCR were played through the TV audio system with good results.

Compared to the sound quality of a standard TV receiver, the Sylvania Superset Two audio performance is excellent. Most listeners will be satisfied with what they hear. Only in direct comparison to the same audio material (taken from the audio-output jacks and reproduced over a good *component* system with three-way speakers including a large woofer) does the Sylvania audio seem inadequate. Of course, most customers who buy this type of TV receiver/monitor do not want the bother and expense of adding an external amplifier and two large speaker cabinets.

To recap, the sound reproduced by the Sylvania internal amplifiers and the supplied matching speakers is pleasant and unobtrusive, but not outstanding. Extreme treble and low bass below about 80Hz are rolled off to produce a good balance between highs and lows.

There is one important operating precaution when bringing in audio signals to the J4 and J6 audio input jacks. Do not use signals having amplitudes above about 0.8V rms (approximately 0dB). If you are forced to connect higher amplitude signals, reduce them carefully with the VR4 dual volume control. The reason for this recommendation is illustrated by the waveforms, top. IC201 in Figure 2 includes a voltage-controlled amplifier whose voltage gain is determined by the value of a dc control voltage. This is done to make the control of volume easy from the remote-control hand unit. However, VCAs will distort with clipping if the input level is too high and the internal gain is reduced too much in an attempt to reduce the overall level. The same problem can occur in audiocassette decks and other audio equipment that control the volume with push-buttons rather than analog controls.

End of the series

Part six is the end of the series about Sylvania's RXS198WA receiver and its 19C4-03AA chassis. Please write to the editor if you have any questions about this TV receiver/monitor, or if you would like similar explanations of other popular models. ES&T

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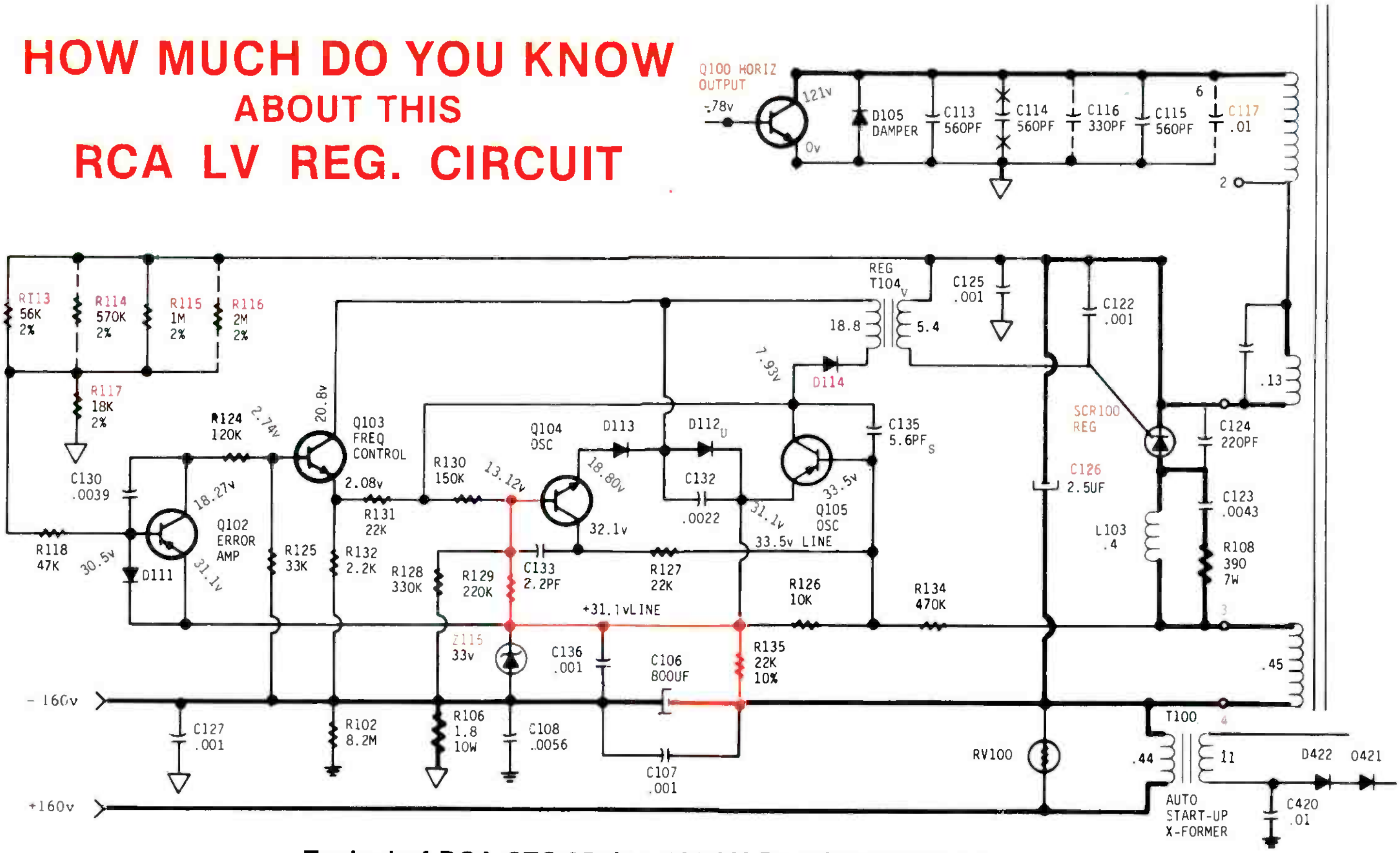
HOW MUCH DO YOU KNOW
ABOUT THIS
RCA LV REG. CIRCUIT



Typical of RCA CTC 85 thru 108 LV Regulator Circuits

Schematic by Diehl Engineering

How many of these questions can you answer ?

(1) Every circuit has a beginning and an ending. Where does this circuit begin ?

(2) Specifically, what is the purpose of this circuit ?

(3) What turns it on ? What turns it off, or does it ever really turn off ?

(4) Does this circuit have a shut down feature ? If so, which components are involved ?

(5) What would happen if Q103 were to become shorted E to C ?

(6) What purpose does Z115 serve ?

(7) What would happen if D114 became shorted ?

(8) What purpose does C126 serve ? What will happen if C126 becomes open ?

(9) Is the winding between terminals 3 and 4 of the flyback a primary or a secondary winding ?

(10) What purpose does C117 serve ? Exactly what does it do, and exactly how does it do it ?

(11) Exactly what do resistors R113, 114, 115, 116, and 117 do ? What happens if they change value ?

(12) What occurs that causes this circuit to produce an initial start up pulse ?

(13) Why does this entire circuit become shorted and begin to destroy horiz output transistors if the regulator SCR becomes shorted ?

(14) There is exactly one safe and practical method of circumventing this LV regulator circuit for test purposes. This technique does not involve a variac. Instead, you must disconnect one wire then connect a jumper wire from terminal #4 directly to .... Which wire do you disconnect and where do you connect the other end of your jumper wire ?

(15) If SCR100 is shorted, this circuit will still "eat" horiz output transistors even if you are using a variac. Why ?

(16) Why does this circuit use a floating ground ?

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What do you know about electronics?

Know your enemy-NOISE

By Sam Wilson

When I was very young, I was told that all of the noise created by a resistor in a circuit is caused by electrons bumping into molecules. By the time I was 25, I was a walking encyclopedia of misinformation. I'm just now starting to get my head straight. As closely as I can figure it, by the time I get all the junk out of my head, I'll only have three months to work before I'm 65 years old.

Consider the simple amplifier of Figure 1. It will, for the purpose of this discussion, be considered to be perfect. In other words, it will amplify the signal, but it will not add any noise to that signal. The output power is measured by the wattmeter (W), so, with no input signal, there is no output power to be measured.

This concept of a perfect amplifier is actually used to define noise measurements. We are not just playing a game in our minds.

In Figure 2, a resistor has been connected between the amplifier input and common. Immediately, there is output power from the amplifier. This is strictly noise power. It is the result of amplifying the noise generated by the resistor.

There is no current flowing through the resistor in Figure 2. It is obviously *not* caused by electrons bumping into anything.

Well, we know what it is *not* caused by, so, now let's see where the noise *is* coming from. As shown in the model of Figure 3, at room temperature there are always some free electrons moving around in a material. This happens to be a resistor, but there are free electrons in *all conductor and semiconductor materials at room temperature.*

At a given temperature, some materials (metal conductors) have more electrons moving around than others (semiconductors). The motion of the electrons inside the material is called *intrinsic current.*

The motion of the electrons is entirely random. That is an educated way of saying that even though there is a motion of elec-

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trons, there is no current flowing into or out of the resistor.

At any single instant of time, there must be more electrons flowing in one direction than in the other direction. At that instant, there will be a very small voltage across the resistor. In the next instant, everything will change. In other words, that small voltage is a tiny pulse.

Over any period of time, there will be millions of those tiny voltage pulses. That is the noise signal that is being amplified in Figure 2.

If you raise the temperature of the resistor, there will be an increase in the intrinsic current, and an increase in the noise.

Any time you connect a resistor across the input to an amplifier, there will be noise introduced into that amplifier. This noise is

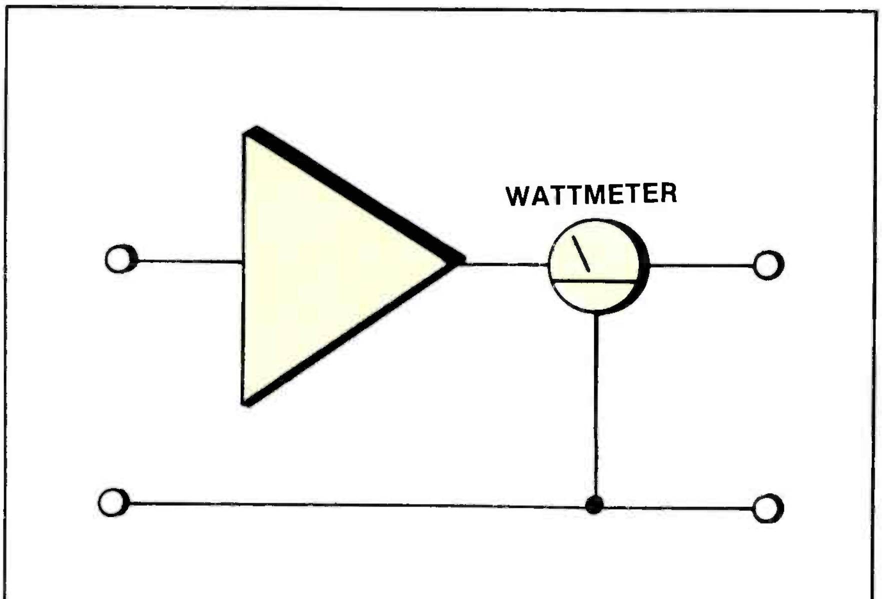

Figure 1.

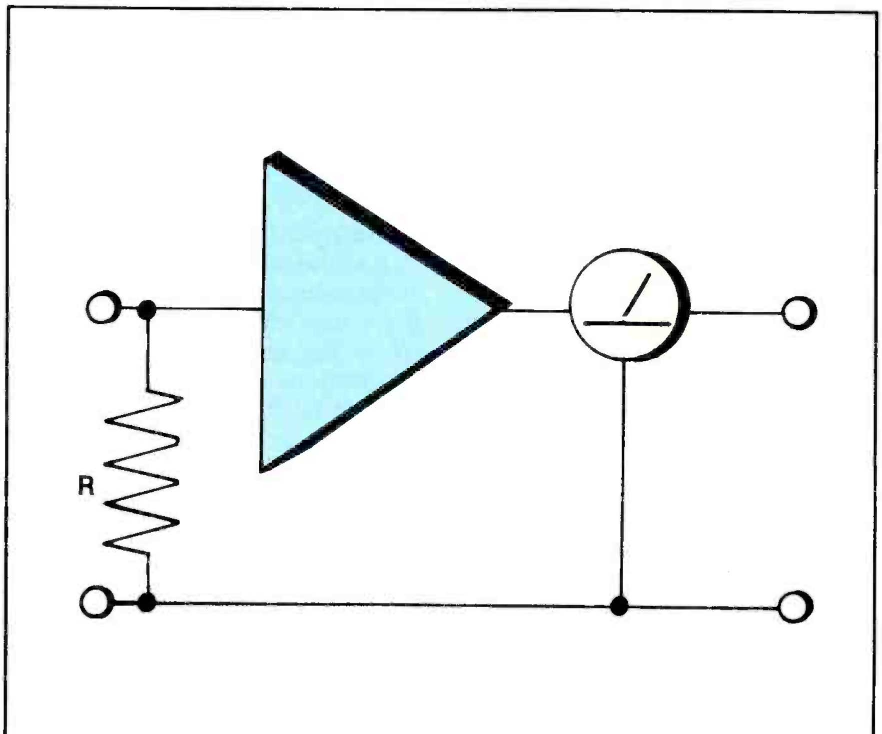

Figure 2.

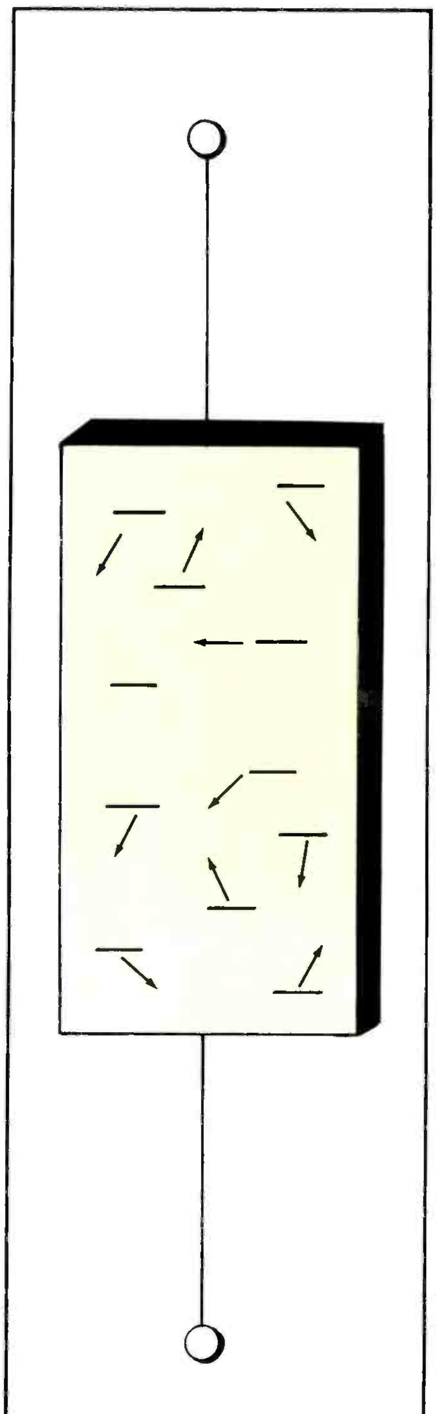

Figure 3.

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NOISE

especially troublesome in a system where the signal has a low amplitude. The reason is that the signal-to-noise ratio will be low if the noise is anywhere near the same amplitude as the signal.

It is obvious that you must be very careful when you replace resistors in certain circuits. If you replace a film resistor with a carbon resistor, you can introduce enough additional noise to change the characteristics of the system.

When you connect an antenna to a receiver you are going to introduce noise. It is caused by the antenna resistance. That is one of the things that makes some antennas perform better than others—they introduce less noise.

Any conductor or semiconductor device that you connect across the input to a small-signal amplifier will introduce noise into that amplifier. So, connecting a transducer will cause noise to be injected. Low signal-to-noise ratio!

A world-famous gas man

I have to stop here and tell you about a man who became famous by studying gases. I often wonder what he told his friends he was doing. His name was Boltzmann.

When you fill a balloon with gas, it holds its shape because gas molecules are banging against its inside surface. If you increase the temperature of the gas, the energy of the molecules (and, therefore, the pressure) increases. *The energy of the molecules is directly related to the gas temperature.*

And when Boltzmann studied the relationship between temperature and gas molecules, he discovered that electrons and temperature have the same relationship. He developed a constant that relates the energy of the molecules (and electrons) to the temperature. For obvious reasons it is called *Boltzmann's constant.*

Voltage generated by a resistor

You can expect that the amount of energy of the electrons in carbon (or any material that conducts electrons) is related to the temperature of that material. In fact, they are related by Boltzmann's constant. As you will see, that constant is needed to express the noise generated by a resistor.

The equation of the amount of noise power generated by a resistor is given here:

Pnoise (available) = KTB

where

K is Boltzmann's constant
B is the bandwidth
T is the resistor measured in degrees Kelvin.

The noise voltage is given by:

$e_n \sqrt{4KTBR}$

where K and B have the same meaning as above
R is the resistance

As an example, if you connect a 1k resistor across the input of an RF amplifier that has a bandwidth of 5MHz, the noise injected into the amplifier will be about 10μV at room temperature. As you know, 10μV can be an appreciable part of the total input for an RF amplifier.

The equation for the voltage shows that the amount of resistor noise increases if you increase the temperature, the bandwidth of the amplifier, or the resistance of the resistor.

An update on white noise

Older books and articles say that communications cannot take place if the amplitude of the noise level is above the amplitude of the communications signal noise level. That is no longer true. By using some very sophisticated statistical techniques, it is now possible to dig the desired signal out of the static.

You can buy a test instrument called a *noise generator* that produces genuine noise. That isn't as easy as it sounds. In order for it to be true white noise, the frequencies and amplitudes of the pulses must be entirely random. If the amplifiers in the instrument do not have a very wide bandwidth, or if they clip the signal at any point,

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then the noise will not be true white noise.

White noise can be used for alignment of tuned amplifiers. The noise is dumped into the input of the amplifiers and then the amplifier is tuned for maximum noise. That, of course, means maximum bandwidth according to the equation that was given earlier in this article.

Although resistors could be used to generate the white noise, there is a special type of semiconductor diode that is usually used for this purpose.

The sound produced by a white noise generator is used in medical applications. For people who have a constant ringing in their ears, the white noise is used to mask the sound. (That problem is more common than you might suspect.)

Some dentists claim that white noise puts their patients at ease.

You can try this experiment. It has been used with a wide variety of results. Turn your TV set to a channel where there is no station. Turn the brightness off and the sound level up. What you are hearing is very near to white noise. The bandwidth, dynamic range of the receiver amplifiers, and speaker response will cause some reduction in quality, but it is still very close.

With that hissing noise going at a comfortable level, lie back in your recliner and close your eyes. Imagine you are at a waterfall. (Waterfalls produce excellent white noise.) You must concentrate very hard on that waterfall. Get a picture of it in your mind and concentrate on that picture.

The people who know about such things claim that with a little practice you can go into the deepest sleep possible. It didn't work for me. I fell asleep and dreamed I was going over Niagra Falls in a canoe.

Flickers and impulses

In a previous article I defined some types of noise. Two additional kinds are *flicker noise* and *impulse noise*.

When a vacuum tube cathode emits electrons, they are supposed to leave the surface in a random manner. Actually, there will be slight variations in the number emitted from instant to instant. That produces noise in the tube. The same thing happens in bipolar transistors and FETs, but they aren't quite sure about the exact cause.

Impulse noise has a high amplitude and short duration. This type of noise can be greatly reduced with circuits that invert the pulse and mix it with the original.

Other methods of reducing noise will be presented in another article to appear in the near future.

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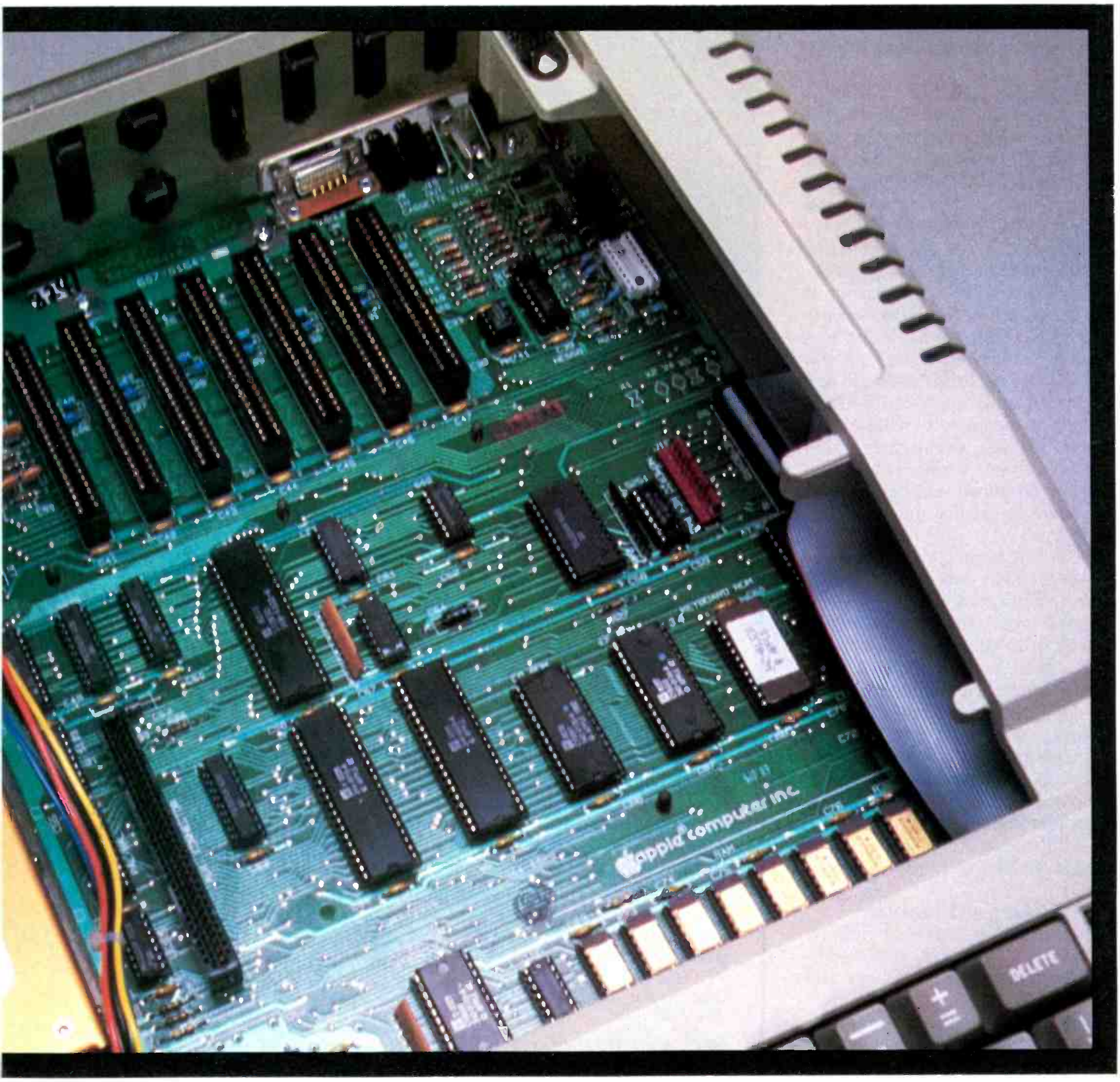
Part 1

Microcomputer troubleshooting

Components of a personal computer



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Editor's note:

Servicing computers is not as difficult as a lot of people think. Computers have fewer sections than, say, a TV and exhibit fewer ambiguous symptoms.

This is the first of a 3-part series of articles designed to describe the components of a personal computer and to provide a logical, practical, approach to troubleshooting the main units: the computer itself and the disk drive.

By Bud Izen, CET/CSM

There are two main reasons why people hesitate to attempt computer repair. The first is that they are confused by all the buzzwords and special terms commonly used by computer people, and often used in the literature without definition. The second is that they feel that they need to know how to program in order to be able to repair. The solution to the first problem is fairly simple. Buy a good dictionary of computer terms and look up these new words and phrases *as you encounter them.* You should *never* go past a word or term you don't understand. The second solution is even simpler. There is no reason to learn how to program in order to be able to repair a microcomputer.

There is of course an underlying third reason why many people hesitate to become involved with micros. Put simply, it is plain fear. Fear of the unknown, fear that the device may be more than we can handle, fear that our brains may not be up to task, and so forth. Few people admit their fear, but most of us, myself included, at one time have felt it. Let me tell you in no uncertain terms, that your fears are groundless.

Microcomputers are simple to repair

If you can repair a television, a video recorder, a cassette or reel recorder, or a stereo system, you are certainly capable of taking on a micro. With the greatest of ease! Why can I say that with so much certainty? You are reading the words of a consumer electronics (analog) technician turned self-taught computer technician. Also, the microcomputer is less complex than most consumer electronic products, especially the television. There are fewer sections to a micro than to a television, and many fewer confusing and misleading failure symptoms. My feeling is that if you are able to service a television, you already have the necessary logical approach required to service a computer. And a logical approach is what gets computers fixed, not knowing how to program.

The "black box" approach is a good way to think about computers when troubleshooting. In case you are not sure what that means, let's define some terms. For example, you might consider that a television is a black box. You don't have to have any idea as to what may be inside to operate it. If you apply power and a signal and turn the box on, a picture, sound and color should come out and that picture and color should be stable (i.e., not rolling or flipping). The black box is a functional block. A functional block is defined as a circuit, group of circuits, or group of groups of circuits that have one or more inputs, require power, have one or more outputs, and perform at least one clearly identifiable task. To the extent you need to understand the device in question, you can subdivide the device (the black box) into a system composed of functional blocks. For example, a color television can be subdivided into approximately 25 functional blocks (including the tuner and the power supply). Each of these can be further subdivided into individual circuits that also meet the test of being functional blocks.

Most of us troubleshoot based on our knowledge of the system upon which we are working. In other words, before we can fix anything we need to know what it does *normally.* Even if we haven't seen the particular type of, say, stereo receiver before, if we get the proper service literature (and sometimes even that isn't needed) we can troubleshoot it successfully, because we know what stereo receivers do normally.

After we understand what the system does normally, we can then use the various *symptoms* that a defective device is exhibiting to help us localize the source of the *problem* to a particular functional block. For example, if we were working on a stereo receiver that was completely dead, we would automatically consider the power supply as the functional block most likely to be at fault. Somewhat less likely would be the possibility that both channels failed at the same time, or that the problem might be related to the tuning section of the receiver. This is the process of logical troubleshooting that most experienced technicians take for granted. Unfortunately, many of us do not think about that process consciously anymore. We've been doing it for so long and so automatically, we forget that what we are doing is generalizing our troubleshooting ability each time we fix a product that is new to us.

There are many favorable aspects about working on micros both from the technical aspect as well as the business aspect. There are far fewer functional blocks (i.e., major sections) in a micro than in almost any consumer electronic product. Needless to say, the fewer functional blocks there are, the fewer the number of failure symptoms there can be. That's why televisions are so hard to fix – lots of functional blocks means literally thousands of possible failure symptoms. Because a microcomputer consists of digital circuits, it is either functioning correctly or not functioning usably at all. Not only that, the technician is able to do quite a bit of problem isolation by just disconnecting system components and inputting (typing in) some information at the keyboard. Many microcomputers are constructed modularly so that, when in doubt, each suspected functional block can be completely replaced. Also, most manufacturers (both OEM and private vendors) issue diagnostics that help greatly to isolate the nature of certain defects.

The microcomputer system

Contrary to popular belief, you

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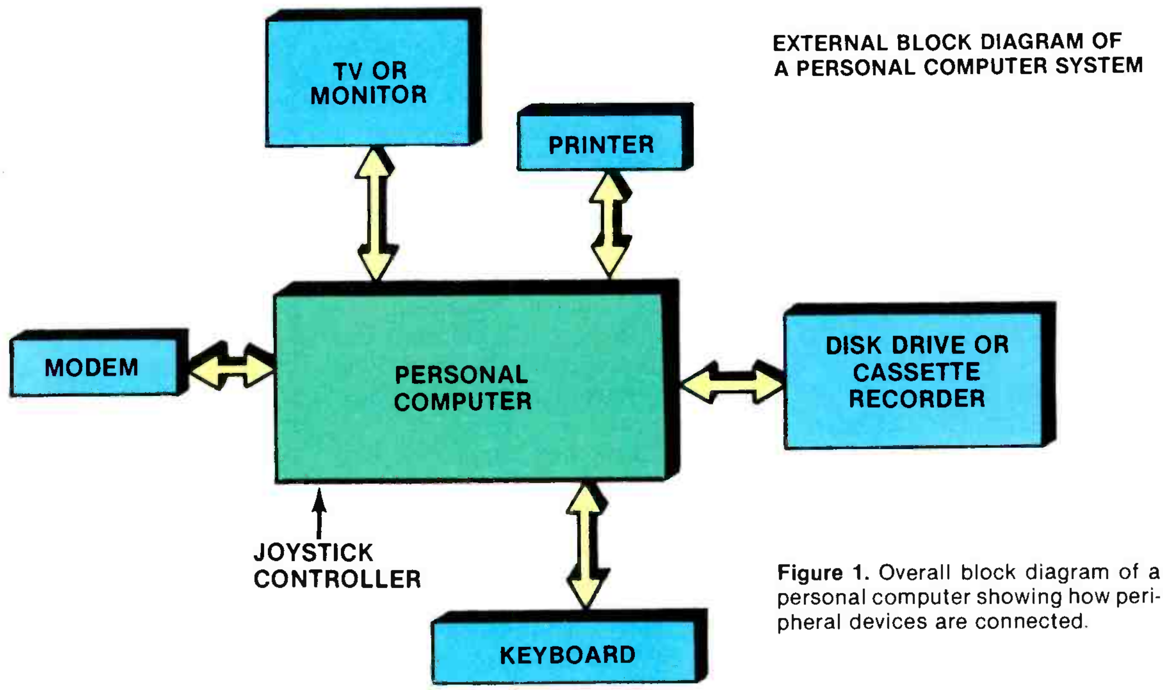

Figure 1. Overall block diagram of a personal computer showing how peripheral devices are connected.

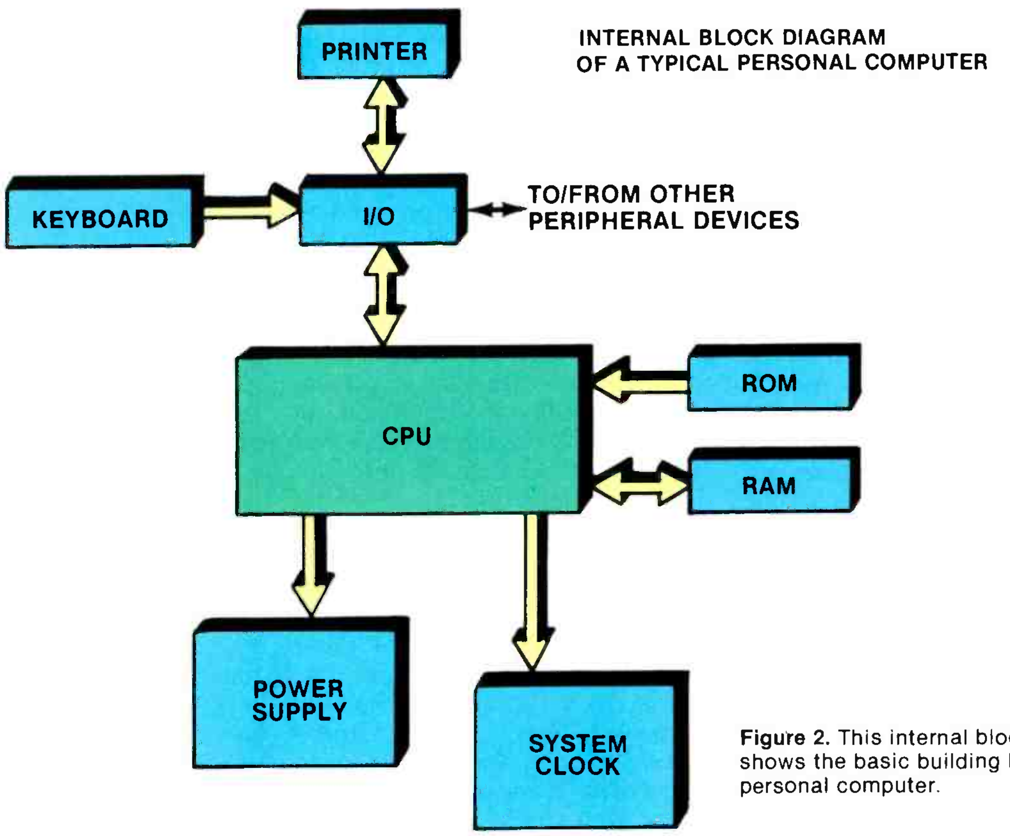

Figure 2. This internal block diagram shows the basic building blocks of a personal computer.

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do not need to understand microprocessor architecture to perform microcomputer repair. What you do have to understand is what each basic building block of the microcomputer does, and how it relates to the other blocks. It also is not necessary to get too machine-specific. So, this article will be as general as possible while staying as practical as possible.

The main section of the microcomputer is the CPU. (Did you look this term up?) The CPU (central processing unit) is the heart of the micro. Although the CPU fundamentally controls what the microcomputer is able to do, not all of its capabilities are built into the microprocessor itself. If the system is an 8-bit system, the processor is able to address directly up to 64K (actually 65,535 bits) of memory. Without playing any hardware tricks, this is the limit of the machine's capability of addressing the total of RAM (random-access memory) and ROM (read-only memory). Usually the manufacturer will limit the amount of available RAM to less than the maximum amount available in order to let the processor get its housekeeping and I/O (input/output) routines from a ROM device, usually called the monitor or monitor ROM. In most 8-bit micros, ROM routines up to 16K are common, limiting user memory to 48K at most. Note that just because a CPU is capable of addressing up to 64K, this does not automatically mean that it does so in any particular machine. Because of breakthroughs in the price of memory ICs, most machines made these days will take advantage of as much memory as the CPU can handle.

The routines stored in ROM extend the built-in capabilities of the processor and allow it to communicate with the outside world, as well as letting the outside world communicate with it. ROM routines also customize the processor to meet the requirements of the manufacturer. This is essentially what makes the difference between two machines made by two different manufacturers that both use the same microprocessor.

Microcomputers having disk-drive systems also have their capabilities extended by means of an operating system that is loaded off the first disk, which is loaded into the computer *(booted)* when the system is first turned on. There are many different operating systems available for many different machines. Generally, little or no knowledge of them is required for troubleshooting purposes. Whatever knowledge about any operating system you might need to diagnose a particular machine should be furnished to you by the manufacturer.

The physical layout of most microcomputers is similar. The components associated with the central processor and main memory usually are located on one large printed circuit board, commonly called the motherboard. Devices that the CPU uses to listen to or communicate with the outside world use interface devices that usually plug into connectors

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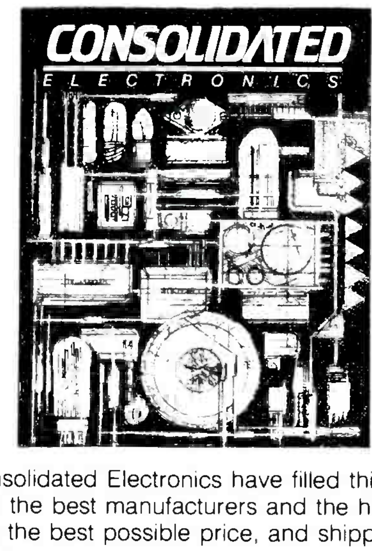

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on either the motherboard itself, a board connected to the motherboard (called a daughterboard), or into one of the series of independent backplane connectors which are connected to the motherboard (for example, the S-100 bus).

The keyboard

The keyboard is the device used most often by users to input information. The most common form of keyboard is the matrix type. By pressing a key, the user causes a voltage to be placed across a unique combination of two wires. The combination is fed into a specific memory location and is read by the processor using the appropriate monitor ROM routine.

The video display unit

The VDU either can be a regular television or a specifically designed monitor. Some computers can support both types of display devices, some can support either one or the other, and some can be adapted to be used with a monitor in conjunction with a special interface device plugged into a peripheral slot. Regular televisions, when used as VDUs, can clearly display up to 40-character columns, whereas monitors can display 80-character columns or more.

The main difference between a monitor and a regular television is video bandwidth. Video bandwidth determines the ability of the display to present picture detail accurately without smearing. The higher the bandwidth, the finer the detail that can be presented. A typical receiver has a video bandwidth of about 3.2MHz. A video monitor usually has a bandwidth of from 10MHz to 20MHz. The minimum bandwidth judged to be satisfactory in order to display 80 columns is about 12MHz.

Using a regular television as a computer display has an additional disadvantage. A monitor accepts direct video from the computer. In order to use a television, the direct video must be modulated onto a regular TV channel frequency by an accessory device called a modulator. If the modulator is cheaply made, it will contribute its own bandwidth limitation to the degradation of the display. Also, since the computer signal must be processed through the tuner and intermediate frequency sections of the receiver, each of those sections, if not correctly adjusted and aligned, can also degrade the signal.

Today's microcomputers, typified by this Apple IIe, provide 64K or more of RAM, upper-case and lower-case letters and 80-column capability. *(Photo courtesy Apple Computer, Inc.)*

The keyboard is the primary interface between the computer and the operator. *(Photo courtesy Elan Computers Ltd.)*

Depending upon the design of the computer, the video signal either is available at a rear panel jack whose signal comes directly off the motherboard, or is available from the output of a peripheral card. In some cases, the *regular* or low-resolution display is available from the video output jack, while the high resolution video output is optionally available from the output of a specially designed peripheral card. In the case of other, usually less expensive, computers, the video signal is provided already modulated onto a TV channel carrier. In such cases, the user is limited to the use of a regular TV receiver unless the computer design permits internal modification and the user is willing to have this done.

The printer

The other main output device used with most microcomputers is the line printer. This device is handy for printing out programs as they are being developed, or for displaying the results of a program. Of course, printers also can be used in conjuction with word processing programs to produce correspondence.

Use of the printer requires some sort of interface device that serves to interpret and convert the data sent by the computer into the form required by the printer. Because the computer is able to send data faster than any printer can print it, the interface needs to have some means of storing some data temporarily (in a buffer) as well as some means of telling the computer that the buffer is full and the printer is busy. This last task is called *handshaking*. Printers can

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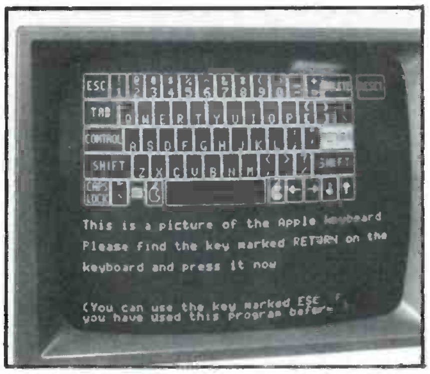
accept data in either of two ways, serially (one bit at a time) or in parallel (all bits of a word at one time). Whenever you see or hear the phrase RS-232, it refers to serial data transmission (also used for some modems). If you see or hear the term Centronics-compatible, that refers to parallel interfacing.

The disk drive

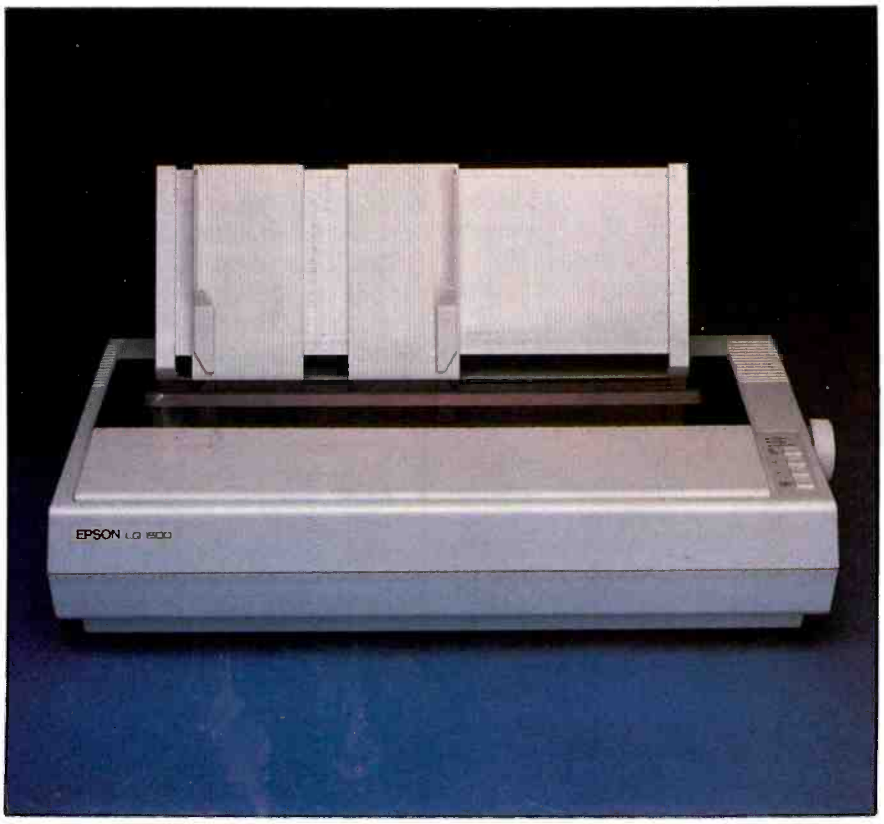
When the micro industry was new, the only type of permanent storage available was cassette tape. The disadvantages of this type of storage are numerous. The two major ones were the slow speed of loading and storage, and the extreme difficulty of storing anything but programs. Some microcomputers still offer a cassette interface, but most of the more expensive machines do not.

There are two main types of disk drives – floppy and hard. Floppy disk drives come in all sizes, from the new 3-inch drives up through 8-inch drives. The size refers to the diameter of the disks themselves. Hard-disk technology has only recently become financially accessible to the non-business micro user. Hard disks come from mainframe computer technology. Floppy disk storage uses a removable magnetic pancake enclosed in a protective envelope. Most hard disk systems use a non-removable disk, although recent breakthroughs have brought about the removable hard disk.



The video display unit may be a television or a special monitor manufactured for the purpose. *(Photo courtesy Mark Anthony Computers, Fairfield, CA.)*

The printer provides *hard copy* output from the computer. *(Photo courtesy Epson.)*



The floppy disk's main advantages are relatively low cost, access time many times faster than that of cassettes, and ease of backup. Its main disadvantage is the relatively delicate nature of the disks. The advantages of the hard disk are its incredibly fast access time, media reliability, and large storage capacity cost effectiveness (dollars per byte). Its main disadvantage is its difficulty in making cost effective backup copies.

With the advent of the various available disk drives came the proliferation of operating systems. An operating system increases the power of the microcomputer, enabling it to execute more commands and to address other devices, such as modems and multiple storage devices. For the most popular types of microcomputers, such as Apple, IBM and Radio Shack (to name just a few), more than one operating system is available. You may have heard the terms CP/M, DOS 3.3, MS-DOS and PC-DOS. Now you know to what these abbreviations refer.

The time and scope of this article does not permit a more thorough coverage of all the other possible building blocks of a microcomputer system, such as modems, real-time clocks, memory expansion boards, D/A converters, and so forth. However, by understanding the main building blocks, you will very readily be able to generalize your knowledge with further reading and experience.

Troubleshooting computer systems

When a computer system ceases to function, some basic knowledge such as that discussed above, along with specific manufacturer's information and a logical troubleshooting approach, will usually solve the problem. The next article in this series will provide some recommended troubleshooting techniques for personal computers, and a third and final article will cover troubleshooting of disk drives. ES&T

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News

NATESA and NESDA join together

Displaying a rare degree of unity and optimism, the members of NESDA and NATESA voted at separate conventions to consolidate their membership forces into a single national association.

The delegates to the National Electronics Sales & Service Dealers Association (NESDA) meeting in annual convention in Hartford, CT, voted unanimously to accept proposed articles of accommodation with NATESA and to ask NATESA members to join with them as partners in a larger single association.

Some 16 days later, delegates to the National Association of TV & Electronic Servicers of America (NATESA) in annual convention in St. Charles, IL, voted unanimously to accept the NESDA proposal and mutually-revamped articles of accommodation.

Under the mutually accepted agreement, the Chicago-based NATESA organization will become the NESDA state affiliate in Illinois while NESDA will accept and perpetuate the heritage of NATESA as its own. About the first of the year, 1986, all NATESA members will become NESDA members. For two years, current NATESA members outside of Illinois, may choose either to remain members of the Illinois association or to join the NESDA affiliate in their state. Current NESDA members in Illinois have two years to decide to join "TESA of Illinois."

Former officers and past presidents of NATESA will be recognized equally with those of NESDA. Frank J. Moch EHF, the founder of NATESA, will be perpetually honored as the father of both organizations.

For the immediate 1985-86 fiscal year, NESDA has created two additional officer positions to be filled by NATESA members chosen by NATESA. Vice President Roger Companion from Winooski, VT, will be the new NESDA second national vice president. Ellis Hall, NATESA immediate past president from Middletown, OH, will serve as the NESDA second Region 5 vice president. NATESA Executive Director George Weiss, of Chicago, will serve as the state delegate to the NESDA House of Representatives.

Newly elected NESDA President Dorothy Cicchetti from Long Island, NY, and repeating NATESA President Tom Leeney were lavish in their praise of the agreement that they said signals a new age of cooperation and progress for the electronics sales and service industry.

Study shows color TV sets still in use after 15 years

According to a report released by EIA's Consumer Electronics Group, one-half of all color television sets purchased 15 years ago are still in use, and four out of five are in use 10 years after purchase.

The study, which was prepared by Market Facts for CEG's Marketing Services Video Committee, was conducted early this year and based on a nationally representative sample of 17,000 households.

Its objectives were to describe current color TV ownership patterns, purchasing trends, and replacement cycles. The study also examined the role of electronic peripherals in the purchase of color televisions and assessed interest in new color TV products. Of the households that received questionnaires, 74% responded.

Among the findings were the following:

- Forty-six percent of color TV households have more than one color television; 12% have three or more color sets.
- Portable models represented 74% of color televisions sold in 1984, up from 48% in 1970. In 1984, monitors represented 2% and projection televisions 1% of color televisions purchased by U.S. consumers.
- Remote control is becoming a common feature of color televisions. In 1984, 58% of all consoles and 37% of all portable models sold were equipped with remote control.

RCA patents electronic device that measures heartbeat by analyzing chest movement

RCA has received a patent for a device that can remotely measure human heartbeat and respiratory rate by electronically analyzing the movement of the chest.

Called a dual frequency microwave heart rate monitor, the device utilizes a radar technique for detecting and measuring vital signs. It is slightly larger than a smaller transistor radio.

A unique feature of the patented device is that no part of the body needs to be exposed for the heart or respiratory measurement. Therefore, the monitor eliminates the need of disturbing a person to remove clothing.

Since the device is wireless it does not require attaching any sensors to a person's body. The unit also could operate as a sensor up to a distance of about eight feet from someone being observed.

In operation, the small device sends out two different types of signals, called microwave beams, which are directed toward the person being examined. One relatively high-frequency signal checks the heartbeat. Similar to a radar system, the different signals are reflected back to the monitor and recorded.

Since the lower frequency signals penetrate the human body to a greater extent than high frequency signals, it is possible to distinguish signals emanating from different depths of the body. In this manner, the monitor differentiates between the respiratory rate and heartbeat.

The interrogating signals employed in the system are many times less than the limits recommended by the American National Standards Institite (ANSI).

In the September 1985 issue of **ES&T**, page 9, we published a forecast of the increase in the use of surface-mount technology. We failed to give credit to the originator of the information. That forecast was based on a study called "Surface-Mount Technology," prepared by
Electronic Trend Publications
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Continued on page 37

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News, continued from page 28

1985 video market trends

U.S. Video Market Statistics
Unit Sales to Retailers
August 1984 through August 1985

	1985	1984	Percent change (−)	Percent change (+)
Color Television	9,705,153	9,590,050		+ 1.2
Monochrome	2,080,148	2,894,313	− 28.1	
TOTAL TELEVISION (excludes projection)	11,785,301	12,484,363	− 5.7	
Projection Television	131,919	104,381		+ 26.4
Home VCR	6,243,519	3,924,297		
Color Video Cameras	269,334	262,594		+ 2.6 / + 59.1

With August 1985 sales of nearly 800,000 units, more than 6.2 million videocassette recorders (VCRs) were sold during the first eight months of this year, according to the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

Data compiled by CEG's Marketing Services staff indicate that August VCR sales to dealers were up 50% over the same month a year ago, with year-to-date sales running nearly 60% ahead of their pace during January-August 1984. EIA – whose members include the major manufacturers and marketers of audio and video equipment, blank tape, and personal computers for the home – has predicted that 11.5 million VCRs will be sold during calendar 1985, as compared with 7.6 million last year.

Color television sales were up fractionally in August to approximately 1.28 million units, bringing the 8-month sales of color televisions to 9.7 million units or 1.2% ahead of January-August 1984, previously the best sales year in that product's history.

Projection television scored another impressive sales month in August, jumping nearly 38%, and on a year-to-date basis is running 26% ahead of the same period a year ago. Video cameras (excluding *camcorders*, which are counted as VCRs) declined slightly (1.7%) in August but remain 2.6% ahead of last year's sales. **ES&T**

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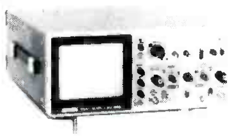
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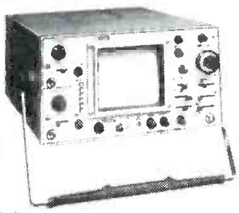
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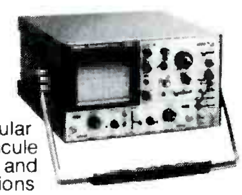
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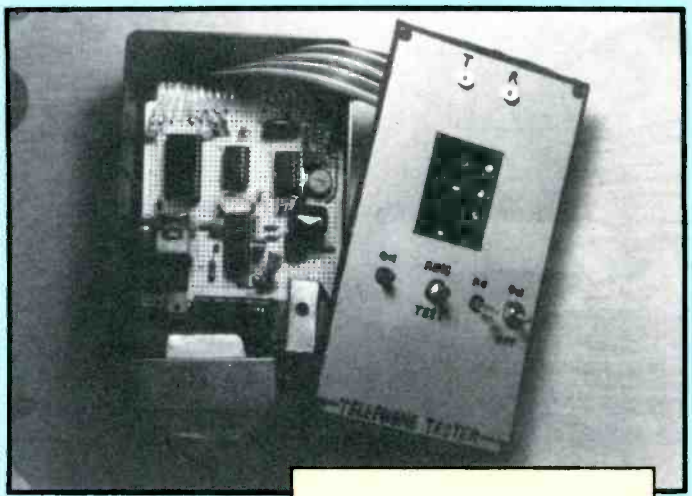
Build this telephone tester

By Joseph T. Szumowski, CET



You can build this telephone tester in a day at reasonable cost and use it to check tone-dial outputs and ringing voltage.

A most valuable piece of test equipment for servicing telephone units and systems is a device that can check all your Touch-Tone outputs and provide ringing voltage to test the ringer. This article describes how to build such a telephone tester. Thanks to recent developments–the high voltage MOSFET and the M-956 integrated circuit–cost will be reasonable and the circuit construction, straightforward. It can be completed in one afternoon.

There are basics that must be considered before proceeding to the circuit. Table 1 shows that each DTMF signal (1 through D) has a unique frequency pair. For example, the "#" signal is made up of two frequencies, 941MHz and 1477MHz.

Once the numbers and symbols have been encoded (put into tone pairs), some way of decoding (changing each tone pair into its binary equivalent) is necessary.

Until recently, this was quite complicated: Two ICs were required for each pair of frequencies for a total of no less than 24 separate ICs plus associated outboard components (resistors and coupling capacitors). A complete Touch-Tone decoder not only was involved, but required a considerable investment in parts and time.

The M-956 tone decoder receiver chip changed the whole picture. It now is possible to build a complete Touch-Tone decoder with just one IC, a resistor and an inexpensive 3.58MHz color crystal. In fact, when you purchase the M-956 from Teltone, you also receive the 22-pin socket and 3.58MHz crystal, as well as the 1MΩ resistor.

In Table 1, note the *HEX OUTPUT* column. The output of the M-956 is really four pins on the chip. As you examine the hex output, keep in mind that wherever you see a *1*, this means that the indicated pin (3, 2, 1 or 0) has an output of +5V, or a *high*. When you see a *zero* (0), you will read 0V, or ground potential, on a voltmeter connected to the pin. To be sure you understand, imagine that the input signal to the IC is the tone pair for the numeral *9* (frequencies 852MHz and 1477MHz). The four output pins would have outputs of 1001, or a high, low, low and high. As you examine the hex output column, note that each tone pair or signal has a unique hexadecimal output of ones and zeros, highs and lows.

To further understand the M-956, look at specific pins of the IC and determine how they apply to the test unit, see Figure 1.

- Pin 12–This is the input. It requires a minimum of a 0.2Vpp to effect proper decoding.
- Pins 14, 15–Connect the 3.58MHz crystal and its associated resistor to these pins.
- Pin 7–Connect an LED to this pin to indicate when a tone-pair input is being decoded.
- Pin 5–This is the pin that will determine if the M-956 will detect all 16 tone pairs or only the most common 12 pairs. When it is connected to +5V, it will detect only 12 tones. Connect it to ground and it will detect all 16 tone pairs.
- Pins 20, 21, 22, 1–These are the data-output pins, see Table 2.

Pin 20 = 3, D3
Pin 21 = 2, D2
Pin 22 = 1, D1
Pin 1 = 0, D0

Other pins connect to ground or +5V as shown in the schematic, page 42.

Any pin not used is not needed for this application. The data sheet for the M-956 provides a complete list of pin function and purpose.

When the device decodes the tones and provides a binary output at pins 1, 22, 21 and 20, this is fed into a 74154 Data Selector. The combination of highs and lows on the four input pins of the 74154 will cause only one of its output pins to go to ground potential, or a low. All that is necessary is to connect an LED to this output. The illuminated LED indicates that a specific hex combination is present at the input. The truth table (Table 3) for the 74154 illustrates input and output pattern for that device. Figure 2 is the complete schematic diagram of the telephone tester.

To complete the theory of operation, look at the final part of the tester: the ring-voltage generator. The circuit is made possible by the use of the high-voltage, logic-level, compatible-power MOSFET. The circuit diagram reveals that the heart of the circuit is a low-frequency, gated-output oscillator:

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Table 1. DTMF to Binary Decoding

SIGNAL	LOW-FREQUENCY COMPONENT (Hz)	HIGH-FREQUENCY COMPONENT (Hz)	HEX OUTPUT FORMAT 3210	2-OF-8 OUTPUT FORMAT 3210
1	697	1209	0001	0000
2	697	1336	0010	0001
3	697	1477	0011	0010
4	770	1209	0100	0100
5	770	1336	0101	0101
6	770	1477	0110	0110
7	852	1209	0111	1000
8	852	1336	1000	1001
9	852	1477	1001	1010
0	941	1336	1010	1101
*	941	1209	1011	1100
#	941	1477	1100	1110
A	697	1633	1101	0011
B	770	1633	1110	0111
C	852	1633	1111	1011
D	941	1633	0000	1111

Note: The M-956 detects signals A through D only when the $12/\overline{16}$ input is at logic "I."

TABLE 1.

Table 1. When a button on the tone-dial telephone is pressed, the telephone generates a pair of tones (for example, pressing the 7 button creates a pair of tones – one at 852Hz and one at 1209Hz). The M-956 converts this pair of tones into a binary (HEX) output.

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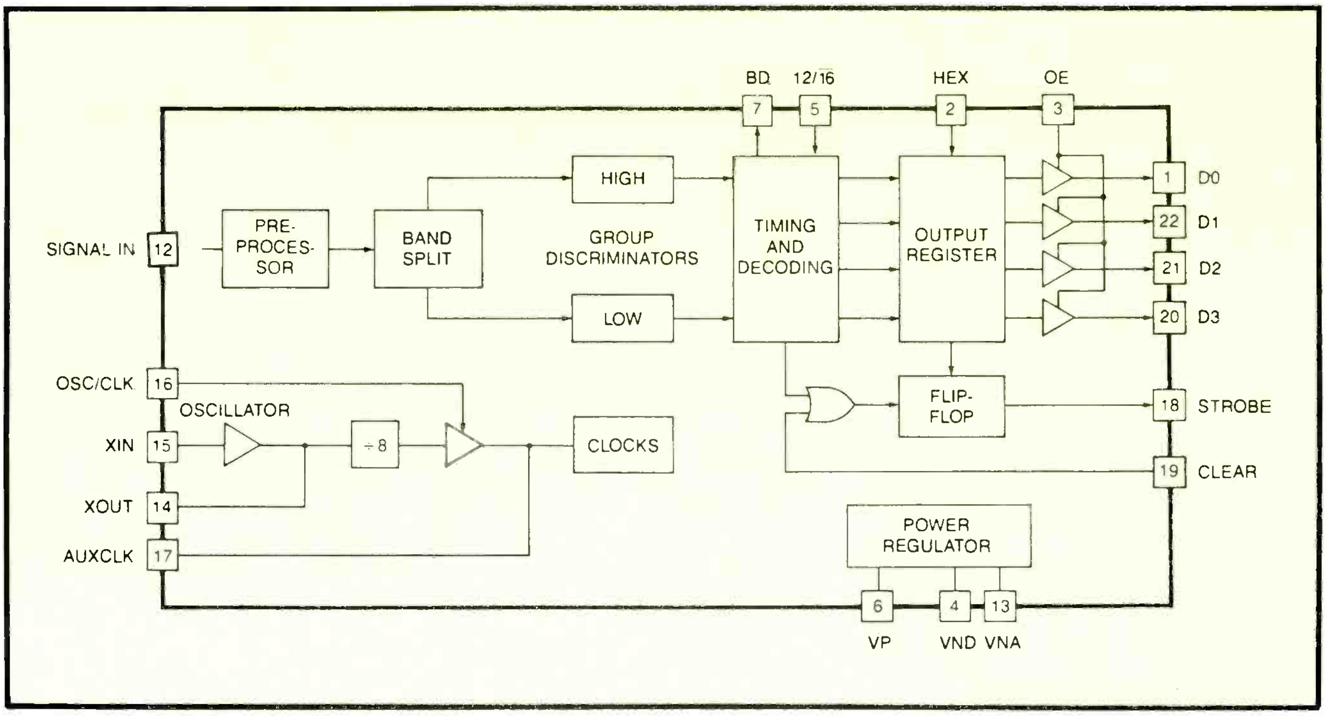

Figure 1. DTMF receiver (M-956) converts a dual-tone multifrequency input, pin 12, into a 4-bit binary output, pins 20, 21, 22, 1.

TABLE 2. PIN FUNCTIONS

PIN	FUNCTION	FUNCTION DESCRIPTION
12	SIGNAL IN	DTMF input. Internally biased so that the input signal may be ac-coupled. Signal in also permits dc-coupling as long as the input voltage does not exceed the positive supply. See Table 1 for the frequency pairs associated with each DTMF signal.
5	12$\sqrt{}$16	DTMF signal detection control. When 12$\sqrt{16}$ is at logic *1*, the M-956 detects the 12 most commonly used DTMF signals (1 through #). When 12$\sqrt{16}$ is at logic *0*, the M-956 detects all 16 DTMF signals (1 through D).
20, 21 22, 1	D3, D2 D1, D0	Data outputs. When enabled by the OE input, the data outputs provide the code corresponding to the detected digit in the format programmed by the HEX pin. See Table 1. The data outputs become valid after a tone pair has been detected and are cleared when a valid pause is timed.
3	OE	Output enable. When OE is at logic *1*, the data outputs are in the CMOS *push/pull* state and represent the contents of the output register. When OE is driven to logic *0*, the data outputs are forced to the high impedance or *third* state.
2	HEX	Binary output format control. When HEX is at logic *1*, the output of the M-956 is full, 4-bit binary. When HEX is at logic *0*, the output is binary coded 2-of-8. Table 1 shows the output codes.
18	STROBE	Valid data indication. STROBE goes to logic *1* after a valid tone pair is sensed and decoded at the data outputs. STROBE remains at logic *1* until a valid pause occurs or the CLEAR input is driven to logic *1*, whichever is earlier.
19	CLEAR	STROBE control. Driving CLEAR to logic *1* forces the STROBE output to logic *0*. When CLEAR is at logic *0*, STROBE is forced to logic *0* only when a valid pause is detected.
7	BD	Early signal presence output. BD indicates that a possible signal has been detected and is being validated.
14, 15	XOUT, XIN	Crystal connections. When an auxiliary clock is used, XIN should be tied to logic *1*.
16	OSC$\sqrt{}$CLK	Time base control. When OSC$\sqrt{CLK}$ is at logic *1*, the output of the M-957's internal oscillator is selected as the time base. When OSC$\sqrt{CLK}$ is at logic *0* and XIN is at logic *1*, the AUXCLK input is selected as the time base.
17	AUXCLK	Auxiliary clock input. When OSC$\sqrt{CLK}$ and XIN are at logic *0*, the AUXCLK input is selected as the M-956's time base. The auxiliary input must be 3.58MHz divided by 8 for the M-956 to operate to specifications. If unused, AUXCLK should be left open.
4, 13	VND, VNA	Negative analog and digital power supply connections. Separated on the chip for greater system flexibility, VNA and VND should be at equal potential.
6	VP	Positive power supply connection.
8, 9, 10, 11	N/C	Not connected. These pins have no internal connection and may be left floating.

Table 2. Pin functions for DTMF receiver IC.

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the 4001 IC, designed to oscillate at about 20Hz. Its frequency is controlled by R_{17}. The output, on pin 4, is 10Vpp. To simulate the *on* and *off* times of ringing voltage, the 4001 oscillator is gated (turned *on* and *off*) by the timer IC (555). The duration of this gating pulse is controlled by R_{14}. Finally, this gated 20Hz signal is applied to the gate of a power MOSFET, the RFP1ON15. To check on the operation of the oscillator, connect an LED to the gate. When this LED goes *on* it indicates that a ringing frequency is applied.

The indicator in the drain lead provides the load for the simplified ringing voltage. There should be about 105V, 20Hz of square wave developed at the output.

Circuit construction

Using a board already laid out for ICs–such as a Radio Shack 40-pin circuit board–makes it easy to mount the ICs and hardwire the remaining components, see photo of tone-decoder board, page 42.

The power supply transformer and other related components were wired separately in the mini-box. The front panel was wired to the output pins on the circuit board. There is no critical wiring, but it is necessary to observe good wiring practice and to keep the wires short.

In due time–but not until after you carefully checked your work–the M-956 should be socketed. This is no problem because the manufacturer will supply you with the necessary 22-pin socket. Remember that this is a CMOS IC. Handle with care.

Final testing

When you complete the wiring, give your work a complete visual check. Examine carefully for any solder bridges. Especially check the IC socket pins to be sure that no pins are touching.

Do not insert the M-956 in its socket until you have completed the following determinations:

- Make a few resistance checks.
- Be sure all grounds are common.
- Check the 5V supply pins for any shorts to ground.
- Check the 105V supply for any continuity to ground.

Once you are satisfied that all is well, turn on the power. Test for proper output on both the +5V and +105V supplies.

Now, shut off the power and insert the M-956. When you turn on the power again, scope pin 17 of the M-956. If all is in order with the M-956, you should see a waveform with a frequency of 440kHz on this pin.

Connect a Touch-Tone telephone to the proper input pins and depress any key (holding it in). Scope the output of the 741 (pin 6) and adjust R_4 for about 200mV at pin 6. Note that D1 will light, and when you adjust R_4 for more than 200mV, D1 will go out. Either too-much or too-little signal will cause the M-956 not to decode.

Also at this time, you should see the proper output LED light. If you do not see this, test for proper inputs to the 74154: pins 20 to 23. Once you are satisfied the decoder section is working, test the ringer output subsection. Caution: you have 105V at the output test jacks. Be careful! It can bite.

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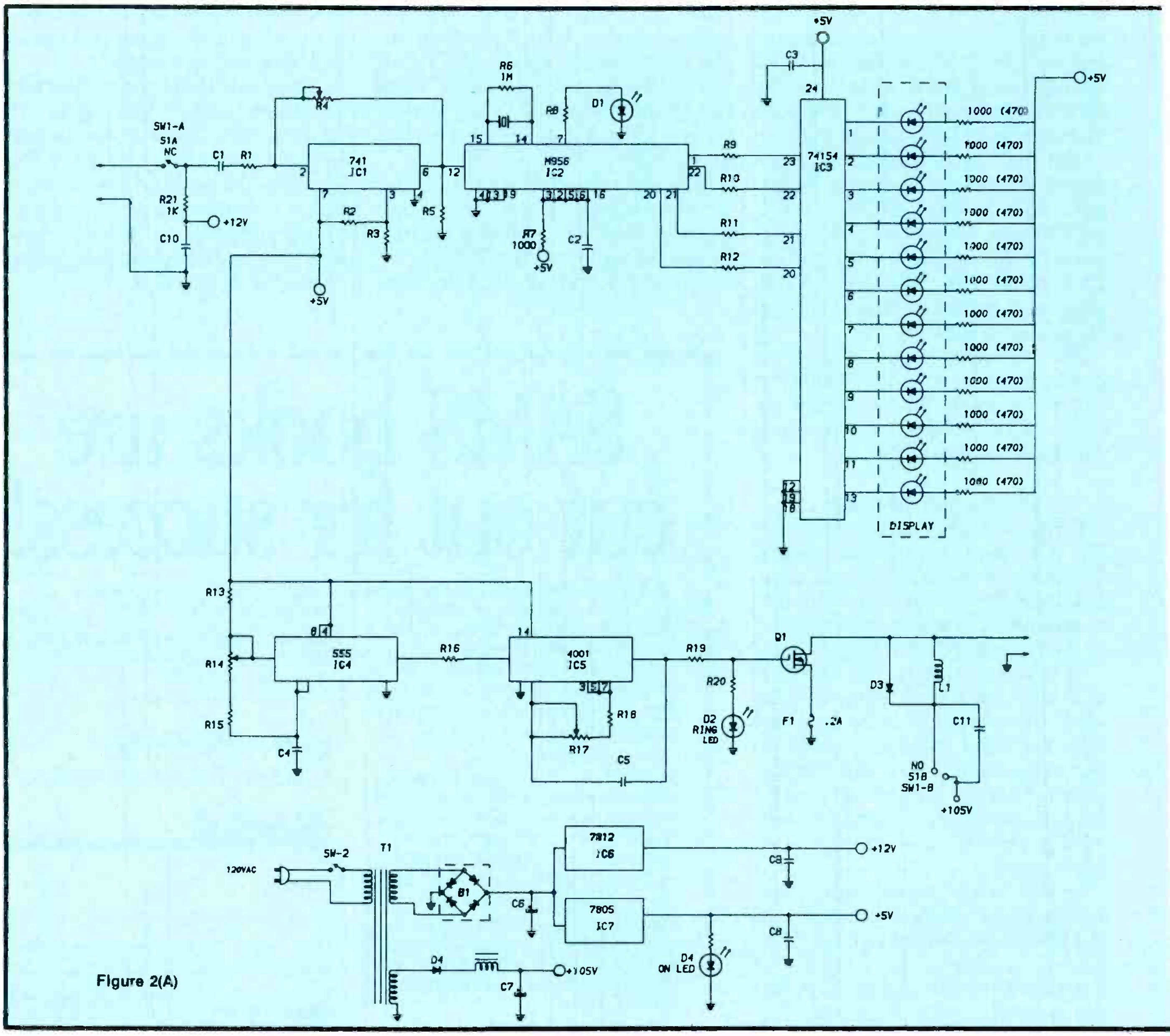


Figure 2(A)

TRUTH TABLE FOR 74154

INPUTS D C B A (PIN→ 20 21 22 23)	OUTPUTS PIN	LOW*
0 0 0 0	1	
0 0 0 1	2	
0 0 1 0	3	
0 0 1 1	4	
0 1 0 0	5	
0 1 0 1	6	
0 1 1 0	7	
0 1 1 1	8	
1 0 0 0	9	
1 0 0 1	10	
1 0 1 0	11	
1 0 1 1	13	
1 1 0 0		
1 1 0 1		
1 1 1 0		
1 1 1 1		

NOTE
only the pin indicated here is low. All other pins are *high*.

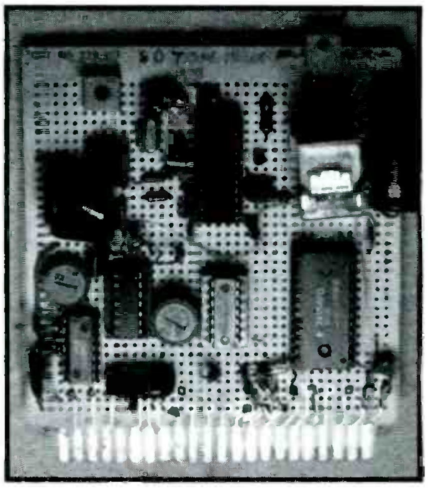
Example
When a *binary five* is inputed,
0101 = only pin 6 is low,
LHLH all others high.

0 = Low (Ground)
1 = High (+5V)

PIN
12 = Ground
24 = +5V

*Be sure pins 18 and 19 are grounded.

Table 3. The data selector circuit, a 74154 IC, converts a 4-bit binary input signal at its input pins; 20, 21, 22, 23, into a single-pin output signal. This is the truth table for that circuit.



The telephone tester circuit was constructed on a Radio Shack 40-pin circuit board.

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PARTS LIST

R1	10k ½ W	C1	0.47μFd 16wV
R2	68k ½ W	C2	0.01μFd 16wV
R3	68k ½ W	C3	0.01μFd 16wV
R4	50k Trimpot	C4	25μFd 16wV
R5	1k ½ W	C5	1μFd 16wV
R6	1M ½ W	C6	1000μFd 25wV
R7	1k ½ W	C7	200μFd 350wV
R8	1k ½ W	C8	0.1μFd 16wV
R9	1k ½ W	C9	0.1μFd 16wV
R10	1k ½ W	C10	1μFd 16wV
R11	1k ½ W	C11	0.1μFd 350V
R12	1k ½ W	B1	Bridge rectifier
R13	1k ½ W	IC-1	741 op-amp 276-007
R14	50k Trimpot	IC-2	M956
R15	100k ½ W	IC-3	74154 available in
R16	4.7k ½ W		ECG or RCA SK type
R17	100k Trimpot	IC-4	555 276-1723
R18	10k ½ W	IC-5	4001 276-2401
R19	1k ½ W	IC-6	7812 276-1771
R20	10k ½ W	IC-7	7805 276-1770

NOTE:
All *276* part numbers are Radio Shack type.

Figure 2(B)

Q_1 = RCA type RFP1ON15 MOSFET

Switches

SW1-A > **SW2-B** Single momentary contact toggle switch. Wire SW1-A as a normally closed (NC) and SW-B as a normally open (NO).

SW-2 = SPST 125V@ 1A

Miscellaneous

T1 = Power transformer: 90V out @ 100mA, 12.6V out @ 1A.

L1 = Inductor coil (not critical: for example, a 7H @ 150mA).

D1, D2, D4 = 5V LEDs

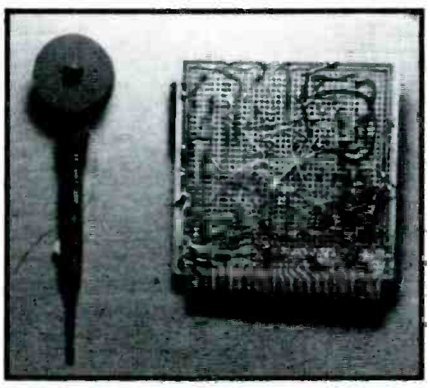
D3 = Any 1A 500 PIV silicon diode. For example: Radio Shack 276-1104.

Minibox - 270-227, Radio Shack.

Figure 2. (A) Complete circuit diagram of test unit shows both sections: the tone decoder and the ring tester. (B) Parts list.

The ringer operates at about a 20Hz frequency. If your oscillator (IC5) is not properly adjusted, the ringer will not ring.

Connect a scope to the gate of the MOSFET. There should be about 10Vpp. Adjust R_{17} for a 20Hz square wave: Note that LED D2 should be blinking. Now adjust R_{14} for the duration of the *time-on, time-off* interval. Observe the ring LED and judge its intensity (this is not critical). Finally, check at the drain of *Q* for 105V, 20Hz square wave. Be sure you depress the *ring* test button.



The interconnections at the back of the circuit board were made with a manual wire-wrap tool.

Ringer-only procedure

If there is no interest in the *on, off* feature but only in whether or not the ringer works, eliminate IC4 (555). However, be sure you connect pin 1 or IC5 to −5V. Do not leave it floating or disconnected.

Also, be sure the telephone is *on-hook* before you test the ringer. When the receiver is off-hook, the ringer is not connected to the input lines of the telephone. If the receiver is on-hook and the breaker trips, this indicates a short somewhere in the ringer circuitry. ES&T

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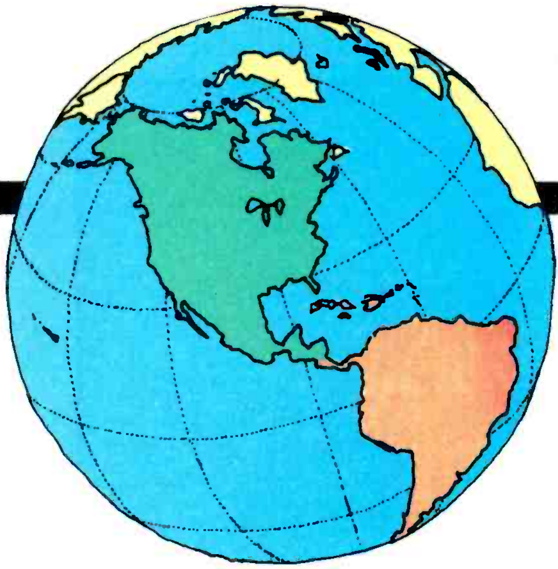

Today and Tomorrow

TV signals around the world

Several transmission systems for color television are in use in the world. They have similarities, but differences make them highly incompatible. Future TV standards may provide improved pictures for everyone as well as possible, but politically dependent, world compatibility.

By Carl Bentz, TV technical editor, *Broadcast Engineering*

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Editor's note: One of the subjects that seems to be glossed over in TV courses and books is the nature of the composite video signal transmitted from the TV broadcasting station and received by the TV receiver to cause the wonderful picture on the TV screen that we all take for granted. This casual treatment is odd in view of the fact that if you thoroughly understand the information carried in the composite video signal, you have the beginnings of a firm grasp of the theory of operation of television.

This article won't make anyone an instant expert in video signals, but it does discuss what the composite video signal used in U.S. television consists of, and contrasts it with the two other systems used throughout the world.

For starters, contrast the composite video signals with something simple—say an AM radio signal. The AM radio signal is extremely simple: It consists of audio information that has been mixed with a radio frequency signal so that the result is a radio frequency duplicate of the original audio information. To recover the information from the radio signal, music or voice, for example, all a radio receiver has to do is tune it in, return the information to its original audio frequency, amplify it and apply it to a speaker.

A TV signal, in contrast, has a lot more work to do. For each line of the 525 lines that make up a TV picture, the video signal carries luminance information: This tells the TV circuitry where to make the screen black, where to make the screen bright enough to be perceived as white, and renders every shade of gray in between. At the end of each line, the composite video signal has to synchronize the start of the next line.

At the end of 262½ horizontal lines, the composite video signal makes sure that the TV circuitry causes the electron beam (which paints the picture) to return to the top of the screen at exactly the right instant, and, at the same time, to blank out the spot so the viewer won't see it.

In addition to all of this, the video signal must contain color information for every color dot on every one of those 525 lines that makes up each of the 30 frames that appear on the color TV screen every second. This is quite an order.

The composite video signal is a complex signal, but studying what's going on in that signal can greatly enhance an understanding of TV operation.

Three major color TV transmission standards are found scattered around the globe. The most used standard in the western hemisphere is NTSC. In Western Europe PAL is the primary standard, while SECAM is found in France and the USSR. All three are sprinkled worldwide, generally following lines of the countries' political affiliations at the time that color transmissions were started.

NTSC

In the United States, NTSC is used. The NTSC stands for National Television Systems Committee, a subgroup of the Electronic Industries Association (EIA). The NTSC system was recommended by the committee to the FCC and was adopted by December of 1953. Several restrictions were placed on the system to be used in the United States. The primary requirement was that existing b&w receivers would be able to receive transmissions.

EIA television

Monochrome television in the United States was based on a 525-line picture structure. The 525-line format was broken into two fields of 252.5 lines. Sixty fields or 30 frames of complete pictures occurred each second. By alternating or *interlacing* lines on the TV screen, objectionable flicker is eliminated in the reproduced image. This system results in a horizontal scan rate of 15,750 lines per second. The picture was negatively amplitude-modulated on the visual carrier. In other words, the greater the instantaneous video signal, the less the actual modulation of the carrier at that instant. This approach reduced the effect of electrical noise on received video signals. Noise that created spikes in the transmitted signal resulted in blacker-than-black video, for example, in the region of sync. One drawback was that large spikes,

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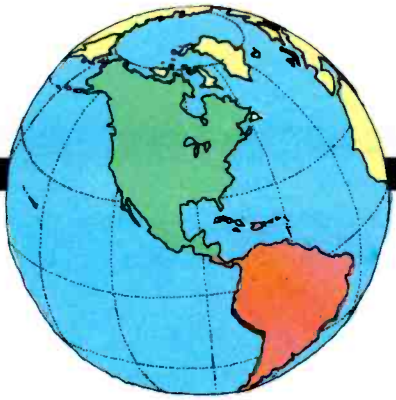

greater than the amplitude of the sync pulses, would momentarily upset the sync of the pictures.

The 6MHz bandwidth signal was to include an aural carrier that used FM modulation to reduce interference. The aural carrier would be located at 4.5MHz above the visual carrier. After modulation, special circuitry would remove some of the information below the visual carrier, resulting in a narrower bandwidth vestigial sideband signal.

Adding color

Because the NTSC insisted that color TV signals must be compatible with existing b&w sets, the process of adding color could not create interference in the monochrome picture. It was discovered that the energy that formed the picture was located in packets at harmonics of the horizontal scan frequency. Proper selection of a color reference would place color information between the black and the white data. A high frequency color subcarrier would be unnoticeable on monochrome sets. As a result of the study, 3.579545MHz (3.58MHz for short) was chosen as the subcarrier frequency. Not only was it high enough to be filtered out by most b&w sets, it was 455x0.50 the horizontal scanning rate.

Adding the 3.58MHz signal caused the field rate to be moved to 59.94, the frame rate to become 29.975 and the horizontal scanning rate to be 15,734.264. Circuitry in the receivers was not so critical that it could not track these slight changes, however.

RGB to YIQ

In a TV camera, red, green and blue signals are formed by the camera pickup tubes. These three signals are matrixed to form one luminance and two chrominance channels. Luminance, called the Y-channel, is primarily green, and contains information that forms the b&w picture. One chroma signal, an in-phase (I) component, contains red-through-cyan information from the televised scene. The quadrature-phase (Q) signal contains green-through-magenta information.

The I signal directly amplitude-modulates the 3.58 subcarrier, while Q modulates a 90° shifted copy of the subcarrier. The bandwidths are limited, I to about 1MHz, Q to 500kHz, and the subcarrier signal is suppressed to reduce interference. These are then combined with Y to form the composite video signal of NTSC.

In the receiver, you may be more familiar with the terms R-Y and B-Y as the color components. The color-difference components are shifted in phase from I and Q by 33°. The difference is corrected by circuit components. Using R-Y and B-Y is less expensive in terms of the required components for relatively stable decoding of the color information.

PAL

A number of variations of PAL are used throughout the world. They are similar because of a 625-line image structure, a field rate of 50Hz and a frame rate of 25Hz. The resulting horizontal scan rate is 15,625Hz. A color subcarrier of 4.43361875MHz is common.

Just as in NTSC, red, green and blue color signals are matrixed into luminance and chroma signals. The chroma components, usually called U and V, are amplitude modulated onto the subcarrier, but for PAL the basic R-Y (V) component sees a subcarrier that is shifted by 180° for every line. This is the origin of PAL or phase alternation, each line.

In the receiver an R-Y, B-Y decoding usually is used, again due to economics of receiver design. The circuitry is synchronized to shift

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the phase again on each line to decode color properly. The reason for the shift is to avoid level-dependent phase shifts that may occur in the signal as it travels from the studio to the home receiver. The removal of phase errors has caused PAL to jokingly be called *Phased At Last*. The color system avoids the need for a hue/-tint control on the receiver, and because of its hue stability is considered superior in color reproduction to NTSC.

The variations in PAL are mainly the result of FM modulated aural carrier frequency above the visual carrier. Different offsets from the visual carrier include 5.5MHz, 6MHz and 6.5MHz, resulting in overall bandwidths of 6MHz, 7MHz and 8MHz in the various vestigial sideband transmission systems.

The scanning frequencies of PAL are sufficiently close to NTSC that many NTSC receivers can present an acceptable monochrome image. Color, however, will not lock, if it appears at all. The same situation occurs if a PAL receiver is used to decode NTSC signals. Because of close political ties between many countries using NTSC and PAL, variations of both standards have been developed. NTSC-4.43 uses NTSC timing with the 4.43MHz subcarrier, while PAL-3.58 uses PAL timing with 3.58MHz color.

PAL, like NTSC, uses a negative amplitude modulation scheme to avoid electromagnetic interference in the pictures.

SECAM

SECAM is a line-sequential color system, and uses delay lines to combine the various components. The name comes from French that means *sequential colors and memory*, but humorously is called *System Essentially Contrary to American Method.*

AM modulation is used on the visual carrier to transmit a matrixed luminance signal. During each line time, one of the two chrominance signals is transmitted by FM modulation of the chroma subcarrier. The basic R-Y and B-Y signals thus are sent alternately. In the receiver, a switching circuit directs the components to the proper decoding circuitry, while delay lines are used to ensure that both components arrive for decoding at the same time. Decoding of the color components also is involved with the use of 4.406250MHz for red-related information and 4.250MHz for blue-related data.

In the many variations of SECAM, both positive and negative AM modulation of visual information are found. Also differing from NTSC and PAL, AM modulation of the aural carrier is sometimes used. Channel bandwidths generally are wider than NTSC, although vestigial sideband filtering is used to reduce them to some extent.

The line structure of the SECAM image is based on 625 lines with a field rate of 50 per second. If the transmission uses negative AM visual modulation, a PAL receiver might produce a monochrome image, but locked color is impossible.

Systems using SECAM as a transmission standard must use some other form of color standard in their studios. It is impossible for a SECAM signal to be used with special effects, including simple fades from one picture to another. For that reason, PAL, or occasionally NTSC, is found within the production facility, with the conversion to SECAM prior to the transmitter.

Stereo audio

The most recent improvement to any TV transmission has been the use of stereo aural signals. Binaural audio was initiated in

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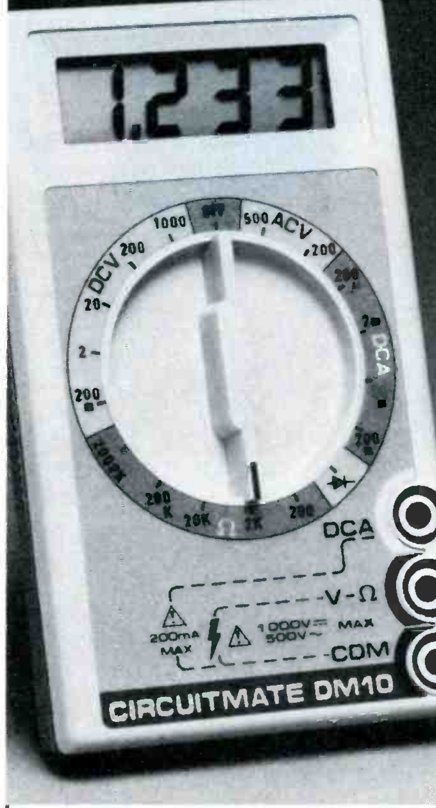

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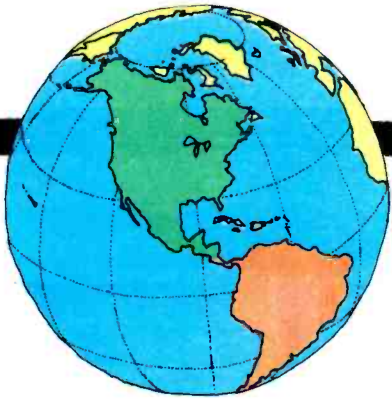

Japan by NHK (the Japanese Broadcasting Company) in 1978. The stereo mode is used primarily for music programming, baseball and Sumo wrestling, while news and other programs often use the 2-channel capability for bilingual purposes.

Germany began 2-channel audio transmissions in 1981. Using two aural carriers, the German system also provides stereo capability for music presentations, while bilingual audio is normally provided for news and information programs.

The Zenith/dbx system, recommended by the EIA Broadcast Television Systems Committee (BTSC), was protected by the FCC's decision in March 1984. The system was designed to meet several qualifications. It must be compatible with present monaural receivers: For example, a stereo mode transmission may not cause undue interference with mono televisions. In addition to a stereo mode, the system includes a separate audio program (SAP) channel for use with bilingual presentations or even non-related information. A third channel is provided for use by TV stations for cueing remote crews, telemetry to the transmitter or other data transmissions. Special audio processing (by dbx Inc.) is required to keep audio bandwidths in check and to provide audio signals that at least equal, and hopefully exceed, the quality of current monaural audio.

Implementation of stereo audio in the United States may be slow, as it will be expensive for many stations to change their systems.

More defined pictures

The next few years will offer improved definition in pictures. High definition (HDTV), high quality (HQTV) and enhanced definition (EDTV) imaging has been demonstrated by NHK (Japan) and the CBS network, as well as by a number of manufacturers' research departments. Sony and Ikegami lead the list of equipment manufacturers working on systems that will display up to 1125 line pictures.

Several ideas are being considered in the United States. One approach doubles the 525-line structure to 1050 lines. This can be achieved in either of two approaches: Cameras could be used to create the extra lines, or microprocessor-based systems would look at the existing 525 lines and develop interim information to fill in the blanks. Another approach uses a large memory in the television that receives the signal in an interlaced format, then reads the stored data out onto the screen in a sequential scan approach. The CBS research division has shown a 2-channel approach to improved definition. One channel would be used to transmit a normal picture signal, while a second channel would carry the information for higher definition.

The improved definition systems plan on a change in the aspect ratio of the picture. Instead of the current 4H:3V format, the newer pictures will use a 5H:3V format. Generally, HDTV and its variations will require a new TV set.

Via satellite

Satellite distribution of TV signals is not new. The Public Broadcast Service (PBS) has used a satellite interlink between its network headquarters and over 270 stations for several years. The commercial networks have been using satellite technology to transport programming from their technical centers, while cable systems typically receive distant channels and special services via satellite TVRO systems. But within about two years, it is possible that all interested viewers may be able to use direct broadcast satellite (DBS) reception.

DBS may require the user to install a small dish antenna to receive signals in the 12GHz range. Special receiver systems probably

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will convert the signals to work with present sets. Ideally the viewer will have an improved receiver for higher definition pictures.

In addition, development of new transmission formats has introduced component color transmissions. By removing the 3.58MHz subcarriers, improved color reception is possible without many of the faults noted for NTSC and PAL color systems. Depending upon which of the multiplexed analog component systems (MAC for short) might be selected, it would be possible for various modes of transmission to be provided. The picture could be arranged for high definition with the newer aspect ratio, although 4:3 pictures also could be sent. Up to eight channels of digital audio would allow stereo transmission in different languages. Or the use of several digital data channels for text-based screen displays, such as teletext, would be possible. MAC systems also could allow addressability to millions of individual TV receiver systems for special pay-TV services.

When the DBS service becomes a reality, consumers who have purchased low cost TVRO systems may find they have to invest in new systems if they hope to get the new, enhanced services successfully. Conversions of the "cheap" systems that have flooded the market will be unuseable or at last inferior to DBS-type equipment.

More in store

Flat screen televisions surfaced at the 1984 Chicago CES show. Thus it would seem that the long predicted *picture frame on the wall* may be reality soon, but probably at a high price. It will be followed by 3-dimensional imaging. Unlike the questionably successful attempts at 3-D that were shown in 1983, the 1984 demonstrations provided impressive dimensional images. Like 3-D movies and earlier red/cyan attempts, viewers will wear some form of glasses to watch the program. Without differently polarized material in front of each eye, the image will be a somewhat confusing picture.

What comes next is hard to say. Aldous Huxley introduced *feelies* in "Brave New World Revisited." Perhaps *smellovision* will follow that!

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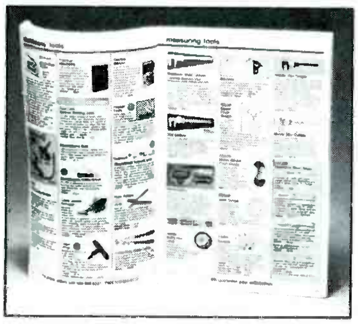

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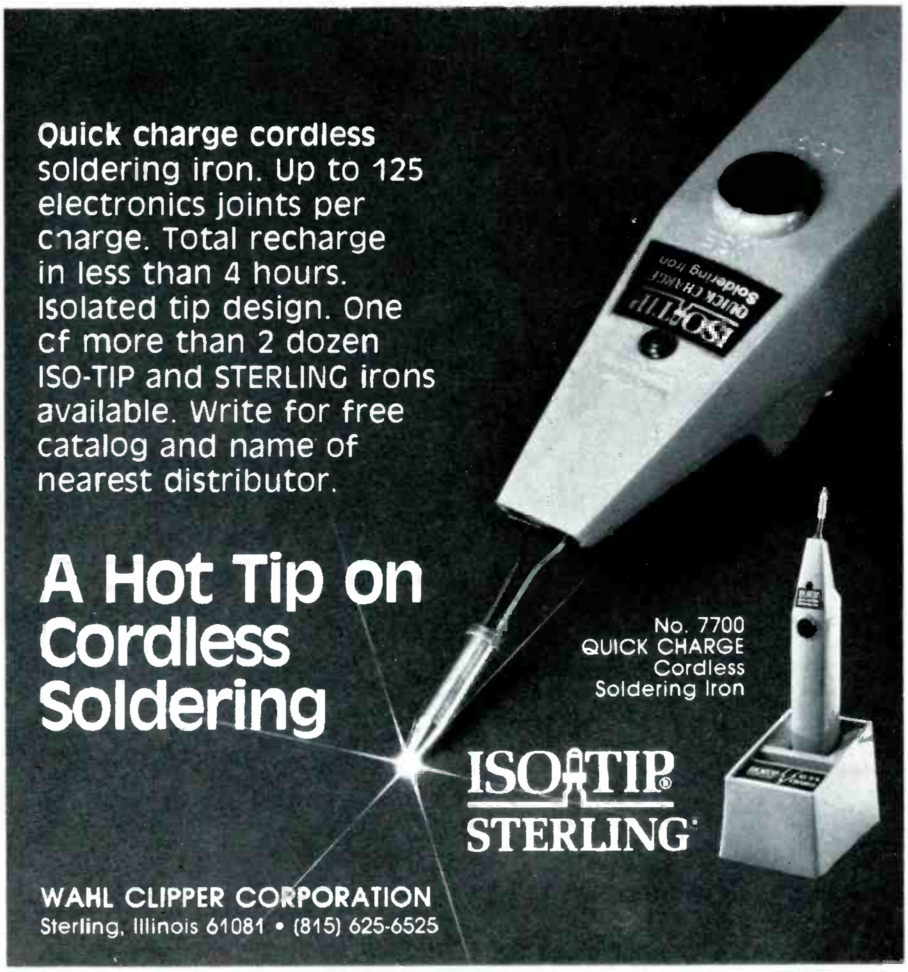

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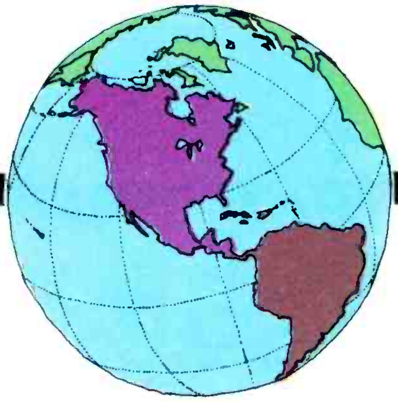
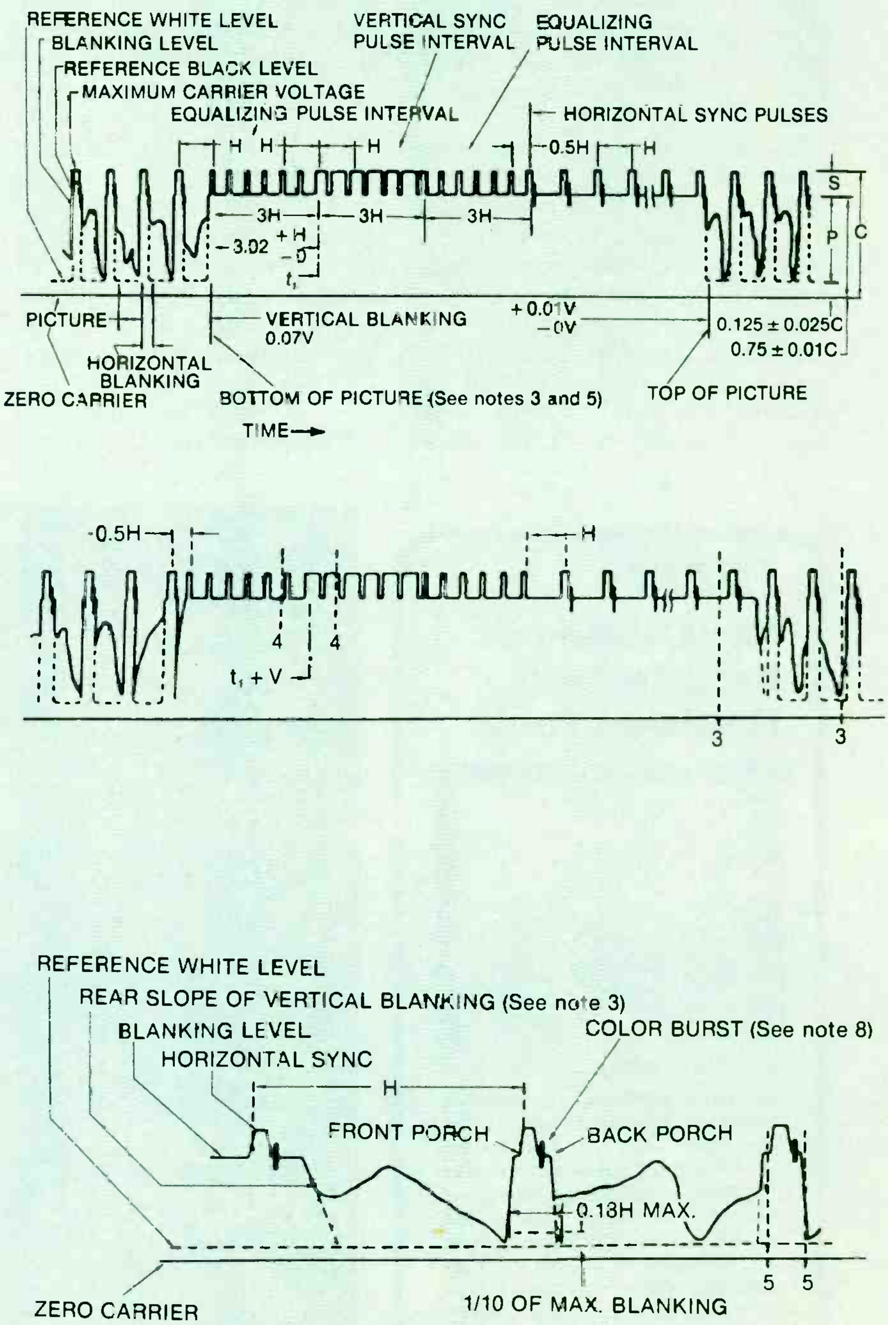


TELEVISION SIGNAL STANDARDS



DETAIL BETWEN 3-3 IN FIGURE 2
Horizontal dimensions not in scale in Figures 1 through 3

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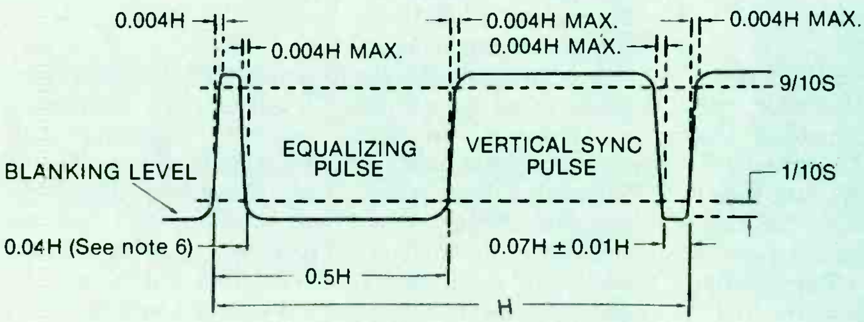
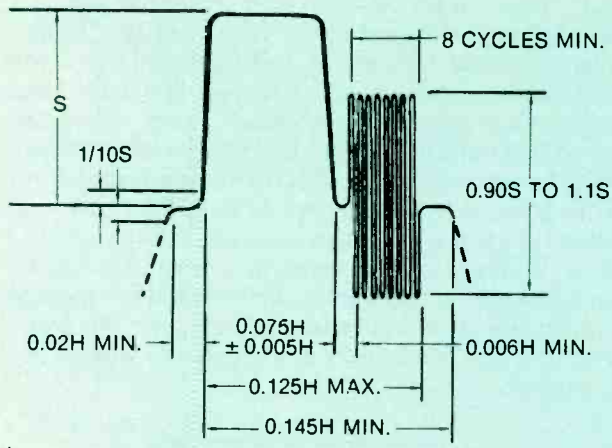


DETAIL BETWEEN 4-4 IN FIGURE 2

Figure 4.



DETAIL BETWEEN 5-5 IN FIGURE 3

Figure 5.

NOTES

1. H = Time from start of one line to start of next line.
2. V = Time from start of one field to start of next field.
3. Leading and trailing edges of vertical blanking should be complete in less than 0.1H.
4. Leading and trailing slopes of horizontal blanking must be steep enough to preserve minimum and maximum values of (x + y) and (z) under all conditions of picture content.
5. Dimensions marked with asterisk indicate that tolerances given are permitted only for long time variations and not for successive cycles.
6. Equalizing pulse area shall be between 0.45 and 0.5 of area of a horizontal sync pulse.
7. Color burst follows each horizontal pulse, but is omitted following the equalizing pulses and during the broad vertical pulses.
8. Color burst to be omitted during monochrome transmissions.
9. The burst frequency shall be 3.579545MHz. The tolerance on the frequency shall be ± 0.0003% with a maximum rate of change of frequency not to exceed 1/10Hz per second.
10. The horizontal scanning frequency shall be 2/455 times the burst frequency.
11. The dimensions specified for the burst determine the times of starting and stopping the burst but not its phase. The color burst consists of amplitude modulation of a continuous sine wave.
12. Dimension *P* represents the peak excursion of the luminance signal at blanking level but does not include the chrominance signal. Dimension *S* is the sync amplitude above blanking level. Dimension *C* is the peak carrier amplitude.

The composite video signal has a lot of work to do, as this representation shows. Figures 1 through 5 contain the information necessary to paint the TV picture, color it, synchronize the circuits that cause the horizontal and vertical motion of the electron beam, and blank the electron spot when it's moving back to start another line or frame. (Waveform drawings taken from the "Handbook of Electronics Tables and Formulas" courtesy of Howard W. Sams & Company, Indianapolis, IN).

ES&T

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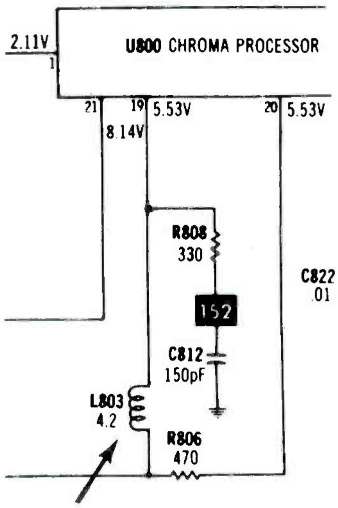
Troubleshooting Tips

Normal sound but no picture; strong snow on the raster RCA CTC101

(Photofact 1896-2)

When operated on the test bench, the RCA color receiver had no picture, only snow. However, the snow was not the conventional kind. Instead, the noise dots were very large, resembling those from an arcing flyback. I listened for audible arcs and found the flyback was originating some noise. Because RCA has had a fairly high flyback failure rate, I decided to replace this flyback. The new flyback was quiet, but the screen still showed large snow dots.

I injected a VA48 signal into the video IFs and used a scope to prove video was present at the TP1 testpoint at the output of the IC's third IF. Normal video also was present at the pin 3 input of the comb-filter module. Next, I scoped the delay line, finding only noise without video there. Also, the comb-filter output at pin 15 had noise without video. With the upstream end of R707 disconnected from pin 15 and a video signal applied to R707, the screen showed a good clear video pattern. After checking the dc voltages on the comb-filter module without finding anything significant, I concluded the module must be defective and ordered a new one. But when I replaced the comb-filter module, there was no improvement.



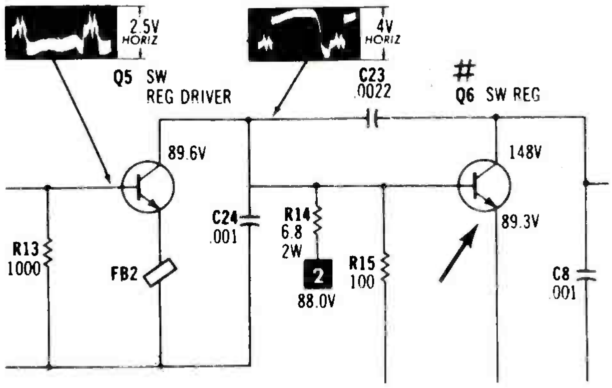
After studying the schematic, I noticed that comb-filter module pin 7 was supplied with 3.58MHz from the color oscillator (without tripled 3.58MHz applied to pin 3 of integrated circuit U1, U1 cannot process or pass the video signal). But when pin 7 was scoped, there was no signal. Also, the 3.58MHz was missing from U800 pin 21. When I injected a test 3.58MHz signal at pin 21, the video appeared on the screen. I checked components of the color-oscillator circuit, finding L803 was open. The coil had to be back-ordered, but when it was installed, the television operated correctly on monochrome and color.

Lester M. Troeckler, Jr.
Edwardsville, IL

Horizontal cannot be locked Magnavox T809-10

(Photofact 2025-1)

According to the large number of diagonal horizontal bars across the TV screen, the horizontal oscillator was far out of frequency. Adjustments of the horizontal-hold control changed the number of horizontal lines very little. Therefore, the horizontal-oscillator circuit was suspect, and because this is a modular-type receiver, I replaced the horizontal-oscillator/driver circuit board. When the picture appeared, I expected to see a synchronized picture. But the many diagonal stripes proved the oscillator frequency was far from correct.



Next, I obtained Photofact 2025-1 and located the horizontal oscillator-driver module on the schematic (a note said "non-repairable; replace only"). Since I had replaced the module before, I decided to measure dc voltages of the various module pins. At the supply-voltage end of R227 (a 560Ω resistor supplying pin 13), the voltage expected to be +87.9V was extremely high, almost equal to the +148V supply voltage at the input of R228 that is connected to pin 8. This indicated a regulator defect that increased the regulated voltage.

After examining the regulator schematic for several minutes, I suspected Q6 switching-regulator transistor. After Q6 was removed from the board, I checked it with my ohmmeter, finding an emitter-to-collector short. Replacement with an ECG165 restored normal operation.

Excessive regulated source voltage had triggered the safety shut-down circuit that in this model changes the horizontal-oscillator frequency so much that it cannot be locked by the hold control. The horizontal oscillator-driver module responded as designed when the high voltage was excessive from a defect elsewhere.

Howard R. Gain
Dearing, GA

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ERIC JACOBSON

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Products

Strip oval shaped feeder cables

Rush Wire Strippers announces the Model F, a precision die blade automatic stripper for stripping TV feeder cables.

The Model F is a light-weight, automatic hand tool that strips the insulation neatly from oval shaped TV feeder cables with PVC, teflon, or PTFE insulations. Cables are cleanly stripped with no risk of nicking, cutting or deforming the conductors.

Hardened steel, precision ground die blades are activated by a single squeeze of the tool handles. The blades automatically cut the insulation and the slug is removed.

Circle (75) on Reply Card

Heating element is under tip

A general purpose soldering iron that features the heating element directly under the tip for thermal efficiency has been presented by *M.M. Newman Corporation.*

The Antex model X-25 soldering iron heats up to 750°F in 45s, and – although it is a 25W iron – is the equivalent of 40W conventional irons. The slide-on iron plated tips cannot stick or freeze; they are available in 3/32-inch, 1/8-inch and 3/16-inch diameter. Also featured is a thermoset plastic handle that will not melt if touched by another hot iron.

Circle (76) on Reply Card

Workbook on fiber-optic testing

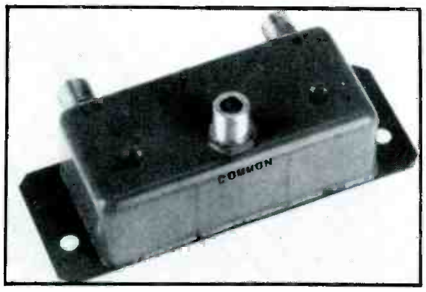
A workbook covering the essentials of testing fiber-optic components and systems is available from *Fotec.* The workbook was developed to accompany the Fotec seminars and training programs available on tape, but can be used as a separate teaching aid for anyone wishing to learn about fiber-optic testing.

The workbook, titled "Practical Testing of Fiber-Optic Systems and Components: Seminar Workbook," covers basic fiber-optic communication system technology, system and component test requirements, types of fiber-optic instruments and applications.

Circle (77) on Reply Card

Splitter combiner for VHF lowband/midband

Model number 3329-88/120 from *Microwave Filter Company* can be used to separate or combine the VHF sub and lowbands 5-88MHz and the VHF mid, high and superbands 120-450MHz.

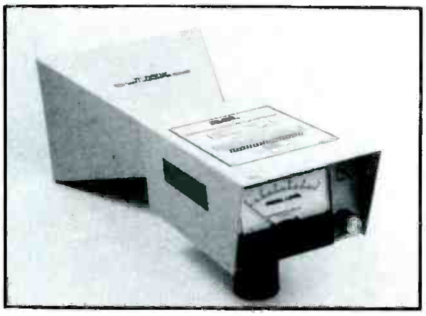


Passband loss is 1dB with a mutual isolation of 25dB minimum. Impedance is 75Ω and the filter comes with F (female) connectors on its three ports. The common port is used for the input or the output. One port is for the sub and lowbands and one port is for the midband and above.

Circle (78) on Reply Card

TI detector

Micro Scientific Labs is releasing the HR1000 Terrestrial Interference Detector Gun. By using the HR1000, a TVRO installer can run a fast terrestrial interference



check to determine interference contours, identify the source of interference and minimize or overcome the problem. The hand-held, self-contained device features a 65° LNA/25dB gain feed horn, broadband amplifier and 2% meter circuitry. It is selectively tuned to cover a 3.7GHz to 4.2GHz frequency range. The unit provides a beam width narrow enough to permit walking to an interfering carrier or noise source.

Circle (79) on Reply Card

MAX-500 frequency counter

Global Specialties has introduced the MAX-500 frequency counter. Designed with 5Hz to 500MHz response, the MAX-500 also features 4-ppm accuracy and an 8-digit, 7-segment LED display. The range of the MAX-500 makes it suitable for a variety of applications, including signal processing, time base calibration and measurement of audio signals and transmitter frequencies, particularly ham radio.

Circle (80) on Reply Card

Dual soldering station

Edsyn's 935-2 Dual Soldering Station consists of one power supply module (static-free construction) that supports two different models of soldering tools simultaneously.

The two soldering tools are the CL1080 (power output of up to 70W on demand) and CL1180 (50W on demand). Both tools are designed for safety on static-sensitive components. Each soldering tool contains the proportional solid-state circuitry that regulates temperature to ±6°F (3°C). Temperature range is 400°F to 800°F (205°C to 425°C).

While not in use each tool is placed in its own removable, *closed* pod atop the power supply module; the closed design minimizes heat loss, thus conserving energy. It also extends tip life, and isolates the hot element and tip from objects that could pass through an open, spring-type holder. The holder also catches solder splashes into a replaceable solder-debris collector.

Circle (81) on Reply Card

Short-circuit locator

From *Micro Products Unlimited* comes the audible-tone ESP (Electronic Short Path-finder) designed to pinpoint short circuits within 0.2 inch of their location whether or not PC boards are fully loaded. The unit is relatively inexpensive and, according to the manufacturer, uses two test leads and probe to cut troubleshooting time by 95%. ESP is available in the plug-in ac-powered model JL-A or the model JL-N with battery pack for field use.

Circle (82) on Reply Card

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New power conditioner for microcomputers

Topaz announces its Peak-Current Line 2 power conditioners designed specifically to meet the needs of microcomputers that have internal switched-mode power supplies.

Besides providing protection against electrical noise disturbances, these power conditioners also provide immediate correction of voltage fluctuations that can impair computer performance. Featuring *Powerlogic* microprocessor-controlled voltage regulation, output voltage is corrected to within +4% to −8% of nominal rated voltage for input voltage variations of +15% to −25%. Because of low forward transfer impedance, Line 2 power conditioners provide undistorted power to high-crest-factor loads, such as the switched-mode power supplies commonly found in today's microcomputers.

Circle (83) on Reply Card

Mini drilling system

Automated Production Equipment model SRS 020 miniature drilling system provides for all drilling, grinding and polishing of PCBs during repair operations. This portable equipment includes a variable regulated power supply and features a precision, miniature hand-held drill, with an infinitely adjustable 3/16-inch, 3-jaw chuck. Bits, burs and abrasives are also included. Model SRS 020 is packaged in a high impact plastic carry case.

Circle (84) on Reply Card

Extinguishes electrical fires without leaving residue

A compact UL-listed Falcon Halon 1211 fire extinguisher specifically designed for electronics benches and workshop areas surrounded with costly test equipment has been developed by *Falcon Safety Products.* Halon 1211 snuffs out electrical fires, burning grease and chemicals without making a mess or leaving a harmful residue.

Halon 1211 under pressure, five times heavier than air, speeds into hard-to-reach areas within a TV set, a fuse box or a computer. It evaporates completely, leaving neither a foamy residue nor a destructively water-soaked area in the fire's aftermath, damage that can be worse than damage from the fire. Barely as tall as a soda bottle, the one-pound Falcon Extinguisher may be kept on a shelf, in a drawer or in the available, optional wall-mount holder.

Circle (85) on Reply Card

Digital clamp testers

Models 40 and 42 digital clamp testers introduced by *Triplett Corporation (A Penril Company)* permit fast voltage, current and resistance measurements without breaking the conductors or insulation in a circuit. An integral split yoke (2½-inch ID) can be opened

and clamped around a single conductor for fast laboratory or in-field testing. Standard test-lead measurement of voltage and resistance also can be accomplished.

The large 3½-inch digit LCD is easy to read and autoranging on all functions, annunciator and overrange indication are provided.

Circle (86) on Reply Card

Project forms available

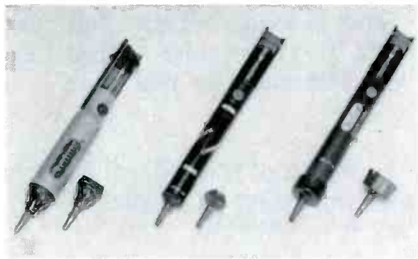
A set of time-saving project design forms useful to electronic technicians, hobbyists and engineers is available from *AF Publishing Company.*

The six different forms – block diagram form, schematic form, PC board layout form, construction details form, parts list and wire list – come 50 sheets per pad. Each is on a different color paper for easy selection and reference. The 8½ x 11-inch forms have grids to simplify drawing and layout and include areas for entering other important information.

Circle (87) on Reply Card

De-soldering tool series

Wahl Clipper Industrial Products has introduced a series of three anti-static or static-free de-soldering tools that are equally appropriate for industrial use, and for the home electronics hobbyist.



Features include one-hand operation, durable construction, high vacuum, recoil protection and self-cleaning plunger. Thumb profiles are comfortable.

Circle (88) on Reply Card

New aerosol product restores TV tuner performance

One of the high technology aerosol chemicals available from *Philips ECG, a North American Philips* company, is PH900-16 Tuner Restorer and Lubricant that

coats contacts with a neutral lubricant, reducing friction and protecting against oxidation. It is recommended for all types of mechanical tuners used in imported and domestic television sets.

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Test your electronic knowledge

By Sam Wilson

This is a quiz review. Ten questions from previous quizes have been rewritten for this issue.

1. Which of the following is correct regarding a compiler?
A.) It is software.
B.) It is hardware.
C.) It is a section inside a microprocessor
D.) It is used for making alphabetical lists.
E.) It is a computer trade name.

2. The purpose of the circuit in Figure 1 is to
A.) eliminate harmonics.
B.) introduce phase inversion.
C.) produce oscillations.
D.) produce a glitch.
E.) increase input impedance.

3. The circuit of Figure 2 is
A.) in a common collector configuration.
B.) in a common base configuration.
C.) in a common emitter configuration.
D.) inoperative due to incorrect supply polarity.
E.) used for converting sine waveforms to sawtooth waveforms.

4. A certain meter is rated at 100,000Ω per volt. The amount of current required to deflect the meter pointer to full scale is
A.) 100μA.
B.) 50μA.
C.) 25μA.
D.) 10μA.
E.) 1μA.

5. The collector current of a certain transistor flows through a relay coil. Which of the following components would be connected across the coil to protect the transistor from inductive kickback?
A.) VIR
B.) VOR
C.) VER
D.) VDR
E.) VAX

6. The reciprocal of reactance is
A.) susceptance.
B.) conductance.
C.) elastance.
D.) impedance.
E.) (none of these choices is correct).

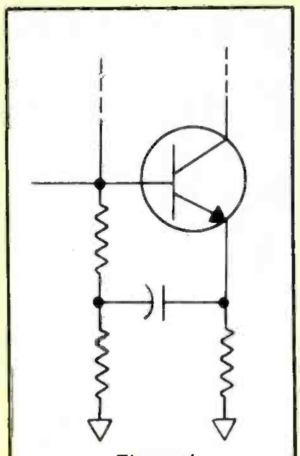

Figure 1.

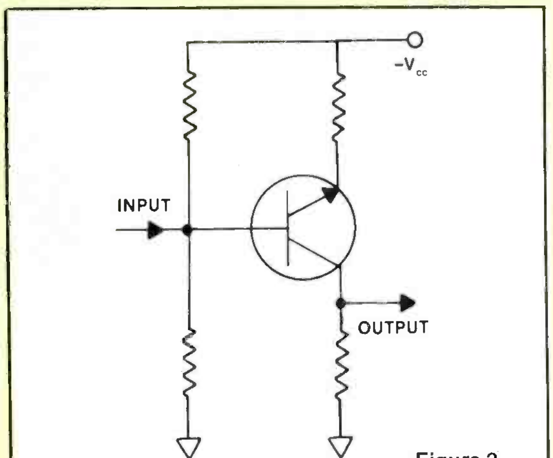

Figure 2.

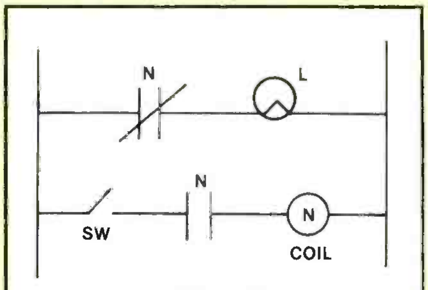

Figure 3.

7. Refer to the ladder diagram of Figure 3. The lamp (L) is
A.) *On* all of the time.
B.) *On* only while the switch is closed.
C.) *Off* only while the switch is closed.
D.) *Off* all of the time.

8. Which of the following best describes an electret?
A.) permanent magnet
B.) non-polarized electrolytic capacitor
C.) very high impedance voltmeter
D.) permanently charged dielectric
E.) feed-through capacitor

9. Which of the following is used to prevent false triggering of an SCR in an inductive circuit?
A.) snuggie
B.) snippet
C.) snubber
D.) snobbie
E.) (none of these choices is correct).

10. Which of the following is preferred – because of its lower noise – in an RF circuit?
A.) MOSFET
B.) NPN transistor

Answers are on page 60.

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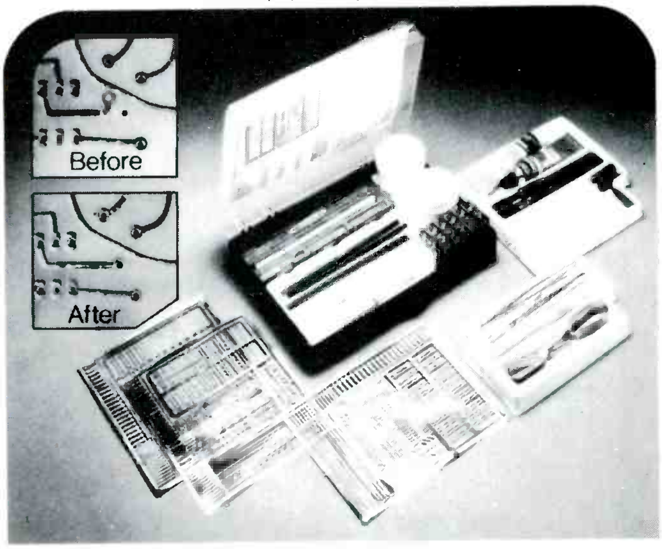

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Symptoms and cures compiled from field reports of recurring troubles

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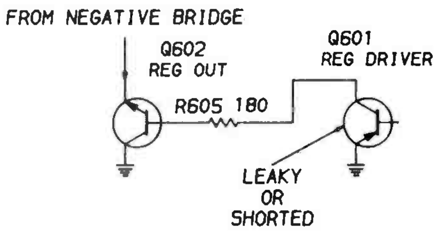
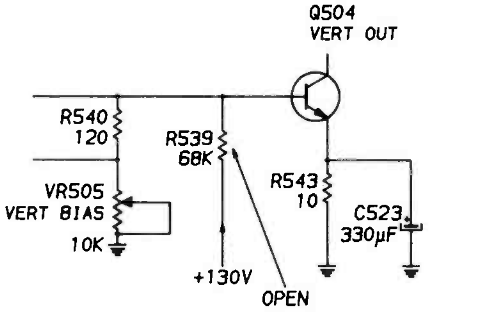
PHOTOFACT – 1954-2



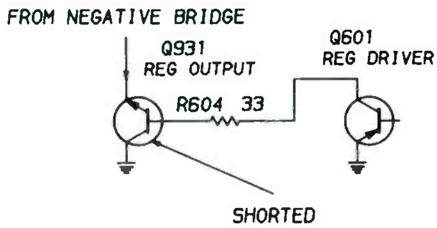
Symptom – Shutdown occurs instantly after turn-on.
Cure – Check regulator-driver transistor Q601, and replace it if leaky or shorted.

Chassis – Sony KV-1920 2
PHOTOFACT – 1455-2



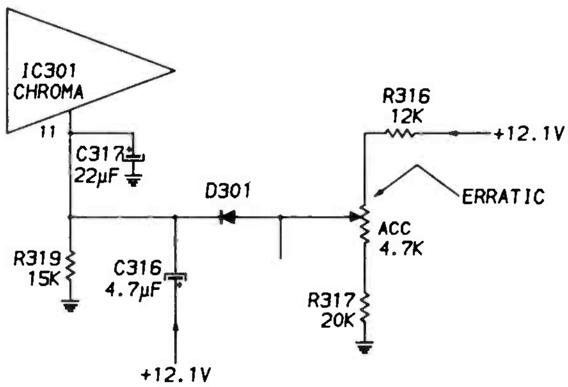
Symptom – Foldover at top or bottom of picture
Cure – Check R539, and replace it if open or increased in value.

Chassis – Sony KV-1930R SCC-64B 3
PHOTOFACT – 1592-1



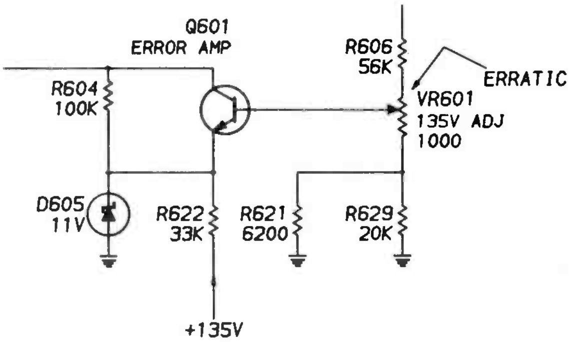
Symptom – HV and sound are present, but there is no raster or picture.
Cure – Check regulator transistor Q931, and replace it if shorted.

Chassis – Sony KV-1920D SCC-100F-A 4
PHOTOFACT – 1708-2



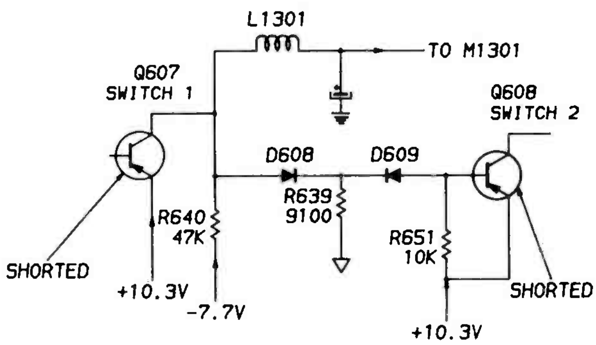
Symptom – Intermittent or no color
Cure – Clean and adjust (or replace) VR301.

Chassis – Sony KV-1920D SCC100F-A 5
PHOTOFACT – 1708-2



Symptom – Picture blacks-out erratically; sound, okay.
Cure – Clean or replace VR601 and adjust for regulated +135V.

Chassis – Sony KV-2649R SCC406-A 6
PHOTOFACT – 2180-2



Symptom – Antenna/auxiliary switch will not operate.
Cure – Check transistors Q607 and Q608, and replace if shorted.

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Books

Editor's note: Periodically ***Electronic Servicing & Technology*** *features books dealing with subjects of interest to our readers. Please direct inquiries and orders to the publisher at the address given, rather than to us.*

Using Integrated Circuit Logic Devices, by Delton T. Horn; Tab Books; 432 pages; $21.95 hardbound, $14.95 paperback.

Aiming both to those to whom digital circuitry seems confusing, and to technicians who seek to refresh prior knowledge, the author uses analog electronics for comparison to explain the complexities of digital logic. Readers proceed through theory, mathematical concepts including binary arithmetic, Boolean algebra and the hexadecimal number system, to detailed instructions for devising digital ICs they will use – with requisite components – in many practical applications.

Projects include a digital logic probe that can be used to study – and troubleshoot – other projects, a digital clock-oscillator, bounce-free switch and an LED flasher. Additionally, there are directions for building a number of useful and entertaining devices plus troubleshooting hints and tips. There are 565 illustrations.

Tab Books, Blue Ridge Summit, PA 17214

Towers' International Digital IC Selector, by T.D. Towers, Tab Books; 248 pages; $19.95 vinyl cover only.

This book's principal thrust is to provide instant access to essential data on all types of IC devices manufactured worldwide, both current and obsolete. There is an alphanumeric listing, by device type number, of all standard ICs produced in the United States, the United Kingdom, continental Europe, Eastern Europe and Japan – a total of approximately 50,000 devices. There are full descriptions and control specifications for more than 10,000 common denominator units.

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Video Electronics Technology, by David Graham; Tab Books; 256 pages; $15.95 hardbound, $10.95 paperback.

Keeping up with rapid advances in technology is easier when related information can be drawn from a single source. This book was written to provide a 1-stop reference for developing video technologies for microwave and satellite television to VCRs and laser-scanned videodiscs. Someone working in any phase of video electronics or an allied field, or simply interested in the subject, will find detailed coverage, beginning with a review of the principles of b&w television and continuing with an update of present and future systems.

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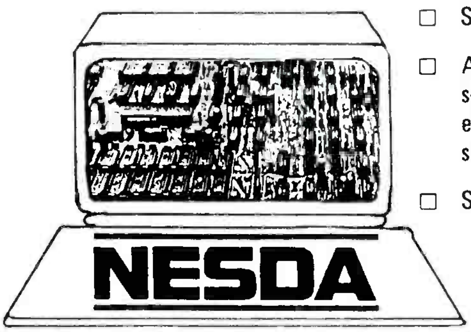

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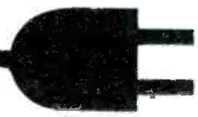

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Circle (126) on Reply Card

Questions are on page 56.

Answers to the Quiz

1. A. It converts high-level language to machine or assembly language.

2. E. It is called a bootstrap circuit.

3. C. The input is at the base and the output is at the collector. The emitter is common to the input and output signals.

4. D. The full-scale deflection is the reciprocal of the ohms-per-volt rating.

5. D. The resistance of the voltage-dependent resistor is low when the voltage across it is high. This device practically short circuits the inductive kickback voltage of the coil.

6. A. The symbol for susceptance is B.

7. A. The switch is in series with a normally open contact, so it cannot operate the coil.

8. D. Electrets are used in microphones, speakers and other electronic devices.

9. C. This circuit consists of a resistor and a capacitor in series. It is connected across the SCR.

10. A. One reason is that the MOSFET does not have partition noise.

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