RCA

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Plug-in Modules for Television

Two recently announced television chassis use plug-in AccuCircuit modules for a majority of the circuit functions. One chassis, the CTC 49 which is used in the Trans Vista® portable receiver, uses 11 modules containing a substantial percentage of the chassis circuits. The other module equipped chassis is the black and white KCS 185, where the majority of the circuitry is assembled on six plug-in modules. Although modular circuits are not completely new to RCA home entertainment products, having been used for sound in the CTC 41, 42, 43 series chassis and for video and sound processing in the KCS 176 and 177, these new chassis are the first where extensive use is made of plug-in modules.

The CTC 49

The CTC 49 is a vertical chassis designed for use in an 18-inch (diagonal) portable receiver. The Model EP 506 containing this chassis features the first use of the short neck (110° deflection angle) 18VANP22 color picture tube. The CTC 49 modules use familiar CTC 40 type circuitry in many areas. These circuit areas include AFT, low-level vertical and horizontal deflection, sound, and the sync separator. The pix IF, video, and chrominance sections are advanced designs that make extensive use of integrated-circuits. The largest, and most complex, of the 11 modules is designated as **Module MAK.** It contains the pix IF, keyed AGC, picture detector, 4.5 MHz detector, one stage of 4.5 MHz amplification, and a low-level video stage. All of these listed functions are performed by a single IC. In addition, **Module MAK** includes a second IC, serving the AFT circuit. Two transistors are found on the module—one is a video emitter-follower; the other is a voltage regulator. **Module MAL** contains two video amplifier stages and the sync separator. These stages use conventional transistor circuitry.

Two modules are used to process the chrominance signal. **Module MAC,** using a single IC, contains the chroma-bandpass amplifiers, 3.58 MHz reference-oscillator, color-killer, and the ACC and AFPC circuitry. **Module MAE** functions include color demodulation and amplification of the color difference signals. One IC recovers R- Y and B- Y signals. The G- Y signal is obtained by a matrix circuit. Individual emitter-follower stages within the IC provide the three color difference signals at sufficient level for input to RED, BLUE, and GREEN kine-driver modules. Three identical modules are used to drive the cathodes of the color picture tube—one for each color. These modules, designated as **MAD,** combine the luminance (black and white video) and the color difference signals

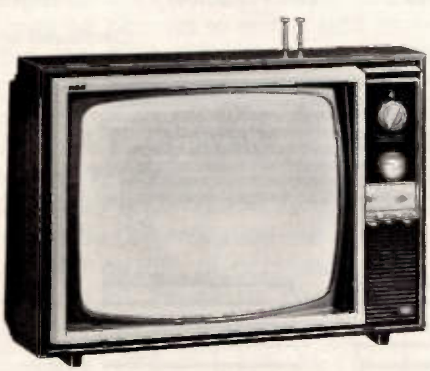

Figure 1—Model EP 506 (CTC 49)

Figure 2—Model AP 103 (KCS 185)

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to obtain RED, BLUE, and GREEN video signals which are amplified and supplied as direct-coupled signal drive to the respective cathodes of the color picture tube. Each **MAD** module contains two transistors. One transistor serves as a video amplifier; the second transistor is part of a bias circuit that assures that the picture tube cathodes operate at the correct DC level to achieve and maintain correct gray-scale tracking—individual drive controls set highlight gray as in other chassis.

Low-level vertical sweep circuitry is contained on **Module MAG.** The vertical sweep system of the CTC 49 features the highly successful "Miller-Rundown" circuit, first used in the CTC 40, driving a complementary symmetry output stage which is similar to the audio amplifier used in stereo phonographs of recent manufacture. In this case the amplifier drives the vertical coils of the deflection yoke, rather than a loudspeaker. The remaining modules include **MAH,** the CTC 40 type horizontal oscillator (drives familiar SCR horizontal output stage), a power supply module **(MAB)** containing all rectifiers and degaussing components, and the CTC 41, 42, 43 type IC sound module **(PM 200).**

The remaining CTC 49 circuitry is situated on four major circuit boards; the **PW 200** board containing secondary controls and the service switch; the **PW 300** board containing sockets for all plug-in modules except MAB, MAG and MAH; the **PW 400** board with horizontal sweep, and modules MAG and MAH; and the **PW 800** convergence board.

The KCS 185

Model AP 103, using the modular KCS 185 chassis, is 9-inch diagonal instrument featuring AC, 12-volt battery-pack, or in-the-car operation. The six plug-in circuit modules incorporated in this chassis include the **PW 300 Sound Module, PW 350 Audio Output Module, PW 400 IF Module, PW 500 Video Module, PW 600 Power Supply Driver Module, and the PW 900 Horizontal Oscillator Module.** Three of the above modules are identical to those used in the KCS 176 and 177 chassis. These being the IF, video, and sound modules. The remaining modules use transistor circuitry which is similar to that used in the previous AC/battery operated KCS 157 chassis.

4-Channel Stereo Tape Player

The increasing popularity of prerecorded entertainment, and the efforts by manufacturers to provide true-to-life music, has led to the development of the four-channel stereo tape system. In August of this year, RCA Consumer Electronics Division introduced the YZD 400 4-Channel tape player which will play either conventional 8-track stereo cartridges or the new two program four-channel tape cartridges. This compatability feature is possible because the four-channel tape system uses the same cartridge, tape width, and tape speed as conventional 8-track cartridge players. Switching

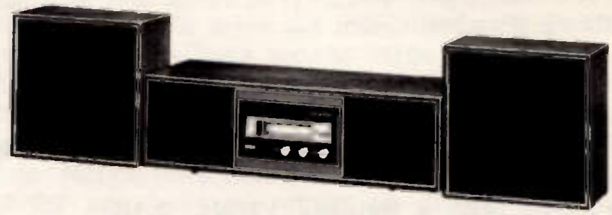

Figure 3—Model YZD 400 4-Channel Tape Player

from 2-channel to 4-channel operation is accomplished manually with a front panel switch.

The four-channel stereo system divides the tape into two 4-track stereo programs of up to 25-minutes each. Figure-4 illustrates that four of the eight tracks on the tape are used for each of the two stereo programs. When playing a 4-track program, each head section drives a separate amplifier, and loudspeaker. The head functions as follows:

4-Channel Operation

Head Section	Channel
A	Left Front
B	Left Rear
C	Right Front
D	Right Rear

Program-1 head position—UP
Program-2 head position—DOWN

At the end of program-1, the head mechanically shifts position so that program-2 is played back on tracks 2, 4, 6 and 8.

2-Channel Operation

Program	Head Section	Head Position	Channels
1	A	UP (Track-1)	Left F/R
1	C	UP (Track-5)	Right F/R
2	A	DN (Track-2)	Left F/R
2	C	DN (Track-6)	Right F/R
3	B	UP (Track-3)	Left F/R
3	D	UP (Track-7)	Right F/R
4	B	DN (Track-4)	Left F/R
4	D	DN (Track-8)	Right F/R

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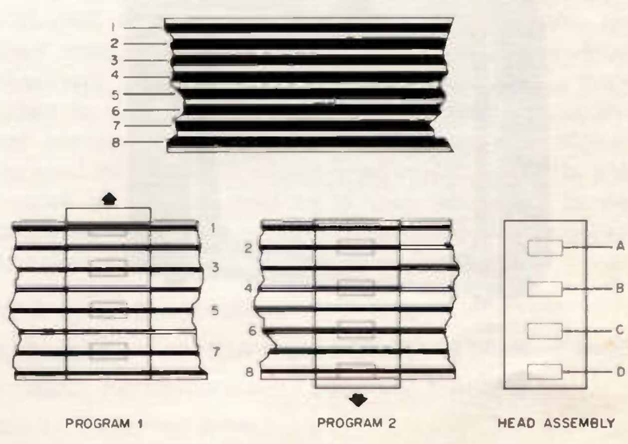

Figure 4—Tape Tracks and 4-Channel Head

Transistors and Miller-Feedback

Tubes and transistors exhibit definite capacitances between electrodes—interelectrode capacitance as shown in Figure-5. At low frequencies, the interelectrode capacitance of the amplifying device may be ignored. However, at high frequencies, the engineer must pay careful attention to the collector/emitter and collector/base capacitances when designing circuits such as radio and television IF-stages, VHF and UHF tuners, etc. The following text explores the problems associated with interelectrode capacity and the methods by which these problems are overcome in practical circuits.

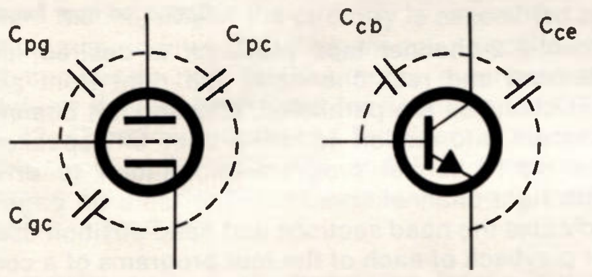

Figure 5—Interelectrode Capacity

Collector/emitter capacitance (C_{ce}), although it is usually rather small, can shunt the output signal in a common-emitter stage, making the actual stage gain somewhat less than maximum. This is usually not a serious problem in most transistor circuits because of the relatively low collector/emitter impedance and the small value of C_{ce}. Far more serious is the effect of the collector/base capacitance C_{cb} on amplifier performance, for this capacitance allows an increasingly greater amount of collector signal to leak back to the base circuit at high frequencies. This collector to base leakage signal, may be phased to either add to, or subtract from, the input signal. Thus, feedback can be either positive or negative as determined by phase shifts occurring in the transistor at high frequencies, and the characteristics of the input and output circuitry. When the leakage signal is negative feedback, less than optimum gain is the result. Positive feedback can cause the stage to oscillate. (Often, in the design of oscillators, this feedback is considered to be all or part of the feedback capacity required to sustain oscillation.)

This leakage signal feedback phenomenon is known as the "Miller-Effect," and for this reason the interelectrode capacitance which allows output to input signal leakage is often referred to as "Miller-Capacity." The amount of Miller-Effect feedback is determined by several circuit parameters. One consideration is stage voltage gain; higher gain means a larger output signal with respect to the input and consequently more feedback signal voltage is developed across the input impedance (Z_{in} as illustrated in Figure-6). Reduced feedback can be obtained by lowering the voltage gain by the stage. By so doing, the output signal, and hence the feedback is smaller. This is often done by reducing the impedance of the collector load at the expense of gain. Often a compromise between gain and the requirement to reduce feedback (usually to prevent oscillation) can be found which provides adequate circuit performance.

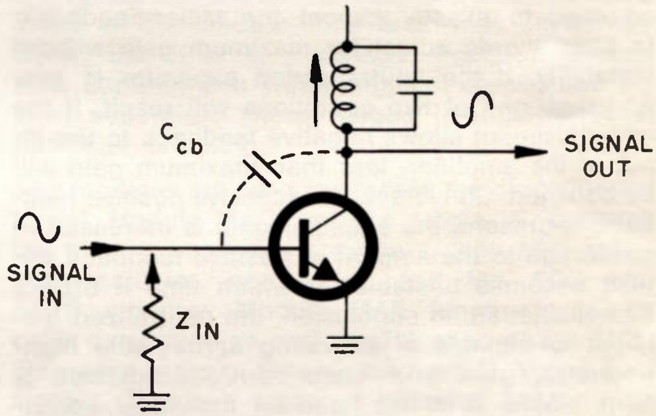

Figure 6—Miller-Feedback

The input impedance of the stage must also be considered when determining the effects of Miller-Feedback. For a given output signal and value of Miller-Capacity, a lower input impedance allows less feedback to be developed. Also, the reactive component of the input impedance (inductance or capacitance) can phase-shift the feedback, producing undesired gain reduction or oscillation. Hence, from the standpoint of reducing the undesired effects of Miller-Feedback, low input impedance is desirable. However, low input impedance reduces the available gain because of loading on the preceding stage.

Neutralized Amplifier

In instances where the previous methods of dealing with the Miller-Effect are not adequate, another method of counteracting this feedback is often used. Many high-frequency amplifiers use a technique known as "neutralization" to achieve useable high-frequency gain. Neutralization is accomplished by introducing a controlled amount of positive or negative feedback to the input of the stage to cancel the output to input Miller-Feedback. When the neutralizing capacitor (C_n) of the

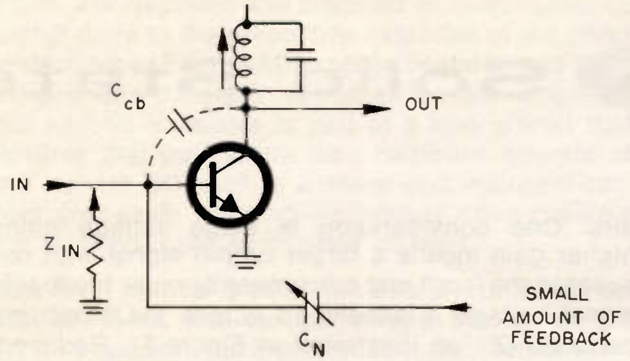

Figure 7—Neutralized Amplifier

circuit shown in Figure-7 is adjusted so that the base voltage developed by the neutralizing feedback exactly equals the Miller-Feedback, best performance is obtained. This adjustment is critical; in VHF and UHF amplifiers it is **extremely** so.

It is important that the neutralization capacitor be adjusted to exactly cancel the Miller-Feedback. In other words adjust for maximum gain without instability. If the neutralization capacitor is misadjusted, one of two conditions will result. If the misadjustment allows negative feedback to the input of the amplifier, less than maximum gain will be obtained. Conversely, if excessive positive feedback is present, the amplifier gain is increased in proportion to the amount of positive feedback until it becomes unstable, at which time it breaks into oscillation. In conclusion, the neutralized amplifier is capable of providing appreciable high-frequency gain, and when correctly adjusted is quite stable. It is this need for individual adjustment that makes the neutralized circuit a little cumbersome for high-volume products such as radio and television receivers.

Cascode Amplifier

Years ago engineers, realizing the limitations of neutralized circuits, began using what is now known as the "cascode" circuit for high-frequency amplifiers. Today a transistor version of this same circuit is widely used. The cascode circuit of Figure-8 depends on operating transistor Q1 at relatively low voltage gain so that a little voltage is available at the collector to feed back by way of the Miller-Capacitance to the base. The low-voltage gain first stage (Q1) is possible because it is only required to drive the low-impedance emitter of the common-base second stage (Q2).
However, even though there is little voltage gain, there is still adequate power gain to drive transistor Q2 which is capable of substantial voltage gain. Notice here that the collector/base leakage of Q2 can have no effect on signal gain because of the grounded-base connection. Although the collector/base Miller-Capacitance still shunts some of the signal to ground, this is far less serious than the gain degeneration or instability that would result if this same amount of signal were applied to the input of the amplifier. Thus, transistors Q1 and Q2 connected in a cascode configuration allow good high-frequency gain without the need for individual adjustment.

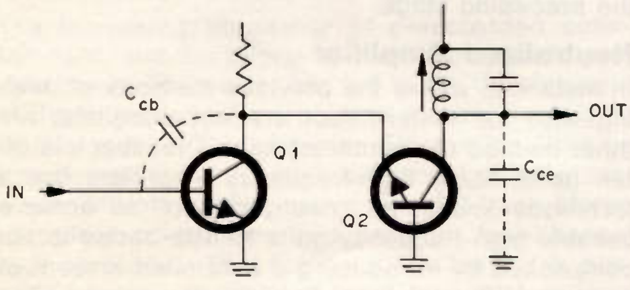

Figure 8—Cascode Amplifier

4-Channel Stereo Tape

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When a 2-channel tape playback is desired, the left front and rear channels, and right front and rear channels are paralleled, allowing left channel program information to drive both left speakers and right channel program information to drive both right channel speakers. The table on page 2 indicates the head sections and head position used for playback of each of the four programs of a conventional 8-track tape. Notice that electrical head switching is used in conjunction with two head positions when the YZD 400 is playing 2-channel tapes.

For best 4-channel stereo listening with the YZD 400 instrument, the listener should sit in the center of the room directly in front of the tape player instrument. In this manner the left front and right front channels are provided by the speakers contained in the instrument. The left rear and right rear channels are provided by external speakers, which should be placed at the back of the room facing forward.

After placing the rear speakers, the YZD 400 is easily adjusted for best stereo listening. A ganged **VOLUME** control, located on the front panel, allows simultaneous level adjustment of all four channels. A front panel **BALANCE** control is provided to allow adjustment of left and right channel stereo balance. Additional balance controls, located on the rear of the instrument, permits the output of the left and right rear speakers to be adjusted for optimum stereo listening with a given speaker placement.

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