"THE EYES HAVE IT!"

Electron-ray Tubes Speed-up Operation and Increase Versatility of the RCA Rider Chanalyst

MORE than 4,000 satisfied users already know the Rider Chanalyst employs four electron-ray tube indicators, and one meter-type of indicator. The decision to use the electron-ray indicator in four of the channels in the instrument, and the one meter indicator in the volt-meter channel, was not an arbitrary move. It was a deliberate step taken as the final result of several years of research in which every conceivable type of indicator including the neon tube, various types of vacuum-tube voltmeters, and the cathode-ray oscillograph was used in each of the channel indicators. Various other forms of indication were tested—such as signal levels in absolute values upon meters and scales associated with the cathode-ray tube and the electron-ray tube, and the relative indications using electron-ray tubes as well as meters.

Use of Meter Was Carefully Considered

Ample opportunity existed during the development of the Rider Chanalyst, to investigate the utility of meters as indicators. In fact, as is evident in the Rider Chanalyst, *a new type of vacuum tube voltmeter intended for the measurement of d/c potentials was developed, to fill existing and future requirements of the servicing industry.* From all appearances, the many meritorious features visualized in this new development were correct. Because of this tube voltmeter circuit in the Rider Chanalyst, it has become increasingly popular in the test equipment field.

Basis of Signal Tracing

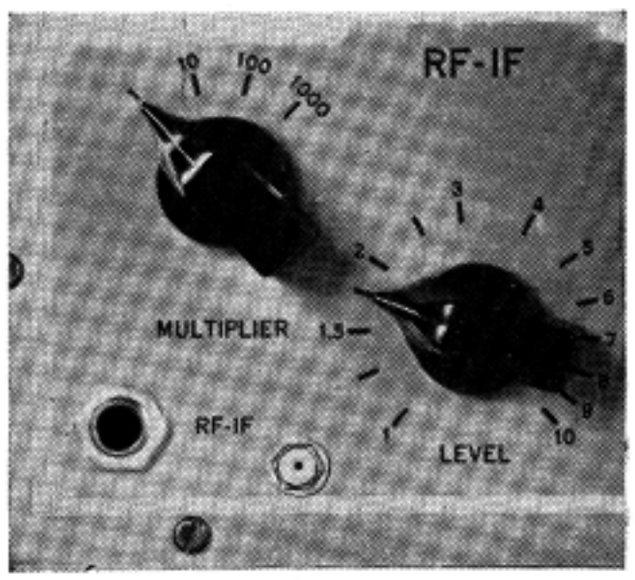
To understand the decisions made after detailed research, it is necessary to dissect some of the basic considerations involved in signal tracing.

Essentially, a test signal is traced through a communication system so as to determine where it exists—where it dies, or no longer exists—where it appears in circuits where is does not belong—where it does not receive the proper amount of amplification—where it becomes distorted—where it takes on hum, etc. There are, of course, other supplementary operations such as visual examination of the signal and listening to the signal, but these are supplementary to the basic or essential operations already mentioned.

If you analyze these operations in a critical manner, one fact stands out. At no time are you concerned with the exact magnitude of the signal expressed in microvolts at various places in the device being diagnosed. Signal tracing provides all of the necessary information and points to the trouble without requiring measurement of signal levels in absolute values. This is true irrespective of the type of indicator used. There are, of course, a few exceptions to this statement, such as the determination of the signal level at the antenna, the audio voltage across the detector output or input to the a-f amplifier, and across the voice coil. If you compare the last three tests with the numerous other tests in a receiver where conventional signal tracing is employed, you will find the places where signal voltage in absolute values is not necessary, greatly outnumber those where such data might be needed. Therefore, calibration of the test unit irrespective of the type of indicator used need not be in absolute values of signal voltage.

Accuracy of Electron-ray Fully Established

However, it was impossible to dismiss the use of meters as indicators on the grounds that absolute values of signal voltage *did not represent essential data for rapid signal tracing.* Another very important factor required consideration. This was the matter of accuracy. Was the use of meters as indicators justified on the grounds of greater accuracy in measurement? *Experiments definitely proved the contrary.* They proved the meter was no more accurate than the electron-ray tube as an indicator in any calibrated circuit, because of certain definite controlling influences which exist in all such signal-tracing equipment.



RF-IF Multiplier and Level calibrated controls on the RCA Rider Chanalyst.

Editor's Note: In response to a number of inquiries as to why electron-ray tubes were used in some channels of the Chanalyst instead of meters, we went straight to headquarters for the inside information! Here are the facts, the substance of which are based on conversations with Mr. John F. Rider, himself.

To appreciate this comparison between the electron-ray indicator and the meter-type indicator, you must understand the manner in which these units can be used. Both the electron-ray type of indicator and the meter-type indicator are located in the output circuit of the amplifier channel. Such being the case, *the signal applied to the two indicator systems depends upon the performance of the amplifier and rectifier ahead of the indicator in the test unit.* You can therefore readily understand that any change in the gain characteristics of this amplifier will change the signal level at the output of the amplifier—consequently, the indication of signal level shown upon the indicator. This applies to the electron-ray tube, as well as the meter-type indicator. Doubtless you are well aware of the fact that many variations exist in amplifier operations, such as variation in the condition of the tubes during their normal life, variation in line voltages, humidity, etc. Any one, or all of these will change the signal level at the output of the test unit amplifier; therefore the indication upon any type of indicator used. Thus it is clearly evident that the meter as an indicator cannot give any greater degree of accuracy in measurement in any one channel, than is possible with an electron-ray tube used as an indicator.

The fact that the meter itself is accurate to within a few percent means very little in the overall result, because variations of gain in even well-constructed amplifiers may be as great as from 30% to perhaps 100%, depending upon the existing conditions.

Recalling that calibrations in absolute values are not necessary—the comparison between the meter and the electron-ray tube narrows down to reference level indications.

Electron-ray Speeds Servicing!

Still further investigation of the use of the indicators calibrated in absolute values of signal voltage as against those used as reference level indicators, show the latter to be greatly superior in speed of servicing operations involving gain and in interpretation of the indications. The prime reason for this condition was found to be the necessity, in the case of absolute value calibration, of reading the value of signal voltage for each position of the pickup probe; then converting the indicated signal level into the same electrical units, and then dividing one by the other to arrive at the quotient which represented the gain in signal level between any two points being checked. *This work involved entirely too much time and was not conducive to rapid servicing.*

In the case of reference level indicators, operation was much more rapid because this type circuit employs level and multiplier controls which are direct reading in amplification. This was complete proof of the advantage of the reference level indicator over the absolute signal level indicator.

The relative value of using meters or electron-ray tubes as reference level indicators was then investigated. From the viewpoint of general performance, the reference level type of meter indicator was just as good as the electron-ray tube—but since it afforded no advantages over the tube type of indicator, yet cost many times more and had other weak points—no justification was found for its use, since its employment in four channels meant a very great increase in the cost price to the servicemen.

To use meters just for the sake of using them or possibly for sales appeal was penalizing the servicing industry by unnecessarily increasing the cost of the instrument. Further progress in this investigation uncovered several disadvantages of the meter-type indicator even as an established reference level indicator and the definite superiority of the electron-ray tube as an indicator.

A very simple reason explains the superiority of the reference level type of indication. The calibrated controls used with such

a reference level indicator to establish differences in signal level are so located in the channel, *that the calibration indications are substantially independent of changes in the operating characteristics of the test unit amplifier.* A very significant detail developed during this investigation. The *electron-ray tube type of indicator, which is inherently stable, did not require balancing adjustments and other precautionary measures necessary when meter-type indicators are employed in such circuits.*

Longer Life and Greater Stability

From the viewpoint of operating life and stability, one prime requisite of servicing equipment is longest useful operating life and maximum stability. It was logical that the fewer complicated and critical circuits in the test unit, the more stable the operation of the unit and the longer its probable operating life. Each of the meter indications, even as a reference level indicator, required the use of a vacuum-tube voltmeter circuit, and if each amplifier channel employed such vacuum-tube voltmeter systems, it meant three additional critical circuits.

Another point taken in consideration was the fact that in normal signal tracing operations, the signal level increases between test points in unknown quantities until the actual tests are made. A meter-type indicator, even though it is a reference level indicator, cannot help but be subjected to very frequent input signal overloads as the pickup probe is moved from point to point, with resultant "banging" of the meter pointer off-scale. While such meter circuits can be designed to minimize burn-out of the meter winding, the continual banging of the pointer off-scale may result in "needle sticking" and is not conducive to long life.

The electron-ray type of indicator has no such weak point. A signal overload causes nothing more than a change in shadow angle. This change in shadow angle, even to the extent of an overlap—which means a very definite signal overload—is entirely within the normal operating capabilities of the tube and no damage is done.

Electron-ray Simplifies Replacement

When speaking about operating life, we also have to consider what happens in case replacement of the indicators becomes necessary. The electron-ray tube is replaceable everywhere so that a minimum loss of useful operating time of the instrument or channel is entailed if anything goes wrong with the indicator system. Since the parts are few, replacement of components, if found necessary, can be made with ease. And the cost of such replacement of the indicator is negligible.

As to the meter-type of indicator, replacement is not only more expensive but might conceivably be difficult because jobbers are not prone to stock such special meters as replacement items. A definite loss in operating time would ensue in the event such replacement was necessary and the replacement meter was not locally available.

After considering all these factors, the conclusions strengthened the conviction that the use of electron-ray tubes as indicators was definitely preferable to meter-type indicators.

Summary of Amplifier Channel Indicators

Summarizing the development of the Rider Chanalyst as it related to the use of the "eyes" instead of meter indicators, it became clearly evident that if the electron-ray tube as a reference level indicator is preferable to the use of a meter to establish the extent of amplification of the signal in a communication unit being checked, then most certainly it is to be preferred in all of those applications which do not in any way involve measurement of signal level. As to those few instances when it is desired to actually establish the signal level, it can be done with the electron-ray indicator just as conveniently as with a meter-type because the nature of the circuit permits calibration with normal reasonable tolerances. In fact, this is done in the Chanalyst and applies in those cases where it is vitally important; namely, the r-f and i-f channel and the a-f channel. In the case of the oscillator channel, it was definitely established that the function of the indicator was purely one of a tuning meter, to be employed in such operations as monitoring the oscillator output, checking frequency of signals within the frequency range of the channel, checking for drift, etc.

As the measurement of the output of oscillating systems, such as used in radio receivers and other places, the accepted practice, as shown by engineering data, is measurement of the oscillator grid current through the grid leak or the d-c voltage developed across the oscillator grid leak by the grid current. For this purpose the ideal method is to use the isolated electronic d-c voltmeter channel provided. That such form of measurement is the accepted practice is attested to by the fact that the receiver manufacturers who stipulate oscillator output do so by stating the d-c voltage present across the oscillator grid leak.

Wattage Indicator

The decision to use a special circuit terminating in an electron-ray indicator in this portion of the Chanalyst, was based *upon existing needs.* The primary purpose of this channel was to provide a rapid but safe check of the approximate power consumption of the device being serviced so as to identify if the condition of the unit was such as to permit a signal tracing test, to show a major overload or an underload. The higher accuracy of a standard wattmeter was recognized but the cost of such a device with respect to its advantages over the special circuit devised, did not seem justified. Possibillty of costly meter burn-out and/or bothersome fuse replacement is entirely *eliminated* with the special electorn-ray wattage indicator circuit. Did you know that the current transformer feeding the circuit is so designed and built that a direct short in the average receiver's power cord would cause the receiver's cord to burn-out *before damage could occur to the wattage indicator channel?*

The Eyes Have It!

It is possible to mention many more reasons why the electron-ray indicators were selected instead of meters, but we feel that the reasons given herein are the important ones—and they must be correct because the experience of the thousands of satisfied men who have used the Chanalyst in the field have proved the soundness of this fundamental design. Ask the man who uses one!

QUESTIONS AND ANSWERS

That help you summarize the many advantages of the electron-eye indicator!

Why doesn't the Chanalyst use meters in every Chanel?
The development of the Chanalyst was over a period of years during which time all types of indicators were tried and all factors considered for *every channel use*—the electronic type voltmeter proved best for voltage measurement and the electronic-ray eyes proved best for signal level and watts indication. Tip jacks are provided so the voltmeter channel can be used in three other channels should the owner so desire.

Why are "eyes" better for signal level and watts indication?
Because:

1. Faster—No balancing meter adjustments necessary.
2. Accurate—No meter scale calibration to vary with amplifier gain characteristics, tube replacement, etc.
3. Safe—No meter needle to bang off scale to cause "needle sticking" and even fracture in time—Eye silently overlaps. Permits use of damage-proof wattage indicator circuit.
4. Stable—Practically independent of line voltage variation.
5. Electronic—No inertia—Freedom from mechanical moving parts—Visual indication of noise pulses or hum.
6. Simple—No mathematical division of scale readings to obtain circuit gain data published in service notes.
7. Lowest Up-Keep—Easily replaceable locally—No service time lost—Less circuit parts—Less likely to cause trouble.
8. Lowest Initial Cost—Money can best be placed in a better designed and built RF-IF or AF Channel.

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