PRECISION TEST EQUIPMENT
STANDARD OF ACCURACY

# PRECISION TESTIPS

## Construction and Application of Special Oscillograph Probes

This material is provided for your convenience and future reference. It covers the high points of that portion of the lecture which deals with the subject of oscillograph probes, and their applications to alignment and trouble-shooting of television receiver circuits.

A: The Voltage Doubler Signal Tracing Probe:
The most useful general-purpose probe is the voltage-doubler signal-tracing probe shown in Fig. 1. This probe can be used to calibrate a signal generator against a crystal oscillator by demodulating the beat between the two RF signals, and providing a visible display of the wave envelope on the scope screen. This probe can also be used to trace a modulated signal through the RF, mixer, and IF stages of a TV receiver. Either the TV station signal can be used as a source, or a modulated RF voltage from a signal generator.

B: Ratio Detector Alignment and Marking:
When ratio detectors are sweep-aligned, the visibility of the 4.5-Mc marker depends upon the degree of AM rejection inherent in the FM detector circuits. It is sometimes found that the marker is invisible, unless circuit modifications are made to decrease the AM rejection (such as disconnection of the stabilizing capacitor); if such is done other difficulties and circuit disturbances may be encountered.

For this reason, it is very useful to have a suitable test method available for marking the "S" curve in a straightforward manner, as follows: - Temporarily disconnect the intercarrier receiver from the alignment instruments, and substitute the crystal probe, shown in Fig. 1, in place of the receiver. Since the probe has no AM rejection, the operator will find that the 4.5-Mc marker then appears clearly on the scope trace.

Make note of the exact position along the trace at which the marker appears. Then reconnect the intercarrier receiver to the instruments, and observe where the marker position, previously noted, falls with respect to the S curve. The 4.5-Mc marker position will remain at exactly the same distance along the trace as long as the Horizontal controls of the scope are not touched. Alignment adjustments or vertical-gain variations will not affect the distance along the horizontal axis of the screen, at which the 4.5-Mc point is located.

C: Tuned Input Heads for Signal Tracing Probe:
When used with either of the tuned heads shown in Fig. 2, the voltage-doubler signal-tracing probe has great utility in tracing buzz voltages through the high-frequency amplifiers of an intercarrier receiver. The tuned heads must be used in all circuits which carry picture and sound signals simultaneously, as otherwise the vertical sync pulse will mask the buzz pulse. The tuned head for picking up sound signals in the video amplifiers should be resonated at 4.5 Mc for best response.

The tuned IF head for sound signal tracing at other than 4.5 Mc should be resonated at the proper sound - IF frequency of the individual receiver under test. The tuned heads are usually to be coupled to the video peaking coils or the IF coils of the receiver, respectively.

D: The Half-Wave Signal Tracing Probe:
When flat response is desired at station frequencies, a half-wave probe, as illustrated in Fig. 3, will prove most suitable. High-frequency components must be used in constructing the probe, stray capacitance must be minimized, and leads must be kept very short.

E: 10 to 1 Low Capacitance Probes:
When high-impedance, high frequency circuits are under test, correct waveforms can still be obtained on the oscilloscope screen, provided suitable high-impedance probes are used to avoid circuit loading.

High-impedance probes (otherwise known as low-capacitance, or attenuating probes) are customarily constructed to provide 10-to-1 attenuation of the input signal. With this attenuation factor, the operator need merely shift his decimal point when measuring peak-to-peak voltages on a calibrated scope.

The 10-to-1 type of probe attenuates the input signal by a factor of ten, but also increases the input impedance 10 times and reduces the input capacitance of the scope and cable to approximately 1/10 of its normal value.

A 10-to-1 probe can be very easily constructed in either of two forms, shown in Figs. 4 and 5. The AC/DC type, shown in Fig. 5, is to be preferred, because many TV circuits have high DC voltage components which will stress the blocking condenser of the scope input circuit unless the AC/DC type of probe is used.

Both types of 10-to-1 probes require compensation after construction. Apply a 20 to 60 cycle square wave, and adjust the trimmer capacitor for best square-wave response; then apply a 15 to 20 KC square wave, and make a slight compromise adjustment, if required. If a square wave generator is not available, vertical and horizontal synch. signals, (extracted from a good TV receiver) can be substituted respectively for the low and high frequency square waves.

The component values shown in Figs. 1 and 2 are suitable for use with the PRECISION ES-500 and ES-500-A scopes which have 2 megohm vertical input circuits. If another scope is used, suitable resistors must be chosen for 10-to-1 attenuation, based upon the "V" input resistance.

It is apparent that a 10-to-1 probe may be used to obtain just signal attenuation, without regard to high impedance property. In other applications, both probe factors may be useful.

F: 100 to 1 Capacity Divider Probe for High Voltage Tests:
For purposes of high voltage attenuation, the 100-to-1 probe shown in Fig. 6 will be found useful up to 7500 peak volts. This is a capacitance-divider type of probe. Since considerable capacitance is shunted across the scope terminals, the resistive component of the scope input impedance can be neglected. Therefore this type of probe does not require compensation at frequencies encountered in modern horizontal oscillator driven TV power supplies. This probe is not suitable for low frequency applications where the 10-to-1 probe should be employed.

To calibrate the 100-to-1 probe for the attenuation factor of 100, use the coarse decimal attenuator of the oscilloscope. For example, use direct leads to obtain a calibrating voltage from a low-impedance circuit in the TV receiver, such as the cathode of the damper tube. Adjust the vernier attenuator to any convenient position. Switch the coarse attenuator to the "X1" position. Count the number of squares of deflection and do not change the adjustment of the vernier attenuator. Connect the 100-to-1 probe, and switch the coarse attenuator to the X100 position. Using the same input signal voltage, adjust the calibrating condenser on the probe until the same deflection is obtained as before. The probe is then properly calibrated for routine applications.

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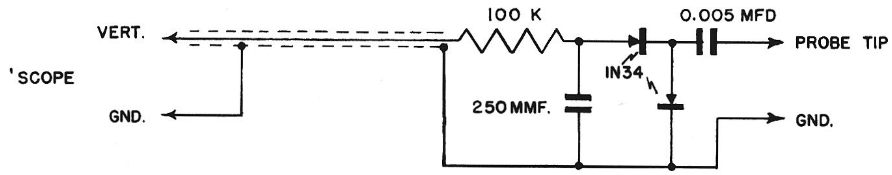
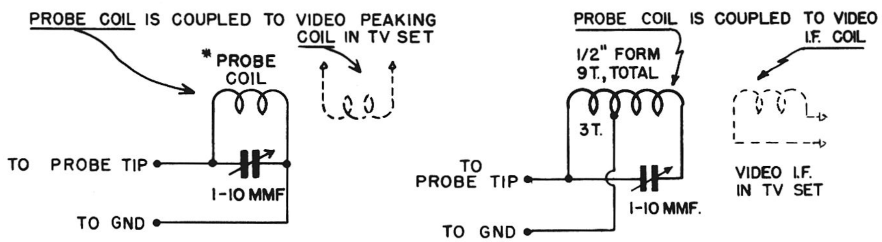



## VOLTAGE-DOUBLER SIGNAL TRACING PROBE

USED FOR GENERAL HIGH-FREQUENCY SIGNAL TRACING. TUNED PICK-UP COILS CAN BE ATTACHED FOR TRACING INTERCARRIER BUZZ, AS EXPLAINED IN FIG. 2.

1



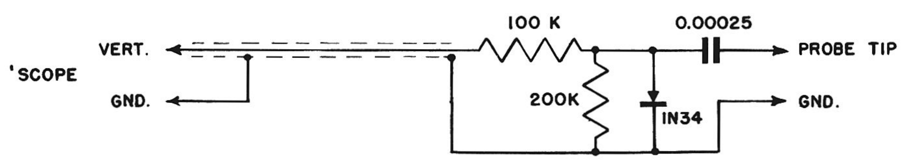

TUNED VIDEO HEAD FOR SIGNAL-TRACING PROBE

TUNED I.F. HEAD FOR SIGNAL-TRACING PROBE

## TUNED HEADS FOR VOLTAGE-DOUBLER PROBE (SEE FIG. 1)

*NOTE: PROBE COIL FOR TUNED VIDEO HEAD MAY BE A STANDARD PEAKING COIL.

2

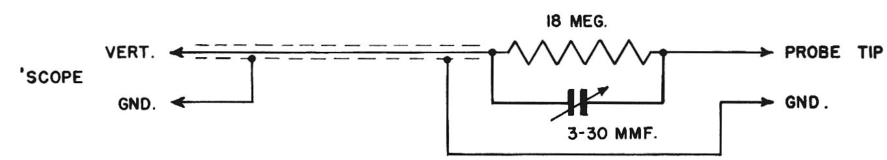



## TYPICAL SIGNAL TRACING PROBE

USED FOR FLAT RESPONSE AT HIGH FREQUENCIES. LESS SENSITIVE THAN VOLTAGE-DOUBLER PROBE SHOWN IN FIG. 1.

3

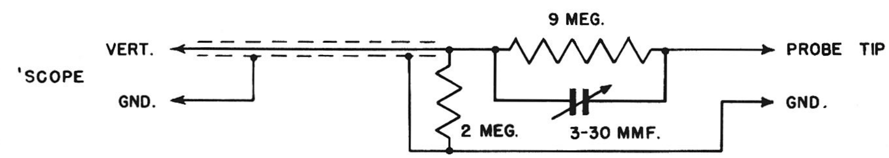
RESISTOR VALUES SHOWN ARE FOR 10-TO-1 ATTENUATION WITH PRECISION SCOPE




## 10-1 LOW CAPACITANCE ATTENUATING PROBE

PERMITS DISPLAY OF TRUE WAVEFORMS WHEN TESTING HIGH-IMPEDANCE CIRCUITS. AVOIDS OVERLOAD OF VERTICAL AMPLIFIER IN MEDIUM-HIGH VOLTAGE CIRCUITS.

4

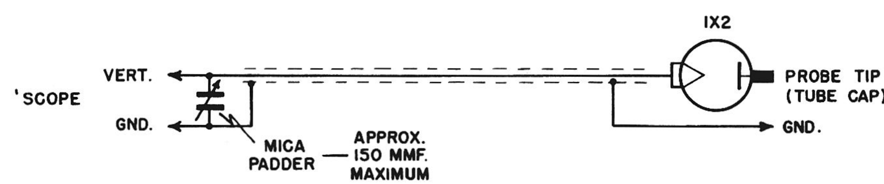



## 10-1 LOW CAPACITANCE ATTENUATING PROBE

(FOR USE WHERE HIGH D.C. COMPONENT IS PRESENT)

AVOIDS EXCESSIVE DC-VOLTAGE STRESS ACROSS SERIES INPUT CAPACITOR OF SCOPE. PROVIDES AC IMPEDANCE STEP-UP OF TEN TIMES.

5




## 100-1 CAPACITANCE DIVIDER ATTENUATING PROBE

A HIGH-VOLTAGE UNCOMPENSATED PROBE FOR USE IN HORIZONTAL CIRCUITS. NOT SUITABLE FOR USE IN VERTICAL (60-CYCLE) CIRCUITS.

6