Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 12 PRINTED IN U.S.A FEBRUARY 1962

MEASURING A SMALL AC COMPONENT RIDING ON A DC VOLTAGE

If you wish to measure a small ac component riding on a dc voltage, a number of ways to do so present themselves. The following describes several of the more simple methods employing Tektronix oscilloscopes.

Perhaps the most simple method is to switch the input selector or AC-DC switch of the scope's vertical input to the AC position. Doing this switches a dc blocking capacitor into the circuit between the input terminal and the vertical amplifier. See Figure 1. The capacitor blocks the dc voltage but allows the ac component to pass through to the amplifier. This blocking or ac-coupling capacitor is usually a 0.1 μfd capacitor rated at 600 volts and the input-grid resistor a 1 megohm precision resistor. The rc time constant of this combination is 0.1 second which contributes 3-db attenuation for 2 cps (approximately) sine wave signals. Combined ac and dc voltage of the input signal should not exceed 600 volts.

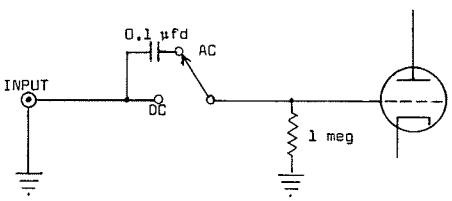


Figure 1

This method works well provided the above conditions are met and the frequency of the ac component is above 10 cps. The vertical-sensitivity control can be set to maximum if needed.

Now let's make the conditions a little tougher. We have a few millivolts of low frequency component riding on a dc voltage of about +2 volts. The frequency of the ac component is down below several cycles per second. Here a differential input (such as that available on the Tektronix Type 502 or Type 503 Oscilloscope, or the Type 63 or Type D or Type G Plug-In Preamplifier in a Tektronix Oscilloscope for which the preamplifier is designed) will help to solve the problem. Set the input-selector switch to A-B, and the AC-DC switch to DC. Apply the signal to INPUT A and feed an equal dc voltage to INPUT B. An inexpensive multi-turn potentiometer (such as made by the Chicago Telephone Supply Company), a battery and a bypass capacitor provide a convenient way to control the dc voltage to INPUT B. See Figure 2. The capacitor, potentiometer and the leads to the oscilloscope of this circuit, as well as the lead from the voltage under investigation to the oscilloscope, must be adequately shielded against stray hum pickup. A battery offers certain advantages over an ac power supply, i.e. low noise and no ripple. For signals having a negative dc component reverse the battery connections.

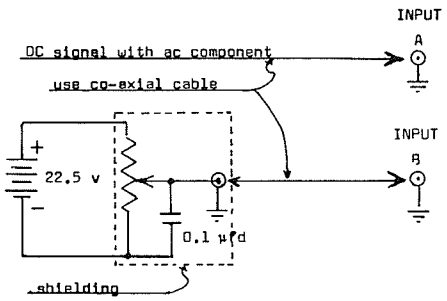


Figure 2

This method will work satisfactorily for dc components up to 2-5 volts depending on the instrument used; beyond that you may saturate the input stage of the differential amplifier unless the input is attenuated.

For dc components up to 20-50 volts, a pair of 10X probes (one for each input) plus 45 volts from batteries will work satisfactorily. This will, however, reduce the sensitivity of the oscilloscope by a factor of ten.

In the case of the Type G Plug-In Preamplifier which has separate input-attenuator controls for each input, you do not need 10X probes. Using these attenuators, a 1.5-volt battery is sufficient for balancing out a dc component up to 600 volts, though the display sensitivity under these extreme conditions is only 20 v/cm.

The Tektronix Type Z Differential Comparator Unit in a Tektronix Type 530, Type 540, Type 550, or Type 580* Series Oscilloscope, will eliminate the need for the extraneous circuitry shown in Figure 2. This versatile unit contains a built-in regulated dc comparison voltage. When the MODE switch is in the A-Vc or Vc-B position, the calibrated dc voltage is internally applied to cancel out any unwanted dc component in the applied signal. This allows accurate measurements of relatively small ac signals riding on relatively large dc signals. Precisely accurate selection of plus or minus dc comparison voltages over a range of from 1 to 100 volts is possible by means of a COMPARISON-VOLTAGE RANGE selector and a Heilidial control.

In using the Type Z Unit to measure signals discussed in this article, set the AC-DC switch to DC. Set the MODE switch to A-Vc if the signal is applied to INPUT A or to Vc-B if the signal is applied to INPUT B. Set the COMPARISON-VOLTAGE POLARITY selector to match the polarity of the dc component of the input signal and set the COMPARISON-VOLTAGE RANGE selector to a voltage value that exceeds the voltage of the dc component of the input signal. By means of the Heilidial, adjust the comparison voltage to cancel out the unwanted dc component of the applied signal. With the A-INPUT VOLTS/CM (ATTENUATOR) control in the .05 position, a 5 millivolt ac component will give 1 mm of deflection on the crt screen. Maximum voltage swing at this sensitivity is ± 100 volts combined ac-dc signal.

By using the VOLTS/CM (ATTENUATOR) control, mixed ac-dc signals up to a maximum of 500 volts peak-to-peak can be investigated in this manner. Bear in mind, however, that the sensitivity of the oscilloscope will be reduced by the factor to which the VOLTS/CM control is set.

* A Type 81 Adapter is required for use with Types 581 and 585.

CONSTRUCTIVELY CRITICAL COMMENTS ON "GRATICULE MOUNTING PROBLEMS"

Tektronix Field Engineer Bob Le Brun (Baltimore) writes us regarding the article "Graticule Mounting Problems," which appeared in the December '61 issue of SERVICE SCOPE, as follows:

"There are a couple of statements in this article that I'd like to comment about.

Statement: 'There is little to be gained by placing the light filter over the graticule. The graticule lines will not show through the filter sufficiently enough to be useable.'

Comment: Placing the light filter over the graticule reduces parallax by moving the graticule and trace one filter thickness closer together. The graticule lines can be made to show through enough to be useable under most ambient light conditions by using the white graticule lines. The red lines, of course, won't show through a colored filter unless it too is red.

Statement: 'If you use the Tektronix Bezel, Tek number 014-001, (for mounting cameras, other than Tektronix types, on Tektronix 5" oscilloscopes), it takes the place of the graticule cover in the above instructions.'

Comment: The Tek Bezel (for non-Tek cameras) can be used with the graticule cover and I believe should be because without it light leakage ruins pictures."

Bob's comments are good and we appreciate them. The idea of using the white graticule lines never occurred to this editor — just too simple a solution, I guess.

Bob is also correct in his belief that the graticule cover should be used with the Tek Bezel (for non-Tek cameras). With the graticule nuts removed, the bezel will mount on the graticule studs and right over the graticule cover. Reinstalling the graticule nuts will then hold all firmly in place.

A CLARIFICATION

In the December issue of SERVICE SCOPE, the article "Accurate Frequency Measurements" suggested a method for checking the accuracy of a Tektronix Type 180A Time-Mark Generator by beating the 1 μsec markers against the WWV carrier. The statement that the "difference frequency in cycles will be a measure of the time-mark generator's accuracy in parts per million" may be misunderstood.

The actual beat (difference) frequency will be between a *harmonic* of the 1 μsec (1 mc) 180A output and the particular WWV carrier used. If WWV's 5 mc carrier is used, a beat frequency of 5 cps will indicate a 180A error of 1 ppm. If the 10 mc WWV carrier is used, a beat frequency of 10 cps will indicate 1 ppm error in the 180A, and so forth.

The nominal accuracy of the 180A when shipped from the factory is $\pm .001\%$, or 10 ppm. After being zero-beat with WWV, it will remain accurate within ± 3 parts per million over a 24 hour period.

FIELD MODIFICATION KITS

TYPE 551 CHOPPING-TRANSIENT BLANKING FIELD MOD KIT

For Type 551 Oscilloscopes, all serial numbers. The Type 53C, Type 53/54C and Type C-A Plug-In Preamplifiers will produce troublesome transients in a Type 551 Dual-Beam Oscilloscope when operated with the preamplifier MODE switch in the CHOPPED position.*

We have available a field modification kit that provides a circuit to blank the transients generated under these conditions. This kit provides individual CRT cathode-selector switches that allow blanking on either or both the LOWER and UPPER beams.

The modification kit includes a complete set of components, prewired amplifier assembly, parts list, schematic, photos and step-by-step instructions. A skilled technician can install the modification in approximately four hours.

Order through your local Tektronix Field Engineer. Specify Type 551 Chopping-Transient Blanking Field Mod Kit, Tek No. 040-224. Price is $17.50.

* Other Tektronix Oscilloscopes in which these Plug-In Preamplifiers will produce transients are:

(1). Type 531, Type 535, Type 541, Type 545, serial numbers 101 to 4999. For these instruments ask your Tektronix Field Engineer for Chopping-Transient Blanking Field Mod Kit, Tek No. 040-200. Price is $5.25.

(2). Type 531A, Type 535A, Type 541A, Type 545A, serial numbers 5,000 to 20,000. For these instruments ask your Tektronix Field Engineer for Chopping-Transients Blanking Field Mod Kit, Tek No. 040-198. Price is $5.25.

TYPE 502 SWEEP LOCKOUT MOD KIT

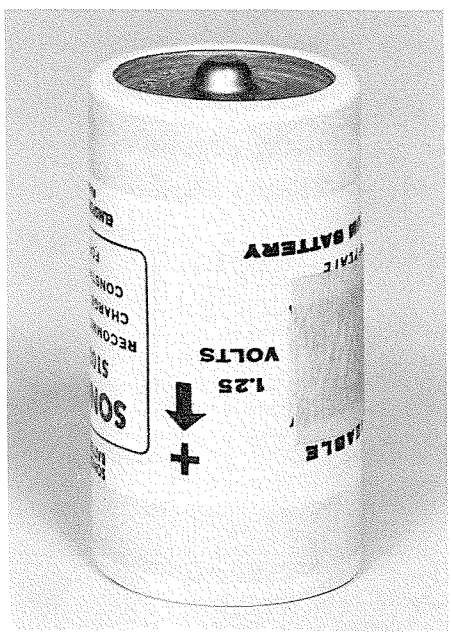
For Type 502 Oscilloscopes, all serial numbers.

This field modification kit converts your Type 502 Oscilloscope for the study of one-shot phenomena.

The mod kit contains a wired chassis assembly, new front panel, and necessary components to incorporate the sweep-lockout feature in your instrument. It also includes a photo, schematic, parts list and step-by-step instructions.

Order through your Tektronix Field Engineer. Specify Type 502 Sweep Lockout Mod Kit, Tek. No. 040-209. Price is $45.00.

A WORD OF CAUTION



Recently we came across a 1.25-v nickel-cadium battery with an improperly applied label—see picture above. Apparently the label has been applied upside down. The arrow supposedly pointing to the positive end of the battery actually points to the negative end.

Batteries of this configuration and voltage are used in the Tektronix Type 321 Transistorized Oscilloscope. An experienced and careful operator would probably notice this error in labeling and install the battery properly polarized.

It is not inconceivable, however, that the battery might be installed incorrectly (polarity reversed) by an inexperienced operator or one in a hurry. In an instrument operated under these conditions the incorrectly installed battery would eventually explode. The explosion could have sufficient force to seriously damage the oscilloscope.

For the benefit of those who may not know, in this type of nickel-cadium battery the protruding or nipple-like end is *always* the positive end. If there is any question about the polarity of a battery, check it out with a voltmeter.

Every nickel-cadium battery received at Tektronix from our suppliers is placed on a charging line. It would be virtually impossible for an incorrectly marked battery to get into a production instrument or to be shipped on a customers parts order.

However, this brand of battery is nationally marketed and may be purchased locally. We do, therefore, urgently recommend a careful inspection of locally purchased batteries of this type before installation in an instrument.

MISSING INSTRUMENTS

The National Broadcasting Company in Burbank, California, reports that a Tektronix Type 310 Oscilloscope, s/n 1864 disappeared from their premises on August 8th, 1961. They presume the instrument to be stolen since a check of authorized personnel failed to reveal the instrument. If you have any knowledge of the whereabouts of this oscilloscope, please contact Mr. Frank Sommers, Engineering Department, National Broadcasting Company, 3000 Alameda, Burbank, California.

A Tektronix Type 317 Oscilloscope, s/n 001771 is missing from the U.S. Air Force at Selfridge AFB, Michigan. The Air Force nomenclature of the missing property is as follows: Portable oscilloscope, Model #317, Serial #001771, Stock #676-1302, Class Symbol 6625, Listed value: $800.00

If you have any knowledge of this instrument contact Gene P. Moritz, Colonel, USAF District Commander, 507th OSI Detachment, Selfridge AFB, Michigan.

The Picatinny Arsenal at Dover, New Jersey, reports that a Tekronix Type 517 Oscilloscope is missing from their premises and is thought to be stolen.

If you have any information on the whereabouts of this instrument, please contact the Picatinny Arsenal or the Tektronix Field Office, 400 Chestnut Street, Union, New Jersey.

The Howe Precision Products Company reports that a Tektronix Type 317 Oscilloscope, serial number 879, was lost in transit to one of their Rail Flaw Detection Cars.

Information on the whereabouts of this instrument should be sent to: Mr. E. I. Cook, Maintenance Manager, Howe Precision Products Company, Shelter Rock Road, Danbury, Connecticut, Telephone: PIoneer 8-9243.

USED INSTRUMENTS FOR SALE

1 Type 561, s/n 889. Price $382.50 1 Type 72 Plug-In, s/n 565. Price $225.00 1 Type 67 Plug-In, s/n 1031. Price $135.00	Transitel International Corporation 615 Winters Avenue Paramus, New Jersey
1 Type 541, s/n 378	Bernie Stapler Columbia Technical Corporation 24-30 Queens Brooklyn Express, West Woodside 77, New York. Phone: YEllowstone 2-0800
1 Type 316, late model	August Schonefeld Precision Instrument Co. 1011 Commercial St. San Carlos, Calif.
1 Type N Plug-In, s/n 683 1 Type 110 Pulse Generator and Trigger Take-off, s/n 294 1 Type 113 Delay Cable, s/n 294	Morris-Cooper Corp. 3832 Terrace Street Philadelphia 28, Pa. Phone: IV 6-6533
1 Type 514AD	Engineering Associates 434 Patterson Road Dayton 19, Ohio
2 Type 551 scopes 2 Type CA Plug-In Preamplifiers	L. Nucci General Applied Science Laboratories Merrick & Stewart Avenues Westbury, Long Island, New York
1 Type 535, s/n 10751 3 Type 545, s/n 14669, 14670, 14671 8 Type 541, s/n 7471, 7472, 7474, 7490, 7491, 7492, 7493, 7494.	R. N. Kampf, P. A. Computer Division Philco Corporation 13900 Welsh Road Willow Grove, Pa. Phone: Oldfield 9-7700

USED INSTRUMENTS WANTED

1 Type 502	Luis A. Rocha, Z. Kepco, Inc. 131-38 Sanford Ave. Flushing, New York
1 Type 545 or Type 545A	Chas. Wilson 501 Keebler Road King of Prussia, Pa.
1 3" Tektronix Oscilloscope	D. Cleveland 10 Museum Road, Beverly, Mass.

INSTRUMENTS TO TRADE

1 Type 515A scope for Type RM15 scope	Bart Healy Technical Instruments, Inc. 90 Main Street Reading, Mass.

KING SIZE HELMHOLTZ COILS USED FOR TEST AND RESEARCH

Tektronix IMSE (Instrument Manufacturing Staff Engineers) recently completed construction of a king size Helmholtz coil. (A Helmholtz coil consists of two equal-diameter coils spaced a distance equal to their diameter apart.) They will use the coil to measure the effects of magnetic fields on Tektronix oscilloscopes.

This Helmholtz coil contains two coils, each two meters in diameter and holding 90 turns of heavy copper wire per coil. A total of just under 4,000 feet of wire — 40 pounds of copper. Spacing the coils one meter apart and applying an electric current sets up a highly uniform magnetic field of about a cubic meter in size between them. That leaves plenty of room to insert an oscilloscope in the field and observe the effect it produces on the electron beam of the scope's crt.

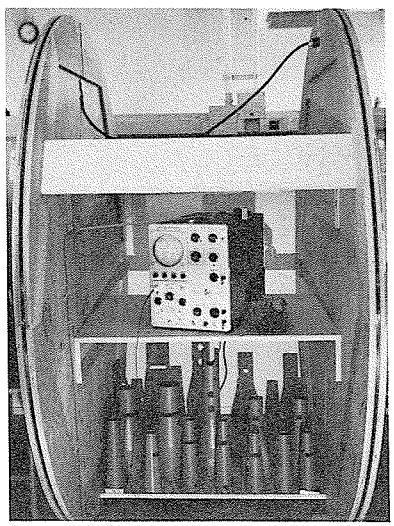


Figure 1

Figure 1 shows a Tektronix Type 531A Oscilloscope sitting in the magnetic field with a search coil (the wand-like device laying on top of the scope) connected to the scope input. The trace on the crt face indicates a pickup by the search coil of an ac magnetic field that measures 25 Oersteds peak-to-peak.

Figure 2 shows the same oscilloscope in the same magnetic field with the sweep synchronized to 60 cycle ac and no signal applied to the scope input. Notice that in this 25 Oersted magnetic field the trace on the face of the crt shows only about 2 mm of ripple. This indicates that the crt shielding prevents all but a negligible amount of the magnetic field from reaching and influencing the electron beam of the crt.

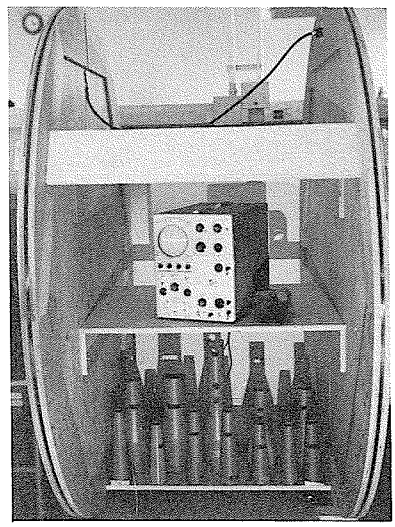


Figure 2

Although built primarily to answer the question, "Can we put our oscilloscopes in a magnetic field 5 units (Oersteds) strong and not displace the crt spot more than 1/16th of an inch?", the Helmholtz coil will lend itself to many other uses as a test and research tool.

What's the answer to the question? Well, IMSE's best guess from previous work was that we could — but no one was positive. Now we *know* we can.

TRUANT SCOPES RETURN TO SCHOOL

Two oscilloscopes absent without leave from their respective schools returned to the halls of learning recently. Mr. R.W. Moulton, Executive Officer of the University of Washington Chemical Engineering Department, writes us that the Tektronix Type 504 Oscilloscope, serial number 214, reported missing in the December '61 issue of this paper, mysteriously reappeared in one of their laboratories.

Through our Palo Alto Field Office, we hear that the Tektronix Type 515A Oscilloscope, serial number 6135, (also reported missing in the December '61 issue of SERVICE SCOPE) has been returned to the San Francisco City College after a four months absence.

We have no way of knowing if the notices in the "Missing Instruments" column of SERVICE SCOPE played any part in the return of these instruments to the schools. We'd like to speculate, however, that maybe —just maybe—the borrowers or "kidnappers" of these instruments read the notices in SERVICE SCOPE and that either prudence or an uneasy conscience moved them to return the oscilloscopes.

Whatever the cause, the scopes were returned and that's the important thing.

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

Tektronix, Inc.
P. O. Box 500
Beaverton, Oregon

A LIMITED OFFER

We have remaining a small quantity of the booklet entitled "Impulse Tests and Measuring Errors". We can best describe the material in this booklet by quoting the introductory paragraph:

"It has been shown . . . . in international comparisons of the work of various laboratories, that the accuracy of measurement in tests with impulse voltage does not fulfill the demands it has been thought appropriate to make. This article analyses a part of the question — the problem of measuring the amplitude and shape of impulse voltages and currents with sufficient accuracy for practical purposes. The methods of checking impulse circuits which have been used at the High-Voltage Laboratory at Ludvika for some years are described and the minimum demands which should be made on measuring circuits intended for various impulse tests are set out. Descriptions are given of a number of measuring circuits".

We offer these booklets to those readers of SERVICE SCOPE whose interests lie in this area. Place your requests for a copy with your local Tektronix Field Engineer. We must of necessity refer all requests sent direct to us to our Field Engineer serving the area in which the request originated. So, since this offer is on a first-come-first-served basis, you will expedite your request if you place it with your local Tektronix Field Engineer.

A CONVENIENT PROBE-TIP HOLDER

Tektronix Field Engineer Jerry Kraxberger sent in this idea for a convenient probe-tip holder.

If you, as this writer often does, spend frustrating minutes looking for mislaid probe tips, the do-it-yourself probe-tip holder pictured in Figure 1 will undoubtedly appeal to you.

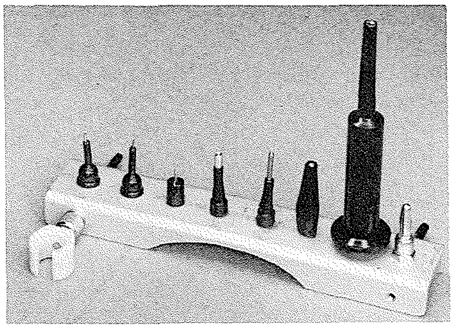


Figure 1

The design of the pictured holder permits attachment of it to any Tektronix 5" oscilloscope (see Figure 2) except when an oscilloscope camera is in use.

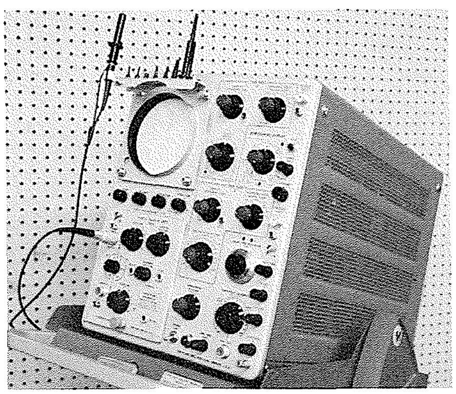


Figure 2

The circular cut out in the base of the holder allows it to fit over the new Polarized Viewer (see October '61 issue of SERVICE SCOPE) or a tubular light shield.

For the base of this holder, we used a piece of sheet aluminum 2" wide by 6" long. We formed the ½" flanges by making two 90° bends using a sheet metal break. On one flange, equidistant from each end and on 5" centers, we drilled and tapped two holes. We used a number 36 drill and a 6-32 tap. Into these holes we screwed the two banana plugs that attach the holder to an oscilloscope by fitting into the two top graticule studs. On the top surface of the holder, we laid out and drilled and tapped eight equi-distant holes again using a number 36 drill and a 6-32 tap. Into each hole, we screwed a 6-32 x ⅜" binder head screw. Taking a 1⅝" length or aluminum rod, we drilled and tapped it at each end for a 6-32 screw. We then mounted the rod on one of the installed 6-32 x ⅜" screws. In the exposed end of the rod, we installed a 6-32 stud. We made the stud by running a 6-32 nut onto a 6-32 x ⅝" screw, threading the screw into the rod until it bottomed and then turning the nut down snug against the rod. We then cut the screw off with a hack saw so that about ¼" extended beyond the nut. After rounding off the edges of the stud, we ran the nut off the stud. This reforms and deburs any damaged threads on the stud.

Use the rod and stud to hold the pincher tip of the probe and the other seven screws to hold the other probe tips.

We used a rat-tail file to remove the metal from the circular cut out of our holder.

For attaching the probe holder (that white plastic object with a slot) to the probe-tip holder, we used an ordinary ground post mounted in a hole drilled in the front flange of the probe-tip holder.

Perhaps you do not care to mount your probe-tip holder on the graticule studs of an oscilloscope or to construct as functional a holder as the one described here. By applying the idea of the seven screws and the rod with stud, you can make a probe-tip holder to suit your individual ambition and needs. Install it any place that's handy—bench, wall, oscilloscope cart.

Installed and used, this probe-tip holder should save you time and put an end to your probe-tip hunting.

Tektronix Instrument-Repair Facilities: There is a fully-equipped and properly-staffed Tektronix Instrument Repair Station near you. Ask your Field Engineer about Tektronix Instrument-Repair facilities.

TEKTRONIX

Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 13 PRINTED IN U.S.A APRIL 1962

FAN-VIBRATION PROBLEMS: SOME CAUSES AND CURES

In Tektronix instruments employing forced-air ventilation, fan vibration is not normally a problem. Fan-vibration problems, when they do occur, generally stem from one of two sources—the fan motor or the fan-blade assembly (fins, spider and hub).

In most of our forced-air-ventilation instruments, the fan motors operate at relatively slow speeds. The fan motors used in these instruments are typically in proper balance as we receive them from the suppliers. In instruments where the rotation speed of the fan motor might conceivably cause a problem we shock mount the fan motor as a precautionary measure.

The fan-blade assemblies are fabricated by techniques designed to produce assemblies in balance both statically and dynamically. The fins in a properly balanced assembly are all aligned to operate in the same plane and all have the same pitch or angle relative to the axis of the fan-motor shaft. Troublesome fan vibration is most often caused by an unbalanced fan-blade assembly. Instruments undergo a check, before they leave our factory, to assure that they have a minimum of fan vibration.

However, any rough handling of the instrument can upset the balance of the fan-blade assembly by altering either the pitch or rotation plane (or both) of one or more of the fins.

Often you can restore the fins to their proper plane and degree of angle by the following procedure:

1. Check all fins to make sure they turn in the same plane by referencing a gauge bar (screw driver tip, pencil or etc.) within ⅛" of one of the side edges of the fins. While maintaining a slight axial pressure toward the fan motor, slowly rotate the fan-blade assembly and note the clearance between the gauge bar and the fin edges. If the fins are all turning in the same plane, the clearance will be the same for each fin. Correct any difference by grasping the tip of the offending fin between a thumb and forefinger and bending in the required direction.
2. Compare the pitch of all fins by checking both sides of the fin edges as in step 1. Twist and bend the fins with thumb and forefinger as necessary to make each side of each fin run in its proper plane. Correctly done, this should establish the same degree of pitch for each fin.

If vibration still persists, remove the fan-blade assembly from the motor shaft and run the motor. If the fan motor is the culprit, vibration will still be present but, most likely, considerably reduced. This will indicate that the fan motor, through wear, has developed excessive bearing play. More rarely, it may indicate a defective motor. In either case, the motor should be replaced.

Absence of vibration will indicate that the fan-blade assembly is too badly out of alignment to be corrected by the means described here. Under these circumstances you will no doubt find it most expedient to replace the old fan-blade assembly with a new one.

SERVICE HINTS

TYPE 551 DUAL-BEAM OSCILLOSCOPES

Filament wiring change to increase power supply reliability—s/n's 101 to 2357.

You can considerably reduce the possibility of heater-cathode breakdown in V734 (6AU6 error-amplifier tube in ±500 v power supply regulator) by changing the heater of this tube from a grounded supply to an elevated supply. Type 551 'scopes, serial numbers 2358 and up incorporate this modification.

To modify instruments in the field, remove the bare wires connecting the filaments of V734 (pins 3 and 4) to pin 7 (grounded) of V657 and the 6.3 v filament buss at pin 8 of V687.

Also, unsolder from pin 4 of V734, the bare wire coming from pin 9 of V616 and resolder it to pin 1 (grounded) of V619.

Wire the filaments of V734, in parallel with those of V747. For proper access, you will probably find it necessary to unsolder one or two of the components mounted above the V747 socket. Unsolder these components at one end only and bend them up out of the way. If you find it necessary to remove the PTM capacitor C744 (0.01 μf), unsolder it at both ends and temporarily remove it.

Use insulated or sleeved wire to connect pin 4 of V734 to pin 4 of V747. If you pay careful attention to lead dress, you may use bare wire when connecting pin 3 of V734 to pin 3 of V747.

After carefully checking the wiring and lead dress, replace and resolder any components unsoldered for access.

A resistance check should now show: Pin 3 or 4, V734 to ±350 v supply buss, approximately 100 k. Pin 3 or 4, V734 to ground, 110 k or more.

Correct the instruction manual (power supply diagram) for the modified instrument to show the filament V734 connected to the elevated (±350 v) filament supply.

TYPE 535A, TYPE 545A, TYPE RM35A, AND TYPE RM54A OSCILLOSCOPES

When operating the above instruments and using Time Base B triggered in the DC mode, tube V94 may go into oscillation. The problem can be overcome by tube selection. However, a very simple modification will give a more satisfactory solution and eliminate the necessity to select tubes.

To make the modification, locate R90, a 1.2 meg, 1 w, 10% resistor. You will find this resistor connected between the 4th and 8th notches (counting from the front of the oscilloscope) of the ceramic strip located almost directly over tubes V74 and V95. These tubes are in turn located on the swing-out chassis containing the Time-Base B Trigger and Generator, Delay Pickoff, and External Horizontal Amplifier circuitry. Replace this resistor with a 2.2 meg, ½ w, 10% resistor. Correct the instruction manual (Time-Base B diagram) to show the new value for R90.

This modification applies to instruments with serial numbers below the following:

Instrument	Serial Number
Type 535A	27860
Type RM35A	2550
Type 545A	33015
Type RM45A	2760

Respective instruments bearing serial numbers above those listed here have this modification incorporated at the factory.

TYPES (53/54) A, B, C-A, G, AND H PLUG-IN PREAMPLIFIERS—TRANSCONDUCTANCE AND GAIN CHECK.

It is sometimes difficult to determine in a low-level, low-gain, video amplifier stage, whether transconductance and gain are adequate or whether the tubes should be replaced.

Here's a trick that works well in Tektronix Plug-In Preamplifiers Types (53/54) A, B, and C-A for checking the in-circuit transconductance of the input-amplifier stages, and in Types G and H for checking the output-amplifier stage, using a display of the calibrator waveform or other convenient signal.

The trick is simply to rotate the VARIABLE VOLTS/CM control over its full range with the GAIN ADJ control fully clockwise. If the range of the variable volts/cm changes display amplitude by 2½-to-1 or more, the transconductance of the tubes in the affected stage is adequate. If the control range is less than 2½-to-1, the tubes are probably weak and should be changed.

This method will also work with the Type K and L Plug-Ins(input amplifier check). In these instruments, however, the range of the variable volts/cm change in the display amplitude will be 2-to-1 (2½-to-1 with new 360°, continuous rotation, potentiometer).

To determine the actual value of transconductance, set the VARIABLE VOLTS/CM control for exactly ½ maximum deflection. Turn off the scope, remove the plug-in and (after allowing several seconds for the tubes to cool), measure the resistance across the VARIABLE VOLTS/CM potentiometer terminals. Dividing this value of ohms into 2 will give you the average in-circuit transconductance (in mhos) of the two tubes whose cathodes are connected to the pot.. To convert to micro-mhos, move the decimal point 6 places to the right.

This transconductance is set by the GAIN ADJUST control, which varies the tubes' cathode current. In instruments where the main amplifier gain has been set too high (and the preamp GAIN ADJUST set too low to obtain calibrated deflection), a full 2½-to-1 (2-to-1, or 2½-to-1, in the case of the Type K and L Plug-Ins) var-volts/cm range may not be obtainable at the normal GAIN ADJUST setting. The solution, of course, is to reset the oscilloscope main-amplifier gain to the standard 100 mv/cm, using the Type TU-1 or TU-2 Test Plug-In, or a Type EP-53A Gain Adjust Adapter and then increase the preamp GAIN ADJ setting to obtain a calibrated deflection.

REMINDING YOU —

... that blue vinyl touch-up paint for Tektronix instruments (with the smooth textured—not crackled finish) is available in 12 ounce pressurized spray cans (Tek no. 252-092). Price is $2.00.

... that in high-speed pulse measurement and observation techniques, impedance mismatching in coupling the oscilloscope to the signal source through coaxial systems must be avoided. Such a mismatch can have an extremely important effect on the accuracy of the information obtained.

6DJ8 CONVERSION

Type 6DJ8 tubes are improved versions of Type 6BQ7A tubes. They offer better performance, more reliability and characteristics more consistent from tube to tube and between sections of one tube. You can use 6DJ8's as direct replacements for 6BQ7A's in most Tektronix instruments including those using aged and checked 6BQ7A's.

In most cases you won't have to change any circuits. Minor adjustments are, however, often necessary. They usually amount to no more than routine calibration for the circuits in which you replaced the tubes. Your instruction manual describes how to make these adjustments.

A premium version of the 6DJ8 tube is available as the Type 6922 tube. We recommend its use where optimum reliability is imperative. Tektronix part numbers for these tubes:

(154-187) tube, electron Type 6DJ8 $2.75
(154-195) tube, electron Type 6922 $7.35

Circuit changes necessary:

Type 53C Plug-In Preamplifier, all serial numbers:

Reduce the gain of the first amplifier stage by changing R3553, R3573, R4553 and R4573 from 680 or 820 Ω resistors to 470 Ω ½ w, 10% composition resistors (Tek no. 302-471).

Type 315D Oscilloscope, all serial numbers:

Install a NE-2 neon bulb (Tek no. 150-002) between pins 7 and 8 of tube V2. This reduces the possibility of a grid-to-cathode short in V2 when the instrument is first turned on.

The MAG CENTERING control (R306) in the time-base amplifier may not have enough range when using 6DJ8's. If it doesn't, change R300 from 200 or 220 k to 250 k, ½ w, 1% precision resistor (Tek no. 309-109). Also, you may run into trouble using 6DJ8's in the time-base generator. If you can't calibrate this circuit with 6DJ8's installed, change back to 6BQ7A's.

Type 524D and Type 524AD Oscilloscopes:

These instruments, depending on the serial number, will require several of the following changes:

All serial numbers:

1. Decouple the plate of V15B by adding a 47 Ω, ½ w, 10% composition resistor (Tek no. 302-470) and a 0.005 μf, 500 v discap (Tek no. 283-001) as shown in Figure 1. This prevents the line-indicating video-output circuit from oscillating when V15 is a 6DJ8 and a 52 Ω load is used.

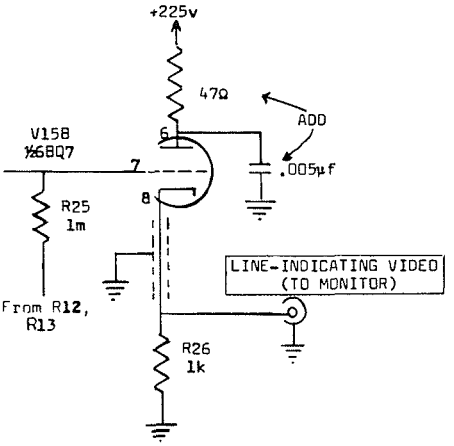


Figure 1. Type 524D/524AD Vertical Amplifier and Delay Line (partial schematic).

2. Shunt C28 and C31, 9-180 or 7-45 pf, variable capacitors in the vertical amplifier, with 82 pf, 500 v, 10% ceramic capacitors (Tek no. 281-528).

Serial numbers 1842 and below:

1. Refer to Figure 2. Decouple the 120 v plate supply of V601B by adding a 1.5 k, 1 w, 10% composition resistor (Tek no. 304-152) and a 0.02 μf, 600 v discap (Tek no. 283-006) as shown in Figure 2.

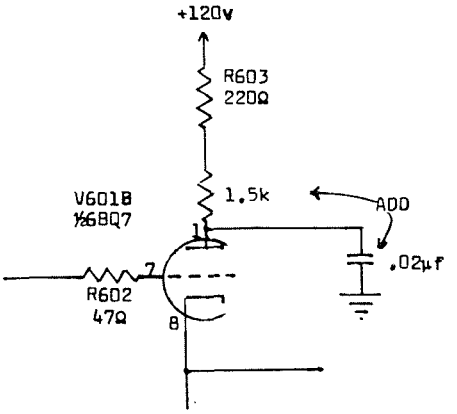


Figure 2. Type 524D/524AD Time-Mark Generator for serial numbers 1842 and below (partial schematic).

2. Refer to Figure 3. Decouple the 120 v plate supply of V601A by adding a 1.8 k, 1 w, 10% composition resistor (Tek no. 304-182) and a 0.1 μf, 500 v discap (Tek no. 283-008) as shown in Figure 3.

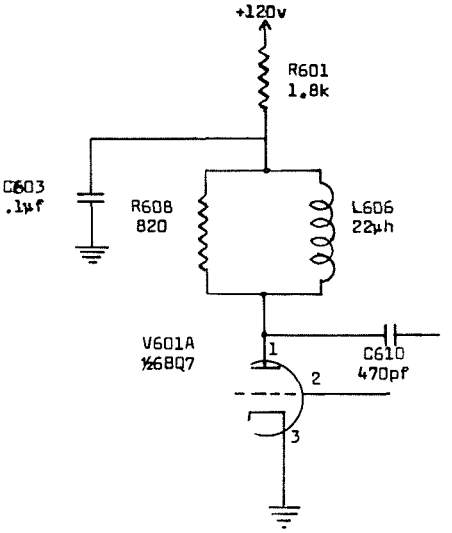


Figure 3. Type 524D/524AD Time-Mark Generator for serial numbers 1842 and below (partial schematic).

Serial numbers 1843 and up:

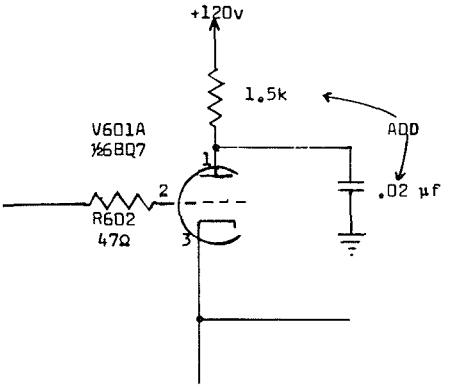


Figure 4. Type 524D/524AD Time-Mark Generator for serial numbers 1843 and up (partial schematic).

1. Refer to Figure 4. Decouple the 120 v plate supply of V601A by adding a 1.5 k, 1 w, 10% composition resistor (Tek no. 304-152) and a 0.02 μf, 600 v discap (Tek no. 283-006) as shown in Figure 4.
2. Refer to Figure 5. Decouple the 120 v plate supply of V601B by adding a 1.8 k, 1 w, 10% composition resistor (Tek no. 304-182) and a 0.1 μf, 500 v discap (Tek no. 283-008) as shown in Figure 5.

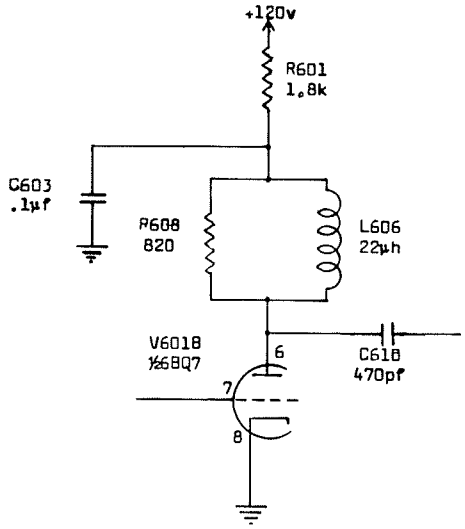


Figure 5. Type 524D/524AD Time-Mark Generator for serial numbers 1843 and up (partial schematic).

Serial numbers 101 through 2154:
Change C28 and C31 in the vertical amplifier from 7-45 pf to 9-180 pf variable capacitors (Tek no. 281-023.) Shunt each with an 82 pf, 500 v, 10% ceramic capacitor (Tek no. 281-574).

Serial numbers 101 through 5341:
Install two neon bulbs, NE-2 (Tek no. 150-002); one between pins 2 and 3 and one between pins 7 and 8 of V222. This helps to prevent grid-to-cathode shorts in this tube when the 524 is first turned on.

Serial numbers 101 through 5899:
Install two neon bulbs, NE-2 (Tek no. 150-002); one between pins 7 and 8 of V23 and one between pins 7 and 8 of V24. This helps to prevent grid-to-cathode shorts in these tubes when the 524 is first turned on.

Serial numbers 6650 and up:
Change R601 from a 1.2 k to 1.8 k, 1 w, 10% composition resistor (Tek no. 302-182).

Serial numbers 101 through 6649:
Refer to Figure 6. Shunt V412 by adding a 3 k, 10 w, 5% wire-wound resistor (Tek no. 308-020) as shown in Figure 6. This limits the power dissipation of V412 and V601.

Type 525, serial numbers 590 and below:
1. Change R19 in the calibrator circuit from a 2.7 meg, to a 2.2 meg, ½ w, 10% composition resistor (Tek no. 302-225). Readjust the CAL ADJ by referring to your instruction manual.
2. Change all 6BQ7A's in the sweep circuit to 6DJ8's at the same time.

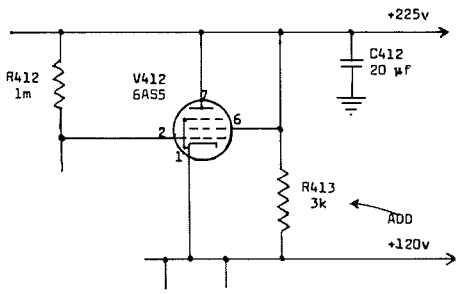


Figure 6. Type 524D/524AD Low-Voltage Power Supply all serial numbers (partial schematic).

3. Change R353 from 10 k to 12 k, ½ w, 10% composition resistor (Tek no. 302-123).
4. Change R354 from 15 k to 18 k, ½ w, 10% composition resistor (Tek no. 301-183).
5. Change R365 from 150 k to 120 k, ½ w, 10% composition resistor (Tek no. 301-124).
6. Change R366 from 150 k to 120 k, ½ w, 10% composition resistor (Tek no. 301-124).
7. Change wiring in the sweep as shown in Figure 7.

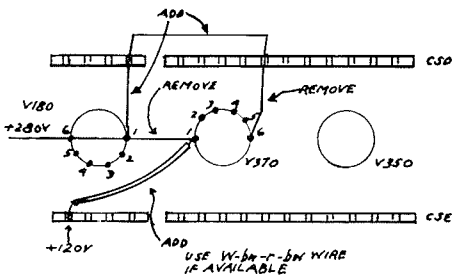


Figure 7.

Readjustments are necessary if you install 6DJ8's in the horizontal or vertical circuits. Refer to your instruction manual. No readjustments are necessary if you install 6DJ8's in the sync separator and trigger amplifier circuit.

Type 531, serial numbers 593 and below:
Type 535, serial numbers 1056 and below:
Reduce the gain of the vertical amplifier by changing the cathode circuits of the delay-line driver stage:
1. Check R503, located between pin 8 of V508 and pin 8 of V509. If it is 3.9 Ω or 5.6 Ω, remove it and the 0.047 μf capacitor, C503, connected in parallel with it. In place of this parallel combination put a series combination consisting of a 1.2 k, ½ w, 10% composition resistor (Tek no. 302-122) and a 100 pf, 500 v capacitor (Tek no. 281-530). Shunt this series combination with another 100 pf, 500 v capacitor (Tek no. 281-530).
2. Change the 10 Ω resistors connected between pin 3 of V508 and V509 and the ceramic strip with 39 Ω, ½ w, 10% composition resistors (Tek no. 302-390).

Type 531A, serial numbers 5969 and below:
Type 535A, serial numbers 6321 and below:
There is a possibility of vertical amplifier parasitic oscillations. This appears as a step on the leading edge on an input squarewave (calibrator waveform for instance). Prevent this by adding C560, a 0.01 μf, 500 v, discap (Tek no. 283-002), between pin 1 and V558 and ground. This is a desirable change even if 6DJ8's are not used in the vertical amplifier.

Type 541A, serial numbers 6475 to 7078:
Type RM41, serial numbers 149 and below:
Type 543, serial numbers 318 and below:
Type 545A, serial numbers 9292 to 11904:
Type RM45, serial numbers 208 and below:
Type 551, serial numbers 596 and below:
In the vertical amplifier (upper-beam vertical amplifier of Type 551) change R1033 from 1.5 k to 2.5 k, 5 w, wire wound resistor (Tek no. 308-127) and R1223 from 2.7 k to 4.7 k, 2 w, 10% composition resistor (Tek no. 306-472).

In the Type 551 lower-beam vertical amplifier, also change R2033 and R2223 to the new values.

Readjust the vertical amplifier and delay line according to your instruction manual. (This SERVICE SCOPE article supersedes FMR 157 - 3/24/61).

MISSING INSTRUMENTS

Tektronix Field Engineer John Griffin of our Stamford Field Office experienced a bit of bad luck recently. A Type 502 Oscilloscope, s/n 5070, and a Type C-12 Camera, s/n 348, with a Shutter Actuator, Model 1 disappeared from his car. John did not authorize anyone to remove these instruments from his car so we presume they have been stolen.

If you have any information regarding these instruments, please get in touch with the Stamford Field Office. Their address is 1122 Main Street, Stamford, Connecticut. Phone number—DAvis 5-3817. Or, if you prefer, contact your local Tektronix Field Engineer.

The Oklahoma State University reports that a Type 561 Oscilloscope, s/n 409, along with a Type 72 Dual-Trace Plug-In Unit, s/n 397, and a Type 67 Time-Base Plug-In Unit, s/n 433, is missing from the Electrical Engineering Department and is thought to be stolen.

Persons with information regarding the whereabouts of these instruments should contact: Gerald Stotts, Head Lab Technician, School of Electrical Engineering, Oklahoma State University, Stillwater, Oklahoma. The telephone number is FRontier 2-6211, Ext. 322.

Our Cleveland Field Office notifies us of a missing Type 321, s/n 883. This instrument disappeared from the Worden Road Plant of the Bailey Meter Company in Wickliffe, Ohio.

Mr. V. S. Rutherford of the Bailey Meter Company would like to hear from anyone who has information on the whereabouts of this instrument. Address information to: V. S. Rutherford, Bailey Meter Company, Worden Road Plant, Wickliffe, Ohio.

Tektronix, Inc.
P. O. Box 500
Beaverton, Oregon

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

USED INSTRUMENTS WANTED

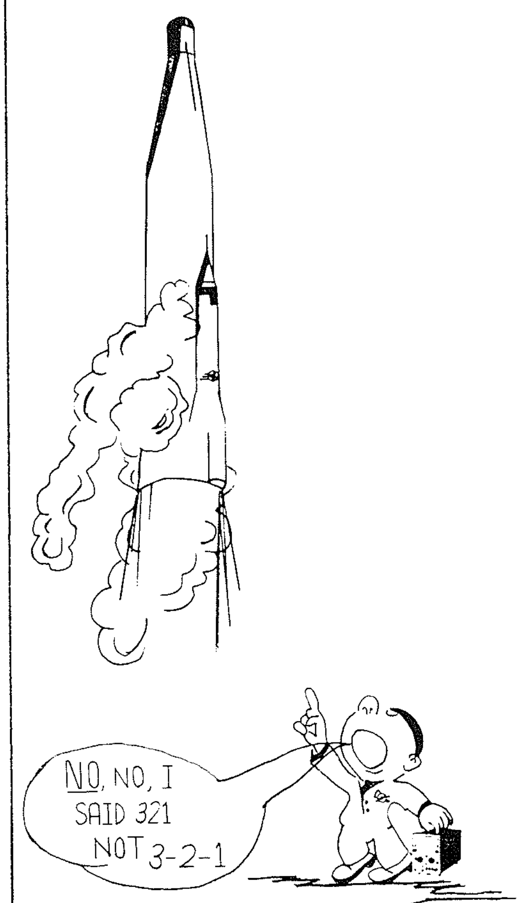
1 3" or 5" Tektronix scope.	John J. Arragnost DeVry Technical Inst. 4141 West Belmont St. Chicago, Illinois
Several Type 511, Type 512 and Type 513 Oscilloscopes.	James Palmer Engineering Department Gannon College Perry Square Erie, Pennsylvania
Several general purpose 10 to 15 MC Oscilloscopes, 3" or 5".	Bob Jones 2406 Eastern Avenue Wesleyville, Pa.
1 Type 524	Ed Shinholt Radio Corporation of America 3301 South Adams St. Marion, Indiana
1 Type 310 or Type 310A	Thomas A. Barr WAFG TV 1000 S. E. Monte Sano Blvd. Huntsville, Alabama
1 Type 502 or Type 503	Joe Posten 309 Benton Drive Indianapolis, Indiana Phone: TU 1-9771
1 Type 514D or Type 310	M. Perez & Sons Television Service Labs. 6475 Main Street Long Hill, Connecticut Phone: AM 8-3766
1 Type 310 or Type 315	Al Willis 70 Pilgrim Lane Westbury, Long Island Phone: ED 4-5604

USED INSTRUMENTS FOR SALE

1 Type 524AD, s/n 6347	Jerry A. Richards Chief Engineer WGTE-TV Toledo, Ohio Phone: 531-1451, Ext. 348
1 Type 502, s/n 1477	Col. Hoxie Lind Industries 2294 Mora Drive Mountain View, Calif. Phone: YOrkshire 8-0083
1 Type 514D, s/n 2812. Price $675.00 1 Type 524D, s/n 1665. Price $775.00	Pete Pappas Electronic Development Laboratories 4307 23rd Avenue Long Island, New York Phone: RA 8-7116

Seller says both scopes in better than average condition.

1 Type 575, s/n 2103. Has had very little use.	Travis Howell RAWCO Instruments 1400 Riverside Drive Fort Worth, Texas
1 Type 551, s/n 2011 2 Type CA Plug-Ins, s/n's 13443 and 13444	Dr. Verner J. Wulff Masonic Medical Research Laboratory Utica 2, New York Phone: RE 5-2217
1 Type R Plug-In Unit	Bob Billings Eldorado Electronics 2821 Tenth Street Berkeley, California
1 Type 533A, s/n 3039	Mr. Blair Eastern Specialty 3617 North Eighth St. Philadelphia 40, Penn. Phone: BA 8-0500



Tektronix Field Engineer Bob Browning with a Type 321 Oscilloscope calls at Cape Canaveral.

Tektronix Instrument-Repair Facilities: There is a fully-equipped and properly-staffed Tektronix Instrument Repair Station near you. Ask your Field Engineer about Tektronix Instrument-Repair facilities.

Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 14 PRINTED IN U.S.A JUNE 1962

HORIZONTAL SAMPLING THEORY

By Hal Hardenbergh; until recently, assigned to our West Los Angeles Field Office.

To recreate a waveform using sampling techniques, samples must be taken over the entire waveform. Taking a sample of the leading edge of the waveform is easy; a trigger circuit is used to trip a strobe pulse generator directly. A block diagram of this system would take this form:

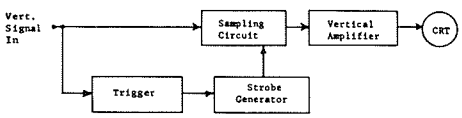


Figure 1

In practice, the system represented by the block diagram above wouldn't be able to sample on the very front of the waveform, because of the finite time delay in the trigger and strobe generator circuits. Therefore, a time delay must be introduced between the trigger input and the sampling circuit. If the vertical signal input is 50 Ω, a 50-Ω coax cable may be used to obtain the necessary delay. A delay of approximately 50 nanosec, representing about 33 feet of 50-Ω coax, is generally used.

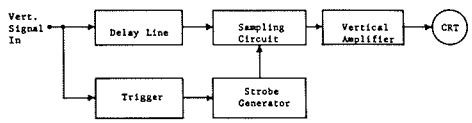


Figure 2

Although the system represented by Fig. 2 would be able to sample an incoming waveform on its leading edge, it probably wouldn't be able to sample in the middle of the waveform, or at the trailing edge. Practical trigger circuits can generally "recognize" only the leading edge (or transition) of a waveform. In order to sample in the middle of the waveform, a time delay must be inserted between the trigger circuit and the strobe generator.

Since long time delays may be necessary (up to a millisecond) and since the delay should be continuously variable, an electronic delay is used. The strobe generator is now tripped by the delayed trigger output of the variable delay circuit. If a sufficient range of delay is available, samples may now be taken over the entire waveform. Our block diagram now takes this form:

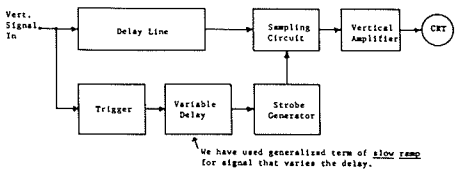


Figure 3

Functionally, this variable delay circuit is identical to the delayed trigger pick-off in the Tektronix Type 535/535A Oscilloscopes. The trigger circuit recognizes the incoming waveform and initiates a voltage ramp or sweep. The voltage ramp is fed into a comparison circuit, or comparator, along with a DC voltage. When the ramp reaches the level of the DC voltage, the comparator puts out a trigger pulse called the delayed trigger. The time delay between the trigger input and the delayed trigger output may be changed by varying either the DC voltage or the slope of the ramp. Usually the DC voltage is changed (by the DELAY TIME helipot on the Type 535 or Type 535A) to obtain a vernier delay, and the slope of the ramp is changed to change the range of the vernier. A block diagram of the delayed trigger circuits in the Type 535 or Type 535A would take this form:

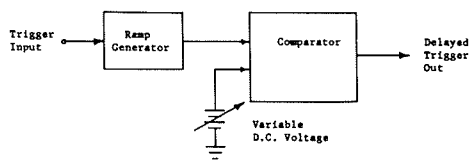


Figure 4

The delays needed in sampling systems are generally much shorter than those available from the delayed trigger of a Type 535 or Type 535A; therefore, the circuitry is different. However, a voltage ramp, now called the "fast ramp," is still compared to a variable DC voltage to obtain the variable time delay needed to sample along the full length of our waveform. Our sampling system block diagram now takes the following form:

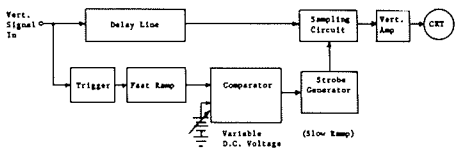


Figure 5

If the DC voltage in the above block diagram is increased each time a sample is taken, comparison will take place progressively further along the fast ramp. Thus, there is a progressive increase in the time delay between recognition and sampling. This causes each sample to be taken on a different part of the incoming signal.

A complete sampling system, therefore, includes an incremental voltage-advancing circuit or "staircase generator." The staircase generator is made to advance one increment immediately after each sample is taken, by feeding the delayed trigger output of the comparator into the staircase generator. By advancing the staircase immediately after a sample is taken, the staircase generator is given the maximum time to reach its new DC level before the next ramp arrives. We now substitute a staircase generator for the variable DC voltage in our block diagram:

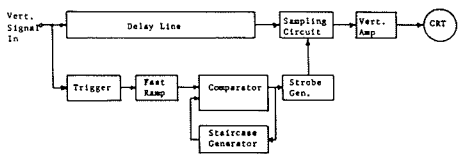


Figure 6

The *real time* spacing is determined only by the repetition rate of the waveform (up to the maximum sampling rate of the oscilloscope). The *equivalent time* spacing is determined only by the fast ramp slope and the amplitude of each stairstep. Therefore, the *equivalent time* of a sampling display is independent of the *real time* of the display and vice-versa.

When we reconstruct the shape of a waveform on the CRT of a sampling oscilloscope, we in effect pretend that all of the samples contained in one sweep were taken on one waveform. Therefore, the time/div calibration of a sampling scope is in *equivalent time*.

If the fast ramp is a linear voltage/time ramp and if the stairstep is advanced in

uniform increments, the spacing of the samples along the incoming waveform will be uniform in *equivalent time*.

To understand the meaning of "equivalent time," consider the following case: If we reconstruct a repetitive pulse 12 nanoseconds wide by taking 12 samples, one *real time* between successive samples depends on the repetition rate of the waveform. However, by using our 12 samples to reconstruct a picture of the waveform, we are in effect pretending that all of the samples were taken on one pulse. If this were true, the time between samples would be only one nanosecond (12 samples along our 12 nsec pulse). This is the *equivalent time* between samples.

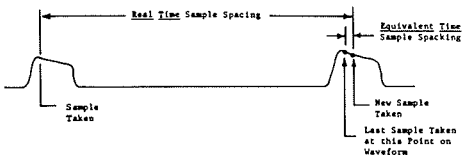


Figure 7

To reconstruct a waveform, the samples must be spaced horizontally in the proper time sequence. This is done by feeding the stairstep into the horizontal amplifier so that the trace moves one increment horizontally as each sample is taken. The relationship between the increment of horizontal distance per sample and the equivalent time per sample will determine the (equivalent) sweep time/div. Adding this function to our block diagram, we now have:

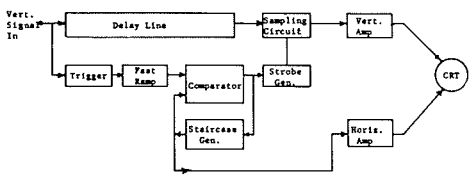


Figure 8

To take a specific example, suppose that the amplitude of staircase going into the comparator is 50 mv/step, where one step equals one sample. If the fast ramp rises 50 mv/nsec, the equivalent time per sample will be one nsec.

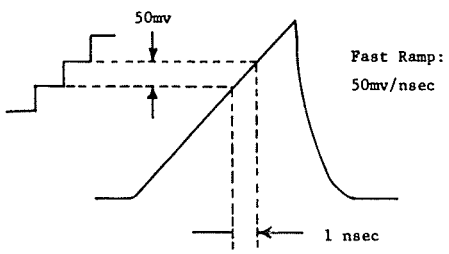


Figure 9

If we adjust the gain of the horizontal amplifier so that each step advances the trace horizontally 1 millimeter, 10 samples (at an equivalent time per sample of 1 nsec) will be required per cm; the sweep time/cm, therefore, will be 10 nsec.

In other words, the (equivalent) time per sample, times the number of samples per division, equals the (equivalent) time per division:

(Time/sample) (samples/div) = Time/div

Returning to our specific example, let's see what happens if we leave the fast ramp and the horizontal gain unchanged, but change the amplitude of each stairstep from 50 mv to 100 mv. This will result in a horizontal step of *two* mm/sample or 5 samples/cm. The equivalent time/sample will increase from 1 nsec to 2 nsec. The resulting time/cm may now be calculated:

(2 nsec/sample) (5 samples/cm) = 10 nsec/cm

Changing only the amplitude of each step within the staircase generator does not affect the time/cm calibration of the crt display—only the equivalent time between samples. However, attenuating the overall amplitude of a given staircase to the comparator will decrease the time/cm by an amount equal to the attenuation.

We've been using a staircase to sample at various points along a waveform (common practice is to say that the strobe pulse "slews" along the waveform). Under certain conditions the stairstep waveform won't resemble its namesake very closely. Actually, the staircase advances one step per sample, so that if we plot the voltage versus the number of samples taken, the graph looks like this:

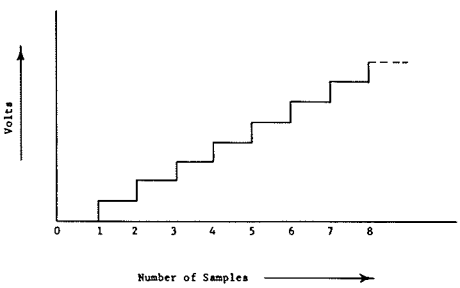


Figure 10

If the incoming waveform repeats at regular intervals, the spacing of the steps on the staircase will be uniform in real time; the waveform observed on a conventional scope will look like this:

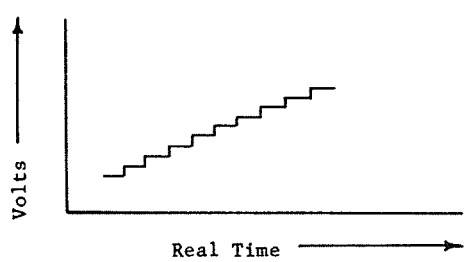


Figure 11

However, if the incoming waveform recurs at an irregular rate, the spacing of the samples (and steps) will be non-uniform in real time:

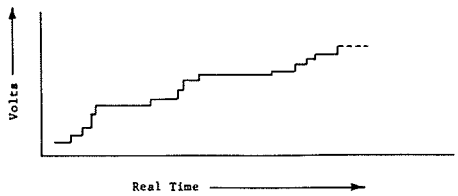


Figure 12

Therefore, do not expect the stairstep *always* to look like a uniform stairstep when observed in *real time*. Note that irregular spacing of samples in *real time* will not cause irregular spacing in *equivalent time*, since the equivalent time calibration is independent of the repetition rate of the incoming waveform. Problems will arise, however, when equivalent time phenomena are viewed on a real time (conventional) oscilloscope.

MEASURING N-PORT PARAMETERS OF NETWORKS

Research engineers at Page Communications Engineers, Inc., Washington, D. C., a subsidiary of Northrup Corporation, have developed techniques for measuring n-port parameters of networks with the aid of the Tektronix P6016 Current Probe and Type 131 Amplifier. Used together with a conventional voltage probe and either a dual-beam or electronically switched dual-channel oscilloscope, with the time base synchronized to the voltage-input channel, the current-probe channel provides both magnitude and phase measurements. With known terminations, such as open circuit and short circuit, a complete set of complex n-port parameters for the component z, y, and h matrixes can easily be determined.

Since the Tektronix Current Probe inserts very little reactance in the lead under test, short-circuit current measurements are feasible. Similarly, driving current and load current can usually be determined directly with little extraneous effort. In general, since the current probe disturbs the measurement less than the shunt capacitance of the voltage probe, the current probe should usually be clipped to a lead directly into the network, while the voltage probe should be on the generator side, not the network side of the current probe.

For passive systems, a check on the measured values is the fact that $Z_{ij} = Z_{ji}$ and $Y_{ij} = Y_{ji}$. Nonlinearities are made evident by distortion of the sine-wave signal. In the past, distorted current waveforms were difficult to detect, but this technique clearly displays any such effects.

SLAVING TYPE 560-SERIES SCOPES

In response to customer interest, Russ Fillinger, Project Engineer with the Medical-Instrument Development Group has come up with a method of slaving one Type 560-Series scope to another. Cost is low and minor modifications are required on the instruments.

The Master scope must furnish four signals to the Slave scope:

1. Vertical signal (single, dual, or four trace)
2. Sweep sawtooth
3. Deflection blanking (for sweep retrace)
4. Transient-spike blanking to CRT cathode (for dual-and four-trace applications)

Modifications required on the Master scope—refer to accompanying diagram:

1. *Vertical System*
   - A. Plug-in
     - (a) Improve transient response of internal trigger C.F.) For Type 72 remove C487 and replace with 1.5 to 7 pf variable.)
   - B. Indicator
     - (a) Bring out vertical signal from pin 11 of the indicator left-side Amphenol connector (or pin 12 of the right-side Amphenol connector) to the vertical input connector of the Slave.
     - (b) Bring out chopped transient blanking signal from pin 24 of the indicator left-side Amphenol connector to pin 24 of the left-side Amphenol connector of the Slave indicator. (For convenience, the first notch on the ceramic strip under the HV supply may be used instead.)
2. *Horizontal System*
   - A. Plug-In
     - (a) Patch sweep signal to pin 24 of right-side Amphenol connector (in Type 67 install a lead from the cathode of V333A to pin 24 of the Amphenol plug).
     - (b) For fast sweeps in Type 67, it may be necessary to decrease R138 to compensate for additional capacitive loading.
   - B. Indicator
     - (a) Bring out sweep signal from pin 24 of the right-side Amphenol connector in the indicator to the horizontal input connector of the Slave.
     - (b) Bring out sweep blanking signal from pin 13 of the right-side Amphenol connector of the indicator to pin 13 on the left-side Amphenol connector of the Slave indicator.

Modifications required on the Slave plug-ins are:

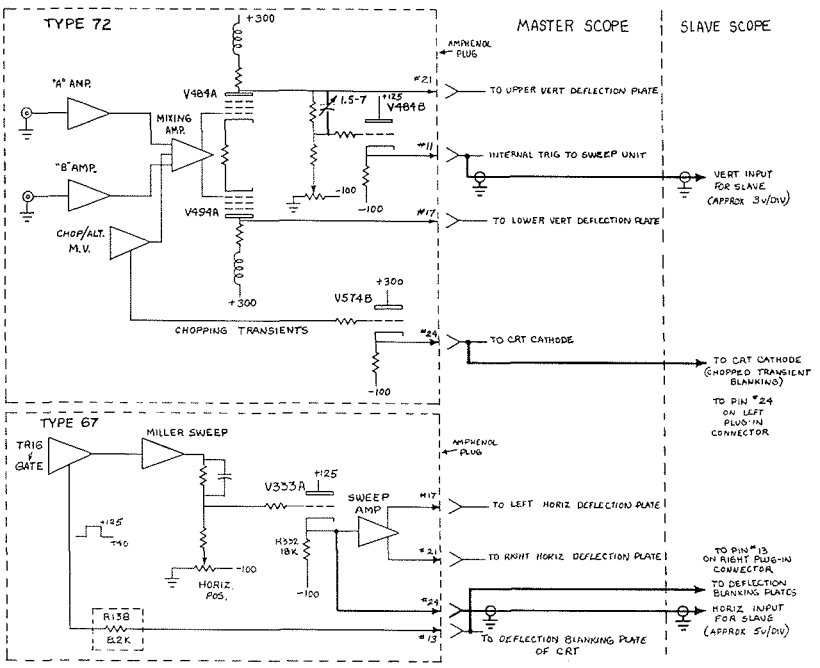
1. Cut tie strap between pins 13 and 14.
2. Remove ground strap from pin 24 (may not be present in early units)

By doing Steps 1 and 2 on both Slave plug-ins, you make them interchangeable from side to side in the Slave indicator.

Russ used a 561/72/67 for the Master and a 561/60/60 for a Slave. The Master had a frequency response of approximately 650 kc; the Slave 390 kc. You may wish to use a 561/59/59 combination for economy.

Linearity of signal will be approximately ±6% in 8 cm because we are using a single-ended sample of the vertical signal from the Master. Linearity is dependent on the output stage of the Master plug-in.

You may wish to install connectors on the back panel of the indicators. If so, you're cautioned that in this case we limited our coax length to four feet.



USED INSTRUMENTS WANTED

1 Type 121 Preamplifier	Harry W. Hammond 1095 Arlington Ave. Teaneck, New Jersey
1 Type 310, 316, 317 or 321 Oscilloscope	Phil Boehme U.S. Navy Electronics Laboratory Code 2623 San Diego 52, California
1 Type 531 or Type 535 with a Plug-In Preamplifier	Alex Levin Bureau of Ships Code 679C3F Washington 25, D. C.
1 Tektronix 5" crt oscilloscope. DC to 10 MC.	G. Servos 686 Fairview Avenue Elmhurst, Illinois
1 Type 502	S. Winston 104 MS U.C. Medical Center San Francisco, California
1 Type 310 or Type 321	James F. Bockelman Aircraft Space Electronics Apalachicola, Florida
1 Tektronix General Purpose Oscilloscope (10-15 mc.	Robert E. Jones 2406 Eastern Avenue Wesleyville, Pa. Phone: TW 9-3456

USED INSTRUMENTS FOR SALE

1 Type 575 Transistor Characteristic Curve Tracer, s/n 3565 Owner says this instrument was used only briefly to evaluate 24 transistors. Price $800.00	Ortho Industries, Inc. 7-11 Paterson Street Paterson, New Jersey
1 Type 127 Power Supply 1 Type E Plug-In Unit	Frank G. Carpenter Assoc. Professor of Physiology Dartmouth Medical School Hanover, New Hampshire
1 Type 541A, s/n 21509, with a Type L Plug-In Unit, s/n 11618	Sprague Engineering Co. 18435 Susana Road Compton, California
1 Type 517, s/n 625. Will sell or trade for either a Type 545A or Type 585 and cash	Ian Isdale 825 Tall Timber Road Orange, Connecticut

Tektronix, Inc.
P. O. Box 500
Beaverton, Oregon

Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

1 Type 316, s/n 187 1 Type 181, s/n 259	Dale Brocker 3008 Lakeshore Avenue Apartment 6 Oakland, California
1 Type 517, s/n 1680	John Ivimey Room 2001 1428 South Penn Square Philadelphia 2, Penn. Phone: LO 3-6531
1 Type 512 with flat faced crt. Price $275. F.O.B San Francisco	S. Winston 104 MS U.C. Medical Center San Francisco, California

MISSING INSTRUMENTS

The University of Alabama reports a Tektronix Type 503 Oscilloscope, serial number 759, as missing from their Electrical Engineering Department. They presume it to be stolen. Information concerning this instrument should be sent to: Willard F. Gray, Department of Electrical Engineering, University of Alabama, University, Alabama.

A Tektronix C12 Camera, serial number 008-980, belonging to the Columbia University in New York City disappeared from the University and is presumed to be stolen. Information concerning the whereabouts of this camera should be sent to: Tektronix, Inc., 840 Willis Avenue, Albertson, Long Island, New York.

Our Chicago Office notifies us that a Tektronix Type 310A Oscilloscope is missing from the General Electric X-Ray Division in Chicago. This instrument is also believed to be stolen. If you have any information pertinent to this instrument, please notify: Tektronix, Inc., 400 Higgins Road, Park Ridge, Illinois.

QUESTIONS FROM THE FIELD

Q. When using my Type 543 at the fastest sweep speeds, the trace intensity is not uniform because of a 5-volt dip in the unblanking waveform. This intensity nonlinearity sometimes makes it difficult to take satisfactory photographs of the crt display. What will cure this?

A. Types 533 and 543 after serial numbers 3000 were modified to overcome this problem. You can make the modification to the sweep-gating multivibrator in the time-base-generator circuit of your instrument. Simply replace L 133 with a strap. Connect an 8 pf, 500 v, ceramic (Tektronix No. 281-503) between pin 8 of V135 and the junction of R133 and R134.

Q. The multivibrator in my 53/54C and CA Plug-In Units will not self-start when the units are warming up in the CHOPPED mode. How can I correct this problem?

A. This problem was solved by a modification installed in CA units with serial numbers above 34790. You can correct the condition in CA units below this number and in 53/54C units, all serial numbers, by adding R3383, a 330 k, ¼ w, 10%, comp. resistor (Tektronix No. 316-334) between the cathode of V3382* (6AL5, pin 5) and +225 v.

The 6AL5 caused the problem. Its cathodes were returned to —150 v through a 1.8 megohm resistor located in the oscilloscope (via pin 16 of the interconnecting plug). This resistor provided a current source for the 6AL5 that tended to balance the multi (V3375, 12AT7) plates; both halves saturated and prevented multi action. The 330 k resistor forms a divider that biases off the diodes.

*V3803 in Type 53/54C Units.

Q. What can I do to correct intensity modulation (noticeable at some sweep speeds when using low intensity) on my Type 321 Oscilloscope?

A. Change C852, an 0.01 μf, 1000 v, Hicap capacitor to an 0.02 μf, 1400 v, DC, Type U capacitor (Tektronix No. 283-022). Type 321's after s/n 1389 have this modification.

PINPOINTING INFORMATION ON POLAROID PRINTS

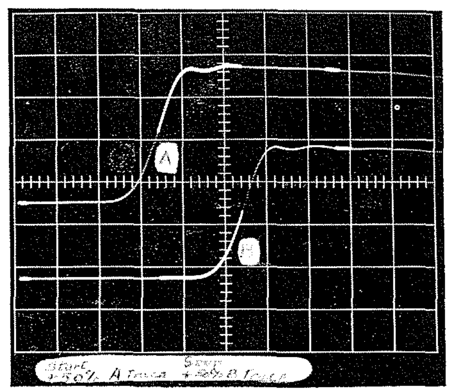


Figure 1

Use a draftsman's thin metal erasing shield and an eraser (an electric eraser is ideal if you're lucky enough to have one handy) to label or pinpoint information on Polaroid* Land prints. The shield and eraser will enable you to erase through the print to the underlying white paper. You can erase away a portion of the print to form an arrow or a space to write in a number or a brief description. See Figure 1.

* Polaroid is a registered trademark of the Polaroid Corporation.

Tektronix Instrument-Repair Facilities: There is a fully-equipped and properly-staffed Tektronix Instrument Repair Station near you. Ask your Field Engineer about Tektronix Instrument-Repair facilities.

Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 15 PRINTED IN U.S.A AUGUST 1962

SAMPLING OSCILLOSCOPES AND THE SLIDE-BACK BALANCED-BRIDGE TECHNIQUE

For those unacquainted with the term "sampling oscilloscope", a brief explanation may be in order.

A sampling oscilloscope measures recurrent waveforms point-by-point in progressive steps much as you would plot a graph of amplitude vs. time with a series of points on graph paper. Unlike a conventional scope display where one signal completes one picture, sampling uses up to 1000 individual amplitude-vs.-time points taken electronically. Each point on the plot is called a sample. After each repetition of the signal the circuit, which samples and measures the input waveform, is told to measure the next recurrence a small increment of time later on the waveform than the preceding sample. The process of advancing sampling time in regular fixed increments is sometimes referred to as "strobing". For each increment of strobing, the voltage present on the input at that particular instant is measured—or as we say "sampled"—and simultaneously plotted as vertical deflection on the crt. At this same instant the horizontal motion of the display moves an increment of time in synchronization with the strobing signal. In this manner, a reconstructed signal is reproduced on the crt.

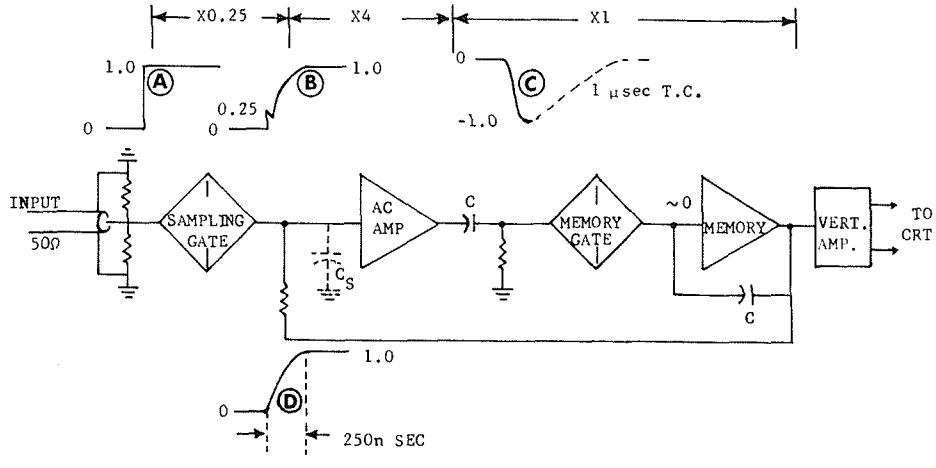


Figure 1

Basic block diagram of circuitry used in the Slide-Back Balanced-Bridge technique.

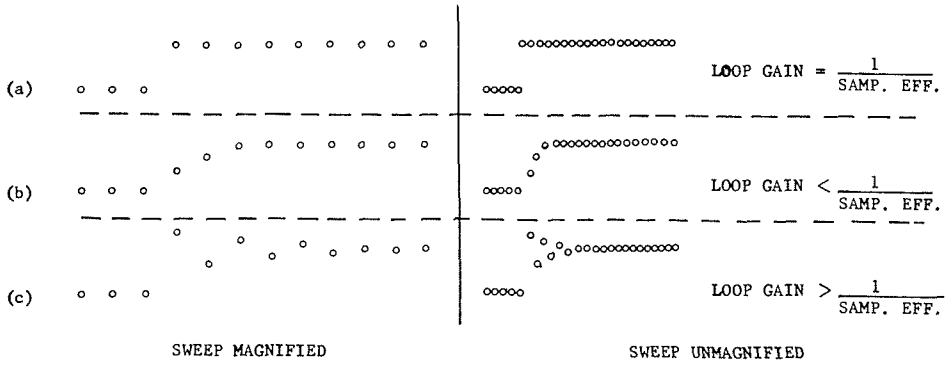


Figure 2

Dot transient response of input circuitry with different loop gains.

What we see is actually an amplitude-vs.-time, point-by-point graph. The reconstructed signal is much slower than the original signal. Thus, it can be handled by conventional, low-speed, high-gain amplifier circuits.

Several techniques are available for obtaining the point-to-point measurements of the applied recurrent waveform. Of these, the Slide-Back Balanced-Bridge technique offers certain distinct advantages. These are: better accuracy, improved linearity and dynamic range, and more effective suppression of noise—the balanced diode gate allows first order cancellation for noise on the interrogate spike.

Three Tektronix Oscilloscopes employ this technique in their vertical circuits. They are, the Type 661 Pulse Sampling Oscilloscope and (when combined with a Type 3S76 Dual-Trace Sampling Plug-In and a Type 3T77 Sampling Sweep Plug-In) the Type 561A and Type 567 Oscilloscopes.

Look at Figure 1. It s a basic block diagram of the circuitry used in the Slide-Back Balanced-Bridge technique. It works like this: The input signal is applied through the 50-ohm delay line to the Sampling Gate. (The Sampling Gate is a balanced diode bridge which acts as a gate for the signal, so you'll hear it referred to variously as the Sampling Gate and as the Sampling Bridge. In this article we'll refer to it, and other circuits like it, as gates. When a gate is "open", the signal can pass through; when a gate is "closed", the signal cannot pass through.)

The waveforms shown in Figure 1 illustrate the operation of the circuit for one sample. As you can see, the entire difference signal applied to the input does not pass through the Sampling Gate during the time it is open. This is due to diode resistance, circuit capacitances, gate-opening duration, etc. The ratio of the signal out of the gate to the signal into the gate is called the "sampling efficiency." The waveforms shown are based on a sampling efficiency of 25%, which is typical.

Waveform A indicates that the input signal has jumped from ground to +1 volt since the last sample was taken. Therefore, when the Sampling Gate opens, the AC Amplifier sees a difference signal of 1 volt. However, the AC Amplifier input is able to move only 0.25 volt before the gate closes again (waveform B). After the gate closes, the AC Amplifier input immediately begins to return toward zero. The AC Amplifier has a gain of minus four, so because its input was moved positively 0.25 volt, its output swung negatively one volt (waveform C). The Memory Gate is also open

at this time so this —1 volt swing is applied to the Memory. The Memory is an inverting Integrator with a gain of one. Its output (waveform D) is applied through the feedback circuit to the input of the AC Amplifier. So this brings the AC Amplifier input up to +1 volt and it is now ready for the next sample to be taken.

Note that there is some time lag between the closing of the Sampling Gate and the arrival of the feedback voltage from the Memory output, as shown by the slight decay in waveform B before Memory output takes over. This is normal.

After the AC Amplifier has amplified the 0.25-volt step of Waveform B, its output decays back toward zero. The low-frequency gain of the AC Amplifier is low enough that it ignores the relatively slow change applied by the Memory at its input.

It can be seen that the gain of the AC Amplifier, Memory Gate, Memory Loop must be equal to the reciprocal of the sampling efficiency for the AC Amplifier input to be brought exactly to the level of the last input sample. Figure 2—waveform A shows the "dot transient response" of the circuit to a step input signal when the loop gain is properly set. If the loop gain is less than the reciprocal of the Sampling Efficiency, the response of the circuit to a step input will look like Figure 2 — waveform B. At each sample, the AC Amplifier input will be brought up only part way to the input signal amplitude, and it will take several samples before the output attains the same level as the input signal. Figure 3—waveform C shows what the output will look like if the loop gain is too high (by a factor of less than two). In this case, the output will overshoot the input signal on the first sample, undershoot the input signal on the second sample, overshoot on the third, etc., until the amount of overshoot and undershoot becomes negligible and the output settles down to the same level as the input. If the loop gain is too high by a factor of more than two, the output will overshoot and undershoot the input by increasing rather than decreasing amounts on each sample. In this case, the loop will be driven into saturation first in one direction and then the other, and there will be no useful output.

To increase the sensitivity of the unit (VOLTS/DIV), we need to increase the output of the Memory relative to the input signal. This is relatively simple; we can just increase the gain of the AC Amplifier. But as mentioned above, this gets us into trouble back at the input. So we must attenuate the feedback signal by exactly the same amount as we increase the AC Amplifier gain. Thus, if we increase the AC Amplifier gain to 20, we'll get five volts out of the Memory for each volt of input signal. Then we'll use a 5X attenuator in the feedback network to keep the proper relationship across the Sampling Gate. It's the 5 volts that goes on into the Vertical Amplifier to drive the crt, of course.

Editor's Note: Authorship of this article can hardly be attributed to any one person. Rather, it is the result of the joint efforts of the people who comprise the Tektronix Field Training group. Paul Thompson of this group is responsible for the literary efforts and the basic discussion is adapted from a seminar originated by the Field Training people and conducted by their Bob Sadilek.

NEW FIELD MODIFICATION KITS

TYPE 502 VERTICAL-SIGNAL-OUT MOD KIT

This modification provides a rear panel, direct-coupled signal out from each vertical amplifier. Output level is approximately 2 volts for each centimeter of crt deflection. Output impedance is 200 Ω. Installation time is approximately 3 hours* for instruments below serial number 1667 and approximately 2 hours for instruments above serial number 1666.

Order through your local Tektronix Field Engineer or Field Office. Specify Tektronix part number 040-284. Price $18.50.

TYPE 507 SILICON RECTIFIER MOD KIT—For Type 507 instruments with serial numbers 101 through 211,
and;
TYPE 575 SILICON RECTIFIER MOD KIT—For Type 575 instruments with serial numbers 101 through 4919.

These modification kits replace the original selenium-rectifier stacks of their respective instruments with a silicon-rectifier assembly. Silicon rectifiers provide better reliability and longer life. Approximate installation times are 1 hour* for the Type 507 and approximately 45 minutes* for the Type 575.

Order through your local Tektronix Field Engineer or Field Office. Specify:

For the Type 507—Tektronix part number 040-259. Price $25.00.

Or,

For the Type 575—Tektronix part number 040-223. Price $29.75.

TYPE RM503 AND TYPE RM504 REAR VERTICAL AND HORIZONTAL INPUT MOD KITS

Two separate modification kits—one for the Type RM503 and one for the Type RM504—supply coax-cable assemblies for adding Vertical and Horizontal Inputs to the rear panels of these instruments. These rear-panel inputs parallel the front-panel inputs and introduce an added input capacitance. Because of this additional capacitance, standard passive probes, when used with these modified instruments, cannot be compensated.

Installation requires approximately 45 minutes* for the RM503 and approximately 30 minutes* for the RM504.

Order through your local Tektronix Field Engineer or Field Office. Specify:

For the Type RM503, all serial numbers; Tektronix part number 040-243. Price is $16.00.

Or,

For the Type RM504, all serial numbers; Tektronix part number 040-272. Price is $9.00.

TYPE 575 INCREASED COLLECTOR VOLTS MOD KIT

Installation of this modification converts the Type 575 (all serial numbers) to the Type 575MOD122C which provides the following features:

a. A maximum Collector Sweep voltage of 400 volts (instead of 200 volts), rated at 0.5 amperes maximum.
b. Three (3) more sensitivities (50, 100, and 200 volt per division) on the HORIZONTAL VOLTS/DIV. switch.
c. A ± 1.5 kv supply for checking peak inverse voltage of rectifiers. The high voltage is accessible at the Collector Test terminals and the supply current is limited by an internal impedance of 1.8 megohms.

Note: The output voltage (Collector Terminal voltage) of the 1.5 kv supply varies directly with the line voltage and inversely with the load current (i.e., at 117 v [235 v] line voltage and zero load current of 1 ma, the output voltage is zero).

This modification requires installation of a new front panel (furnished in the kit). When ordering the modification kit, please give the serial number of the instrument in which it is to be installed. We will stamp the new front panel with the serial number of your instrument before shipping the modification kit to you.

Order through your local Tektronix Field Engineer or Field Office. Specify Tektronix part number 040-276. Price is $200.00.

* Quoted installation times are for first time installations by a trained technician familiar with Tektronix instruments.

MISSING INSTRUMENTS

During the week end of June 30th, 1962, a Type 503 Oscilloscope, serial number 973, was apparently stolen from the Chemistry Department at Carnegie Institute of Technology. This instrument disappeared during the week end and a check of authorized personnel failed to reveal its presence. The Chemistry Department would like to hear from anyone with information regarding this instrument. Their address is Carnegie Institute of Technology, Pittsburgh 13, Ohio. Telephone number is area code 412, MAyflower 1-2600.

Pennon Electronics, 7500 South Garfield Avenue, Bell Gardens, California reports the loss of two oscilloscopes: a Type 503, serial number 291; and a Type 511AD, serial number 5106. These instruments which disappeared about the middle of June '62 are believed to have been stolen. Pennon Electronics asks that anyone with information on these instruments, please contact them at the above address.

Herbert Gunther, New York Representative for the Control Data Corporation called our Long Island Field Office to report a missing Type 317 Oscilloscope, Tektronix serial number not available. However, a tag on the front panel of the instrument says "CONTROL DATA SN 1883-7363".

Mr. Gunther believes this instrument may have been stolen. He asks that anyone with

information on this scope either contact him at 160 Rockaway Parkway, Valley Stream, New York City, New York—telephone VA 5-8852, or report their information to the Control Data Corporation, 8100 34th Avenue, Minneapolis, Minnesota.

USED INSTRUMENTS WANTED

1 Type 535 or Type 545	Dr. J. F. McNall Phoenix Engrg. & Computer 7464 Hubbard Avenue Middleton, Wisconsin
1 Type 515 or Type 310	Tom Hall Geotechnical Corp. P. O. Box 28277 Dallas 28, Texas
1 Type 570 Vacuum-Tube Curve Tracer	Stan Mahurin c/o Marine Radio Service Berth 73 San Pedro, Calif.

USED INSTRUMENTS FOR SALE

1 Type 127 Power Supply (for Type A to Z Plug-Ins), s/n 462	Robert Malta George A. Philbrick Researches, Inc. 172 Clarendon Street Boston, Massachusetts
1 Type 317, s/n 314, with Type 123 Preamplifier, s/n 1054	M. H. Schaffner Columbus Bank Note Co. 40 East Spring Street Columbus 15, Ohio Phone: 224-2117
1 Type 536, s/n 104	General Electric Co. D. Dowell/G. Bedore 13430 Black Canyon Hwy. Phoenix, Arizona
1 Type 513D	William Johnson 31 Waverly Road Wyncote, Penn. Phone: TUrner 4-9837
1 Type 310	Arthur Sommers 1875 S. Taylor Road Cleveland Heights, Ohio Phone: area code 216, FA 1-2277
1 Type 514D	Chuck Phillips Tektronix, Inc. 11681 San Vincente Blvd. West Los Angeles 49, Calif. Phone: GR 3-1105 BR 2-1563
1 Type 514AD	Engineering Associates 434 Patterson Road Dayton 19, Ohio Attn: C. C. Littell, Jr.
1 Type 517A with a Type 500A Scopemobile. Both in good condition. Asking $2250.00	A. Lincoln Mekelburg Decisions, Inc. 142 Second Street Fall River, Mass.

SERVICE HINTS

CONDUCTED OSCILLATOR RIPPLE IN TYPE 503/TYPE 504 OSCILLOSCOPES

Appearance of convertor-oscillator ripple at the input of a Type 503 or Type 504, when connected to a low-impedance signal source, has been traced to a conducted ground-loop via the power-cord third wire.

Type 503's with serial numbers above 1385 and Type 504's with serial numbers above 480 have a factory installed modification to eliminate this ground loop.

For instruments already in the field, Tektronix Field Engineer Frank Elardo worked out a simple field modification to correct this condition. Simply move the ground (green) wire of the power cord from its original installation point — the ceramic strip by C652 — to the small hole in the chassis behind V692 (5642). Use a 4-40 self tapping screw (Tektronix No. 213-035) and a No. 4 solder lug (Tektronix No. 210-201). In some early instruments this point was used for grounding C692 A/B and a new screw will not be required.

To determine whether conducted interference is causing ground-loop problems, disconnect the power-cord ground wire by using a three-to-two wire adapter. If the adapter eliminates the interference, then the ground-relocation modification described here should be performed.

REMOVING PAPER CAPACITOR COVERS

Removing the glued-on paper covers installed over the chassis-mounted electrolytic capacitors in some Tektronix instruments can be quite a chore. Tektronix Field Maintenance Engineer Udo Lindemeyer offers a novel approach to the solution of this problem. Using a hypodermic syringe, Udo injects about two cc's of acetone between the paper cover and the capacitor can. He makes the injection about the middle of the capacitor-cover assembly. In about ten minutes, the acetone softens the glue and the cover slips off easily. Some covers, however, may be glued at the top. In these instances it is necessary to invert the instrument and repeat the injection. Udo suggests that to get through the tough hide of the cover, try cutting the hypodermic needle down to about two centimeters and resharpening it.

TIPS FOR TUBE TAPPERS

Tektronix District Manager Harvey Worth reports that during environment tests, one of his customers found that tapping a tube with a pencil created up to 400 G's. They also found that the tapped tube had only 1/5 the life expectancy of a tube of the same type that was not tapped.

We suggest that a less destructive way of testing tubes for microphonics is to use a tool formed from a piece of ¼" plastic or phenolic rod. By means of a file or grinding wheel shape the rod as shown in Figure 1. When testing tubes for microphonics, gently saw the serrated edge of the tool back and forth over the tips of the tubes while observing the effects.

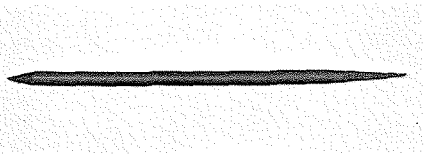


Figure 1

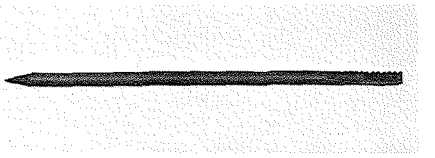


Figure 2

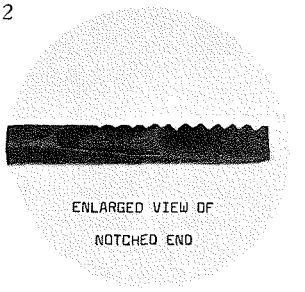


Figure 3

You'll also find that this tool makes a handy aid to hold wires and components in place while soldering. In addition, it makes a dandy non-conducting probe to poke around in an instrument when looking for loose leads or damaged components.

EFFECTIVE AIR-FILTER CLEANING AGENT

Tektronix Field Engineer Duncan Doane sent us the following information: A customer demonstrated the effectiveness of a new (to me) cleansing agent for cleansing the aluminum air filter on Tektronix instruments. He sprayed it on a filter choked with dirt, then merely held the filter under the hot water faucet. The filter came out sparkling! This customer buys the agent in gallon cans and transfers it to a window-cleaner type spray bottle, the name: Grease Off, Garden Products Corporation, Two Rivers, Wisconsin. The customer says it is available in Los Angeles at: Harvey's Butchers and Packers Supplies, 4506 S. Western Avenue, Phone: AXminister 4-8718. Price is $3.85 per gallon.

TRACE BOWING, POOR REGISTRATION AND COMPRESSION

Tektronix Field Engineer Tom Smith received a complaint of bowing, poor registration and compression in a new T502 crt. Investigation revealed about 2 mm of bowing when the trace was positioned to the perimeter of the crt.

Using a soft rag saturated with Anstac "M" *, Tom wiped the face of the crt and the graticule to remove the static charge and then dried them with a soft cloth. Following this action, Tom checked the crt display with a special geometry graticule and found the crt to be good in all respects.

* Anstac "M" is a product of the Chemical Development Corporation, Danverse, Massachusetts. We have found it effective in

Tektronix, Inc.
P. O. Box 500
Beaverton, Oregon

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

removing the static charges which sometimes build up on crt's and graticules. We recommend it also for removing dirt, grease and finger marks from these components.

6U8A TUBES NOT SATISFACTORY AS REPLACEMENT FOR 6BL8 TUBE

Chassis identification and instruction manuals for several Tektronix instruments (Type 503, 504 Oscilloscopes; Type 67 Time Base Plug-In) have indicated that the type 6U8A tube may be substituted for the type 6BL8/ECF80 originally supplied in the sweep generator circuit (V160 in Type 503 or Type 504, V161 or V145 in Type 67).

Recent tests indicate, however, that the percentage of presently available 6U8A's that will operate satisfactorily in these circuits is extremely low. Tektronix no longer recommends this substitution, and references to it on chassis and in manuals will be deleted.

REMINDING YOU —

...that your Tektronix Field Engineer is your best possible source of information pertaining to oscilloscopes, their purchase, use, maintenance and repair.

...that you should apply Filter Coat (Tek no. 006-580. Price $1.00/pint) to the filter element after cleaning.

...that you *should not* apply oil to the air filter element.

...that you should oil the fan motor each time you clean the air filter.

...that to obtain accurate and reliable measurements when using an attenuator probe, you must compensate the probe to the oscilloscope. (See oscilloscope instruction manual).

TEKTRONIX, INC.

Tektronix, Inc., an Oregon Corporation, Home Office & Factory, P.O. Box 500, Beaverton, Oregon
Telephone: MItchell 4-0161 TWX—503-291-6805 Telex: 036-636 Cable: TEKTRONIX

FIELD ENGINEERING OFFICES

ARIZONA	• Phoenix... 7000 E. Camelback Road, Scottsdale...TWX: 602-949-0102 ... WHitney 6-4273 Tucson Area: Enterprise 383
CALIFORNIA	San Diego... 3045 Rosecrans Street, San Diego 10...TWX: 714-276-4265 ... ACademy 2-0384
Los Angeles Area	*Encino*... 17418 Ventura Blvd., Encino...TWX: 213-783-3434 ... STate 8-5170 From Los Angeles telephones call: TRiangle 3-6868
	• *Orange*... 1722 E. Rose Avenue, Orange...TWX: 714-633-2542 ... 633-3450
	Pasadena... 1194 East Walnut Street, Pasadena...TWX: 213-449-1151 ... 449-2164 From Los Angeles telephones call: 681-0201
	• *West L.A.*... 11681 San Vicente Blvd., West Los Angeles 49...TWX: 213-490-3958.... GRanite 3-1105 From Los Angeles telephones call: BRadshaw 2-1563
San Francisco Bay Area	*Lafayette*... 3530 Golden Gate Way, Lafayette....TWX: 415-281-5262 ... YEllowstone 5-6101 From Oakland, Berkeley, Richmond, Albany and San Leandro: CLifford 4-5353
	• *Palo Alto*... 3944 Fabian Way, Palo Alto...TWX: 415-492-9458 ... DAvenport 6-8500
COLORADO	Denver... 2120 South Ash Street, Denver 22...TWX: 303-292-1702 ... SKyline 7-1249, 7-1240 Salt Lake Area: Zenith 381
FLORIDA	• Orlando... 205 East Colonial Drive, Orlando...TWX: 305-275-1734 ... GArden 5-3483 (also serves Puerto Rico)
GEORGIA	• Atlanta... 467 Armour Circle, N.E., Atlanta 9...TWX: 404-527-1029 ... 873-5708 Huntsville, Alabama Area: WX2000
HAWAII	• Kentron Hawaii, Ltd., 1140 Waimanu Street, Honolulu 14...Telex: MHU 0093 ... Phone: 53975
ILLINOIS	• Chicago... 400 Higgins Road, Park Ridge...TWX: 312-823-3639 ... TAlcott 5-6666
INDIANA	Indianapolis... 3937 North Keystone Avenue, Indianapolis 5...TWX: 317-634-0156 LIberty 6-2408, 6-2409
KANSAS	Kansas City... 5920 Nall, Mission...TWX: 913-552-7309 ... HEdrick 2-1003 St. Louis Area: ENterprise 6510
MARYLAND	• Baltimore... 724 York Road, Towson 4...TWX: 301-828-7054 ... VAlley 5-9000
MASSACHUSETTS	• Boston... 442 Marrett Road, Lexington 73...TWX: 617-862-2249 ... VOlunteer 2-7570
MICHIGAN	• Detroit... 27310 Southfield Road, Lathrup Village...TWX: 313-357-4618 ... ELgin 7-0040
MINNESOTA	Minneapolis... 3307 Vera Cruz Ave. North, Suite 102, Minneapolis 22...TWX: 612-292-4133.. 533-2727
NEW MEXICO	• Albuquerque... 509 San Mateo Blvd., N.E., Albuquerque...TWX: 505-243-8433 ... 268-3373 Southern New Mexico Area: Enterprise 678
NEW YORK	Buffalo... 961 Maryvale Drive, Buffalo 25...TWX: 716-770-1565 ... NF 3-7861
	• Endicott... 3214 Watson Blvd., Endwell...TWX: 607-262-0277 ... PIoneer 8-8291
	• Poughkeepsie... 8 Raymond Ave., Poughkeepsie...TWX: 914-452-7738 ... GRover 1-3620
	• Syracuse... East Molloy Road & Pickard Drive, P.O. Box 155, Syracuse 11 TWX: 315-477-1195 ... GLenview 4-2426
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	• *Northern N. J.*... 400 Chestnut Street, Union, New Jersey...TWX: 201-687-6177..... MUrdock 8-2222
	Westchester County, Western Conn., Hudson River Valley...144 Morgan Street, Stamford, Connecticut TWX: 203-327-9538 ... DAvis 5-3817
NORTH CAROLINA	• Greensboro... 1838 Banking Street, Greensboro...TWX: 919-292-1064 ... 274-4647
OHIO	Cleveland... 1503 Brookpark Road, Cleveland 9...TWX: 216-749-6426 ... FLorida 1-8414
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	Houston... 2605 Westgrove Lane, Houston 27...TWX: 713-571-2291 ... MOhawk 7-8301, 7-8302
WASHINGTON	Seattle... 236 S.W. 153rd St., Seattle 66...TWX: 206-998-0618 ... CHerry 3-2494
WASHINGTON, D.C.	• Washington, D.C. ... 4205 Evergreen Lane, Annandale, Virginia...TWX: 703-256-8902 ... 256-6700 Norfolk, Portsmouth, and Hampton, Virginia Area: Enterprise 741

TEKTRONIX CANADA LTD.

QUEBEC	Montreal... 3285 Cavendish Blvd., Suite 160, Montreal 28...Telex: 01-2867 ... HUnter 9-9707
ONTARIO	• Toronto... 4A Finch Ave. West, Willowdale...Telex: 02-2776 ... Toronto, 225-1138

• ALSO REPAIR CENTER

Tektronix Instrument-Repair Facilities: There is a fully-equipped and properly-staffed Tektronix Instrument Repair Station near you. Ask your Field Engineer about Tektronix Instrument-Repair facilities.

8/62

Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 16 PRINTED IN U.S.A OCTOBER 1962

OSCILLOSCOPE PHOTOGRAPHY AND FILM STORAGE

It's smart business to check the expiration date of the film you are using when you engage in oscilloscope photography. Those who attempt to photograph waveform phenomena that tax the writing rate of the oscilloscope and, or, the film should give an attentive ear to this advice. All film, packet or individual roll, carries a definite date stamped on the box. For best results, film should be used before this date.

Also, all sensitized photographic materials are perishable and can sustain damage if not properly stored. The following information appeared originally in the "POLAROID POINTERS", a pamphlet published by the Customers Service department of the Polaroid Corporation. It should be helpful to those who attempt to keep a supply of film on hand.

Storage and the Effects of Temperature: Excellent pictures can be obtained over a wide temperature range. From near freezing to 100° F, the camera and rolls give good results. However, since all sensitized photographic materials are perishable and can be damaged by high temperature and high relative humidity, care should be taken to handle and store the film as recommended below, with as much protection as possible against heat and moisture and away from X-rays, radioactive materials, and chemical fumes.

Protection Before Using: The wrappers in which all Polaroid Land* picture rolls are packaged will provide ample protection to withstand, through the expiration date printed on the box, normal handling in the humidities encountered in most places in the U.S.A. This wrapper does not provide protection against heat and therefore Polaroid Land picture rolls (and any sensitized photographic material, for that matter) should not be stored or left near radiators, hot pipes or other unventilated areas where the temperature may climb. The glove compartment, trunk and back deck of automobiles may reach very high temperatures (in excess of 200°F) in the hot sun. Excessive heat may damage the film, resulting in fogged (or flat and gray) pictures or a collection of developing reagent on the positive print.

If you are in the habit of keeping a number of picture rolls on hand during the summer heat or in tropical areas, it is good practice to store your picture rolls (unopened) in the refrigerator. Wherever possible, store the film under these conditions:

For Storage Up to—	Keep Temperature Below—
2 months	70°F
6 months	55°F
9 months	50°F

Generally speaking, there is no low temperature limit for storing Polaroid Land film, and this means that it can be frozen (or stored in a deepfreeze) for long periods of time. However, before using film that has been stored below 60°F, it must be brought back to room temperature before opening the foil wrapper.

If the foil wrapper on a tray of 4 x 5 packets has been broken, and only a few packets are to be stored under refrigeration, wrap the packets in a good brand of aluminum foil—a sandwich-type wrapping with the ends firmly closed.

Protection After Opening: Once the moisture-vapor-barrier wrapper is opened, the picture roll loses its protection against moisture. Under humid or high temperature conditions, use the roll as soon as practicable and do not allow the roll to remain in the camera longer than necessary. Protect your loaded camera and picture rolls from direct sunlight as the temperature inside the camera or the carrying case may rise extremely high even when the weather is temperate. On long trips through high temperature regions an insulated container will provide protection to your film.

All type 4 x 5 film packets can be damaged by exposure to humidity over 75% R.H. at 75°F or above. To provide protection, each box of 12 packets includes a polyethylene bag. After removing the foil wrap from the box, the tray of packets should be immediately inserted in the bag and the end of the bag folded over several times to seal out moisture. When humidity is high, packets should be developed within 15 minutes after removing them from the polyethylene bag.

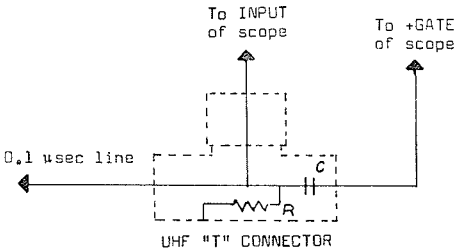
Once the protective wrapper is removed, care should be taken to keep the film away from formaldehyde, industrial gases, motor exhausts, solvents, mercury and radiation in any form.

*Polaroid is a registered trade-mark of the Polaroid Corporation

LOCATING TROUBLE IN TV COAXIAL CABLES

John Unruh, Jr., Tektronix Field Engineer with our Orange, California Field Office, calls on a company which uses a Tektronix Type 317 Oscilloscope to locate trouble in a coaxial cable system. This company picks up a TV signal on a nearby mountain top and relays it into subscribers' homes via this coaxial-cable system. Occasionaly a trouble such as an open circuit, short circuit or connectors with water in them will develop. When this happens they can, with the aid of the Type 317, determine within a few feet (and sometimes precisely) the area of the cable within which the trouble lies. This customer happens to use a Type 317. However, any Tektronix oscilloscope with a passband of 10 mc (or better) will also accomplish this purpose. In fact, the faster the risetime of the oscilloscope the more precisely you can pinpoint the difficulty.

For this application, you connect the + GATE of the oscilloscope to the INPUT through a differentiating circuit (see Figure 1). An UHF "T" connector makes a convenient housing for this circuit. The other



C = is selected for best pulse shape
R = is as close to the ∄ of the cable as possible

Figure 1

end of the "T" connector you connect to a cable with a predetermined delay time (John's customer uses a length of cable with a 0.1 microsec delay time). With this hook-up, by free running the oscilloscope sweep, you produce a pulse on the crt screen. When the cable you wish to check is connected to the 0.1 microsec cable, any irregularities are immediately visible on the screen. Should the cable be open, then a positive reflection will show on the screen sometime after the initial pulse. A short in the cable will show as a negative reflection. Connectors used to couple sections of cables together will appear as a small "bump" similar to a termination bump. Any connectors making a poor connection or ones with water in them will also appear as a bump but will show considerable more + or — amplitude than those produced by normal connectors.

To determine the distance to the defective portion of the cable, you merely determine the time between the initial pulse and the reflected pulse, being sure to measure in microseconds from the start of the rise of each pulse. From this total-time-between-pulses, subtract the 0.1 microsec of the small length of cable used to connect the output of the "T" connector to the cable under test. Multiply the remainder by the multiplying factor for the type of cable under test and you have the distance to the fault in feet.

John's customer uses the following chart:

CABLE TYPE	PROPAGATION FACTOR	MULTIPLYING FACTOR
Solid Poly	.66	325
Foam Poly	.82	404
½" Styro	.89	439
¾" Styro	.90	443

The multiplying factor of a given cable is determined by multiplying the figure for the speed of light (983.5 ft. per μsec) down one foot of the cable by the propagation factor of the cable and dividing by two since the pulse must travel twice the distance to the fault before showing up as an echo. John says that according to his figures the multiplying figure for solid poly should be closer to 320. However, his customer has been using this chart for sometime and hasn't been too far off yet.

When the cable under test is less than 30 or 40 feet, then an additional hundred feet should be inserted. Otherwise, the reflection returns so fast it rides on the top of the initial pulse.

This method is currently being used on cables with lengths up to 2,000 feet. Reportedly, it may be used on lengths upwards of a mile provided the cable is of a low loss type.

THAT OLD BUGABOO "CATHODE INTERFACE"

Tektronix Canada, Ltd. Field Engineer Gordon Dickson (Montreal) called on a customer to find him struggling with the transient response of a Type 545 Oscilloscope. The customer stated that he had spent two days in sporadic attempts to bring the vertical response of the instrument within specifications. He claimed that each time he endeavored to touch up the high frequency peaking and the delay line, the transient response showed a change from the last time he had worked on it.

Immediately suspecting the cause of the difficulty, Gordon connected the instrument to its power source through a variable-voltage transformer. A quick check confirmed his suspicions. The customer had been battling a condition that no amount of tweaking and adjusting would overcome—cathode interface. Cathode interface is a condition that can develop in the vertical-amplifier tubes of any oscilloscope—some tubes being more offensive than others. It will cause degeneration of all but high frequency signal components . . . leaving an overshoot on the leading edge of fast-rise (0.2 μsec or less) squarewaves.

At Gordon's suggestion, the customer replaced the offending tubes and then easily recalibrated the vertical amplifier to bring transient response of the instrument within specifications.

In the August 1960 issue of SERVICE SCOPE we published an article that dealt at some length on this problem of cathode interface. Those who maintain a back-issue file of SERVICE SCOPE may wish to review that article. The title—*"Does The Square Wave Response of Your Scope Look Like This."*

If you do not maintain a back-issue file of SERVICE SCOPE you can obtain a copy of the August 1960 issue by contacting your Tektronix Field Engineer or local Field office.

OSCILLOSCOPE LITERATURE RACK

A DO-IT-YOURSELF PROJECT

This idea for a literature-holding rack (see Figure 1 and 2) comes to us from one of our readers, Anthony J. Kalilich of the NASA in Cleveland, Ohio. Tony uses this rack to hold manuals for easy, ready reference during instrument calibration. He and other engineers at NASA also use it to hold their reference data during various tests. Having this material off the bench but still handily available, tends to minimize the time spent searching under papers and manuals for tools or components. This in turn contributes to a more efficient utilization of the engineer or technician's time.

Fabrication of the rack requires only about 15 minutes of time and most laboratories or maintenance facilities will contain the necessary materials. Suggested materials are two 10/32 female banana jacks and two 30" lengths of buss wire or copper-clad welding rod. The diameter of the buss wire or welding rod should be such that it will fit into the female end of the banana jacks. About ¾" from one end of each wire or rod length make a 90° bend. Insert the end of the ¾" section into a banana jack and solder it to the jack. Now insert the two banana jacks into the two top graticule stud bolts of your Tektronix (5"crt) oscilloscope and bend the wire or rod as shown

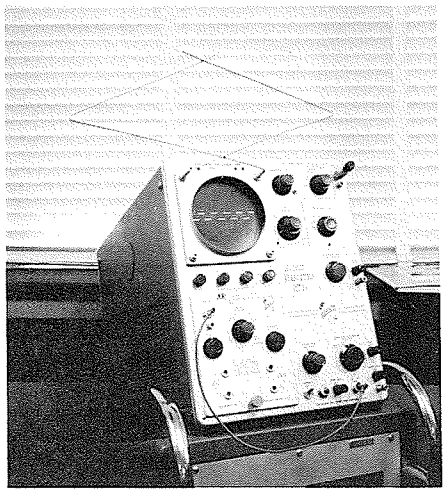


Figure 1

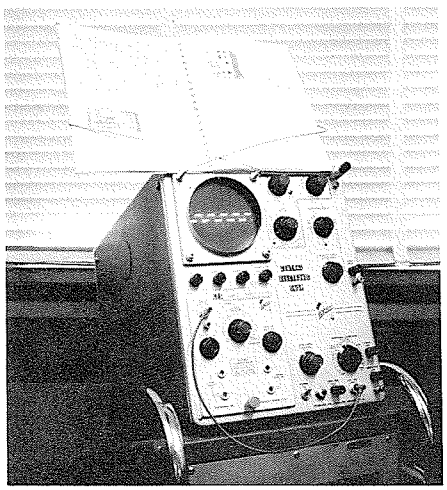


Figure 2

in Figure 1. Solder the two wires or rods together at the two points where they cross. The degree of the angle thus formed by each wire or rod is not critical. However, for appearances sake they should match. If you solder the wires or rods together so that the distance between the two points of the two V's is approximately 18½", the rack will accommodate an opened Tektronix instrument manual as shown in Figure 2.

That's all there is to it . We thought it was quite simple and with only the pictures as a guide.

USED INSTRUMENTS FOR SALE

Type 524D Oscilloscope, s/n 179. Asking $500. Gene Phelps, KPTV, 735 S.W. 20th Place, Portland, Oregon. Phone: CApitol 2-9921.

Type 310A Oscilloscope, s/n 7142. Price $575. Dr. Leonard Rose, 2311 N.W. Northrup Street, Portland 10, Oregon.

Type 310 Oscilloscope, s/n 3350. Mr. La Douceur, American Motor Corp., 14250 Plymouth Road, Detroit 32, Michigan.

Type CA Plug-In Unit. Deictron Electronics Corp., 850 Shepherd Avenue, Brooklyn 8, New York. Phone: NI 9-8110.

Type 105 Square Wave Generator, s/n 5875. Price: $325. Type 110 Pulse Generator and Trigger Takeoff, s/n 600. Price: $525. Type 113 Delay Cable, s/n 294. Price: $150. Type N Plug-In Unit, s/n 683. Price: $475. Bernard H. Shuman, General Manager, Morris Cooper Corp., 3832 Terrace Street, Philadelphia 28, Pa.

Type 122 Preamplifier, s/n 3289. Colonel Hoxie, Lind Instruments, 2294 Mora Drive, Mountain View, California. Phone: 968-0083.

Type 180 Time-Mark Generator, s/n 207. Landy Garman, National Aeronautical Corp., Commerce Drive, Fort Washington, Pennsylvania. Phone: MI 6-2900, xtn. 41.

Type 517A Oscilloscope, s/n 622. Sam Cooper, Rutherford Electronics, 8944 Lindblade Avenue, Culver City, California. Phone: UP 0-7393.

Type 551 Oscilloscope, s/n 369. Type 535 Oscilloscope, s/n 1173. Type 53C Plug-In Unit, s/n 1143. Engineering Dept., Richard D. Brew & Co., 90 Airport Road, Concord, New Hampshire.

Type 533 Oscilloscope, s/n 515. Price: $775. Type 53/54E Plug-In Unit, s/n 2090. Price: $125.
Type 53/54C Plug-In Unit, s/n 20261. Price: $175. Type RM181 Time-Mark Generator, s/n 1034. Has a crystal oven. Price: $195. Type 500A Scope-mobile. Price: $70. Cradle Mount for rack mounting a Type 533 scope. Price: $20. Miscellaneous small accessories including probes, connectors, and other small items will be included with the appropriate units. Joseph M. Edelman, M. D., 4550 North Boulevard, 204 Medical Center, Baton Rouge 6, Louisiana.

1 Type 517 Oscilloscope, s/n 161. Price: $1500. Needs work. Armond Piscopo, 1546 Slater Street, Toledo 12, Ohio.

USED INSTRUMENTS WANTED

1 Type 124 Television Adapter. Purchasing Agent, Owen-Illinois Technical Center, 1700 N. Westwood, Toledo, Ohio.

1 Type 575 Transistor Curve Tracer. L. Bachhuber, Appleton Mills Co., 614 S. Oneida Street, Appleton, Wisconsin. Phone: REgent 4-9876.

2 Type 535 or Type 545 Oscilloscopes. J. R. Halchak, E. G. & G., Inc., 160 Brookline Ave., Boston 15, Mass.

1 Type 531 and 1 Type 533 Oscilloscopes. Harry Applebay, 902 West Pedragosa, Santa Barbara, Calif.

1 Type 310 or 310A Oscilloscope. Steve Karapti, National Aeronautical Corp., Commerce Drive, Fort Washington, Penn.

1 Type 541 Oscilloscope and 1 Type CA Plug-In. Joe Gaon, 64-50 229th Street, Bayside, N. Y.

1 Type 531A, Type 533A, Type 541A or Type 543A Oscilloscope. A. R. Shelby, President, Production Electronics, Inc., 525 Lehigh Avenue, Union, New Jersey.

1 Type 515A Oscilloscope. John Harshbarger, Systems Research Laboratories, Inc., 500 Woods Drive, Dayton 32, Ohio. Phone: CH 4-4051.

1 Type 531A Oscilloscope with a Plug-In Preamplifier (Type CA preferred). 1 Type 516 Oscilloscope. 1 Type 524AD Oscilloscope. Charles Hanavich, 712 Grandview Drive, Alexandria, Virginia.

MISSING INSTRUMENTS

Our Long Island Field Office advises us that a Type 533 Oscilloscope, serial number 1202, and a Type CA Plug-In Unit (serial number not available) are missing from the Alternating Gradient Synchrotron at Brookhaven National Laboratory, Upton, New York. These instruments are the property of the United States Government and unauthorized possession of them is a federal offense. Officials consider this a serious matter and the Federal Bureau of Investigation has been called in on the case.

Persons with information on the above instrument should contact Mr. Herb Lutz at the Brookhaven National Laboratory. Telephone number is: area code 516, number 924-6262, extension 2193. Or, you may contact the nearest Federal Bureau of Investigation office.

Mr. Sternberg, with the Department of Entomology at the University of Illinois in Urbana, Illinois, reports that his Type 502 Oscilloscope, serial number 901, disappeared on August 6, 1962. This instrument was not in working condition. Suspected trouble was a crt or high voltage problem. All instrument repair centers and technicians are asked to be on the alert should a Type 502 with these symptoms of trouble be presented for repair.

Mr. Sternberg would appreciate hearing from persons with information regarding this instrument. They may contact him at the address given above.

The Deer Valley Park plant of General Electric Company asks that our readers keep an eye out for a Type 535A Oscilloscope, serial number 27884 and two Type CA Plug-In Units, serial numbers 41577 and 45244. These instruments have disappeared from this facility and they would like very much to recover them. Direct any information you may have on the whereabouts of these instruments to the General Electric Company, 13430 North Black Canyon Highway, Phoenix, Arizona. Attention: C. H. Worlock, Mgr., Product Service Administration.

NEW FIELD MODIFICATION KITS

TYPE 180 TIME-MARK GENERATOR CRYSTAL OVEN MOD KIT—For Type 180 instruments with serial number 951 to 5000 inclusive.

This modification installs a temperature-stabilized crystal oven in the Type 180. Frequency-stability characteristics will be improved to three (3) part per million over a 24 hour period. Time required for installation is approximately one and one-half hours*.

Order through your local Tektronix Field Engineer or Field Office. Specify Tektronix part number 040-285. Price: $49.50.

A previously announced Crystal Oven Mod Kit installs a temperature stabilized crystal oven in Type 180 Time-Mark Generators with serial numbers below 951. For this modification order Tektronix part number 040-252. Price: $50.75.

TYPE 532 AND TYPE RM32 OSCILLOSCOPES CHOPPED-TRANSIENT BLANKING MOD KIT. All serial numbers.

Installation of this modification adds blanking to the crt cathode to eliminate switching transients when using the Type 53/54C, 53C, CA, or M Plug-In Units in the CHOPPED Mode. Time required for installation is approximately two and one-half hours*.

Order through your local Tektronix Field Engineer or Field Office. Specify Tektronix part number 040-283. Price: $70.00.

TYPE 517 AND TYPE 517A THERMAL PROTECTION MOD KIT—For serial numbers 101 through 1739.

When installed, this modification provides thermal cutouts for both the Indicator and Power Supply units. In instruments wired for normal line voltages (i.e. 105 to 125 v), should the chassis temperature reach approximately 137° F, the cutout will turn the affected unit off. The fan will continue to operate as an aid to cooling the unit to a safe operating temperature. In those instruments wired for 210 to 250 v line voltages, the cutouts will operate in the same manner with one exception—the fan will not operate during the cooling off period. Time required for installation is approximately two and one-half hours*.

Order through your local Tektronix Field Engineer or Field Office. Specify Tektronix part number 040-291. Price: $58.00.

Tektronix, Inc.
P. O. Box 500
Beaverton, Oregon

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

CRT SCREW ALIGNMENT MOD KIT

This modification provides a more satisfactory means for adjusting the crt alignment. A new bracket, with rotator and clamp assembly, replaces the old support bracket and clamp assembly at the base of the crt. This new assembly features a finger-operated screw adjustment for easy and precise rotation of the crt. Another feature is an adjustment to minimize parallax between the phosphor surface and the graticule. Time required for installation is approximately 30 minutes*.

Order through your Tektronix Field Engineer or Field Office. Specify for the following instruments Tektronix part number 040-292. Price: $4.75.

SCOPE TYPE	SERIAL NUMBER
531/531A	5001-20409
532	5001-6519
533	101-1469
535/535A	5001-21349
536	101-1089
541/541A	5001-20469
543	101-1249
545/545A	5001-22059

For these following instruments, specify Tektronix part number 040-293. Price: $4.75.

SCOPE TYPE	SERIAL NUMBER
RM31/RM31A	101-1059
RM32	101-330
RM33	101-139
RM35/RM35A	101-1229
RM41/RM41A	101-1029
RM43	101-111
RM45/RM45A	101-1199

TYPE 127 SILICON RECTIFIER MOD KIT—For Type 127 Preamplifier Power Supplies.

This modification replaces the selenium rectifiers used in the Type 127 with silicon diodes. Silicon diodes offer greater reliability and longer life. Time required for installation is approximately one and one-half hours*.

Two kits, each restricted to a certain serial number range, are offered. In ordering, care must be exercised to be sure that you order the kit for the serial-number range in which your instrument's serial number falls.

Order through your Tektronix Field Engineer or Field Office. For instruments with serial numbers 101 through 358, specify Tektronix part number 040-217. Price: $29.50. For instruments with serial numbers 359 and up, specify Tektronix part number 040-282. Price: $34.00.

*Quoted installation times are for first-time installations by a trained technician familiar with Tektronix instruments.

DON'T LET THIS HAPPEN TO YOU

One of the prime purposes of the Tektronix Field Office and its Field Engineers is to help customers select the instruments best suited to their present and future needs. To prepare himself for this task, the Field Engineer spends at least six months in training—at the factory—and returns periodically for further training and indoctrination on new instruments.

The following incident illustrates what can happen when a customer, not completely familiar with Tektronix instruments, places an order without availing himself of a Tektronix Field Engineer's counsel and advice.

A certain company makes solenoid-operated, fast-response valves for a special application. These valves must open or close within several milliseconds of the application of current to the solenoid.

One of this company's customers suggested that this response time can be measured with a Tektronix Type 551 Dual-Beam, Dual-Plug-In Oscilloscope. The company ordered one, regrettably not through the Tektronix Field Office that should serve them.

When the instrument was delivered, they found that they did not have an end-use instrument—they had not ordered Plug-Ins.

Duncan Doane, of our Encino, California Field Office, was the Tektronix Field Engineer finally called on for help. When he determined the company's actual application, he informed them that a less sophisticated oscilloscope could do the job for them and at a considerable savings. He offered to take back the Type 551 and replace it with a less expensive oscilloscope.

Possibly to show their appreciation for Tektronix efforts to be agreeable and fair, they declined the offer. However, they did ask Dunc if he would advise them on what they must do to make the measurement.

Here was a natural for the Tektronix Type Q Transducer and Strain Gage Plug-In Unit and Dunc so advised them. They will use a Stratham P-27 pressure transducer with it. To fill in the other vertical plug-in compartment of the Type 551, Dunc suggested a Type A Plug-In unit to monitor the current build up through the solenoid. They will use the drop-in-potential method across a series resistor.

Remember, your Tektronix Field Engineer can be your best source of help—before, during, and after delivery of your Tektronix instruments.

SERVICE HINTS

VERTICAL DRIFT IN TYPE 503 OSCILLOSCOPES

The flange-mounted electrolytic capacitors C652 and C654 affect the output voltage of the —12, +100 and +250 volt supplies in the Type 503. These supplies are only indirectly regulated. In cases of vertical drift, not attributable to tubes, try cinching down the flange-mounting screws of these capacitors.

Tektronix Instrument-Repair Facilities: There is a fully-equipped and properly-staffed Tektronix Instrument Repair Station near you. Ask your Field Engineer about Tektronix Instrument-Repair facilities.

Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 17 PRINTED IN U.S.A DECEMBER 1962

NEW TRIGGER-CIRCUIT ADJUSTMENT METHOD

By Paul Thompson
Tektronix Field Training Department

We present here a new method of adjusting the trigger circuits in the Tektronix Type 530/540 and Type 530A/540A Series Oscilloscopes having a PRESET position for the STABILITY control. It is fast, simple and accurate and requires a minimum of equipment (a screwdriver, and one or two jumper leads). Normally it does not require any "adjust this while tweaking that for minimum this." It also provides a check on the tubes in the circuit. Try it; we think you'll become a convert.

This method also works on the Type 316, s/n's 1298 and up; Types RM16 and RS 16, s/n's 900 and up; Type 317, s/n's 900 and up; Type 516, 551, 555, all s/n's; and Type 515A, s/n's 5309 and up. It will not work on a trigger circuit which has no Trig. Sens. adjustment.

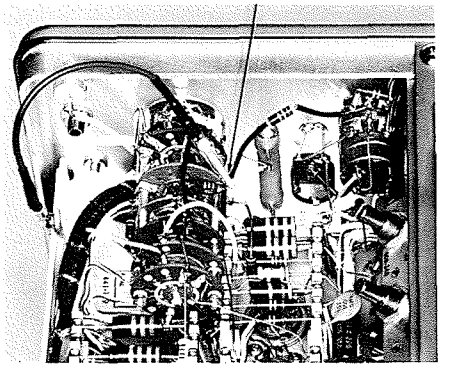
In the procedure that follows, the completely capitalized terminology refers to controls or switches located on the front panel of the instrument. Terminology with only the first letter of each word capitalized refers to adjustment controls located within the instrument.

1. Set the PRESET ADJUST by the standard method. (Set the TRIGGERING MODE to AUTO and the TIME /CM switch to .1 millisec. Set the STABILITY to the PRESET position. Set the PRESET ADJUST control halfway between the points where the trace first appears and where it brightens.) Position this trace to the vertical center of the graticule, you'll need it there later. Leave the STABILITY control in the PRESET position for the rest of this procedure.

2. Set the trigger controls to EXT., either + or —, and AC. Ground the junction of the two resistors in the time base trigger circuit as indicated in the following chart:

Oscilloscope Type	Resistors
530/540 Series	R16 and R17
530A/540A Series	R19 and R20
551	R19 and R20
555	R19 and R20
316	R426 and R427
317	R426 and R427
515A	R24 and R25
516	R20 and R21

3. Turn the TRIGGERING LEVEL control fully clockwise. You may or may not get a trace on the crt screen.



In the figure above the arrow points to the junction of the two resistors and shows the grounding jumper referred to in step 2. (Instrument: Type 533A. Resistors: R19 and R20).

4. Set the Trig. Level Centering adjustment to the center of the region which makes a trace appear on the screen. (If you can't get a trace by manipulating the Trig. Level Centering adjustment, the trigger Schmitt circuit is not working properly.)

5. Turn the TRIGGER SLOPE switch (TRIGGER SELECTOR on some instruments) between + EXT. and — EXT. and readjust the Trig. Level Centering adjustment, if necessary, to get a trace in both the + and — positions. If you can't, the trigger amplifier circuit is not operating properly (probable cause; a gassy tube).

6. Set the triggering controls to INT., either + or —, and DC. The trace will probably disappear.

7. Set the Int. Trig. DC Level adjustment to the center of the region which makes the trace appear on the screen. This region will probably be very narrow.

8. Remove the grounding strap you connected in step 2, and position the TRIGGERING LEVEL control until the trace reappears. The white spot on the knob should then be at or very near the top (opposite the "O" on the front panel). If it is not, loosen the Allen set screw in the knob and position the knob properly.

9. Turn the Trig. Sens. adjustment counterclockwise until the trace just disappears and then about 45 degrees further counterclockwise. This will provide adequate triggering capabilities for most uses and will probably put the scope within factory triggering specifications. If you want to make sure, go on to steps 10 and 11.

10. Set the triggering controls to EXT., either + or —, and AC. Set the AMPLITUDE CALIBRATOR to .2 volts and connect the CAL. OUT to the vertical INPUT. Set the VOLTS/CM switch to .1 or .05.

11. Turn the Trig. Sens. adjustment counterclockwise until the trace disappears and then clockwise just far enough to get proper triggering in both the + and — EXT. positions. If the scope won't trigger in both the + and — positions, touch up the Trig. Level Centering adjustment until it does.

Theory: In step 3, you are setting the trigger Schmitt to free run when the dc voltage on its input grid matches its inherent hysteresis level. In step 4, you are setting this hysteresis level to match the dc level of the trigger-amplifier output plate with both grids at zero volts. In step 5, you are checking the trigger-amplifier tube for gas under much more rigorous conditions than would ever be present in normal scope use (one grid to ground through 1 meg, the other grid to ground through 47 ohms). In step 7, you are setting the Int. Trig. DC Level adjustment to the point where the vertical amplifier places zero volts on the trigger-amplifier grid when the trace is centered on the screen. In step 11, you are adjusting the circuit so that it will trigger on 0.2 volt external but not on much less than that. (The hysteresis gap closes as the Schmitt tube ages; if the Trig. Sens. is set too sensitive, you may be adjusting it again next week.)

GREASE-OFF

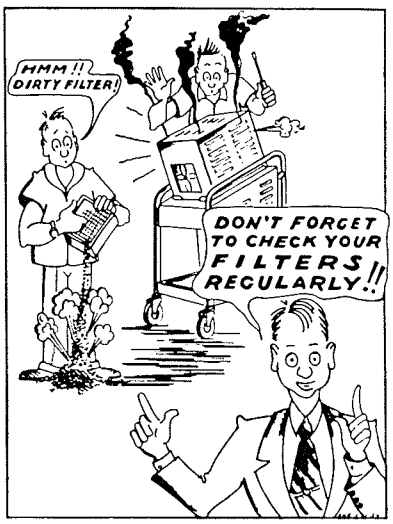
In the August '62 issue of Service Scope we referred to an air-filter cleaning agent called "Grease-Off", a product of the Garden Products Company of Two Rivers, Wisconsin. Several customers have written to us or our Field Offices asking for a more complete address for this concern. Here it is:

Garden Products Company
3914 Monroe Street
Two Rivers, Wisconsin

According to Gordon Allison, District Manager at our West Los Angeles Field Office, the West Coast source of supply

for Grease-Off is the American Geophysical and Instrument Company, 16440 South Western Avenue, Gardena, California — Phone 321-2634. Also, according to Gordon, we were misinformed as to the price of Grease-Off. Correct price is $6.85 per gallon not $3.85 per gallon as we stated.

REMINDING YOU



. . . that you should not operate your Tektronix forced-air-ventilation instruments, for extended periods, with the side panels removed. The panels contain and conduct the flow of air for maximum cooling efficiency. Damage from overheating can occur if the instrument operates for extended periods of time with the side panels removed.

. . . that to ensure an adequate flow of ventilating air, we recommend a clearance of approximately one foot (sides, top and rear) for the instrument.

. . . that instruments with dirty air filters cost you money by causing more down time, more maintenance problems, more need for replacement parts and a shorter life expectancy for the instrument.

. . . that you should clean air filters (see your instrument's instruction manual or the October '59 issue of SERVICE SCOPE) at least every 500 hours of operation—more often under difficult environmental conditions.

MORE ABOUT PIN POINTING INFORMATION ON POLAROID PRINTS

In an article in the June issue of Service Scope, we described a method for pin pointing information on Polaroid Land Camera prints. We neglected to state that the system works well only after the print's surface has dried a couple of minutes or more after development, and before the preservative coating is applied.

Quite a few of our readers called this oversight to our attention. One of them, Mr. William R. Hayes, manager of the Electrical Laboratory at Joslyn Manufacturing and Supply Company, offered an alternate method of adding notes to Polaroid prints.

Here, in Mr. Hayes' own words, is his suggestion: "—For some years now our laboratory has used a faster and simpler method of adding notes to Polaroid prints that takes advantage of the softness of the print's surface just after development. It is so soft in fact, that it is easily scratched; so we scratch out our notes. It is still soft enough to scratch for perhaps an hour after development. If the print has been coated or if it is a long time after development, the surface can be scratched easily by first wetting it with the print coater.

The success of this method however, lies in the nature of the point used to scribe the emulsion. A pin is too sharp and will dig up the surface. A sharpened pencil is too rounded. Something between these is best. Some experimentation with a whetstone and a metal point is necessary. We have made a number of scribes by pointing the head end of a 6-32 stainless screw and inserting the other end into a threaded ¼" plastic rod about 6 inches long.

These handy instruments have increased our efficiency and accuracy in data recording by immediately scribing sweep times, sensitivities, serial numbers and circuit information on the face of the oscillograms."

Tektronix Field Engineer Earl Williams with our Field Information group suggests a third method: In this method you apply Snopake to selected portions of the Polaroid print. Snopake is a fast-drying correction fluid used in Xerography work. It dries quickly to furnish a snow white surface upon which you may write the required information. Be sure that the preservative coating has been applied to the Polaroid print and allowed to dry thoroughly before using Snopake.

Snopake is readily available through your local business-stationery and office-supplies outlet.

FOR YOUR INFORMATION

Recently we sent to our Field Offices reprints of the booklet "Fundamentals of Selecting and Using Oscilloscopes." This booklet contains two articles, "Appraising Oscilloscope Specifications and Performance" and "Factors Affecting the Validity of Oscilloscope Measurements" which appeared originally in *Electrical Design News*. John Mulvey, Manager of the Field Information group in the Field Engineering Department of Tektronix, Inc., authored the articles.

"Appraising Oscilloscope Specifications and Performance" intends to clarify the significance of many of the technical terms used to describe oscilloscopes. People who, being responsible for buying or recommending such instruments, feel the need for a better understanding of the relative importance of different features will find this article informative.

"Factors Affecting the Validity of Oscilloscope Measurements," the second article in the booklet, discusses some common limitation and application pitfalls which apply to cathode-ray oscilloscopes. Some easily made performance checks are also included.

Another item of the booklet is a ready-reference chart giving the basic specifications of most Tektronix oscilloscopes.

To obtain a copy of this booklet, contact your local Tektronix Field Engineer or Field Office and ask for "Fundamentals of Selecting and Using Oscilloscopes." If you do not know your local Tektronix Field Engineer or the address of the nearest Field Office, direct your inquiries to: Editor, SERVICE SCOPE, Tektronix, Inc., P. O. Box 500, Beaverton, Oregon. We'll send you the needed names and addresses and see that you receive a copy of the booklet.

We recently received word from our Phoenix Field Office that a Type 310A Oscilloscope, s/n 10023, belonging to U. S. Semcor is missing. Mr. Porter of U. S. Semcor has asked that we request our readers to be on the lookout for this instrument. If you have any information regarding this Type 310A, please contact Mr. Porter. His address is: U. S. Semcor, 3504 West Osborn, Phoenix, Arizona.

* * *

The Physics Department of the College of William and Mary notifies us that a Type 503, s/n 000230, disappeared from the college last May and is now presumed to have been stolen.

Dr. Melvin A. Pittman, Chairman of the Department of Physics, will appreciate it if anyone with information on the whereabouts of this instrument will contact him or Mr. John H. Long, Assistant Professor, Department of Physics. Address your information to either man at the College of William and Mary, Williamsburg, Virginia.

USED INSTRUMENTS WANTED

1 Type 545 Oscilloscope and 1 Type CA Plug-In Unit. George J. Kominiak, 195 Preakness Avenue, Paterson 2, New Jersey.

* * *

1 Type 502 Oscilloscope. Ken MacIntosh, Lectour, Inc., 4912 Cordell Avenue, Bethesda 14, Maryland. Telephone OLiver 2-4477.

* * *

USED INSTRUMENTS FOR SALE

1 Type 511 Oscilloscope (s/n not given). J. Greenspan, Process and Instruments Corporation, 15 Stone Avenue, Brooklyn 33, New York.

* * *

For sale or trade 1 Type 105 Square-Wave Generator, s/n 4348. Would consider trade for good Frequency Meter to cover Marine to Business Radio Band. Dan J. Mooney, Communications Equipment Company, P.O. Box 35, Handsboro, Mississippi.

* * *

1 Type 503 Oscilloscope, s/n not given but instrument is less than one year old and in "mint condition." Asking $540.00. Bernie Markam, Cabinart Inc., 35 Geyser Street, Haledon, New Jersey.

* * *

1 Type 105 Square Wave Generator, s/n 2970, Autoelectronics, Inc., Attention: Allan Sicks, 6207 Braemore Road, Indianapolis 20, Indiana. Telephone CL 3-6100.

* * *

1 Type 541 Oscilloscope, s/n not given. Al Browdy, KCOP TV, 915 La Brea, Los Angeles 38, California. Telephone OL 6-6050, Ext. 305.

* * *

1 Type 517 Oscilloscope, s/n not given. Mr. Osborne, 153-13 Northern Boulevard, Flushing, New York.

* * *

1 Type 502, MOD 407 Oscilloscope, s/n 5531, complete with accessories and polarized viewer. Instrument has been used less than six months. Asking $825.00. Bob Briggs, Geosonic, Inc., Box 22166, Houston 27, Texas. Telephone: Sunset 2-2250.

* * *

2 Type 581 Oscilloscopes, s/n's 163 and 167. 2 Type 80 Plug-In Preamplifiers, s/n's not given. 1 Type 517A, s/n 1680, with a Type 500A Scopemobile. John Ivimey, 595 5th Avenue, New York 17, New York. Telephone: PLaza 2-1144.

* * *

1 Type 515A Oscilloscope, s/n 3979. Webster Enterprises, 795 Marin Drive, Mill Valley, California.

* * *

1 Type 512 Oscilloscope, s/n 3317. Ken Goodman, Chief Engineer, Engineered Electronics, P. O. Box 659, Santa Ana, California.

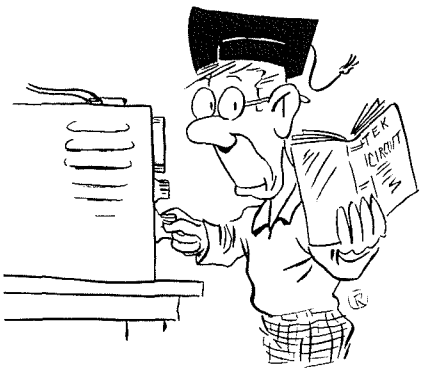
* * *

1 Type 561 Oscilloscope, s/n 646; 1 Type 72 Dual-Trace Amplifier, s/n 409; 1 Type 67 Time-Base Unit, s/n 719, and 1 Type 201 Scopemobile. Henry Petheridge, Electronics, Inc., 2440 Maryland Avenue, Willow Grove Industrial Park, Willow Grove, Penna. Telephone: OL 9-6666.

* * *

1 Type 72 Dual-Trace Plug-In Amplifier (no serial number given). Price: $200.00. Dr. Dick Tuttle, Masonic Research Laboratory, Utica, New York. Telephone: RE 5-2217.

"TYPICAL OSCILLOSCOPE CIRCUITRY"



". . . Manipulation of the front panel controls of an oscilloscope can be learned by rote. To use the instrument to its fullest capabilities a knowledge of oscilloscope circuitry is essential . . ." These words help to introduce the reader to a new book, "Typical Oscilloscope Circuitry," published by Tektronix Incorporated.

"The purpose of this book," as the preface explains, "is to provide a basic understanding of the functioning of those fundamental circuits that appear most often in Tektronix instruments. It is aimed at the man who maintains and calibrates instruments. But a knowledge of the information that is in this book will also help the instrument user to appreciate the characteristics, performance and limitations of his instrument. . . The treatment throughout is essentially nonmathematical. Some of the most elementary ideas of algebra and trigonometry (sine waves) are used. A few calculus symbols appear but these are applied only graphically and no knowledge of calculus operation is needed. The purpose of using these calculus symbols is one of brevity. . ."

We think you will find that the order of subject presentation plus the clear, concise wording of the subject explanations accomplishes the stated purpose of this book and with a minimum of confusion for the reader.

Price of the book is $5.00. Copies may be ordered through your Tektronix Field Engineer or local Field Office. Specify Tektronix part number 070-253.

SERVICE HINTS

SERVICING HIGH-VOLTAGE POWER SUPPLIES

Ron Bell, Tektronix Field Engineer with our Pittsburgh Field Office, uses this trick quite frequently when trouble-shooting the high-voltage power supply of Tektronix oscilloscopes: He removes the cover from the high-voltage supply and inspects the filaments of the type 5642 tubes. Should he find the filaments of one tube glowing brighter than the others, he replaces that tube on suspicion.

The type 5642 tube has a direct heated cathode. The filament or heater wires are coated with an emitting material and this material acts as the cathode for the tube. Over a period of time sublimation of this material takes place and the cathode emits fewer and fewer electrons, finally reaching a point where electron emission is too low for the tube to function properly. This low emission is one of most common causes of faulty performance in these high voltage power supplies.

Ron claims that it takes only a few minutes to whip off the cover and replace a faulty tube and it can save hours of frustration in trying to trouble-shoot with a meter.

Other difficulties can develop in the power supply that will cause the filaments of one or more of the 5642 tubes to glow unnaturally. A replaced 5642 tube whose filaments continue to glow too brightly indicates the need for a more thorough investigation of the high voltage supply. Also, reoccurrence of unnatural filament brightness in replaced 5642's after only a relatively short period of operation (50 to 100 hours) suggests the need for this more comprehensive investigation.

TYPE 60 AMPLIFIER—INSTRUCTION MANUAL CORRECTION

Starting with serial number 432, the Type 60 Plug-In was modified to operate V434 and V444 from the regulated dc-filament supply, and to delete HUM BALANCE control R493.

Information concerning the modification was inadvertently omitted from the Type 60 Instruction Manual until serial number 480, when the omission was discovered and the manual corrected.

Owners of Type 60 Plug-In above serial number 432 whose manuals do not agree with the instruments circuitry may order updated schematics. Tektronix number for the schematic is 061-374. Order through your nearest Tektronix Field Office or overseas representative. There is no charge for one or two copies.

TYPE 502MOD104 OSCILLOSCOPE—INCREASING NEON LIFE

You can extend the life expectancy of the "READY" neon in this instrument by removing the strap, located between the neon and ground on the SINGLE SWEEP toggle switch, and installing a 27 k, ½ watt, 10% resistor mounted between the neon and the detent plate of the TRIGGER SELECTOR switch.

TYPE 504 AND TYPE RM504 OSCILLOSCOPE—DECREASING TUBE SELECTION

You can decrease the necessity of tube selection for V24 in these instruments by making the following changes:

(1). Remove R26, a 100 k ½ watt, 10% resistor and replace it with a 120 k, ½ watt, 1% precision resistor.

(2). Remove R28, a 33 k, 1 watt, 10% resistor and replace it with a 33 k, 1 watt, 1% precision resistor.

This modification applies to Type 504 instruments with serial numbers below 530 and Type RM504 instruments with serial numbers below 550. Instruments with higher serial numbers have this modification incorporated at the factory.

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

Tektronix, Inc.
P. O. Box 500
Beaverton, Oregon

QUESTIONS FROM THE FIELD

Q. I've had some trouble with a Type 507 arcing at the crt anode connector. How can I correct this?

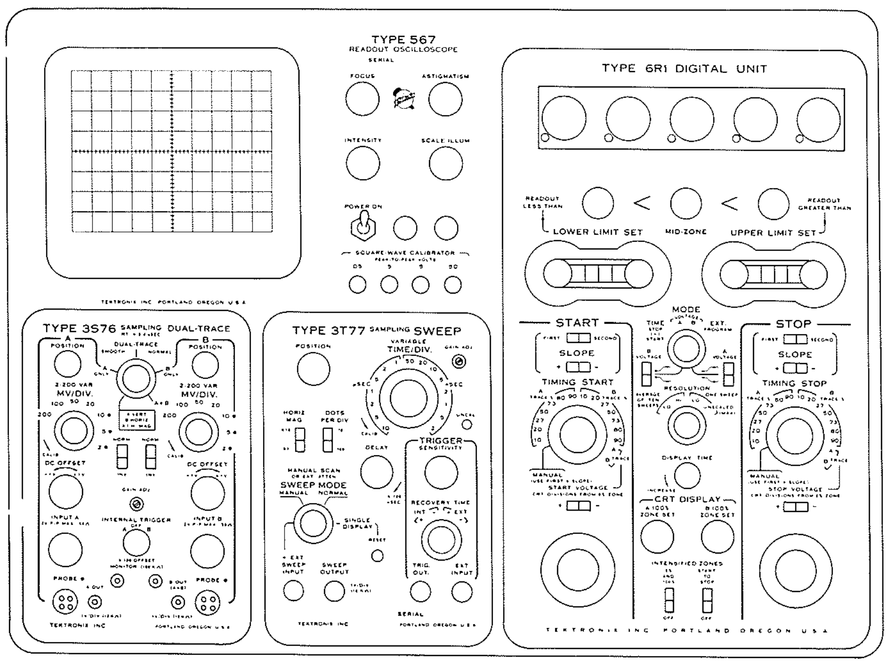
A. Sometimes a conductive coating on the crt glass and anode button will cause the arcing you describe. Try scrubbing the anode button and surrounding glass area with alcohol or acetone. Check the length of the anode brush and trim the brush if it bows. Twist the brush to prevent loose strands.

In rare cases the crt may be rotated far enough for arcing to occur between button and shield. We've been able to cure this problem with Corona Dope (General Cement No. 47-2 or equivalent). Apply the dope to the inside of the shield. Paint a band about 1.5 inches wide overlapping the seam between the light cap and the crt shield. Apply two coats.

Q. When viewing 1-μsec time markers from the output of the Type 181 Time-Mark Generator, while triggering the scope externally with 100-μsec markers from the front panel binding post of the Type 181, we have a spurious pulse of less intensity than the main pulse. How can we get rid of this spurious pulse?

A. The pulse is actually very regular, but appears spurious when the sweep is triggered at a repetition rate higher than 1 kc. Every 10th 100-μsec pulse is loaded by the 1-msec multi, which shifts the time position of every 10th 100-μsec mark slightly with respect to the others. When an occasional sweep is started by the "spurious" 100-μsec marker, faster pulses will be out of relationship with the majority and will appear to be spurious. The condition is normal in the Type 181, but can be improved by putting a 12 pf capacitor across R170, a 22 k, ½ w, 10% comp. resistor.

TYPE 567 TEST SET-UP CHART



DATA: This is a Type 567 Test Set-Up Chart. It provides a ready means of recording instrument control settings for any given test or production set up. A facsimile of the trace resulting from the set up can be drawn on the chart graticule or a picture of the waveform attached to the chart. In the "DATA" space, where this message to you is printed, special instructions or pertinent information concerning the test or production set up can be recorded.

Besides the Type 567 Digital Readout Oscilloscope, Test Set-Up Charts are also available for the following instruments: Type 502, Type 503, Type 545A (with CA, R, or Z Plug-In Units), Type 570 and Type 575 Oscilloscopes.

Your Tektronix Field Engineer will be glad to give you more detailed information on these Test Set-Up Charts. Why not call him right now?

TEK 001-826D — TEKTRONIX, INC.

Tektronix Instrument-Repair Facilities: There is a fully-equipped and properly-staffed Tektronix Instrument Repair Station near you. Ask your Field Engineer about Tektronix Instrument-Repair facilities.