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.

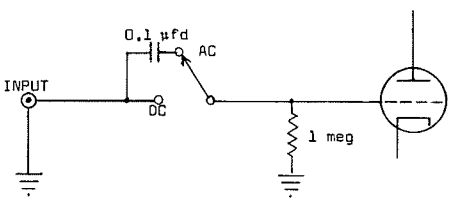


Figure 1

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 pick-up. 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.

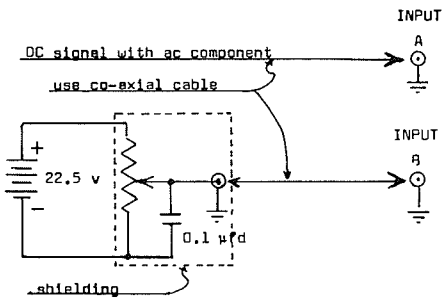


Figure 2

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 ±.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

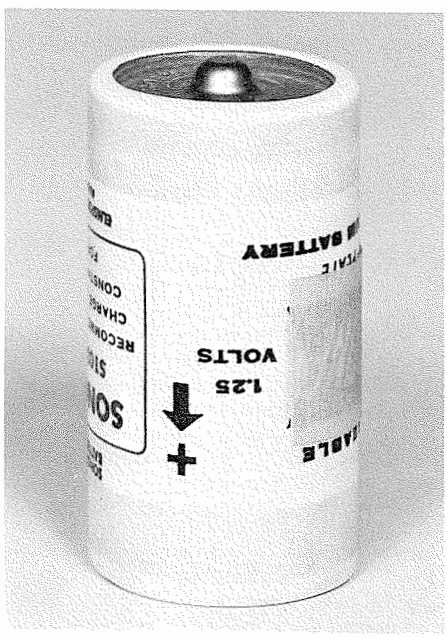
For Type 502 Oscilloscopes, all serial numbers.

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.

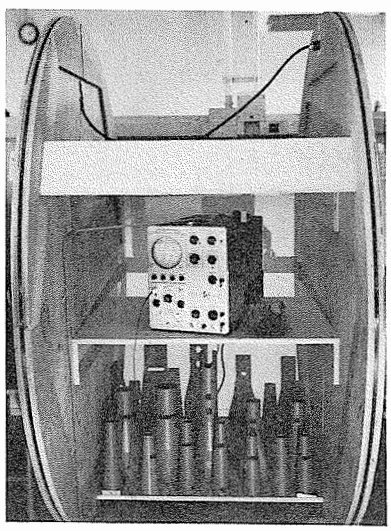


Figure 1

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.

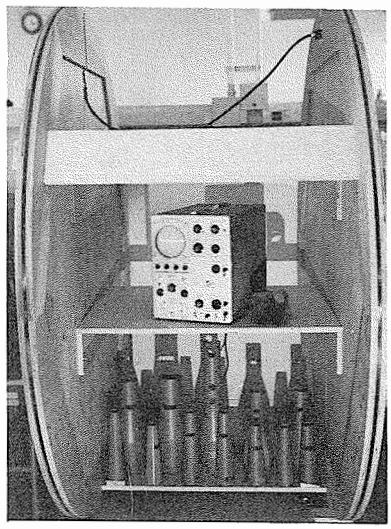


Figure 2

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.

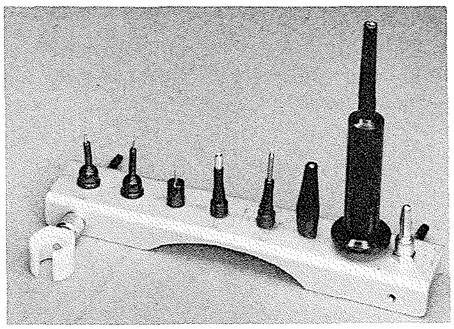


Figure 1

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.

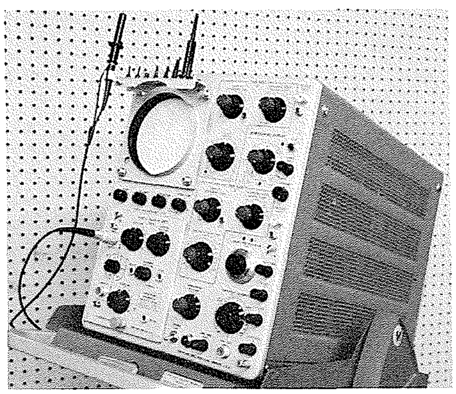


Figure 2

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.