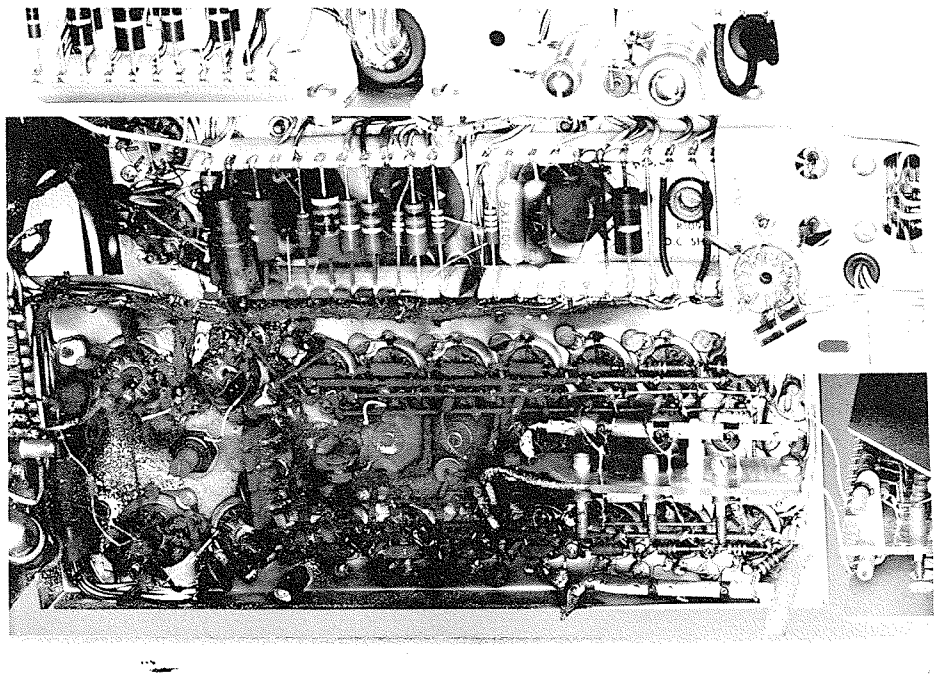
TEKTRONIX

Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 6 PRINTED IN U.S.A FEBRUARY 1961



Damage caused in the distribution amplifier of a Type 545A Oscilloscope as a result of a shorted crt lead.

NOTICE! IMPORTANT INFORMATION

A seriously damaged distributed amplifier CAN occur in any of the following oscilloscopes:

Type 541, all serial numbers above 6565
Type RM41, all serial numbers above 111
Type 545, all serial numbers above 9720
Type RM45, all serial numbers above 132
Type 541A, all serial numbers
Type RM41A, all serial numbers
Type 543, all serial numbers
Type RM43 all serial numbers
Type 545A, all serial numbers
Type RM45A, all serial numbers
Type 551, all serial numbers
Type 555 all serial numbers

In these instruments, certain types of short circuits (such as a crt lead becoming disconnected and shorting to ground) will cause the terminating resistor to burn. Secondary effects caused by the burning of these resistors can result in extensive damage as shown in the picture above. Repairs in such an event are costly, both in money and down-time for the instrument. This is indeed a regretable situation, but one that only time and experience in the field with the instrument could have brought to light. Since becoming aware of the difficulty, we have developed a field modification kit that protects the distributed amplifier from damage due the these short circuits. We offer this modification kit free of charge.

We earnestly recommend that owners of these instruments consider the installation of this modification a must.

Order the modification kit through your Tektronix Field Engineer. For Type 551 and Type 555 Oscilloscopes, order: Field Modification Kit—"Fuse for Protection of the Distributed Amplifier", Tek number 040-226.

For all other instruments listed above, order: Field Modification Kit—"Fuse for Protection of the Distributed Amplifier", Tek number 040-227.

Immediate steps are being taken at Tektronix plants to incorporate this modification in all affected production instruments. The Type of oscilloscope and the serial number at which the modification become effective will be announced in a future issue of SERVICE SCOPE. For the present, please consult your Tektronix Field Engineer to determine if instruments you have on order or have recently received are affected by this notice.

TYPE 530/540 OR TYPE 530A/540A SERIES OSCILLOSCOPES AND COMPOSITE VIDEO SIGNALS

Part I

Several TV Broadcast Studios have been using Type 530/540 or Type 530A/540A Oscilloscopes and trying to trigger on a nonintegrated composite video signal. There are three different pulse trains, all very close in amplitude, at the start of a composite video signal. Most oscilloscopes, when presented with this signal, will try to trigger on each pulse of the three trains. The result is an unstable display.

Television engineers generally will prefer the Type 524AD over other oscilloscopes for viewing the composite video signal. This instrument, specifically designed for television broadcast studio requirements, contains carefully planned trigger separator and sync separator circuits that enable the instrument to trigger reliably on composite video signals. It also provides other characteristics desirable for the maintenance and adjustment of television transmitter and studio equipment. The Type 524AD enables the engineer to observe any portion of the television picture—from complete frames to small portions of individual lines.

However, the Type 530/540 or 530A/540A Series Oscilloscopes give usable results if an integrator circuit is employed. A suitable integrator circuit consists of a 10 k resistor and a 0.01 μfd capacitor.

To use this circuit with these instruments, patch the VERT SIG OUT of the oscilloscope to the TRIGGER INPUT via the integrator circuit.

For the Type 531, 532, 533, 541, and 543 or Type 531A, and 541A proceed as follows:

Step 1. Use a wide band Plug-In Preamplifier in the oscilloscope and apply the composite video signal to the INPUT. Adjust the VOLTS/CM to give 3 or 4 centimeters of vertical deflection.

Step 2. Patch the VERT SIG OUT to the TRIGGER INPUT via the integrator circuit. See fig. 1.

Step 3. Set the TIME/CM switch to 5 MILLISEC.

Step 4. Set the TRIGGER SLOPE switch to —EXT for negative-going signals or +EXT for positive-going signals and the TRIGGER MODE switch to AC or AC SLOW.

Step 5. Turn the STABILITY and

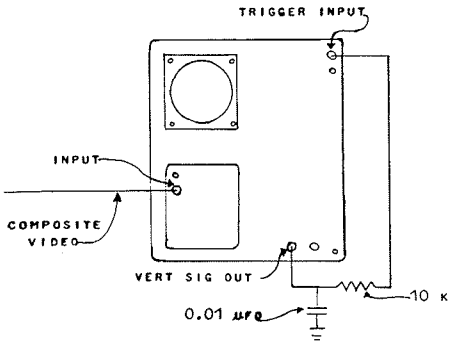


FIG. 1

TRIGGERING LEVEL controls full right.

Step 6. Turn the STABILITY control to the left until the sweep ceases to operate. Continue to turn the control to the left for several more degrees.

Step 7. Turn the TRIGGERING LEVEL control to the left until a stable display is obtained.

On instruments for which this procedure is intended, the operator can view either a field or line presentation. Limitations of these instruments, however, will not permit the operator to select the line to be presented.

Editors note: Part II of this article will appear in the next (April) issue of SERVICE SCOPE. The procedure for viewing composite video signals on the Type 535, 545, 535A, and 545A will be given at that time.

HELP IN USING AND UNDERSTANDING YOUR TYPE 535A OR TYPE 545A OSCILLOSCOPE

The Type 535A and Type 545A Oscilloscopes are extremely versatile instruments. To fully utilize their capabilities, an operator must be completely familiar with each control and its function. The new operator, the partially informed operator, or even the experienced operator will find the booklet "Using Your Oscilloscope Type 535A or Type 545A" a great aid in acquiring this desired degree of familiarity with these instruments.

This booklet is a revised and up-dated version of one originally written for operators of the old Type 535 and Type 545 instruments*. It is written in two parts. Part 1, "Getting Acquainted", describes the effect of each front-panel control, explains in detail the unique Tektronix features: Delayed Trigger, Delayed Sweep and Single Sweep modes of operation (that give to these instruments their high degree of flexible versatility), and outlines some of the more frequently encountered oscilloscope operations.

Part 2 of the booklet includes the information in the "Getting Acquainted" section, in condensed form for easy reference, plus simple, easily-understood instructions on other applications of the oscilloscopes.

To obtain a copy of this booklet, ask your Tektronix Field Engineer for FIP-8 "Using Your Oscilloscope Type 535A or Type 545A".

*A limited number of the booklets for the Type 535 and Type 545 are still available. Ask your Tektronix Field Engineer for FIP-1, "Using Your Type 535 or Type 545 Oscilloscope.

TEKTRONIX FIELD MAINTENANCE FACILITIES AND SERVICES

The Field Maintenance Facilities and Services available through your Tektronix Field Engineer are described in a recently published booklet. Also in the booklet are some pictures of a typical maintenance facility and a map of the United States showing the location of Tektronix Field Offices. Those Field Offices having a Repair Center are identified and they, their addresses and telephone numbers are listed for ready reference.

For your copy just call your Tektronix Field Engineer and ask him for the Field Maintenance Facilities and Services booklet.

QUESTIONS FROM THE FIELD

1. Q. What is the risetime of the P500CF Probe?

   A. We used the following equipment: a Type 545A Oscilloscope with Type K Plug-In (Passband of this combination was 30.5 mc), a Type 108 Fast-Rise Mercury Pulser, and a P500CF Probe. Risetime figures obtained under these conditions were as follows:

   P500CF (with no attenuation) 13.0 nsec.
   P500CF (with 10X attenuator) 17.5 nsec.

2. Q. Do you have any drift figures on the Type 503 Oscilloscope?

   A. We have never quoted any drift specifications for the Type 503. However, we ran some checks on ten production Type 503's. After an initial warm-up period to allow the instruments to stabilize, the following drift figures were recorded at a sensitivity of 1 mv/cm. Remember, these are only typical figures and are not to be considered drift specifications for the Type 503.

   Average drift 1.5 cm/hr.
   Minimum drift 0.5 cm/hr.
   Maximum drift 3.0 cm/hr.

   The input 6DJ8's have the greatest effect on drift. Also, the two 2N544 transistors designated Q454 and Q464 in the vertical amplifier affect the drift.

3. Q. In the Type 580 Series Oscilloscopes can a signal be connected directly to the vertical deflection plates of the CRT?

   A. According to Vaughn Weidel (Engineering), we have not developed an acceptable method for inserting signals directly into the vertical deflection plates of the crts in these instruments. The problem is to match the signal source to the approximate 900-ohm impedance of the distributed plates. If any matching device such as a transformer is used, much ringing and distortion occurs.

4. Q. Can you suggest a device for coupling the output of a sine-wave or square-wave generator to the P6016 Current Probe when testing the passband or square wave response of the probe?

   A. A 1½" piece of No. 18 solid wire, formed into a question mark, in series with a small 50 Ω—1% resistor and soldered to a female uhf connector will do the trick. (See fig. 2). This test jig has a VSWR

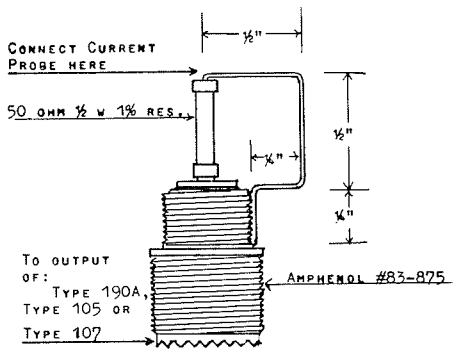


Fig. 2

   of 1.05 at 20 mc and can be used with a Tektronix Type 190A Constant Amplitude Signal Generator for passband response, and a Type 105 or Type 107 Square Wave Generator for square wave response.

5. Q. We have noticed a spurious pulse on a Type 575 Transistor-Curve Tracer. This is a positive pulse which occurs between each normal cycle for P-N-P transistors). The pulse length is about 5 milliseconds and about 4 volts in amplitude when the base current is set for 1 milliampere per step. Could this pulse damage transistors having a low reverse rating between base and emitter? If so, how can it be eliminated?

   A. The transistor is driven from a constant-current source. If the Step Zero is set so that the first base step occurs when the transistor is cut off, the maximum voltage capabilities of the Base Step Generator will be present at the base terminal of the transistor under test. Since the first step current is limited to the scale setting, there is small chance of damage to the transistor under test. The Step Zero control can be set to eliminate this pulse if desired.

6. Q. Can a Type 502 Dual-Beam Oscilloscope be modified to provide variable controls on the vertical amplifiers?

   A. Yes, a field modification kit is available to accomplish this. The kit

adds a VARIABLE VOLTS/CM control to the front panel for both the UPPER and LOWER beam vertical amplifiers. It includes a complete set of components, parts list, schematic, photos, and step-by-step installation instructions. Order the kit from your Tektronix Field Office. Specifiy; Type 502 Variable Volts/cm Mod. Kit, Tek part number 040-222. The price is $10.50.

USED INSTRUMENTS FOR SALE

1 Type 315 s/n 198 2 Type 512 s/n's 1817 & 2717	Eric Vaughan Superior Electric Co. 83 Laurel Street Bristol, Connecticut
1 Type 524	Boco Wu Livingstone, New Jersey Tel. Wy 2-4790
1 Type 514D s/n 2615	Walt Jannsons Isomet Corporation Palisades Park, New Jersey Tel. Windsor 4-3070
1 Type 512 s/n 1111	Gus Winston 227 Marina Way Pacifica, California

USED INSTRUMENTS WANTED

1 Type 310A	Milton D. Post 460 N.W. 30th Terrace Ft. Lauderdale, Florida
1 Type 517	G. Connell 212 Wensley Lane East Islip, Long Island, New York
1 Type 535 or Type 545	Purcell Robinson 1442 North 62nd Street Philadelphia 31, Penna.
1 Type 511 or Type 524	Weaver County School District L. O. Keys Salt Lake City, Utah Elgin 9-7691
1 Type 535 or 535A 1 Type CA 1 Type C	Robert Sinn Ultronics 118 North 3rd St. Camden, New Jersey Woodlawn 4-4664
1 Type 530 or 540 Series with a Type 53/54C or CA Plug-In	Professor George C. Newton, Jr. Electronic Systems Laboratory Massachusetts Institute of Technology Cambridge 39, Mass.
1 Type 112 Preamplifier	Westinghouse Electric Corp. Cletus Hostetler P. O. Box 284 Elmira, New York
1 Type 531 or Type 535	Richard Van Lunen 9203 Alcona Street Lanham, Maryland
1 Type 530 Series or Type 540 Series or Type 550 Series 1 Type CA, or K, or L Plug-In	Leonard M. DeBall 5247 S. Avers Avenue Chicago, Illinois

MORE LOST OR STOLEN SCOPES

Tektronix Field Engineer Ron Bell reports that a Type 316S1, serial number 902, is missing from the Goodyear Aircraft Corporation in Akron, Ohio. If you have any information on this instrument notify the Goodyear Aircraft Corporation.

Tektronix Field Engineer Duncan Doane reports the disappearance of a Type 310A, serial number 011213, from the Electronic Specialty Company, 5121 San Fernando Road, Los Angeles 39, California. If you run across this scope in your area, notify the Electronic Specialty Company by collect wire, or phone, Chapman 5-3771.

The following instruments have disappeared from the custody of the Philco Corporation, Government and Industrial Group, 4700 Wissahickon Avenue, Philadelphia, Penna.

1 Type 541A Oscilloscope s/n 20379
1 Type CA Plug-In Preamplifier s/n 10031
1 Type L Plug-In Preamplifier s/n 5235
1 Type 107 Square-Wave Generator s/n 625

If you know the whereabouts or have any information on these instruments, please contact the Philco Corporation, Computer Division, Test Equipment Control Section, Willow Grove, Pennsylvania, Oldfield 9-7700, Extension 537.

The Florida Power Corporation at Winter Park, Florida, reports that their Type 310S2 Oscilloscope s/n 6674 is missing and may have been stolen. Please contact them if you have any information on this instrument.

DO YOU UNDERSTAND THE SWEEP DELAY FEATURE OF YOUR TEKTRONIX OSCILLOSCOPE?

The Sweep Delay* is an important feature of the Type 535A, 545A, 555 and 585 Oscilloscopes. However, some users of these instruments are completely unaware of the flexibility this feature provides or the many applications made possible by it.

It is not within the scope of this publication to explain the Sweep Delay feature —space will not permit it—but we can tell you how you can have it explained and demonstrated to you. Call your Tektronix Field Engineer!

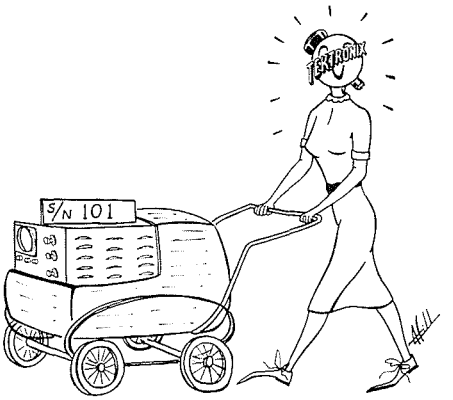
The explanation and demonstration, if you desire, can be given before a group of your technicians and engineers at a convenient time and place.

You will find your Tektronix Field Engineer to be a competent instructor with a minimum of six months factory training in the use and service of Tektronix instruments. Furthermore, he is keenly and genuinely interested in your scope related problems and anxious to help in their solution.

This is an economical program offered on a no charge basis. The only thing we ask you to spend is your time!

*In the Type 535 and 545 this feature is known as the Delaying Sweep.

ORIGINAL PRODUCTION OSCILLOSCOPE RETURNS TO TEKTRONIX



In July of 1947 Tektronix shipped its first production oscilloscope—a Type 511, serial number 101. Dr. A. R. Tunturi; Director of Navy Acoustic Research at the University of Oregon Medical School in Portland, Oregon, took delivery on this instrument for the purchaser, the U. S. Navy.

For 13½ years this Type 511 aided in providing Dr. Tunturi with reliable information in his research work—electronic mapping of the brain. Knowledge gained in this research is valuable in the diagnosis and treatment of neurological diseases and for the possible importance of applying how the brain works to the development of a mechanical brain for guided missiles. During this time installation of several factory-developed improvement modifications aided this Type 511 to keep abreast of Dr. Tunturi's oscilloscope requirements. The instrument remained, however, essentially a Type 511 while Dr. Tunturi's work continued to advance. Eventually the need for a more sophisticated oscilloscope became undeniable.

Rudy Vuksich of the Tektronix Advertising Department could see reciprocal benefits in Dr. Tunturi's need for a more advanced oscilloscope and the Tektronix desire to return their original production instrument to its place of origin.

Accordingly, he assisted in working out a mutually beneficial agreement between the interested parties. In exchange for the Type 511, serial number 101, Dr. Tunturi accepted for the U. S. Navy a Tektronix Type 515 Oscilloscope, an instrument admirably suited to his present oscilloscope requirements.

Type 511, serial number 101 now stands proudly on display in the reception area of the Tektronix factory in Beaverton, Oregon. Every Tektronix employee expresses his thanks to the U. S. Navy and Dr. Tunturi for their co-operation in returning this instrument to us. We are proud of our "first born"!

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

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

COMPUTER ENGINEERS SAY P6016 CURRENT PROBE A NECESSITY

Tektronix Field Engineer Owen Harrison reports many of the computer engineers he calls on consider the Tektronix P6016 Current Probe a necessity in computer service work. They claim that considerable savings in computer service time can be realized by the use of this probe. Compared to the method where a one ohm resistor must be inserted into the circuitry to obtain readings, the use of a P6016 Current Probe can cut computer service time by as much as 50%.

If you are not acquainted with the Tektronix P6016 Current Probe, call your Tektronix Field Office. A Field Secretary or a Field Engineer will be happy to arrange a demonstration at your convenience. In addition to being informative, the demonstration may aid in solving (or making it easier to solve) some of your engineering or servicing problems.

TEKTRONIX TOUCH-UP PAINT

Touch-up paint to match the colors and finishes of Tektronix instruments is now available. The paints for touch-up jobs on gray-wrinkle, blue-wrinkle, or blue-vinyl finished cabinets come in 2 ounce jars. Also, the blue-wrinkle and blue-vinyl paints thinned for spraying, are available in 1 quart cans.

Order through your Tektronix Field Engineer or Field Office from the following chart.

TEK NO.		DESCRIPTION	QTY.	PRICE
252-083	Gray	Wrinkle Touch-up	2-oz	$1.10
252-084	Blue	Wrinkle Touch-up	2-oz	1.10
252-085	Blue	Wrinkle Thinned*	1-qt	3.00
252-086	Blue	Vinyl Touch-up	2-oz	1.10
252-087	Blue	Vinyl Thinned*	1-qt	2.80

*These thinned paints are intended for spray-gun application

FINDING BURIED CABLES

You may easily determine the position of a single conductor, buried eight to 10 feet below the ground surface, by magnetic detection.

A 10 to 15-ampere 60-cycle current passed through a buried conductor will create a strong magnetic field that a simple pickup loop and detector can locate easily.

If two wires of 117 v ac circuit must be located, one of them must be disconnected and an alternate external lead substituted. (A good ground will do.) If both wires are used, the magnetic flux from one will cancel the magnetic flux of the other.

An effective pickup loop consists of four to 10 turns of wire formed into an oval about five feet long and a foot wide. Bypass the two leads from the loop with a .01 μf capacitor to reduce any radio frequency energy from broadcast stations.

(If cable near a broadcast antenna is to be located, you may need an additional low-pass filter to keep r-f from reaching the detector.)

The detector needs enough sensitivity to indicate signals at a maximum of about .05 volts rms. A simple battery-powered transistor amplifier with frequency multiplication will raise both the signal level and the frequency for headphones.

A Tektronix Type 321 battery-powered portable oscilloscope may be used to make a visual measurement. It will do this job without an external preamplifier. Using the 321 with the pickup loop and a .01 μf capacitor, you may locate each ground radial of a broadcast antenna while the station is on the air. In this case the signal will be the station's carrier.

You search with the pickup loop flat on the ground. When the loop is on both sides of the buried conductor, it will pick up energy from the conductor.

As the loop passes directly over the conductor, the signal disappears. When it moves past the conductor, the signal reappears.

For cables deeper than 10 feet, increase all dimensions of the coil to maintain the same accuracy.

CORRECTION

We must call your attention to three errors, one typographical and two of omission, in the article "Timing the Type 530A/540A Series Oscilloscopes". This article appeared in the December 1960 Service Scope.

In Step 6 of this article the .5 μsec/cm setting of the TIME/CM switch should read .1 μsec/cm.

Instructions for adjustment of C375 should have followed the instructions for adjusting C364. Here they are: Adjust C375 for best linearity between the 2nd and the 6th vertical graticule lines.

Finally, if it is necessary to replace the two 6DJ8 output tubes, the whole timing procedure should be run through again.

Now, if you don't mind, we will go apply a soothing lotion to a very red face.

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.

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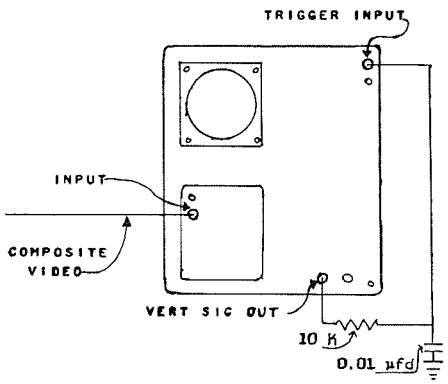
USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 7 PRINTED IN U.S.A APRIL 1961

TYPE 530/540 OR TYPE 530A/540A SERIES OSCILLOSCOPES AND COMPOSITE VIDEO SIGNALS

Part 2

Fig. 1, which appeared with Part 1 of this article in the February issue of SERVICE SCOPE, was incorrectly drawn. The circuit as shown was not an integrator circuit. Notice that in the corrected drawing (fig. 1 below) the 10 k resistor precedes the 0.01 μfd capacitor in the circuit from the VERT. SIG. OUT to the TRIGGER INPUT.



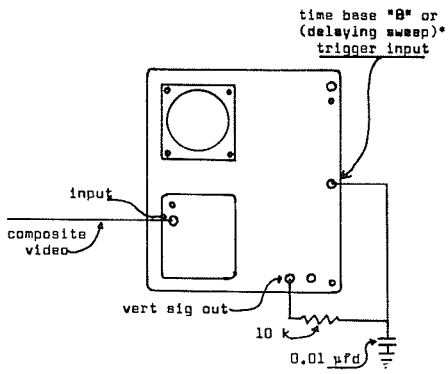
Instructions in Part 1 of this article dealt with the Type 531, 532, 533, 541, 543, 531A and 541A instruments. Part 2 will deal with the Type 535, 535A, 545 and 545A oscilloscopes.

These more sophisticated oscilloscopes provide the Tektronix unique Delaying Sweep feature and can also display either field or line presentations. In addition, the Delaying Sweep feature permits the operator to select the line presented. Also, once the instrument is set up, the operator can switch from line to field presentation by simply turning the HORIZONTAL DISPLAY switch.

Here's how you set it up:

Step 1. Use a wide-band Plug-In Preamplifier in the oscilloscope and apply the composite video signal to the INPUT. Adjust the VOLTS/CM to give 3 or 4 centimeters of deflection.

Step 2. Couple the VERT SIG OUT to the TIME BASE B (DELAYING SWEEP) TRIGGER-IN with an integrator circuit consisting of a 10 k resistor and a 0.01 μfd capacitor. See fig. 2



(Note: If available, Field sync pulses are preferable for triggering the Delaying Sweep.)

Step 3. Set the HORIZONTAL DISPLAY switch to the 'B' INTENSIFIED BY 'A' (DELAYING SWEEP)* position. Turn the TIME BASE B (DELAYING SWEEP)* STABILITY and TRIGGERING LEVEL controls full right. Set the TIME BASE B (DELAYING SWEEP)* TIME/CM switch to 5 MILLISEC and the LENGTH control for 9 to 10 centimeters of sweep. For displaying positive-going video signals, turn the TIME BASE B (DELAYING SWEEP)* TRIGGER SLOPE switch to +EXT (+)* and the TIME BASE B TRIGGERING MODE switch to AC (Type 535 and Type 545 instruments do not have a triggering mode switch on the DELAYING SWEEP section of their front panel), for negative-going signals, switch the TRIGGER SLOPE to −EXT (−)*. Turn the TIME BASE B (DELAYING SWEEP)* STABILITY control to the left until the sweep ceases to operate. Continue turning the control several more degrees to the left. Now turn the TIME BASE B (DELAYING SWEEP)* TRIGGERING LEVEL control to the left until a stable display is obtained. This should occur when the index mark is at or near the straight up position.

Step 4. Set the HORIZONTAL DISPLAY switch to the 'A' DEL'D BY 'B' (MAIN SWEEP DELAYED)* position. Set the TIME BASE A (MAIN SWEEP)* TIME/CM switch to display any desired number of lines. Trigger the 'A' DEL'D BY 'B' (MAIN SWEEP DELAYED)* from the first line sync pulse after the delayed trigger by turning the TIME BASE A (MAIN SWEEP)* STABILITY and TRIGGERING LEVEL controls full right and then turning the STABILITY control to the left until the sweep ceases to operate. Continue turning the STABILITY control to the left for several more degrees.

If you are displaying video signals of positive-going polarity, switch the TIME BASE A (MAIN SWEEP)* TRIGGER SLOPE control to +INT: if you have negative-going signals, switch TIME BASE A (MAIN SWEEP)* TRIGGER SLOPE control to −INT. Turn the TIME BASE A (MAIN SWEEP)* TRIGGERING LEVEL control to the left until a stable display is obtained.

The display will now be similar to the display obtained when using the Type 524 Oscilloscope; the line presentation will jump from one line to the next as the DELAY TIME MULTIPLIER is turned through its range.

Step 5. By switching the HORIZONTAL DISPLAY control from 'A' DEL'D BY 'B' (MAIN SWEEP DELAYED)* position to the 'B' INTENSIFIED BY 'A' (DELAYING SWEEP)* position, you can have either line or field presentation. The TIME BASE A (MAIN SWEEP)* brightening on the TIME BASE B (DELAYING SWEEP)* will indicate the horizontal lines being observed with reference to the entire frame. +GATE A (+GATE MAIN SWEEP)* could be used to modulate the 'Z' axis of a monitor kinescope.

Step 6. If dual trace operation with a Type 53/54C, 53C, or CA Plug-IN is desired, the trigger must be derived from an external source rather then the VERT

SIG OUT, due to the switching signals present. TIME BASE A (DELAYING SWEEP)* sweep rates and length should be adjusted to give proper presentation of interlaced pairs of lines.

The above method will give usable results, but for specific applications most engineers will prefer a Type 524AD Oscilloscope with its carefully designed sync-separator circuits.

* (Captions in parenthesis apply to the Type 535 and Type 545 instruments.)

SERVICE HINTS

Tektronix Field Maintenance Engineer Jack Banister finds a pressure can of contact cleaner a handy service tool. The use of this cleaner has usually been with tube sockets in jittery vertical amplifiers. He squirts the cleaner into the vertical-amplifier tube sockets. Several times this operation has cleared up the trouble just fine. Indications of faulty pin contacts can generally be made apparent by wiggling a tube in its socket.

The brand name of the contact cleaner Jack uses is "Injectoral". There are probably other good contact cleaners in pressure cans on the market, but this is the only one Jack has had experience with.

Occasionally, when a Type 530/540 Series Chopping-Transient-Blanking Mod Kit (Tek. No. 040-200) is installed in an instrument, the unblanking-spike phasing occurs too early and does not cover the switching transient.

Increasing the blanking period should correct this condition. To do this, change the resistor on the grid (pin 5) of V78 from 270 k to 390 k.

The 390 k resistor will generally increase the blanking period enough to cover the switching transient and enable the modification to work correctly. However, isolated cases may require a resistor of an even higher value. Tektronix Maintenance Engineer Udo Lindenmeyer found one instrument that required a 560 k resistor to give correct results.

SOLVING POWER LINE PROBLEMS FOR BETTER SCOPE PERFORMANCE

Problems arising from excessively high or low line voltage continue to plague users of Tektronix oscilloscopes in some areas. Tektronix oscilloscopes are designed to accommodate line-voltage variations up to roughly ±10% from design center without loss of stability or accuracy; however, variation beyond these limits (105-125 volts for most instruments wired for domestic use) causes loss of accuracy and often, severe instability.

The problems reported seem to fall into three main categories: (1) continuously high or low line voltage; (2) fluctuation between high and low line voltage; and (3) serious waveform distortion, giving the effect of low line voltage. Some suggested solutions to these problems are:

(1) The first problem is easily solved for the owner of a Type 310(A), 316, 317, 502 or 516 Oscilloscope. These instruments are equipped with multi-tap power transformers, for use at various "high" or "low" line-voltage ranges. For other instruments, it is necessary to provide some external step-up or step-down transformer to provide the necessary operating voltage to the scope. A variable autotransformer of the "Variac" or "Powerstat" type is particularly useful in accomodating a wide range of input voltages. An inexpensive filament transformer may also be used as an autotransformer in cases where the line voltage is consistently high or low. Reconnected as shown in Figure a, the transformer's

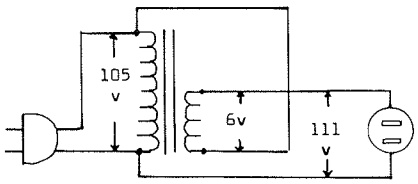


Figure A. Low-cost line-voltage boost or drop circuit, using a filament transformer. Connect as shown for 6 v boost; reverse secondary connections for 6 v drop. Filament winding must have minimum rating indicated in Figure B.

secondary voltage is added to or subtracted from the incoming line voltage to bring it within range. Be sure the filament-winding current rating is adequate to carry the oscilloscope load (Fig. B).

Scope Type	Max. Power Consumption	Recommended Transformer Rating (Min)
310(A)	175 W	2 Amp
315	375 W	4 Amp
316	260 W	3 Amp
317	260 W	3 Amp
321	20 W	¼ Amp*
502	280 W	3 Amp
503	107 W	1 Amp
504	93 W	1 Amp
507	600 W	8 Amp
511(A)	240 W	3 Amp
512	280 W	3 Amp
513	475 W	6 Amp
514(A)	375 W	4 Amp
515(A)	300 W	3 Amp
516	300 W	3 Amp
517(A)	1250 W	15 Amp
519	660 W	7 Amp
524(A)	500 W	5 Amp
525	380 W	4 Amp
526	340 W	4 Amp
527	240 W	3 Amp
531(A)	455 W	5 Amp
532	475 W	5 Amp
533	500 W	6 Amp
535(A)	550 W	6 Amp
536	650 W	7 Amp
541(A)	520 W	6 Amp
543	530 W	6 Amp
545(A)	600 W	6 Amp
551	900 W	10 Amp
555	1050 W	12 Amp
561	175 W	2 Amp
570	400 W	5 Amp
575	410 W	5 Amp
581	640 W	7 Amp
585	725 W	8 Amp

*Power-line regulation not required if batteries are in place and line voltage does not exceed 125 v.

Figure B. Chart of Tektronix oscilloscope power requirements.

(2) The second problem is a little more difficult. Although slow periodic fluctuations in power-line voltage can be conveniently handled with a variable autotransformer, as above, there are many areas where wide line-voltage variations are so frequent that a constant-voltage-transformer type of regulator appears to be the only solution. However, for proper operation of the oscilloscope power supplies, it is extremely important that the regulator does not cause waveform distortion. The electronically-regulated power supplies in Tektronix oscilloscopes require not so much a certain rms voltage on which to operate, as a certain minimum peak-to-peak voltage. Many regulating transformers of the saturable-reactance type regulate primarily by limiting the peaks of the incoming sine waves. Either an rms or average-reading AC voltmeter (most voltmeters are of the latter type) may indicate the proper rms voltage for scope operation. However, the actual peak-to-peak voltage supplied by most of the common "constant-voltage" transformers is insufficient for proper operation of the scope's power supplies. Under these circumstances excessive ripple, jitter, and instability will result. Therefore, it is important to use only a low-distortion type of regulator — one having less than, say 5% distortion at the highest expected incoming line voltage under full oscilloscope load conditions. Regulators of this type are available through commercial channels, though at some increase in cost over the models without waveform correction.

The third problem — serious waveform distortion, giving the effect of low line voltage — will be discussed in Part 2 of this article which will appear in the June issue of SERVICE SCOPE. The discussion will include methods of determining whether waveform distortion will seriously affect the performance of your instrument and suggested solutions for the problem.

USED INSTRUMENTS WANTED

1 Type 515	Gene Pulaski 200 Maple Ave. Graterford, Penn.
1 Type 514 or Type 515 for cash or will trade Waterman USM-24C Pulsescope	J. L. Hartke Elec. Eng. Res. Lab. University of Illinois Urbana, Illinois
1 Type 310	Carl C. Rosen Ray Jefferson, Inc. 4000 N. W. 28th Street Miami 42, Florida

1 Type RM16	Herb Evans, Chief Eng. WTHS-TV 1410 N. E. 2nd Avenue Miami 32, Florida
1 General Purpose DC to 1 or 5 mc scope 5" crt	Robert W. Blair, M.D. 3761 Stocker Street Los Angeles 8, Calif. Phone: AX 5-4347
1 Type 575	Roger Hill Electronic Systems of America, Inc. 624 High Street Racine, Wisconsin Phone: ME 4-7747
1 DC-to-10 mc or better scope. 5" crt	Phil Adelman 6332 W. 85th Place Los Angeles 45, Calif. Phone: OR 4-3504
1 Type 121 Amplifier	Stevens P. Tucker Physics Department Oregon State College Corvallis, Oregon
1 Type 512 or Type 513 or Type 514	Art Humphery Digitrols, Inc. 8 Industry Lane Cockeysville, Maryland
1 Type 531A or Type 533 1 Type 53/54C or CA Plug-In Unit	William Bowin 54-D Oak Grove Drive Baltimore 20, Md.

USED INSTRUMENTS FOR SALE

1 Type 53/54C Plug-In s/n 7414 — $125 or best offer	Ken Mollenauer Argonaut Underwriters 250 Middlefield Road Menlo Park, Calif.
1 Type 514D	Gene Phelps KPTV P. O. Box 3401 Portland, Oregon
1 Type 524AD s/n 2710	Seymor Schatz Rainbow TV Sales & Ser. 6302 Fifth Avenue Brooklyn 20, N. Y. Phone: HY 2-6662
1 Type G Plug-In Unit	R. L. Arntz The Hartman Electrical Mfg., Co. 175 N. Diamond Street Mansfield, Ohio
1 Type 543 with Type CA Plug-In	Mr. MacDonald Sports Network 36 West 44th Street New York 36, N. Y. Phone: MU 2-0117
1 Type 513D s/n 1887 Asking $495	Ronald Knight Pulse Engineering, Inc. 560 Robert Avenue Santa Clara, Calif. Phone: CH 8-6040

BEWARE OF MISLEADING INSTRUCTIONS

The instructions for installing the Type 502 Horizontal Beam Registration Field Modification Kit (Tek #040-234) contain an error. On page 4, step 13 should read as follows:

( ) 13. Solder the white-blue wire to the #1 wafer, #4 position.

The possibility exists that there are Type 502 instruments in use with this mod installed with the white-blue wire going to the wrong (#3 position) contact. Under these conditions, one of the horizontal deflection plates will be left "hanging" or unconnected. The noticeable effect of this error is that with the HORIZ. DEF. PLATE SELECTOR switch in the UPPER BEAM AMP. position, the POSITION control on the UPPER BEAM section of the front panel will have only 5 cm of horizontal range (using normal intensity).

To correct the error, place the Type 502 on the bench with the left side facing you and remove the side panel. On the #1 wafer of the HORIZ. DEF. PLATE SELECTOR switch, locate the contact with two white-blue wires (Note: the #1 wafer is the one nearest the mounting bracket). Unsolder, from this switch contact, the white-blue wire that is dressed through one of the grommets on the bottom of the switch bracket (Caution: do not unsolder the white-blue wire running to the neck of the crt). Move the unsoldered wire one contact to the right and resolder (this contact will have a bare wire going to the #2 wafer of the switch). With this correction the instrument should operate properly.

TYPE 580 SERIES OSCILLOSCOPE TRIGGER CIRCUIT MODIFICATION

Installation of a Type 581/585 Tunnel-Diode Trigger Circuit Modification Kit will extend the reliable triggering capabilities of these instruments out to a full 100 mc. The modification will not impair the instrument's ability to trigger reliably on signals of low amplitude or pulses of very short duration.

Time required by a trained technician to install this modification is about six hours. Tentative triggering specifications of the instrument will then be as follows:

	Frequency	Amplitude
Internal Triggering	DC to 10 mc	2 mm
	10 mc to 30 mc	1 cm
	30 mc to 50 mc	2 cm
	50 mc to 100 mc	3 cm
	DC to 10 mc	0.2 v
External Triggering	10 mc to 50 mc	0.5 v
	50 mc to 100 mc	1.0 v

This modification applies to all Type 581 instruments below serial number 511 and all Type 585 instruments below serial number 1071. Please consult your Tektronix Field Engineer to order this modification.

TYPE 570 CHARACTERISTIC CURVE TRACER WILL SAVE THIS CUSTOMER MONEY

Tektronix Field Engineer Francis Frost reports that one of his customers had need of 19 matched tubes. This customer ordered the tubes from a supplier and the charges amounted to $800.00. The raw stock price of these tubes was $1.95 each. Based on this experience, the customer felt he could more than justify the purchase of a Type 570 Characteristic-Curve Tracer. By matching his own tubes, it would take only a couple of situations like the one described above to realize savings that would more than cover the purchase price of a Type 570 instrument. An extra bonus would be that the Type 570 would be readily available to the design engineers in tailoring circuits to fit the operating characteristics of available tubes. Also, tubes could be selected faster and more accurately for circuits requiring other than average electron-tube characteristics.

PREFIXES AND SYMBOLS

Reproduced in the chart below are the prefixes and symbols of electrical units as adopted by The National Bureau of Standards.

Your Tektronix Field Engineer has a supply of these charts in two sizes; a 4¾" x 7" card suitable for posting near your desk or in your work area, and a handy wallet-sized card convenient to carry with you as a quick and ready reference.

He offers these charts to you with his compliments and suggests you contact him if you have not received yours or if you require additional charts.

Tektronix, Inc.
P. O. Box 500 • Beaverton, Oregon
Phone Mitchell 4-0161 • TWX—BEAV 311 • Cable: TEKTRONIX

PREFIXES and SYMBOLS
of Electrical Units as Adopted by
The National Bureau of Standards

UNIT	PREFIX	SYMBOL
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	dk
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

Compliments of your Tektronix Field Engineer

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

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

MISSING INSTRUMENTS

Our Chicago Field Office sends word that a Type 310A oscilloscope, s/n 13069 is missing and may have been stolen from the Toledo Scale Company, 2033 South Michigan, Chicago, Illinois.

If you have any information regarding this instrument, please wire or call the Toledo Scale Company collect. The telephone number is CA 5-7143.

TYPE 81 PLUG-IN ADAPTER PARASITIC OSCILLATIONS

Parasitic oscillations can occur on the trace of Type 581 and Type 585 Oscilloscopes when using the Type 81 Plug-In Adapter. These oscillations appear at a frequency of approximately 200 mc and have an amplitude of from two to four mm.

A simple modification of the Type 81 will eliminate these oscillations. This modification consists of 0.01 μf, 150 volt discap added in parallel to R549, a 3k, 5w, wire wound resistor.

To install this modification, remove the Type 81 from the oscilloscope and place it on the bench bottom side up. Locate contacts 14 and 16 on the male amphenol connector. Trace back from these connectors to where R 547 and R 548; two 93 Ω, ½ w, precision resistors, join R 549, a 3 k, 5 w, wire wound resistor. Solder one end of an 0.01 μf, 150 volt discap to this connection and solder the other end to the ground lug located on the female amphenol connector.

This modification applies to all Type 81 Plug-In Adapters except the following:

105	232	279	646
107	236	502	649
136	237	590	652
140	250	600	653
143	264	641	654
152	266	642	655
154	268	644	656
188	272	645	664

These instruments were modified out of sequence at the factory.

REACTIVATING THE CATHODES OF STORED CATHODE-RAY TUBES

A cathode-ray tube that has been in storage for some time should be "reactivated" before being placed in service. To reactivate the cathode, operate the CRT with 8 volts on the heater (other operating conditions normal) for about one hour, and follow with 24 hours of operation at normal heater voltage. During the reactivation period the beam should be positioned off the face of the CRT.

TEKTRONIX OPENS IN MONTREAL, MARCH 15

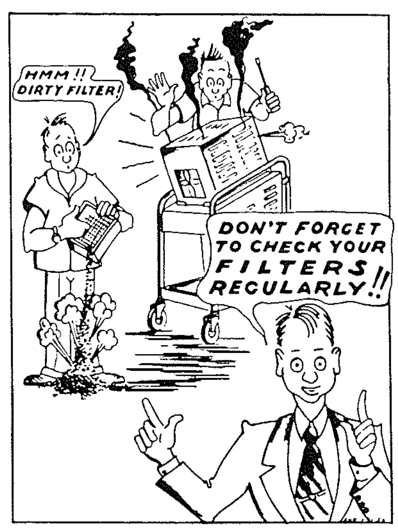
Opening the 36th Field Office provides more immediate attention to the needs of Tektronix customers in Quebec, Nova Scotia, Prince Edward Island, New Brunswick, and Newfoundland. These areas were formerly served from our Toronto Field Office.

CHECK YOUR SERVICE SCOPE ADDRESS!

Please, if you wish uninterrupted delivery of your copy of Service Scope, advise us of **any** change in your address immediately.

After every mailing of this publication, our returned mail contains a large number of copies marked "undeliverable". Investigation discloses that an addressee may have moved only from one room to another within the same building, however, Service Scope delivered to his old address may not reach him. The reason for their non-delivery seems to stem from the rapid expansion, both in size and activity, that many companies and military installations are experiencing. Apparently, the people responsible for internal distribution of mail at these organizations find it difficult to keep abreast of the many moves and changes of personnel resulting from this expansion.

As an aid in insuring the delivery of mail under these conditions, we would like to offer the following suggestions: Determine through the people responsible for distribution of mail within your organization, the address information required to assure delivery of mail intended for you. Advise your correspondents of this information. Notify them as quickly as possible when changes occur in this information.



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 8 PRINTED IN U.S.A JUNE 1961

SOLVING POWER LINE PROBLEMS FOR BETTER SCOPE PERFORMANCE

Editor's note: Part 1 of this article appeared in the April 1961 issue of SERVICE SCOPE. As explained there, the problems that affect Tektronix instruments and arise from the condition of excessively high or low line voltage, seem to fall into three main categories: (1) continuous high or low line voltage; (2) fluctuations between high or low line voltage; and (3) serious waveform distortion, giving the effect of low line voltage. The first two of these categories were discussed in Part 1 and some suggested solutions outlined. Part 2, below, takes up the third category and concludes the article.

Part 2

The third major problem — serious waveform distortion — is the most difficult to overcome, since general-purpose correction systems are not always immediately available. To determine whether waveform distortion will seriously affect the performance of your instrument, use an oscilloscope to measure carefully the peak-to-peak voltage on the instrument's filament line, and compare this reading with the rms reading, as taken with a calibrated voltmeter. For 6.3 volts rms (indicating 117 volts rms power-line voltage) the peak-to-peak reading on the oscilloscope should be 17.8 volts. If this reading is less than 17.0 volts peak-to-peak, it indicates that the power supplied to the instrument is not adequate for proper power-supply regulation throughout the instrument's nominal 105-125 volts rms rating. The instrument will probably be in difficulty somewhere above 105 volts rms. A peak-to-peak reading of 15.5 volts or less for a 6.3 volts rms voltmeter reading indicates that the instrument's power supply will regulate only marginally even at 117 volts rms, on the power-line waveform supplied.

We have had reports of a few cases where local waveform distortion, combined with slight deterioration of tubes, rectifiers or capacitors in the oscilloscope, has caused a customer to go to considerable expense in component replacement because the instrument "dropped out" of regulation above what appeared to be 105 line volts. We suggest in these cases that an accurate measurement of the actual peak-to-peak line voltage be made before replacing other than obviously-failed components. An adapter such as that illustrated below (Figure C)

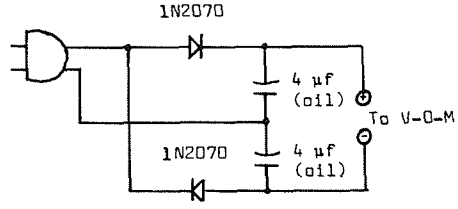


Figure C. Peak-to-peak reading adapter for 20,000 Ω/volt V-O-M.
Use of silicon diodes and oil-filled (or Mylar or paper) capacitors assures accurate voltage output.

RMS	Peak-to-Peak
105 v	297 v
117 v	331 v
125 v	354 v

can be used with a voltmeter to obtain peak-to-peak measurement of the line waveform at moderate construction cost. Alternatively an oscilloscope equipped for accurate differential voltage measurements in the 300-350 volt range can be used to make the peak-to-peak voltage measurement directly from the power line. It is **not** recommended that a scope be used "single ended" to measure its own power line voltage because of possible measurement errors and serious shock and damage hazards. The oscilloscope power supplies should continue to regulate properly down to 295 volts peak-to-peak. If the peak-to-peak line voltage is less than 295 volts for an rms reading of 105 volts, but the scope power supplies do regulate correctly at 295 peak-to-peak volts, then the trouble is mostly in the power-line waveform, and power-supply components are probably in good condition.

If power-line waveform distortion exists on the power lines into your building, the easiest solution may be to have the local power company correct the waveform for you. However, if it's caused by in-plant equipment (any high-current, nonlinear load will cause some distortion), it may be necessary to apply your own waveform-correction, using a filter of appropriate design and a transformer (to compensate for filter losses) between the power line and the oscilloscope. In extreme cases where severe fluctuations and transients are also involved, it may be necessary to employ a motor-generator set to obtain a steady, sinusoidal waveform. As before, be sure that the current rating of the filter or motor-generator set is adequate for oscilloscope operation (See Figure B).

Scope Type	Max. Power Consumption	Recommended Transformer Rating (Min)
310(A)	175 W	2 Amp
315	375 W	4 Amp
316	260 W	3 Amp
317	260 W	3 Amp
321	20 W	¼ Amp*
502	280 W	3 Amp
503	107 W	1 Amp
504	93 W	1 Amp
507	600 W	8 Amp
511(A)	240 W	3 Amp
512	280 W	3 Amp
513	475 W	6 Amp
514(A)	375 W	4 Amp
515(A)	300 W	3 Amp
516	300 W	3 Amp
517(A)	1250 W	15 Amp
519	660 W	7 Amp
524(A)	500 W	5 Amp
525	380 W	4 Amp
526	340 W	4 Amp
527	240 W	3 Amp
531(A)	455 W	5 Amp
532	475 W	5 Amp
533	500 W	6 Amp
535(A)	550 W	6 Amp
536	650 W	7 Amp
541(A)	520 W	6 Amp
543	530 W	6 Amp
545(A)	600 W	6 Amp
551	900 W	10 Amp
555	1050 W	12 Amp
561	175 W	2 Amp
570	400 W	5 Amp
575	410 W	5 Amp
581	640 W	7 Amp
585	725 W	8 Amp

*Power-line regulation not required if batteries are in place and line voltage does not exceed 125 v.

Figure B. Chart of Tektronix oscilloscope power requirements.

Incidentally, it should be mentioned that a step-up transformer alone should not be used where waveform distortion is the primary cause of power-supply regulation problems. If the peak-to-peak voltage of a seriously flattened power-line waveform is increased sufficiently to obtain good power-supply regulation, the unregulated filament lines in the scope will rise to excessive levels, causing premature tube failures from increased dissipation, gas, leakage, and filament burnouts.

As with other problems in using or maintaining your Tektronix oscilloscope, you'll find your local Tektronix Field Engineer is anxious to help in identifying and solving any power-line problems that

interfere with your instrument's best performance. A list of Tektronix Field Offices can be found in our current catalog, and is reprinted from time to time in Service Scope.

TESTING UNIJUNCTION TRANSISTORS WITH TRANSISTOR CURVE TRACER

By Walter Keller, Project Engineer, Cordis Corporation, Miami, Florida, with Jerry Kraxberger, Tektronix Field Engineer, St. Petersburg, Florida, assisting with write-up.

Editors note: If you are (as your editor was) in a bit of a quandary as to what is a unijunction transistor, a little research may be indicated.

The General Electric Transistor Manual, Fourth Edition, contains a description of unijunction transistors with an explanation of their theory of operation. I believe the short time required to read this material will be time well spent. It will aid in the more thorough understanding of Mr. Keller's and Mr. Kraxberger's article and perhaps give a greater appreciation of the versatility of unijunction transistors in many circuit applications.

The utility of a curve tracer for circuit design has proved itself to many. For those who have let it become a second "right arm", it is a major handicap when the curve tracer can not be employed to study one of the less conventional semiconductor groups.

In studying the uniformity of a few commercially acquired 2N492 transistors —particularly the intrinsic stand-off ratio[1] or the breakdown point of the emitter voltage as a function of the voltage between the bases—the following technique was used:

Employing any conventional transistor-curve tracer, connect B_1 of a unijunction transistor to ground and B_2 to the sweep voltage as the collector would be connected. Then connect the emitter to the stepping constant current source and shunt a 0.1 μf capacitor from B_1 to E. Sweep the bases with a positive half-sine-wave voltage and the emitter with a positive constant current just as one would do in the common emitter NPN connection. (See Figure 1.)

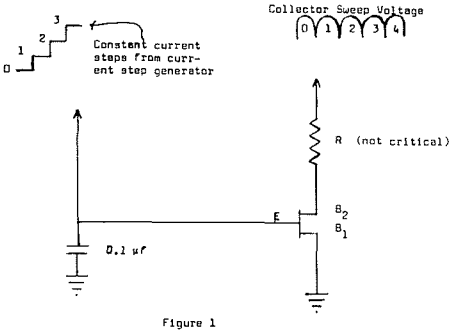


Figure 1

On a Tektronix Type 575 Transistor-Curve Tracer, connect B_2 to the terminal marked base, and B_1 to the terminal marked emitter (ground). Connect an 0.1 μf capacitor from emitter to ground. Apply voltages for the common emitter NPN transistor connection.

Consider a single emitter current step and the accompanying half-sine-wave voltage applied to B_2 (illustrated in Figure 2). Initially the current is stepped

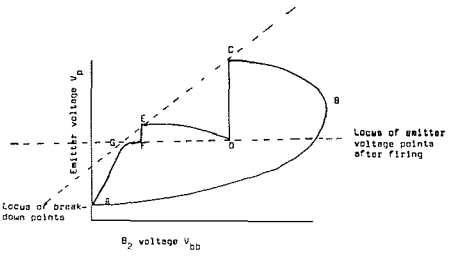


Figure 2

from zero to a positive value of constant current (say to step #1) as in Figure 1. This constant current step causes the capacitor C to charge at a linear rate and the instantaneous voltage is plotted as emitter voltage on the vertical axis in Figure 2. While the emitter voltage is increasing, the B_2 voltage (half-sine-wave which coincides with current in step #1) is increasing (moving to the right from A to B in Figure 2). Even though the voltage of B_2 reaches the peak value of B, the transistor is inactive because the capacitor charges rather slowly. As the B_2 instantaneous voltage decreases from point B to C, the capacitor voltage has increased sufficiently for the emitter to trigger the transistor into conduction causing the emitter voltage to discharge the capacitor voltage from C to D. Note that a second (E to F), and even a third, firing point can sometimes be observed. In Figure 2 we have shown only one complete emitter current step with its accompanying B_2 half-sine wave sweep. Figure 3 is an actual photograph of a General Electric Type 2N492 unijunction transistor (formerly called double-based diode) displayed on a Tektronix Type 575 Transistor-Curve Tracer. Front panel controls of the instrument were set as follows:

Vertical—0.5 Base Volts/Div.
Horizontal—1 Collector Volt/Div.
Base Step Generator—Polarity to + and Step Selector to 0.01 ma/step.
Collector Sweep—Polarity to + and Peak Volts to 10 volts on 20 volt range.
Dissipating Limiting Resistor—to approx. 2 Ω.
Transistor Mounting Board—to grounded emitter position.

If one considers the locus of breakdown points (point C for each curve), a complete relation of emitter breakdown voltage as a function of B_2 voltage is obtained. All points below and to the right are nonconducting points; above and to the left are emitter and base voltages where conduction would occur with the conventional unijunction characteristics.

$$V_p = N\,V_{bb} + \frac{200}{T_J}$$

V_p=peak emitter voltage
N=intrinsic stand-off ratio (1) (2) (3)
V_{bb}=interbase voltage
T_J=junction temp. (Deg. Kelvin)

In Figure 2 V_p is the emitter voltage on the vertical axis and V_{bb} is the B_2 voltage on the horizontal axis for point C.

References:

1. "Silicon Unijunction Transistor Types", General Electric Company Brochure #Ecg357 Rep 1/60
2. General Electric Company Transistor Manual, 2nd. Edition, pp 40-44.
3. "A Handbook of Selected Semiconductor Circuits", NavShips 93483, NObsr 73231, BuShips, Navy Dept., pp 6-57, circuit #6-15.
4. T.P. Sylvan, "Bistable Circuits Using Unijunction Transistors", Electronics, December, 1958.

TYPE Z UNIT DAMAGE HAZARD

We have found a problem in the Type Z Differential-Comparator Units (with serial numbers below 749). Under a particular set of conditions this problem can cause trouble. The contacting sectors of the MODE switch are a few thousandths too wide. Consequently, if you turn the MODE switch too slowly when changing from one mode to another you may ground the input signal through the 10-Turn Precision Potentiometer...we traced several potentiometer failures to this problem. Also, you may short INPUT A directly to INPUT B as you turn the MODE switch.

You can minimize the chances of this trouble occurring by turning the MODE switch quickly when changing from one position to another—the trouble is more apt to occur if you hesitate between switch positions. However, a more practical way to protect the instrument is to install a Z-Unit Field Modification Kit, Tek number 040-262. The Kit contains four each 0.02μf, 150 v capacitors and 33 k, ¼ w, 10% composition resistors, a schematic diagram and installation instructions. There is no charge for this kit. Place your order through your Tektronix Field Engineer and be sure to include the serial number of the Z Unit for which the modification is intended.

If you prefer, you may obtain the capacitors and resistors locally and make the modification using the instructions that follow as your guide. First, however, consult the switch identification aid shown in figure 1 below.

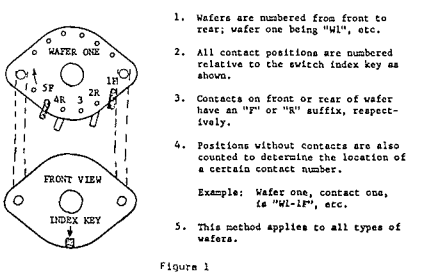


Figure 1

Here are the instructions for the modification:

INSTRUCTION:

( ) 1. Remove the strap connecting W2-12F to W1-12R of the mode switch (see figure 2, step 1).

( ) 2. Remove the white-violet wire from W1-12R (see figure 2, step 2).

( ) 3. Replace the .01 μf capacitor (located between W2-12F and the metal shield plate of the mode switch) with a .02 μf 150 v capacitor (see figure 2, step 3).

( ) 4. Solder one end of a .02 μf 150 v capacitor to W1-12R and solder the other end to the metal shield separating W1 and W2 (see figure 2, step 4).

( ) 5. Solder one end of a 33 k, ¼ w, 10¾ resistor to W2-12F (see figure 2, step 5).

( ) 6. Solder one end of another 33 k, ¼ w, 10% resistor to W1-12R (see figure 2, step 6).

( ) 7. Solder the remaining ends of the 33 k, ¼ w, 10% resistors (just installed) and the white-violet wire (removed in step 2) together (see figure 2, step 7).

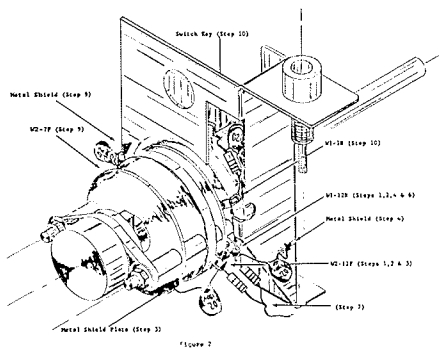
( ) 8. Parallel each of the remaining 33 k, ¼ w, 10% resistors with the remaining .02 μf 150 v capacitors. Clip both combinations to leads of approximately ¼ inch.

( ) 9. Replace the ground strap connecting W2-7R to the shield (separating W1 and W2) with one of the 33 k—.02 μf combinations described in step 8 (see figure 2, step 9).

( ) 10. Using a scribe or a sharp soldering aid, unsolder W1-1R from the shield. Solder the remaining combination of the 33 k—.02 μf from this contact to the key of the switch (see figure 2, step 10).

( ) 11. THIS COMPLETES THE INSTALLATION. Recheck your work.

Figure 2—Drawing showing installation steps for the above Z-Unit field modification.



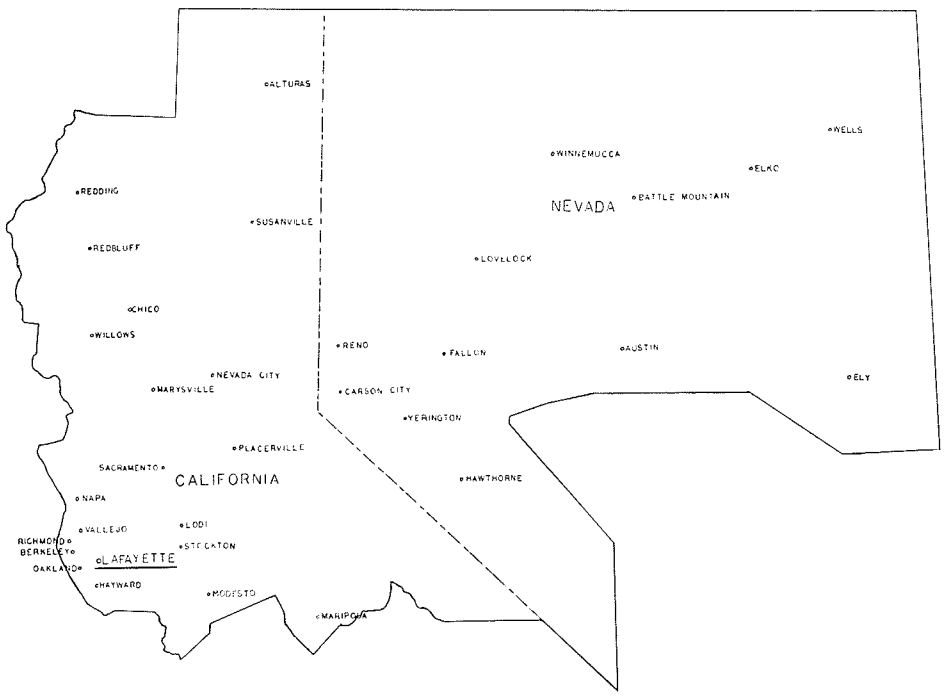
USED INSTRUMENTS FOR SALE

1 Type 524D	Jim Robertson Chief Engineer WLEX TV Lexington, Kentucky Phone LE 4-8747
1 Type 511AD s/n 1730	Harry Nickerson Chief Engineer Chalco Engineering Corporation 15126 Broadway Street Gardena, California
1 Type 511AD s/n 1223	Erich Frank University of Chicago Enrico Fermi Institute 5630 S. Ellis Street Chicago 37, Illinois Phone MI 3-0800, Ext. 3757
1 Type 535 s/n 7189	Chas. Hagen, Test Eng. Microsonics, Inc. 349 Lincoln Street Hingham, Mass.

USED INSTRUMENTS WANTED

1 Type 531 or Type 532	Donald Lusk 2521 South Pearl St. Denver 10, Colorado
1 Type 512 or Type 514	Douglas Waltz 410 West Park Avenue Kokomo, Indiana
1 530 Series (or equivalent) scope	George Jacobson 2931 Anzac Avenue Roslyn, Pennsylvania Phone TU 4-1345
1 Type 317 or other DC to 10 MC scope	Charles Woll 361 Holmes Road Holmes, Pennsylvania
1 Type 514D or Type 515	John Creedon Applied Radiation 2404 N. Main Street Walnut Creek, Calif.
2 Type 310 (instruments in need of repair preferred)	Howard E. Winch, CWO, W3 Det. 2, 714th AC& WRON Driftwood Bay, Alaska
1 Type 121 Amplifier (condition of instrument not important)	John West Tektronix, Inc. 442 Marrett Road Lexington 73, Mass.
1 Type 545	Chas. Hagen, Test Eng. Microsonics, Inc. 349 Lincoln Street Hingham Mass. Phone RI 9-3100
1 Type 524 and 1 Type 511	Test Equipment Co. 9012 Diana El Paso, Texas

ANOTHER NEW FIELD OFFICE



To better serve the area outlined by the map above, we have opened a new Tektronix Field Office at 3530 Golden Gate Way in the community of Lafayette, California. Strategically located in the fast-growing East Bay region, this office makes the many services offered by a Tektronix Field Office more conveniently available to people in this area.

Tektronix Field Engineer Howard King will be in charge of the new office. Howard joined Tektronix as a Field Engineer in 1956 serving in this capacity in our Long Island Field Office until June 1959 and more recently in our Palo Alto Field Office.

Tektronix Field Engineer Tony Bryan, presently with our Field Office in Endicott, New York, will join Howard in the new location on about July 1st.

Field Secretary Virginia Brown will assist Howard and Tony with details in the new office.

Telephone numbers of the new office are: For the Oakland, Berkeley, Richmond, Albany, San Leandro communities CLifford 4-5353; for all others YEllowstone 5-6101. TWX Number: LAF CAL 1639.

Form 3547 requested

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

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

BULK RATE
U. S. POSTAGE
PAID
Beaverton, Oregon
Permit No. 1

MISSING OSCILLOSCOPES

Our Union, New Jersey Field Office sends word that a Type 310A Oscilloscope, serial number 29959, is missing and may have been stolen from the National Cash Register Co. of Newark, New Jersey. If you have any information on the whereabouts of this instrument, please contact the National Cash Register Co. in Newark, New Jersey.

A WORD OF THANKS AND A SUGGESTION

The February issue of SERVICE SCOPE carried an article warning against damage that can occur to the distributed amplifier of some Type 540/550 Series Oscilloscopes.

We wish to thank the many, many people who wrote us expressing appreciation for our candor in bringing the situation to your attention. Requests for the modification kits have been so numerous we have not been able to procure enough components to fill your orders promptly. We are asking for your patience until we are able to do so.

In the meantime we would like to emphasize the fact that chances are **extremely** small that you will have any trouble. If you wish to reduce these chances still further, we suggest that you check to see that the base of the CRT is clamped securely. Most cases of trouble have been caused by the vertical deflection-plate leads shorting to the edge of the CRT shield opening after the CRT has moved in its clamp; rough handling may cause slippage if the clamp is not secure. Some plastic electricians' tape placed around the shield opening will also help.

We do not wish to retract the recommendation that the modification be made—it can prevent a costly repair. However, some have felt a degree of panic which we did not intend and which cannot be justified.

Field Engineering Offices

ALBUQUERQUE* ..... Tektronix, Inc., 509 San Mateo Blvd. N. E., Albuquerque, New Mexico....TWX—AQ 96 .... AMherst 8-3373
Southern New Mexico Area: Enterprise 678
ATLANTA* .... Tektronix, Inc., 3272 Peachtree Road, N. E., Atlanta 5, Georgia....TWX—AT 358.......... CEdar 3-4484
Huntsville, Alabama Area: WX 2000
BALTIMORE* .... Tektronix, Inc., 724 York Road, Towson 4, Maryland....TWX—TOWS 535 .... VAlley 5-9000
BOSTON* .... Tektronix, Inc., 442 Marrett Road, Lexington 73, Massachusetts TWX—LEX MASS 940 .... VOlunteer 2-7570
BUFFALO .... Tektronix, Inc., 961 Maryvale Drive, Buffalo 25, New York....TWX—WMSV 2.......... NF 3-7861
CHICAGO* .... Tektronix, Inc., 400 Higgins Road, Park Ridge 15, Illinois ....PK RG 1395.......... TAlcott 5-6666
CLEVELAND .... Tektronix, Inc., 1503 Brookpark Road, Cleveland 9, Ohio TWX—CV 352 .... FLorida 1-8414
Pittsburgh Area: ZEnith 0212
DALLAS* .... Tektronix, Inc., 6211 Denton Drive, P. O. Box 35104, Dallas 35, Texas....TWX—DL 264....... FLeetwood 7-9128
DAYTON .... Tektronix, Inc., 3601 South Dixie Drive, Dayton 39, Ohio....TWX—DY 363.......... AXminster 3-4175
DENVER .... Tektronix, Inc., 2120 South Ash Street, Denver 22, Colorado......TWX—DN 879.......... SKyline 7-1249
Salt Lake Area: Zenith 381
DETROIT* .... Tektronix, Inc., 27310 Southfield Road, Lathrup Village, Michigan...TWX—SFLD 938.......... ELgin 7-0040
ENDICOTT* .... Tektronix, Inc., 3214 Watson Blvd., Endwell, New York....TWX—ENDCT 290..........PIoneer 8-8291
GREENSBORO ......Tektronix, Inc., 1838 Banking Street, Greensboro, North Carolina....TWX—GN 540.......... BRoadway 4-0486
HOUSTON .... Tektronix, Inc., 2605 Westgrove Lane, Houston 27, Texas....TWX—HO 743.......... MOhawk 7-8301, 7-8302
INDIANAPOLIS ...... Tektronix, Inc., 3937 North Keystone Ave., Indianapolis 5, Indiana....TWX—IP 361X .... LIberty 6-2408, 6-2409
KANSAS CITY ...... Tektronix, Inc., 5920 Nall, Mission, Kansas....TWX—KC KAN 1112 .... HEdrick 2-1003
St. Louis Area: ENterprise 6510
LOS ANGELES AREA
East L. A. ....Tektronix, Inc., 5441 East Beverly Blvd., East Los Angeles 22, California....TWX—MTB 3855 ...RAymond 3-9408
Encino ....Tektronix, Inc., 17418 Ventura Blvd., Encino California....TWX—VNYS 5441 .... STate 8-5170
*West L. A. ....Tektronix, Inc., 11681 San Vicente Blvd., West Los Angeles 49, California.......... GRanite 3-1105
TWX: W L A 6698 From Los Angeles telephones call .... BRadshaw 2-1563
MINNEAPOLIS ...... Tektronix, Inc., 3100 W. Lake Street, Minneapolis 16, Minnesota....TWX—MP 983 .... WAlnut 7-9559
MONTREAL ....Tektronix, Inc., 3285 Cavendish Blvd., Suite 160 Montreal 28, Quebec, Canada .... HUnter 9-9707
NEW YORK CITY AREA
*New York City and Long Island served by:
Tektronix, Inc., 840 Willis Avenue, Albertson, L. I., New York....TWX—G CY NY 1416.......... PIoneer 7-4830
Westchester County, Western Connecticut, Hudson River Valley served by:
Tektronix, Inc., 1122 Main Street, Stamford, Connecticut....TWX—STAM 350 .... DAvis 5-3817
*Northern New Jersey served by:
Tektronix, Inc., 400 Chestnut Street, Union, New Jersey....TWX—UNVL 82 .... MUrdock 8-2222
ORLANDO* ....Tektronix, Inc., 205 East Colonial Drive, Orlando, Florida ..TWX—OR 7008.......... GArden 5-3483
PHILADELPHIA* ..... Tektronix, Inc., 7709 Ogontz Ave., Philadelphia 50, Pennsylvania....TWX—PH 930.......... WAverly 4-5678
PHOENIX * ....Tektronix, Inc., 7000 E. Camelback Road, Scottsdale, Arizona......TWX—SCSDL 52.......... WHitney 6-4273
PORTLAND .... Hawthorne Electronics, 700 S. E. Hawthorne Blvd., Portland 14, Oregon .... BEImont 4-9375
POUGHKEEPSIE * ....Tektronix, Inc., 8 Raymond Avenue, Poughkeepsie, New York .. TWX—POUGH 5063 .... GRover 1-3620
SAN DIEGO .... Tektronix, Inc., 3045 Rosecrans Street, San Diego 10, California..........TWX—SD 6341 ACademy 2-0384
SAN FRANCISCO BAY AREA
Lafayette ....Tektronix, Inc., 3530 Golden Gate Way, Lafayette, California....TWX: LAF CAL 1639 .... YEllowstone 5-6101
From Oakland, Berkeley, Richmond, Albany and San Leandro .... CLifford 4-5353
*Palo Alto ....Tektronix, Inc., 3944 Fabian Way, Palo Alto, California........TWX—PAL AL 112 .... DAvenport 6-8500
SEATTLE .... Hawthorne Electronics, 112 Administration Bldg., Boeing Field, Seattle, Washington ..TWX—SE 189 PArkway 5-1460
ST. PETERSBURG ..... Tektronix, Inc., 2330 Ninth Street South, St. Petersburg 5, Florida ....TWX—ST PBG 8034 .... ORange 1-6139
SYRACUSE* .... Tektronix, Inc., East Molloy Road and Pickard Drive, P. O. Box 155, Syracuse 11, New York
TWX—SS 423 .... GLenview 4-2426
TORONTO* .... Tektronix, Inc., 3 Finch Ave., East, Willowdale, Ontario, Canada .... Toronto, BAldwin 5-1138
WASHINGTON D. C.*..Tektronix, Inc., 9619 Columbia Pike, Annandale, Virginia ...... TWX—F CH VA 760 ...... CLearbrook 6-7411

***ALSO REPAIR CENTERS** — Norfolk, Portsmouth and Hampton Virginia Area: Enterprise 741

17-19

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 9 PRINTED IN U.S.A AUGUST 1961

ADVANTAGES OF INSTRUMENT CYCLING AND A DESIGN FOR A CYCLING UNIT

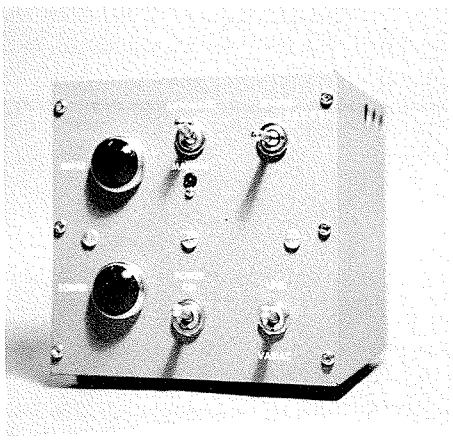


Figure 1—Instrument Cycling Unit.

The cycling of an instrument after repair invites incipient failure from any cause before placing the instrument in service. Periodic switching of the instrument on and off over a span of from 16 to 24 hours can precipitate tube failure (opens or shorts), electrolytic breakdown, transformer breakdown or failure of components in marginal condition. Cycling will also accomplish the gradual aging of any new tubes installed in the repair process.

Changes in original characteristics of tubes and other newly installed components will most likely occur during the cycling period. For this reason, cycled instruments require a recheck of calibration before returning to service.

Typical check points are:

Vertical balance and gain

Plug-in gain and D.C. balance

Sweep timing (sweep cal. at 1 msec/cm)

Complete check and final adjustment of trigger operation.

Les Hurlock of the Tektronix Field Training staff has designed a unit to control the cycling of repaired instruments. It provides simplicity of operation with reliability and at the same time incorporates sufficient versatility to cover most anticipated cycling conditions.

The unit cycles a maximum of four instruments at a time—two on at a time and two off at a time. This arrangement limits the current drawn through the wall outlet and associated breakers.

The unit offers a normal duty cycle of 15 minutes on and 15 minutes off. However, by turning the REVERSE-RACKS switch, you can leave a particular instrument on or off for a longer period of time. Under these conditions, a MANUAL-WARNING neon indicates that the instrument will not cycle unless done so manually. Apart from providing manual operation, the REVERSE-RACKS switch facilitates initial setting up when adding an instrument to or removing an instrument from the racks.

By applying the output of a variable autotransformer to the AUTOTRANSFORMER-IN connector and switching the LINE-AUTOTRANSFORMER control to AUTOTRANSFORMER you can cycle an instrument at a voltage other than that supplied by the line.

Note: Some means of monitoring the auto-transformer voltage should be employed.

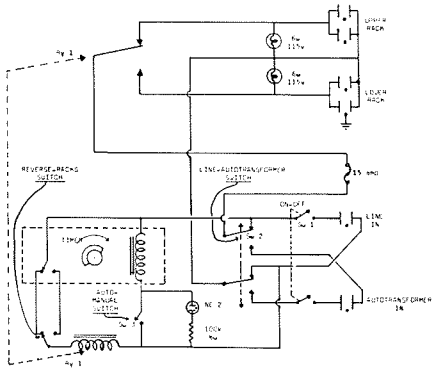


Figure 2 shows the circuit design used in this cycling unit. Notice the 15 amp fuse in the common supply to the upper and lower racks. This fuse prevents excessive current drain in the event of short circuits in the unit or the instruments under-going cycling.

CYCLE UNIT PARTS LIST

QTY.	PART
	SWITCHES
1	DPST 25 amp (Sw. 1)
1	DPDT 25 amp (Sw. 2)
1	SPST (Sw. 3)
1	DPDT (Sw. 4)
	RELAY
1	Ryl-Power* DPDT 25 amp
	TIMER
1	Herco HR026* 2R.P.M.-standard 15 min. on 15 min. off OR Herco HR027* 1R.P.M.-optional 30 min. on 30 min. off
	INDICATOR LIGHTS
1	Socket for candelabra bulb-red jewel (Upper)
1	Socket for candelabra bulb-green jewel (Lower)
2	56 115V-6W bulbs
1	Neon bulb socket
1	NE15 neon bulb
	CONNECTORS
2	3 pin recessed, male (Line-In and Autotransformer-In)
4	3 pin, female (2 for Upper Rack and 2 for Lower Rack)
	MISCELLANEOUS
1	Fuse holder
1	15 amp fuse
1	100 K MΩ comp. resistor
1	Metal Cabinet Budd AU1039-HG*

* or equivalent

Figure 3 shows a chart of the parts required to build the cycling unit.

SERIAL NUMBERS OF INSTRUMENTS MODIFIED TO PROTECT THE DISTRIBUTED AMPLIFIER

The February 1961 issue of SERVICE SCOPE carried an article warning of possible damage to the distributed amplifiers of Type 540A and 550 Series Oscilloscopes. At that time we promised to announce the serial numbers at which a corrective modification became effective.

Here is that information. For the:

Type 541A s/n 21701 RM41A s/n 1271
Type 543A s/n 3151 RM43A s/n 101
Type 545A s/n 29162 RM45A s/n 2191
Type 551 s/n 3180
Type 555 s/n 1683

ALL respective instruments above these serial numbers have the modification. Also; many, many instruments with serial numbers below those listed were modified out of sequence. Visually check the distributed amplifier of your instrument to determine its status. If, after this examination, you are still confused as to your instruments status, contact your Tektronix Field Engineer. He has a complete list of modified instrument serial numbers.

MISSING OSCILLOSCOPES

Through our Chicago Field Office we have learned of the loss of a Type 310 Oscilloscope, serial number 2241 by the G. E. X-Ray, 1061 Jackson Boulevard, Chicago, Illinois. This instrument disappeared from a car parked in front of the G. E. X-Ray office on June 19th, 1961. Please contact these people at the above address if you have any information on this oscilloscope.

From our Long Island Field Office comes word of the disappearance of three Type 310 Oscilloscopes from the Royal-McBee Corporation at 2 Park Avenue, New York City, New York. Serial numbers of these missing instruments are 11496, 4510 and 4511. If you see any of these instruments or have any information regarding them, please contact the Royal-McBee Corporation or your nearest Tektronix Field Office.

Seems that the Type 310's handy size and convenient portability make it a highly desirable item for those who purchase on a "midnight requisition".

A Type 545A Oscilloscope, serial number 22088, and a Type L Plug-In Pre-

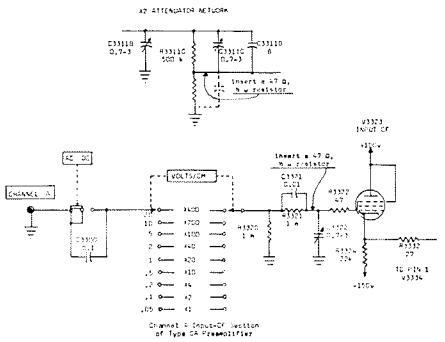
amplifier Unit, serial number 6696, are missing from the Osborne Electronic Corporation, 712 S.E. Hawthorne Boulevard in Portland, Oregon. These instruments were apparently taken from the premises of the Osborne Electronic Corporation by unauthorized persons on the night of March 31, 1961. Please call the Osborne people if you have any information on these instruments. Their telephone number is BE 2-0161.

TYPE 53/54C AND TYPE C-A PARASITIC OSCILLATIONS

On some Type 53/54C and Type C-A Plug-In Units a parasitic oscillation occurs when the attenuator switch is in the .1 VOLTS/CM position and the input is grounded or connected to a low impedance source through a patch cord.

Where these oscillations are only an occasional problem the solution may be to use short ground straps or alligator clips to ground the input instead of patch cords, and use coaxial cables or shielded leads to couple the input to a low impedance source. If this is an impractical solution or the oscillations are a continuing problem, modification of the plug-in unit is recommended.

Type C-A units with serial numbers above 25730 will have this modification incorporated at the factory. For all other Type C-A or Type 53/54C units here's how you install the modification:



Shown in Figure 1 are the two portions of the channel A schematic affected by this modification. The two corresponding portions of the Channel B schematic are identical except for identifying component numbers. Whereas; identifying numbers for components in Channel A are in the 3300 range those of Channel B are in the 4300 range. Bear this in mind as you follow the ensuing instructions.

Channel A—

( ) 1. Locate C3322 (C3023*), a variable tubular-capacitor mounted on the chassis under the Channel A VOLTS/CM switch. From this capacitor, unsolder the 1 meg, ½ w, 10%, composition resistor paralleled by a 0.01 discap.

( ) 2. Solder one lead of a 47 Ω, ¼ w, 10%, composition resistor to the lead of the resistor-capacitor combination unsoldered in step 1. Solder the other lead to the variable tubular-capacitor C3322 (C3023*).

( ) 3. On the dielectric mounting board situated beside the Channel A VOLTS/CM switch locate the variable tubular-capacitor C3311C (C4823*). From this capacitor a bare wire runs to a contact on the second-from-the-front ceramic wafer of the Channel A VOLTS/CM switch. Replace this bare wire with a 47 Ω, ½ w, 10%, composition resistor.

Channel B—

( ) 4. Locate C4322 (C4823C*), a variable tubular-capacitor mounted on the chassis under the Channel B VOLTS/CM switch. Unsolder from this capacitor the 1 meg, ½ w, 10%, composition resistor paralleled by a 0.01 discap.

( ) 5. Solder one lead of a 47 Ω, ¼ w, 10%, composition resistor to the lead of the resistor-capacitor combination unsoldered in step 4. Solder the other lead to the variable tubular-capacitor C4322 (C4023*).

( ) 6. On the dielectric mounting board situated beside the Channel B VOLTS/CM switch, locate the variable tubular-capacitor C4311C (C4923C*). From this capacitor, a bare wire runs to a contact on the second-from-the-front ceramic wafer of the Channel B VOLTS/CM switch. Replace this bare wire with a 47 Ω, ½ w, 10%, composition resistor. This step completes the modification.

*53/54C Unit symbol numbers

TWO NEW SILICON- RECTIFIER MODIFICATION KITS AVAILABLE

Because they offer better reliability and longer life, the relatively new silicon rectifiers are generally preferred over selenium rectifiers.

You can enjoy the advantages of these new rectifiers in your Type 517 or Type 517A Oscilloscopes by installing a Type 517 Silicon Rectifier Mod Kit, Tek number 040-210. Each kit contains a prewired chassis with silicons mounted, schematic, parts list and step-by-step instructions. Type 517 or Type 517A instruments with serial numbers 101 through 1900 will accept this modification—instruments with serial numbers above 1900 come equipped with silicon rectifiers. Price of the Mod Kit is $50.00.

Users of Type 524D or Type 524AD Oscilloscopes can also enjoy the benefits of silicon rectifiers by the installation of a Type 524 Silicon Rectifier Mod Kit, Tek number 040-236. Price $32.00. All but the following Type 524D and Type 524AD instruments will accept this modification:

1. Those with serial numbers 941, 989, 991, 994, 996-998, 1000, 1002, 1006-1008, 1039-1044, 1046-1049, 1051-1053, 1055, 1057, 1058.
2. Those instruments that have had Mod Kit 040-055 or 040-056 installed (selenium stack relocated in line with the fan).

For instruments in the above categories, or for instruments with serial numbers above 1069 which do not have silicon rectifiers, we suggest Type 524 Silicon Rectifier Mod Kit, Tek number 040-177. Price $22.00.

Both the 040-177 and the 040-236 mod kits contain a completely wired chassis with silicons mounted, schematic, parts list and step-by-step installation instrutions.

Order these kits from your Tektronix Field Engineer or Field Office. Be sure to include the serial number of the instrument you intend to modify.

CRYSTAL-OVEN MOD KIT FOR TYPE 180 TIME MARK GENERATOR

The installation of a Type 180 Crystal-Oven Mod Kit in a Type 180 Time Mark Generator will improve the frequency stability of this instrument. The modification replaces the original one megacycle crystal-controlled oscillator with a one megacycle crystal-controlled oscillator mounted in a temperature-stabilized oven. A trimmer capacitor provides a means of adjusting the crystal frequency to zero beat with W.W.V. The modification gives to the Type 180 a stability comparable to that of its successor instrument, the Type 180A.

In addition to the crystal oven with crystal, the kit contains: other necessary components, schematics, parts list, and step-by-step installation instructions that include photographs.

Order from your Tektronix Field Engineer or Field Office. Ask for Type 180 Crystal Oven Mod Kit, Tek number 040-252. Price is $35.00.

SERVICING HINT

Should you find it necessary to replace a precision resistor in the sweep timing circuits of Tektronix oscilloscopes, from stock you have on hand or purchased locally, we suggest you contact your local Field Engineer. One brand we have supplied in the past year has not proved to be as stable as most.

USED INSTRUMENTS WANTED

1 Type 502	Ralph Wiese 674 Sweetbriar Milford, Michigan
1 Type 515	Larry Rhoades Systems Research Labs. 500 Woods Drive Dayton 32, Ohio

1 each Type A, B, C, G, H, K, & L Plug-In Units	Jim Wright 2319 E. Indianola Phoenix 16, Arizona
1 Type 511, Type 513 or Type 514	John Padalino 35 Gail Road Morris Plains, N. J. Phone: JE 9-3918

USED INSTRUMENTS FOR SALE

1 Type R Plug-In Unit, s/n 342. Price $225.00	Bill Crouch Plug-In Instruments, Inc. 1416 Lebanon Road Nashville, Tenn.
1 Type 524, s/n 1161	Jack Bennet, Engineer C.B.S. Electronics 100 Endicott Street Danvers, Mass.
1 Type 127	William H. Read Continental Leasing Co. 5215 Hollywood Blvd. Los Angeles 27, Calif. Phone: HO 9-5371
1 Type 524AD, s/n 1813 1 Scopemobile Price for both $850.00	Monty Studio City Television 12504 Moorpark Street Studio City, California Phone: PO 6-4555 TR 7-1441

QUESTIONS FROM THE FIELD

1. Q: We are having difficulty with noise coming through our 115-v ac line; this noise is being generated by rf oscillations in a nearby department. Do you have any information regarding toroid filters that may help correct the situation?
   A: Toroid cores with an OD of 1", ID of ½" and a thickness of ¼" placed on the instruments power cord should help in filtering out the unwanted signal. It will probably be best to make up a special power cord. Remove the plug or "cap" from the power cord and thread the cord through the core repeatedly until the core center is tightly loaded. Use two or more cores if necessary. If you are unable to obtain the cores locally, you can order them through your Tektronix Field Engineer. Ask him for Tek part number 276-519. Price is 60 cents each.
2. Q: It looks as if the Type 81 Plug-In Adapter's plate dropping resistor R532 (4.7 k, ½ w, 10%, composition) for the output cathode follower might be a bit low on the wattage rating. A check of several adapters reveals this resistor to be blackened around its center. Could we replace this resistor with a 2 watt resistor of otherwise equal value and rating?
   A: Your tip is correct. Our check reveals that R532 is dissipating approximately 1.3 watts of power; that's a little too much. A modification has been submitted to clear up this problem on production instruments. On instruments in the field, this resistor should be replaced with a 2 watt resistor if it shows indication of overheating or burning.
3. Q: What is an easy way to check 6DK6's for cathode interface.
   A: Feed a signal from a Tektronix Type 105 or Type 107 Square Wave Generator into the oscilloscope. Contrive to shift (via a Variac, Powerstat or some similar instrument) the line voltage supplying power to the oscilloscope. If the overshoot in the response changes with line voltage you have it! (cathode interface). Interface will increase as you decrease line voltage.
   Editor's note: We refer you to the August 1960 issue of SERVICE SCOPE. An article in that issue dealt at some length on the problem of cathode interface. The title of the article—"Does the Square Wave Response of Your Scope Look Like This".
4. Q: Let us assume that by miscalculation a very high potential is applied to the signal input of the Type 507 Oscilloscope. Does the Type 507 have any protection for the operating personnel under these circumstances?
   A: We trust a good deal to the operator's judgment in using any oscilloscope. However, included as an accessory with every Type 507 is a heavy copper buss. Mounted in this buss are three coaxial connectors and a ground post. In operation of the instrument, the connectors on the buss are attached to the connectors on the rear of the Type 507. The grounded side of the coaxial fittings provide connection between the oscilloscope, ground, and the ground post at the test setup. It is essential, and should be mandatory, that the observation-shack ground be tied to the oscilloscope also. This should be done by means of the ground post on the buss mentioned above.
5. Q: Is there a way of synchronizing the oscillators of a number of Q Units?
   A: Yes. Connect pin 5 of T5779 in the first Q Unit to pin 1 of V5770 in the second Q Unit through a 50 pf capacitor. Connect the second Q Unit to the third Q Unit in this same manner, etc. This injects enough signal from the first unit into the second, from the second into the third, etc., to bring the oscillators of the several units into synchronization. However, for this method to work the oscillators of the several Q Units must all be adjusted to operate at or very near the same frequency. Adjustment of oscillator frequency is explained on page 6-2 of the Q Unit Instruction Manual.

   The need for oscillator synchronism arises when long input leads to the Q Units are laid closely together or when the leads are not adequately shielded. Under these conditions, capacitive coupling of signals will occur and cause erroneous readings at the output of the Q Units.

DOUBLE PULSER OUTPUT FEATURE

The Tektronix Type 535, 545, 535A, 545A, 555 and 585 Oscilloscopes contain a double pulse generator. When these instruments are set up to provide the "superposition of waveform" feature, the +GATE A (+GATE MAIN SWEEP)* provides a double pulse output with the following variables:

a) The width of the pulse is variable via the Time Base A TIME/CM (Main Sweep TIME/CM)* switch and is variable with the concentric variable control.

b) The time of occurrence relative to the pulse is variable by way of the DELAY-TIME MULTIPLIER control.

c) The point of the double pulsing action can be varied by way of the Time Base B TIME/CM or DELAY TIME (Delaying Sweep TIME/CM or DELAY TIME)* switch and the concentric LENGTH control.

Here's how you set up the oscilloscope to provide the "superposition of waveform" feature:

1. Connect the VERT. SIG. OUT connector to the Time Base B TRIGGER INPUT (Delaying Sweep TRIGGER OR EXT. SWEEP IN)* connector. Connect a capacitor of about 100 $\mu\mu$f capacitance between the +GATE B (+GATE DEL'G SWEEP) * connector and the DEL'D TRIG. (DEL'D TRIG. FROM MAIN OR DEL'G SWEEP)* connector.

2. Set the HORIZONTAL DISPLAY switch to 'B' INTENSIFIED BY 'A' (DELAYING SWEEP)*. Connect the source of the wave train to the INPUT or CHANNEL connector of the plug-in preamplifier. Adjust the controls to obtain a delayed sweep. Turn the DELAY-TIME MULTIPLIER control to a setting in the upper part of its range. Adjust the Time Base B TIME/CM OR DELAY TIME (Delaying Sweep TIME/CM OR DELAY TIME)* control so that the desired number of waveforms is displayed.

3. You should now observe two brightened portions of the display—one at the start of the display at the left-hand end of the graticule, and the other at a later point along the graticule. Set the Time Base A TIME/CM (Main Sweep TIME/CM and MULTIPLIER)* control so

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Beaverton, Oregon

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that the left-hand brightened portion includes the first waveform in the train. With the DELAY-TIME MULTIPLIER, move the second brightened area so that it includes the waveform you want to compare with the first waveform in the train.

4. Set the HORIZONTAL DISPLAY switch to 'A' DEL'D BY 'B' (MAIN SWEEP DELAYED)*. The display should now present both the first waveform in the train and the other waveform that was brightened in the preceding step. You can now use the DELAY-TIME MULTIPLIER to superimpose these two waveforms for precise comparison. The resulting reading of the DELAY-TIME MULTIPLIER, multiplied by the TIME/CM OR DELAY TIME setting indicates the delay time between the waveforms being compared. You can also now observe any jitter in the second waveform with respect to the first.

* Captions in parenthesis refer to the Type 535 and Type 545 instruments.

FUNDAMENTALS OF SELECTING AND USING OSCILLOSCOPES

Two authoritative articles covering the fundamentals of selecting and using oscilloscopes are now available in a single booklet. These articles originally appeared in ELECTRICAL DESIGN NEWS; the first one, "Factors Affecting the Validity of Oscilloscope Measurements", in the November 1960 issue and the second, "Appraising Oscilloscope Specifications and Performance", in the February 1961 issue.

Author of the articles is John Mulvey. John has been with Tektronix since 1952. He has worked in Test and Calibration, in Engineering and in Marketing. In addition, he has had nearly six years experience in the Philadelphia and Los Angeles areas as a Field Engineer. At present he is manager of the Field Information Group supporting Field Office activities. His wide experience enables John to write clearly and interestingly about his subjects. We believe you will find the booklet informative and helpful.

A copy of this booklet may be obtained through your Tektronix Field Engineer or the nearest Tektronix Field Office. A current list of Tektronix Field Offices appeared on page four of the JUNE 1961 issue of SERVICE SCOPE.

DC RELAY FIELD MODIFICATION KIT FOR "A" SERIES 530/540 OSCILLOSCOPES

Magnetic flux leaking from the ac relays will cause ripple on the crt trace of some 530/540 "A" Series instruments. Rack mounted instruments seem to be most susceptible to this difficulty because the crt shield is oriented differently with respect to relay location.

A way to tell how much, if any, ripple is caused by the relay is:

1. Short the vertical-deflection plates together and rapidly rotate the horizontal position control back and forth while looking for vertical ripple.
2. Short the horizontal-deflection plates together and rapidly rotate the vertical-position control back and forth while looking for horizontal ripple.

A Field Modification Kit that replaces the ac relay with a dc relay in the 530/540 "A" Series Oscilloscopes is now available. This modification will eliminate the ripple stemming from the ac relay in these instruments. It will also improve the relay and power supply reliability by eliminating the relay chatter.

The kit contains a complete set of components including; a new time-delay relay and power-supply relay, parts list, schematic and step-by-step instructions. Ask for DC Relay Field Modification Kit, Tek. No. 040-258. Price is $8.00.

We earnestly recommend you consult your Tektronix Field Engineer before ordering this modification kit. It is always to your advantage to avail yourself of his help when ordering Tektronix instruments, replacement parts or modification kits. It may be particularly so in this instance.

THE CORRECT TOOL

The correct tool makes a difficult job easier. It may also point to a successful solution for a seemingly impossible task. Conversely, the selection of an incorrect tool will result in costly delays and bitter disappointment.

The purchase of an accurate, reliable, high-quality oscilloscope involves a substantial sum of money. In these days of tight schedules and even tighter budgets, it is of prime importance that the instrument selected do the job as efficiently, as easily and as quickly as possible. It is to this end that a great measure of the Tektronix Field Engineer's training is directed.

There are many types of oscilloscopes, each designed for a specific application area...from the broad general-purpose oscilloscope to the highly specialized instrument. Your Tektronix Field Engineer can help you make the best possible investment by recommending the oscilloscope best suited to your present and future needs. He will be happy to back up his recommendation with an actual demonstration of the instrument in your application. But he will not hesitate to recommend some other method of attacking the problem if it appears to meet your requirements more efficiently. Try him. A no-pressure consultation with him can help you select the correct tool for your work.

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 10 PRINTED IN U.S.A OCTOBER 1961

PROTECTION OF TYPE 321 VERTICAL AMPLIFIER AGAINST TRANSIENTS

Under certain conditions, the transistor Q443* in the vertical amplifier of the Type 321 Oscilloscope will fail. With the VOLT/DIV switch in the most sensitive (0.01 v/div) position, an inadvertent connecting of the signal input to a high-voltage overload will cause damage to this transistor. Or, with the INPUT switch in the AC position, C401—the AC-input coupling capacitor—can charge to a high negative voltage (150-500 v). If, immediately after reaching this charge, the capacitor should suddenly be discharged by the grounding of the scope input, the transistor will suffer damage. In either instance, the resulting positive surge will cause an excessive B-to-C voltage that will exceed the collector breakdown voltage of Q443.

A germanium diode connected between the cathode of V423 (5718 input CF) and the 6.3-v dc filament supply will protect Q443 against the positive-going surges generated under these conditions. The modification will in no way impair the instrument's performance. We recommend the use of the low-capacitance Type T12G (or equivalent) diode.

To add this protective circuit to the Type 321, connect the recommended diode from the cathode, pin 5, V423, to the +6.3 v (decoupled) source, which supplies filament power to pin 6, V423. The cathode (color-coded) end of the diode should be connected to the filament line so that in normal operation the diode is back-biased by about 5 volts. See figure 1 below.

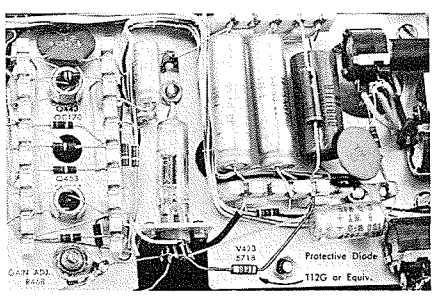


Figure 1

The schematic diagram for the instrument should be modified as shown in figure 2 and the new diode assigned the

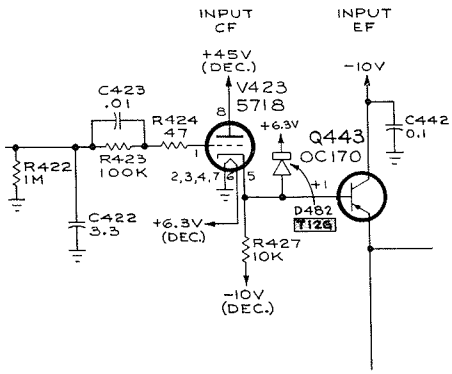


Figure 2

symbol D482 and added to the instrument-manual's parts list.

This modification applies to all Type 321 Oscilloscopes with serial numbers below 479. A factory installed modification protects Type 321's with higher serial numbers.

* This transistor is identified as Q433 on some early schematic diagrams.

FLORIDA OFFICE CONSOLIDATION BENEFITS CUSTOMERS

On September 1, 1961, our St. Petersburg, Florida Field Office consolidated with our Orlando, Florida Field Office. This consolidation will provide larger, more complete facilities and improved service benefits to Tektronix customers in the affected areas.

Among the factors recommending this action several are of particular importance to customers in these areas:

(1) Recent expansion of facilities at the Orlando Field Office provide an enlarged and more complete emergency repair-parts stock.

(2) Direct access to an enlarged repair-parts stock by your Tektronix Field Engineer. Also, more readily at his disposal are the field maintenance skills of the enlarged and well-equipped Field Repair Center.

(3) Installation of special equipment to wash instruments when the need for this treatment is indicated. This equipment includes an oven to dry or bake out residual moisture in washed instruments.

(4) Improvements in the Florida highway system now permit effective service of the eastern and southern parts of the state from this combined Field Engineering Office and Repair Center.

(5) Greater utilization of Field Office personnel and facilities are made possible under this consolidation. Customers in the affected areas—and this includes the St. Petersburg-Tampa area—will receive improved Field Engineering coverage and service benefits.

Customers in the St. Petersburg-Tampa area may call the Orlando Office toll free by using the telephone number WX2199.

For all others, the telephone number for the Orlando Office is GArden 5-3483.

Regular visits by our Field Engineers will continue to provide our Puerto Rico customers with the same service enjoyed by our customers in Florida.

From Puerto Rico call—Orlando, Florida, GArden 5-3483 or write to:

Tektronix, Inc.
205 East Colonial Drive
Orlando, Florida.

TEKTRONIX POLARIZED VIEWER FOR TEKTRONIX 5" OSCILLOSCOPES

To people who must view oscilloscope traces under high ambient light conditions, the problem of light reflections is an irritating one.

Interpreting an oscilloscope display under these conditions is always difficult and sometimes well nigh impossible. Even with the intensity turned up to maximum brightness this is true. And here one encounters another hazard. There is always the possibility of permanent damage to the crt phosphor when the INTENSITY control is set to give maximum trace brightness. This is particularly true when the instrument is operated at the slower sweep speeds.

The new Tektronix Polarized Viewer was designed to overcome these problems stemming from high ambient light conditions. Installed on your oscilloscope, it will reduce light reflection problems to a negligible factor and eliminate the need for dangerous intensity settings at slow sweep speeds.

The pictures shown below were taken in a well lighted office with large windows and a southern exposure. The day was very bright and sunny. These factors combined to give an extremely high ambient light condition.

Both pictures were taken without altering the position of the oscilloscope or camera. This fact is attested to by comparing the pattern of front panel light

reflections. Close scrutiny will also disclose that the position of the front panel controls are the same in both pictures.

Figure 1 shows the oscilloscope without the Polarized Viewer. The Amplitude Calibrator waveform being displayed on the crt was barely discernable to the naked eye and does not show in the photograph at all. Figure 2 with the Polarized Viewer in place eliminates reflection from the crt and the Amplitude Calibrator waveform is readily visible.

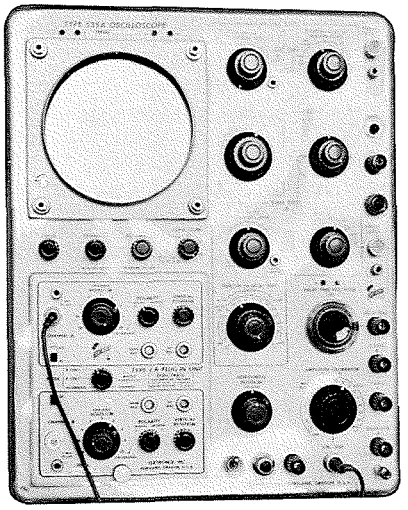


Figure 1

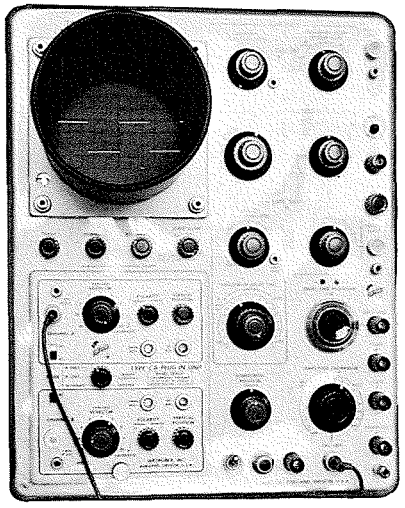


Figure 2

The Viewer slips on or off the oscilloscope in a matter of seconds. There are no nuts or bolts to loosen or tighten.

Ask your Tektronix Field Engineer for a demonstration of the Polarized Viewer. Tek part number is 016-035. Price is $10.00.

NEW FIELD MODIFICATION KITS

SILICON-RECTIFIER MODIFICATION KIT

For Type 532, s/n 101 to 6921, and Type RM32 Oscilloscopes, s/n 101 to 449.

This modification replaces the selenium rectifiers with silicon rectifiers which offer more reliability and longer life.

The kit includes a prewired chassis with silicon diodes mounted, step-by-step installation instructions, photo, parts list and schematic.

Approximate installation time by a trained technician is 30 minutes.

Order through your Tektronix Field Engineer. Specify Type 532 Silicon Rectifier Mod Kit, Tek. No. 040-218. The price is $12.00.

PRESET-STABILITY MODIFICATION KIT

For Type 532 Oscilloscopes, s/n 5420 to 5665.

This modification installs a new potentiometer and preset switch to enable the operator to quickly switch to a preset-stability setting.

The kit includes a Stability-Potentiometer-and-Preset-Switch assembly, step-by-step installation instructions, parts list and schematic.

Approximate installation time by a trained technician is one honr.

Order through your Tektronix Field Engineer. Specify Type 532 Preset-Stability Mod Kit, Tek. No. 040-244. Price is $6.50.

TYPE "N" PROBE-POWER FIELD MODIFICATION KIT

For Type N Plug-In Units, s/n 101 to 220.

This modification kit installs a probe-power socket on the front panel of the Type N Plug-In unit. It permits the use of the P6025 Cathode-Follower Probe* -a high impedance probe designed for use with the Tektronix Type N Plug-In Unit.

The kit includes a probe-power socket, necessary hardware, tags, photos and step-by-step installation instructions.

Approximate installation time by a trained technician is one hour.

Order through your Tektronix Field Engineer. Specify Type "N" Probe-Power Field Mod Kit. Price is $8.65.

* The P6025 Cathode-Follower Probe will be in full production by December 1961.

EXTERNAL-TIME-SWEEP MODIFICATION KIT

For Type N Plug-In Units, s/n 101 to 220.

This modification installs an External-Time-Sweep socket on the front panel of the Type N Plug-In Unit to permit the use of two N Units in the Type 551 or Type 555 Oscilloscopes.

The kit includes all the necessary hardware, tag, photo and step-by-step installation instructions.

Approximate installation time by a trained technician is 30 minutes.

Order through your Tektronix Field Engineer. Specify Type "N" External-Time-Sweep Mod Kit, Tek. No. 040-246. Price is $3.10.

SERVICING HINTS

TYPE 107 WAVEFORM DISTORTION

Some Type 107 Square-Wave generators prior to s/n 1450 may produce distorted waveforms. We find that higain 12BY7's in V45 and V55 positions of the affected instruments produce oscillations which result in poor risetime and cause a step in the negative portion of the square wave (see Figure 1; a, b. c.).

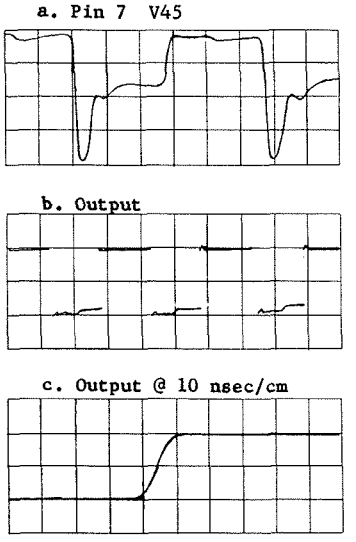


Figure 1

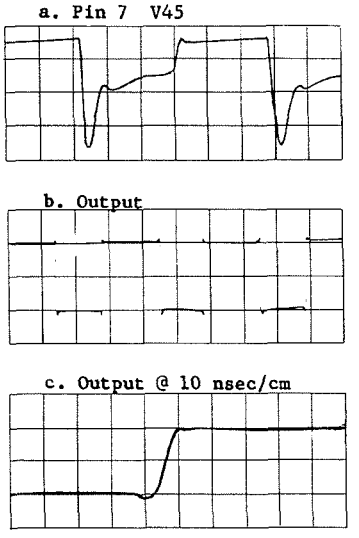


Figure 2

When viewed on a Type 585 scope, the risetime of the affected Type 107's ranged from 4.0 to 8.0 nanoseconds, depending upon the particular tubes used. In less extreme cases of oscillation, the risetime varied with frequency.

To correct this condition in your instrument, dress coupling capacitors C57 and C67 down close to the filament buss line. Relocate C49 and C59 directly over the tube sockets, and with leads as short as possible. Connect these capacitors between pins 1 and 8 of their respective sockets. C49 and C59 should be dressed

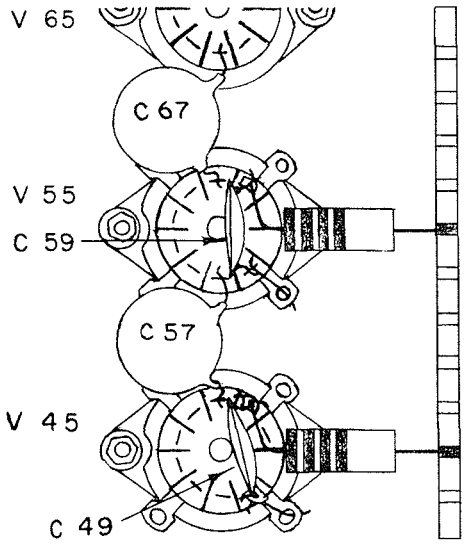


Figure 3

in an upright position (see Figure 3 for proper parts layout).

Type 107's from s/n 1450 on are modified at the factory and should not have this problem. (Figure 2; a, b, c, shows waveforms of a properly working Type 107).

TEKTRONIX TYPE 545 CALIBRATION AND MAINTENANCE PROCEDURE ERROR.

The figures given in the "Tektronix Type 545 Oscilloscope Calibration and Maintenance Procedure" (Tek. No. 070-282) contain an error. The figures given for the vertical amplifier stage gains (Step 7.7.3.1, page 3-30) are not correct. Corrected pages 3-30 will be distributed to Tektronix Field Offices as soon as possible.

Meanwhile, existing copies should be corrected as follows:

7.7.3.1 Insufficient Gain. Use a regular voltage measurement plug-in in the instrument under test. Check stage gains to assure even phase-splitting ahead of the main vertical-amplifier input. Measure amplitude at each grid comparing gain against the tables below:

	Gain	
	Min.	Normal
12BY7A or 6AW8 (GAIN ADJ. clockwise)	4-4.5	5.5-6
6BQ7/6DJ8 Cathode-Follower Stage*	0.7	0.7
Distributed Amplifier (6CB6's or 6DK6's)	20-22	22-24

*Above serial numbers 9292, 0.7 gain is total for **both** cathode-follower stages. If input and output stages are at or near minimum gain, tubes in one or both stages may require replacement.

If overall amplifier gain is 70 or more, the trouble is probably not in the amplifier, and may be in crt sensitivity. Recheck high voltage supplies (4.1) and Deflection factor (6.4).

If vertical amplifier tubes are changed, be sure to repeat all parts of Step 7. If tube change does not provide correct gain, check plate-load resistors, screen potentials, decoupling networks, filament lines, etc. Also check calibrator accuracy (Step 8.)

USED INSTRUMENTS WANTED

1 Type 515 or Type 515A or Type 516	R.H. Dempey Electronic Services 3648 Harkness Street Napa, California Phone: BAldwin 6-7773
1 Type 531 1 Type 53/54C	Customer prefers his name be kept confidential. Please direct inquiries to the Tektronix Endicott Field Office, 3214 Watson Blvd., Endwell, New York
1 Type 513D, Type 514 or Type 310	R.H. Cook 1213 Webster Royal Oak, Michigan
1 Type 541AD or Type 511AD	Johny Russell 2870 Ronald Street Riverside, California Phone: OVerland 6-6119

USED INSTRUMENTS FOR SALE

1 Type 511AD s/n 1821	Dick Stivers Valor Electronics 13214 Crenshaw Gardena, California Phone: FAculty 1-2280
1 Type 531 s/n 2456 1 Type 53C s/n 3580	Dr. K.L. Cook University of Utah Geophysics Department Salt Lake City, Utah
1 Type 127 s/n 155	Dr. Geoorge Czerlincki Johnson Foundation University of Pennsylvania Philadelphia 4, Penn. Phone: Evergreen 6-0100, Ext. 8796
1 Type 555 s/n 282 2 Type CA Plug-Ins, s/n's 15262 & 18353	S. Olive, Vice-President R. D. Brew & Co. 90 Airport Road Concord, New Hampshire
1 Type 512 s/n 2567	Macan Engineering & Mfg. Co. 1564 N. Damen Avenue Chicago 22, Illinois Phone: BE 5-3386
1 Type 511AD s/n 5210	Wilbur McBride Standard Oil Research Laboratory 4440 Warrensville Center Road Cleveland 28, Ohio
1 Type 511AD s/n 4461 Price $200.00	Steve Evans Advanced Instrument Corp. 1475 Powell Emeryville, California

MISSING OSCILLOSCOPES

Bramco, Inc. of 4501 Belevidere, Detroit 14, Michigan, reports that the following instruments are missing from their plant and are presumably stolen:

1 Type 543 Oscilloscope, s/n 158
1 Type 535A Oscilloscope, s/n 20235
1 Type 53/54C Plug-In Unit, s/n 16971
1 Tye 53/54L Plug-In Unit, s/n 2745
1 Type 53/54L Plug-In Unit, s/n 2745

If you have any knowledge of the whereabouts of these instruments, Bramco, Inc. would appreciate it very much if you would contact them.

CORRECTION

"SOLVING POWER LINE PROBLEMS" (JUNE 1961 SERVICE SCOPE)

The method outlined in the June issue of Service Scope for determining power-line distortion by comparison of filament-line rms and peak-to-peak voltages is not valid for Type 517(A) and Type 555 Oscilloscopes, and—even with other model instruments—should only be taken as a rough indication of the line voltage distortion actually present. Gordon Sloat, Manager of the Tektronix Transformer and Coil Department, points out that the implication in the June article that this method provided more than an approximation of line-voltage distortion is incorrect.

The Types 517(A) and 555 Oscilloscopes employ a peak-limiting saturable reactor to provide regulation of the indicator unit filament lines, and the distortion on the filament lines in these instruments will not be representative of the line-voltage waveform. A typical VOM may show only 5.8 volts for a true rms of 6.3 volts on one of these regulated filament lines.

In other instruments, a certain amount of filament-line distortion may be introduced in the transformer because of the filament-winding positions and other transformer design parameters. Since these winding locations and parameters may vary considerably between serial ranges of instruments and between instrument types, Gordon has suggested that the technique of using filament-line distortion as an indicator of power-line

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

Service Scope

USEFUL INFORMATION FOR
USERS OF TEKTRONIX INSTRUMENTS

distortion should **not** be relied on heavily.

Comparison of the actual peak-to-peak versus true rms-power-line voltages is preferred as a much more accurate method of determining the suitability of the power-line waveform for proper B+ regulation.

For the peak-to-peak measurement, the V-O-M adapter suggested in the June 1961 issue of Service Scope, or an accurate peak-to-peak reading voltmeter are recommended; for rms readings, an iron-vane or thermocouple meter will give the most accurate results.

A TIP FOR CLEANING TIPS

Figure 1

Figure 1 above shows a handy-dandy unit for keeping soldering-iron tips clean. We find this cleaner, much more efficient, and quicker than the old wipe-on-a-cloth method.

Easy to construct and simple to use, it does an excellent job. To use it, just draw the soldering-iron tip down through the brush bristles as shown in figure 2.

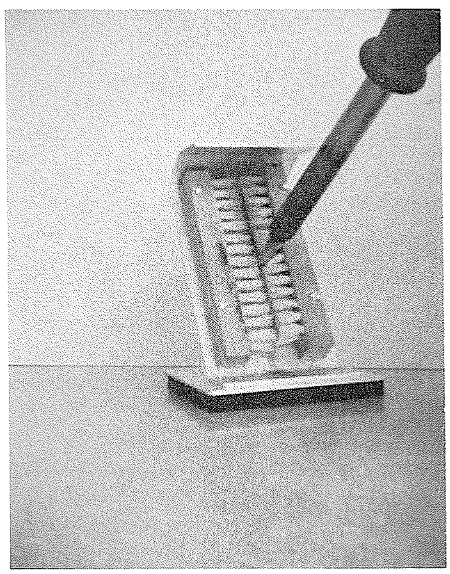


Figure 2

We used 0.064″ aluminum in constructing the unit shown here. Base dimensions are 4″ x 4″. The bracket on which the brushes are mounted is, in this instance, spot welded to the base. You could just as easily mount the bracket to the base with two flat-head bolts counter sunk flush with the bottom side of the base. Locate the bracket ⅜″ from the front edge of the base.

Form the bracket for the brushes from a piece of aluminum 3″ x 8″. One inch from the end of this material make a 60° bend. Five inches from this bend make a 45° bend. One and one quarter inches from the 45° bend make a 30° bend. Be sure you make each bend in the direction as shown in the picture.

On the five inch section of this bracket, 7/16″ in from each side and 1¼″ up from the 60° bend, drill four holes (two holes to a side) on three inch centers. Use a #27 drill. If you wish to be real fancy you can make slots about ½″ long and as wide as the holes. Then as the brush bristles wear you can readjust the brushes close to each other.

The brush portion of the cleaner can be purchased at almost any hardware store. Ask for a white tampico hand brush. Dimensions of the brush should be 4¾″ long by 1½″ wide. One brush will be all you require per unit.

One and one eighth inches from one end of the wood handle and ¼″ down from the top, drill two holes on three inch centers. Use a #14 drill. Now saw the handle through the center lengthwise. This will give you two brushes 4¾″ long by 7/16″ wide. Mount the brushes as shown in the pictures and you have a quick, convenient and efficient soldering-iron-tip cleaner.

You may mount the cleaner permanently in a convenient location by drilling holes in the base plate and securing the unit with screws or bolts. The one shown has sponge rubber strips ½″wide by ¼″ thick cemented to the base. They hold the cleaner in place when it is used and have the added advantage of making the unit portable.

The metal extending out on the top of the cleaner (formed by making the 30° bend) is important. It deflects downward and away from the operator any hot solder or tip flakes dislodged by the cleaning brushes.

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 11 PRINTED IN U.S.A DECEMBER 1961

ACCURATE FREQUENCY MEASUREMENTS

By Jerry Kraxberger, Tektronix Field Engineer

The sweep-time accuracy of most Tektronix Oscilloscopes is specified to be ±3% on any range. Some oscilloscope operators find it necessary, at times, to make time or frequency measurements to much closer tolerances. Faced with these requirements, the oscilloscope operator will most likely rely on the highly accurate and well-known method of using Lissajous patterns to compare an unknown frequency with a standard frequency. This method has two drawbacks; one, it may not be suitable for the oscilloscope at hand; two, it requires considerable set-up time.

You may use a much simpler, yet equally accurate, method provided your oscilloscope possesses—as all Tektronix Oscilloscopes do—a triggered sweep. The accuracy of the instrument does not enter into the measurement and the wave shape of either signal, i.e. sine wave, sawtooth, pulse, etc., is not important.

To use this method, connect one signal to the external-trigger input and the other to the vertical-amplifier input of the oscilloscope. You may use either signal as the standard but you must connect the lower-frequency signal to the external-trigger input. Trigger the sweep in the normal manner. On Tektronix Oscilloscopes, set the TRIGGERING MODE switch to AC or DC. Do not use the AUTOMATIC or HF SYNC modes for this application. Make certain the sweep is not free running by temporarily removing the external-trigger signal. If the sweep is free running, a trace will remain on the crt.

Let's look at a specific application. Suppose you want to adjust a 400-cps signal to an accuracy better than ±0.01%. We suggest the use of a triggered-type oscilloscope and a Tektronix Type 180A Time-Mark Generator* since 400 cps is an integer of the time-mark generator's 1-mc (±0.001%) crystal-controlled oscillator frequency.

Here is a suggested procedure: (see block diagram, Fig. 1)

1. Adjust the oscilloscope sweep time to 1 msec/cm.
2. Trigger the oscilloscope externally from the 10-msec marker (100 cps) of the time-mark generator (external-trigger-input of oscilloscope).
3. Connect the 400-cps signal to the vertical-amplifier input of the oscilloscope.
4. Adjust the 400-cps frequency precisely until it does not move horizontally on the screen.

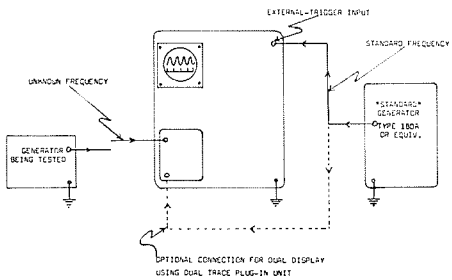


Fig. 1

Since the period of a 400-cps signal is 1/400 sec or 2.5 msec, you should now have 4 complete cycles of the 400-cps signal displayed in 10 cm horizontally (10 msec of time) on the screen.

If the 400-cps signal does not move horizontally, and if the Time-Mark Generator has zero tolerance, the signal under test will be 400 cps ±0.0.

With the Tektronix Time-Mark Generators specified in this article as the standard source, the signal under test can be adjusted to 400 cps ±0.001% or 400 cps ±0.004 cps.

Note that if the signal were off by ± 0.01 cps, one complete cycle would move past a given point on the crt screen in 10 seconds. When you consider the accuracy of the specified time-mark generators, this would be 400 cps ±0.104 cps.

You can use the above method of frequency comparison because the 400-cps signal under test and the 1-msec (1 kc) time-mark signals are exact integers of the 1-mc/sec frequency of the time-mark generators crystal-controlled oscillator. Note that the oscilloscope sweep time does not enter into the measurement. It is, however, an aid when making preliminary adjustments of the signal under test.

If you use a dual-trace preamplifier (Type C-A for example)** in the oscilloscope vertical channel, you can observe both signals on the crt screen simultaneously. To do this, run another jumper from the time-mark generator's 1-msec output to the dual-trace preamplifier's B channel. Set the preamplifier MODE switch to the ALTERNATE, CHOPPED, or ADDED ALGEBRAICALLY position. The 1-msec markers will remain stationary on the crt screen but the 400-cps signal will travel to the right or to the left if it is not exact.

To insure the accuracy of the Type 180A Time-Mark Generator, you can compare or calibrate its frequency with the Bureau of Standards' WWV station as follows: Tune a short-wave receiver to station WWV. Add a short length of wire to the 1-μsec output of the Type 180A Time-Marker Generator. The generator's 1-mc signal will beat with the incoming WWV signal in the short-wave receiver's A.M. detector. The difference frequency in cycles will be a measure of the time-mark generator's accuracy in parts per million. You can minimize this difference by adjusting the variable-trimmer capacitor across the oscillator crystal in the time-mark generator. Monitor this difference signal right off the detector of the short-wave receiver. Use an oscilloscope to do this. One cannot hear the low-frequency zero beat. Besides, the low-frequency response of the receiver's audio system may not be good.

* The following Tektronix Time-Mark Generators may also be used for this application; Type 180 with a Type 180 Crystal Oven Mod Kit (Tek No. 040-252) installed. Type 181 and Type RM 181 with Crystal-Oven Combination accessory (Tek No. 158-007) installed.

** Tektronix instruments on which you may observe these signals simultaneously are; Type 502 Dual-Beam Oscilloscope and Type 516 Dual-Trace Oscilloscope. Any Type 530, Type 540, Type 550-Series Oscilloscope with a multiple-trace, letter-type, Plug-In Preamplifier in the plug-in compartment (this would also include the Type 580 Series Oscilloscopes with a Type 81 Plug-In Adapter). Type 560 or Type 561 Oscilloscopes with a Type 72 Dual-Trace Plug-In Unit.

SHIPPING BLOCKS AND INSTRUMENT PACKAGING

A continuing problem for both Tektronix and our customers is the damage suffered by instruments in transit.

The most foolproof container a customer can use when shipping a Tektronix instrument is the original carton in which it was received. These cartons and their attendant packing materials are the result of much research and some sad experiences. An instrument, properly housed in one of these containers, will come through a normal shipment ordeal in excellent condition.

We earnestly recommend that, whenever possible, the original Tektronix shipping carton along with the dunnage and any shipping blocks be retained and stored for future use.

We would also like to make the following suggestions for packaging Tektronix instruments for shipment:

If you do not have the original shipping carton, contact your Tektronix Field Engineer. He very probably will be able to supply you with a factory-approved carton.

If the instrument has a shock-mounted

chassis, be sure the original shipping blocks are put in place. When these blocks are not available, make substitutes of corrugated paper, sponge rubber, styrofoam or similar material. Customers quite often send a shock-mounted-chassis instrument to us without the shipping blocks or a suitable substitute in place. Almost invariably the instrument will suffer some shipping damage because of the omission.

All instruments should be completely wrapped in kraft paper or other pliable dust-resistant material. Set the wrapped instrument in the original carton and place the dunnage around it. Close carton and seal with gummed tape.

If the original carton is not available, use a container of corrugated paper, wood, or metal construction. The container should be large enough to allow a minimum of one and one-half inches clearance around the instrument—top, sides, bottom and ends. Fill this clearance area with some type of compressible material, *and do not use wooden blocks to support the instrument rigidly in the carton.* Rubberized hair, wood excelsior or paper excelsior are preferred materials. Float the instrument so as to completely surround it with an even thickness of this protective material. In the absence of these materials, sheets of corrugated paper cut from other cartons will make an acceptable substitute filler. Most instruments so packed will survive ordinary shipping conditions in good shape. It takes a very resolute and satanically-minded shipping-agent employee to sucessfully damage an instrument packed in this manner.

If your copy of SERVICE SCOPE did not carry your correct address, we would like to know so that we can remedy the error. Also, if your friends or associates would like to receive their own copies, please tell them to write us—or you can send us their names, titles, and addresses.

NEW FIELD MODIFICATION KITS

TYPE 524 FOUR-POSITION VERTICAL SELECTOR SWITCH MODIFICATION KIT (with Revised IRE Response Network.)*

For Type 524D Television Oscilloscopes, s/n's 101 to 1399 inclusive except those instruments that have had the older Mod Kit, Tek No. 040-057, installed.

This modification kit installs a four-position vertical switch and an access panel to provide the following improvements:

a. A FLAT vertical response to 5 megacycles within 1%. This passband is necessary for measuring the radio-frequency "burst" used in color TV.
b. A new IRE Response Network which changes the roll off characteristics to conform with the Standard '58 IRE 23.S1, as amended July 1, 1961.

Order through your local Tektronix Field Engineer or Field Office. Specify Type 524D Four-Position Vertical Selector Switch Mod Kit, Tek. No. 040-271. Price is $17.25.

* This new modification kit replaces the old Type 524 Mod Kit Tek No. 040-057 which installed a four-position vertical selector switch and access panel but did not include the Revised-IRE-Response Network.

To install the IRE-Response Network in instruments that have been modified with Mod Kit No. 040-057, see Type 524AD Modification Kit described elsewhere in this column.

TYPE 524AD IRE NETWORK MODIFICATION KIT

For Type 524AD Television Oscilloscopes s/n's 1400 to 6584 inclusive and for Type 524D Television Oscilloscopes below s/n 1400 that have been modified (Field Mod Kit, Tek No. 040-057) to include a four-position Vertical Response switch and access panel.

This modification installs a new IRE Response Network in the Type 524AD Oscilloscope. This network changes the roll-off characteristics to conform with the Revised Standard '58 IRE 23.S1 as amended July 1, 1961.

The kit includes a Vertical-Amplifier-Response Selector switch, drawings, schematic and step-by-step installation instructions.

Order through your local Tektronix Field Engineer or Field Office. Specify Type 524AD IRE Response Network Mod Kit, Tek. No. 040-263. Price is $12.20.

TYPE 525 IRE RESPONSE NETWORK MODIFICATION KIT

For Type 525 Waveform Monitor s/n's 101 to 1299 inclusive.

This modification changes the IRE Response characteristics in the Type 525 to conform with the Revised Standard '58 IRE 23.S1, as amended July 1, 1961.

The kit contains all the necessary components, drawings, schematic and step-by-step installation instructions.

Order through your local Tektronix Field Engineer or Field Office. Specify Type 525 IRE Response Network Mod Kit, Tek No. 040-265. Price is $4.50.

TYPE 527 IRE RESPONSE NETWORK MODIFICATION KIT

For Type 527 Waveform Monitors s/n's 101 to 269 inclusive and Type RM527 Waveform Monitors, s/n's 101 to 331 inclusive.

This modification changes the IRE Response characteristics to conform with the revised Standard '58 IRE, as amended July 1, 1961. It also improves the transient response of the instrument when the Vertical-Selector switch is in the IRE position.

The kit contains all necessary components, drawings, schematic and step-by-step installation instructions.

Order through your local Tektronix Field Engineer or Field Office. Specify Type 527 IRE Response Network Mod Kit, Tek No. 040-266. Price is $3.00.

TYPE 531A/TYPE 541A SWEEP LOCKOUT MODIFICAION KIT

For Type 531A, Type RM31A, Type 541A and Type RM41A Oscilloscopes, all serial numbers.

This modification converts the above oscilloscopes for study of one-shot phenomena.

The mod kit includes a wired-chassis assembly, tags, schematic, parts list and step-by-step installation instructions.

Order through your local Tektronix Field Engineer or Field Office, Specify Type 531A/541A Sweep Lockout Mod Kit, Tek No. 040-235. Price is $47.00.

Note: Predecessor models of the above instuments were the Type 531, Type RM31, Type 541 and Type RM41. These instruments may also be converted for the study of one-shot phenomena. To convert these instruments, order Type 531/Type 541 Sweep Lockout Mod Kit, Tek No. 040-118. Price is $47.00.

TYPE 555 OSCILLOSCOPE CRADLE-MOUNT MODIFICATION KIT

For Type 555 Oscilloscopes Indicator and Power Supply. All serial numbers.

This modification allows the rack mounting of the Type 555 Oscilloscope Indicator and Power Supply. The installation will require approximately 34" of vertical height in a standard rack mount.

The kit includes all the necessary parts, hardware and step-by-step installation instructions, including photographs.

Order through your local Tektronix Field Engineer or Field Office. Specify Type 555 Cradle Mount Mod Kit, Tek No. 040-251. Price is $85.00.

MISSING INSTRUMENTS

Shell Development Company of Emeryville, California, advises us that a shipment of Tektronix instruments consigned to them disappeared. These instruments were *not* taken from their premises, but from a truck during transit. The truck was parked in San Francisco, California overnight and the entire load disappeared.

Following is a list of the Tektronix instruments that were lost:

2—Type 163 Pulse Generators, s/n's 3300 & 3301
1—Type 162 Waveform Generator, s/n 6323
1—Type 160A Power Supply, s/n 5567

If you have any information on the whereabouts of these instruments, please contact the nearest office of the Federal Bureau of Investigation. Since this loss involves an interstate shipment, the F.B.I. is concerned in the case.

City College of San Francisco reports; that between September 15 and 18, of this year, a Type 515A Oscilloscope, s/n 6135 disappeared and is presumed to be stolen. Anyone with information on the whereabouts of this instrument should contact Roy Edmison, City College of San Francisco, California.

A Type 512 Oscilloscope, s/n 288, disappeared from the Benson Polytechnic High School in Portland, Oregon, during the summer vacation. A survey of authorized personnel failed to turn up the instrument, so it is presumed to have been stolen. Anyone with information on this instrument should contact Mr. Arnold Grant, Benson

Polytechnic High School, 546 N.E. 12th Avenue, Portland, Oregon.

The Bear Creek Mining Company of Denver, Colorado has asked us to keep an eye open for their Type 531, s/n 1960 and Type 53/54D, s/n 1351. These instruments disappeared and are thought to be stolen. If you see these instruments or have any knowledge of their present location, please contact your local Tektronix Field Office or the Bear Creek Mining Company, 1498 South Lipon Street, Denver 23, Colorado.

The University of Washington notifies us that a Type 504 Oscilloscope, s/n 214, appears to be stolen from one of their laboratories. If you have any information on this instrument, please contact Mr. R.W. Moulton, Executive Officer, University of Washington, Department of Chemical Engineering, Seattle 5, Washington.

USED INSTRUMENTS FOR SALE

1 Type 127	William H. Read Continental Leasing Co. 5215 Hollywood Blvd. Los Angeles 27, California Phone: HO 9-5371
1 Type 570, s/n 381	Brooks Research Corp. Attn.: Mr. Dallas Schutts Rochester, New York or contact Ray Lisiecki Tektronix, Inc. 961 Maryvale Drive Buffalo 25, New York
1 Type 517	Seller wishes to remain anonymous. Tektronix Field Engineer Dick Paterson, 2605 Westgrove Lane, Houston 27, Texas will serve as a contact.
1 Type 512, s/n 118	Marty Arnold Leesona Moos 90—28 Van Wyck Blvd. Jamaica 18, New York
3 Type 511AD, s/n's 1666, 2723, and 3637 2 Type 514AD, s/n's 1332 and 3080	James H. Kennedy Technitrol, Inc. 1952 East Allegheny Ave. Philadelphia 34, Penn. Phone: GArfield 6-9105
1 Type 517, s/n 625. Has duty Cycle Mod Kit installed and extra crt's. Price: $995.	Ian Isdale 825 Tall Timber Road Orange, Connecticut

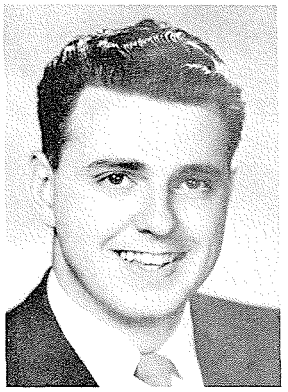
USED INSTRUMENTS WANTED

1 Type 514D or Type 514AD	R.B. Haigh Bendix Corporation Bendix Mishawaka Div. 400 S. Beiger Street Mishawaka, Indiana Phone: BL 5-2111, ext. 329
1 Type 315D or Type 310	Scott M. Overstreet 515 "Q" Central Avenue Mountain View, California
1 Type 535 or Type 535A	Dr. John F. McNall Phoenix Engineering and Computing Service 2462 Hubbard Avenue Middleton, Wisconsin

GREENSBORO FIELD OFFICE NOW SERVING SOUTHWEST VIRGINIA

As of September 15, 1961, the Tektronix Field Office in Greensboro, North Carolina increased its field office coverage. This move brings Tektronix Field Engineering services closer to the Southwest Virginia region.

That portion of Virginia lying within the area outlined by the following counties now comes under the jurisdiction of our Greensboro Office: Lee, Wise, Dickinson, Buchanan, Tazwell, Bland, Giles, Monroe, Greenbrier, Alleghany, Rockbridge, Nelson, Buckingham, Cumberland, Prince Edward, Lunenburg, and Mecklenburg. Customers in this area who formerly were served through our Washington, D.C. Field Office, should direct future inquiries to: Tektronix, Inc., 1838 Banking Street, Greensboro, North Carolina. The telephone number is 274-4647, TWX—GN 540.



Tektronix Field Engineer Rick Ennis of our Greensboro Office will provide field engineering services for customers in this area.

GRATICULE MOUNTING PROBLEMS

Tom Smith, Field Engineer with our Philadelphia Field Office, informs us that some of his customers have a problem. They are confused about the proper sequence for the installation of components over the face of crt's in Tektronix oscilloscopes.

We offer the following information in an effort to clear up some of this confusion.

Except for some instruments (which we will designate later), the light filter is shipped unmounted and as an accessory to the oscilloscope.

We ship all oscilloscopes employing a 5" -crt with a black plastic (Royal-lite) light shield installed. This shield has a 5" opening with a ½" flange at right angle to the opening. The face of the shield is slightly smaller than the graticule cover and contains seven holes. The edge with the four holes is the top. This shield is installed by inserting the flanged portion between the crt and the surrounding mu-metal shield. Properly installed, the light shield fits flush against the instrument panel. The four holes in each corner allow the graticule studs to protrude.

The two inner holes at the top permit the graticule lights to show through the light shield. The seventh hole, located in the lower left-hand corner and just above the graticule stud, permits access to the cam-adjust fitting on instruments containing the cam-adjust feature.

Over this light shield, we install the graticule making sure the etched-line side faces to the crt. The red-rimmed holes in the graticule are positioned at the top and surround the graticule lights.

On each graticule stud, we install a rubber washer. The graticule cover then goes over the whole assembly and the graticule-stud nuts hold all firmly in place. When installing the graticule cover, make sure the small hole in the circular flange of the cover is at the top. Placement in this position permits correct attachment of the Tektronix Viewing Hood with molded-rubber eyepiece (Tek No. 016-001) or the Tektronix Polarized Viewer (Tek No. 016-035).

Instruments shipped with the green light filter installed are; Type 524 AD Television Oscilloscope, Type 525 Television Waveform Monitor, Type 526 Color-Television Vectorscope, Type 527 Waveform Monitor, Type 575 Transistor-Curve Tracer, and all instruments ordered with a P-1 phosphor crt.

Installation of components around and over the face of the crt in these instruments differs from the foregoing instructions in only two respects: (1) We install the green light filter between the black light shield and the graticule. (2) We do not use the four rubber washers between the graticule and the graticule cover.

On oscilloscopes employing 3" crt's we do not install a light shield. The light filter is shipped unmounted as an accessory (unless the oscilloscope is ordered with a P-1 phosphor). Three-inch oscilloscopes do not have the cam-adjust feature. In all other ways, installation of components over the crt follow the foregoing instructions for 5" oscilloscopes.

We place the etched side of the graticules whenever possible next to the face of the crt. This avoids parallax and thus errors in reading oscilloscope measurements.

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.

Should you prefer white graticule lines (such as when taking pictures of oscilloscope traces) you may, on the 5" oscilloscopes only, rotate the graticule 180°. Remember keep the etched side next to the face of the crt. On 3" oscilloscopes the

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

Service Scope

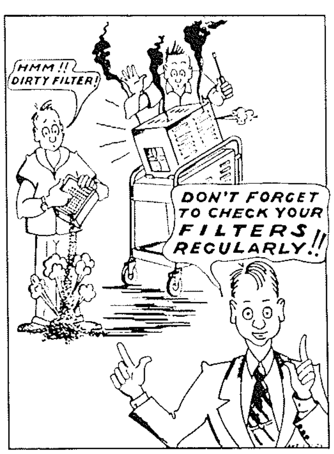
USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

graticule cannot be rotated in this manner. Only by removing the red plastic from around the graticule-light holes in the graticule can you obtain white lines on these instruments. Some solve this problem by keeping two graticules on hand. One for red lines, the other for white lines.

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.

We recommend the removal of the light filter and the use of white graticule lines when taking pictures of oscilloscope traces.

*Note: The Tektronix Type C-12, Type C-13 and Type C-19 Cameras have a hinged adapter and four coin-slotted graticule nuts. The adapter and its four nuts replace the standard graticule cover and graticule nuts. The cameras fit snugly into the hinged fittings, yet lift in and out with ease. Supported in this manner, the cameras have a swing-away action. This feature allows an unobstructed view of the crt without complete removal of the camera.



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

Telephone: MItchell 4-0161 TWX—BEAV 311 Cable: TEKTRONIX

AN OREGON CORPORATION

Field Engineering Offices

ALBUQUERQUE* ..... Tektronix, Inc., 509 San Mateo Blvd. N. E., Albuquerque, New Mexico....TWX—AQ 96 .... AMherst 8-3373
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HONOLULU .... Kentron Hawaii, Ltd., 1140 Waimanu Street, Honolulu 14, Hawaii....Telex: MHU 0093......... Phone: 53975
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TWX—SS 423 .... GLenview 4-2426
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*ALSO REPAIR CENTERS

Norfolk, Portsmouth and Hampton, Virginia Area: Enterprise 741

17-19

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.