Service Scope

USEFUL INFORMATION FOR USERS OF TEKTRONIX INSTRUMENTS

NUMBER 35 PRINTED IN U.S.A DECEMBER 1965

THE FATAL CURRENT

Strange as it may seem, most fatal electric shocks happen to people who should know better. Here are some electro-medical facts that should make you think twice before taking that last chance.

It's The Current That Kills

Offhand it would seem that a shock of 10,000 volts would be more deadly than 100 volts. But this is not so! Individuals have been electrocuted by appliances using ordinary house currents of 110 volts and by electrical apparatus in industry using as little as 42 volts direct current. The real measure of shock's intensity lies in the amount of current (amperes) forced through the body, and not the voltage. Any electrical device used on a house wiring circuit can, under certain conditions, transmit a fatal current.

While any amount of current over 10 milliamps (0.01 amp) is capable of producing painful to severe shock, currents between 100 and 200 mA (0.1 to 0.2 amp) are lethal.

Currents above 200 milliamps (0.2 amp), while producing severe burns and unconsciousness, do not usually cause death if the victim is given immediate attention. Resuscitation, consisting of artificial respiration, will usually revive the victim.

From a practical viewpoint, after a person is knocked out by an electrical shock it is impossible to tell how much current passed through the vital organs of his body. Artificial respiration must be applied immediately if breathing has stopped.

The Physiological Effects of Electric Shock

Chart 1 shows the physiological effect of various current densities. Note that voltage is not a consideration. Although it takes a voltage to make the current flow, the amount of shock-current will vary, depending on the body resistance between the points of contact.

As shown in the chart, shock is relatively more severe as the current rises. At values as low as 20 milliamps, breathing becomes labored, finally ceasing completely even at values below 75 milliamps.

As the current approaches 100 milliamps, ventricular fibrillation of the heart occurs—an uncoordinated twitching of the walls of the heart's ventricles.

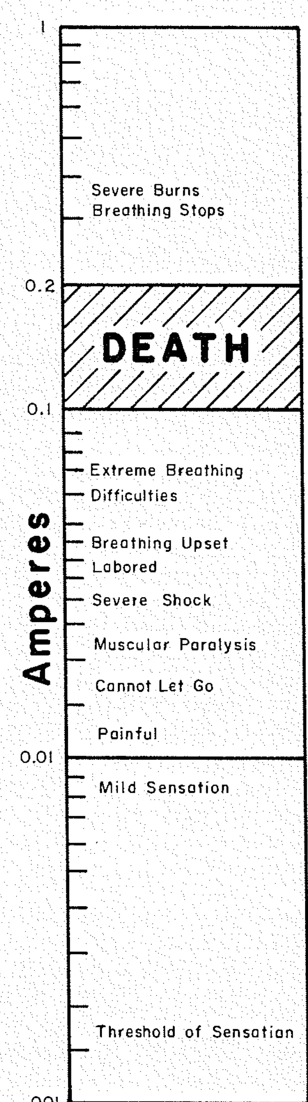
Above 200 milliamps, the muscular contractions are so severe that the heart is forcibly clamped during the shock. This clamping protects the heart from going into ventricular fibrillation, and the victim's chances for survival are good.

Danger — Low Voltage!

It is common knowledge that victims of high-voltage shock usually respond to artificial respiration more readily than the victims of low-voltage shock. The reason may be the merciful clamping of the heart, owing to the high current densities associated with high voltages. However, lest these details be misinterpreted, the only reasonable conclusion that can be drawn is that 75 volts are just as lethal as 750 volts.

The actual resistance of the body varies depending upon the points of contact and the skin condition (moist or dry). Between the ears, for example, the internal resistance (less than skin resistance) is only 100 ohms, while from hand to foot it is closer to 500 ohms. The skin resistance may vary from 1000 ohms for wet skin to over 500,000 ohms for dry skin.

When working around electrical equipment, move slowly. Make sure your feet are firmly placed for good balance. Don't



Physiological Effects of Electric Currents lunge after falling tools. Kill all power, and ground all high-voltage points before touching wiring. Make sure that power cannot be accidentally restored. Do not work on underground equipment.

Don't examine live equipment when mentally or physically fatigued. Keep one hand in pocket while investigating live electrical equipment.

Above all, do not touch electrical equipment while standing on metal floors, damp concrete or other well grounded surfaces. Do not handle electrical equipment while wearing damp clothing (particularly wet shoes) or while skin surfaces are damp.

Do not work alone! Remember the more you know about electrical equipment, the more heedless you're apt to become. Don't take unnecessary risks.

What To Do For Victims—

Cut voltage and/or remove victim from contact as quickly as possible—but without endangering your own safety. Use a length of dry wood, rope, blanket, etc., to pry or pull the victim loose. Don't waste valuable time looking for the power switch. The resistance of the victim's contact decreases with time. The fatal 100 to 200-milliampere level may be reached if action is delayed.

If the victim is unconscious and has stopped breathing, start artificial respiration at once. *Do not stop resuscitation until medical authority pronounces the victim beyond help.* It may take as long as eight hours to revive the patient. There may be no pulse and a condition similar to rigor mortis may be present; however these are the manifestations of shock and are not an indication the victim has succumbed.

—Printed through the courtesy of Fluid Controls Co. Inc., Cliffside, New Jersey, University of California Information Exchange Bulletin and Safer Oregon.

THE READERS' CORNER

Some readers have indicated an interest in articles written by Tektronix personnel. For these readers' information, we list here the title of the article, the author, the author's title, the publication in which the article appeared and the date of the issue. We include also, a thumb-nail sketch of the article's content.

Reprints of these articles are available through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor.

They are offered on a first-come, first-serve basis. When quantities are exhausted they will not be reordered. Another possible source for the articles is the back-issue file (in a public or company library) of the magazine in which the article originally appeared.

"Straight Scoop on Sampling Scopes", Cliff Moulton, Project Engineer (former employee). *MICROWAVES*, February, 1963. An early explanation of the sampling oscilloscope. What is is, how it works, how the various circuits differ from the conventional oscilloscope.

"Pulse Reflections Pin Down Discontinuities", Gordon Long, Design Engineer. *ELECTRONIC DESIGN,* May 10, 1963. Using a sampling oscilloscope to obtain high resolution measurements when using a pulse-reflection technique to test transmission lines.

"The Cathode Ray Oscilloscope", Will Marsh, Staff Engineer. *MACHINE DESIGN,* June 6, 1963. Using an oscilloscope to obtain precise (and sometimes otherwise unobtainable) information in the field of mechanical design.

"Storage to Picoseconds—a Survey of the Art", C. N. Winningstad, Manager, Display Devices Development. *ELECTRONIC INDUSTRIES,* June, 1963. A comparison of the sampling oscilloscope with the conventional oscilloscope in a series of topics including risetime, sensitivity, display modes, system interaction and interference, and continuing accent on tubes.

"Understanding Operational Amplifiers", Geoffery Gass, Staff Engineer. *ELECTRONIC INDUSTRIES*, February, 1964. An explanation of operational amplifiers and how they work.

"The Sophisticated Oscilloscope", John Kobbe, Manager, Advanced Circuitry Department. *INDUSTRIAL RESEARCH,* March, 1964. A discussion of present-day oscilloscopes and the techniques employed to record oscilloscope data.

"How To Get More Out of Your Spectrum Analyzer", A. Frisch and M. Engelson, Project Managers, *MICROWAVES,* May, 1963. Describes five useful microwave measurements that can be performed with a spectrum analyzer.

"Measuring the Cost of Programmed Instruction", Fred Davey and Jerry Foster, Programmed Instruction Group. *ADMINISTRATIVE MANAGEMENT,* September, 1964. Some guide lines for companies considering the feasibility of writing their own programs.

"How To Measure High-Current Recovery Times in Signal Diodes", C. C. Edgar, Design Engineer. *EEE* (Electrical Equipment Engineer), October, 1964. A technique for pulsing a diode on and off with current of 1 amp or higher and observing the current through the diode for the recovery time.

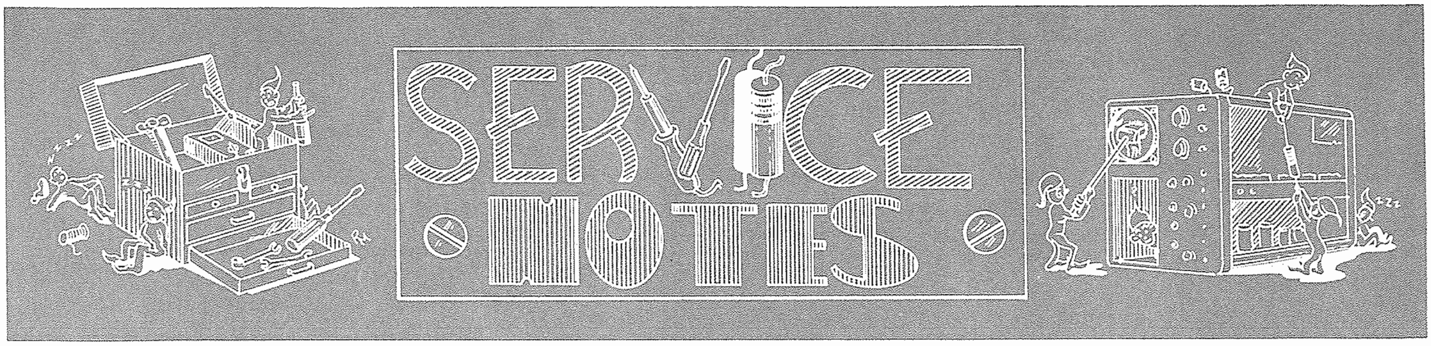
"Nanosecond Measurements with a Sampling Oscilloscope", H. Allen Zimmerman, Project Engineer. *ELECTRO-TECHNOLOGY,* January, 1965. A description of the sampling process and a discussion of the usefulness and versatility of a sampling oscilloscope.

"Oscilloscope Plug-In Spectrum Analyzers", Weis, Engelson, and Frisch, Project Engineers. *MICROWAVE JOURNAL,* March, 1965. Discusses the advantage of a plug-in spectrum analyzer as compared to a conventional spectrum analyzer.

"Design of Transistorized DC Amplifiers with Reduced Thermal Drift", Jerry Foster, Programmed Instruction Group. *ELECTRONICS AND COMMUNICATIONS* (Canada), March, 1965. A discussion of one of the prime considerations during the design stage of semiconductor/dc amplifier circuits — thermal compensation.

"Using a Transistor-Curve Tracer", Ralph Show, Instrument Engineering. *ELECTRONICS WORLD,* September, 1965. An explanation of the operation principles of the transistor-curve tracer. The method of interpreting curves to obtain parameters is also covered.

"The Sampling Oscilloscope", compiled from information supplied by Tektronix, Inc. *EDN* (Electrical Design News) Test Instrument Reference issue, 1965. How a sampling system works. How it buys sensitivity at the price of time. Some application techniques.



TYPE 1A1 WIDE-BAND DUAL-TRACE UNITS — OSCILLATIONS IN THE "ADD" MODE

Sometimes at turn on, an oscilloscope with a Type 1A1 Unit plugged into the vertical amplifier compartment will display a 10 MHz oscillation on the crt. See Figure 1.

This only occurs when the oscilloscope is turned on with the *MODE control in the ADD position.* The phenomena is normal and occurs because: with the MODE control in the ADD position, both halves of the channel-switching multivibrator (Q305 and Q315) are normally biased on. However, during the oscilloscope turn-on cycle, when the power relay (K601) pulls in, the resulting power-supply transients may turn off one side of the multivibrator and it will go into oscillation.

Switching the MODE switch out of ADD kills the oscillation and it will not come back unless you repeat the oscilloscope turn-on cycle with the Type 1A1 in the ADD mode.

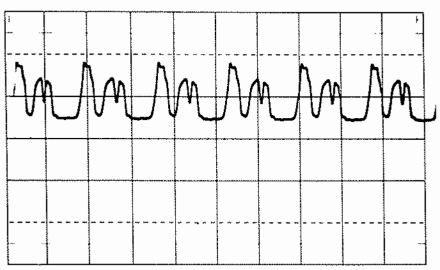


Figure 1. Typical oscillation waveform, caused by conditions described in text, displayed on a Type 547 Oscilloscope. Sweep rate 0.1 μs/cm. Waveform will be different on Type 545 (A), (B) Oscilloscopes but fundamental frequency will still be about 10 MHz.

TYPE RM529 WAVEFORM MONITOR —TERMINOLOGY

Early Type RM529 Waveform Monitors, sn's 101-399, use the terms ODD and EVEN to designate the two positions of the FIELD SHIFT switch. Subsequent to the introduction of the Type RM529, the Federal Communications Commission (FCC) chose to designate these fields as Field One and Field Two. This new system of designating the fields may be related to the ODD and EVEN terminology as follows: Field Two corresponds to the ODD position and Field One corresponds to the EVEN position of the FIELD SHIFT switch on the early Type RM529 instruments.

Beginning with serial number 400 in the Type RM529 we changed the front panel terminology. The designation for the FIELD SHIFT switch became FIELD and the two positions of this switch were relabeled to conform to the FCC's designation for fields of ONE and TWO.

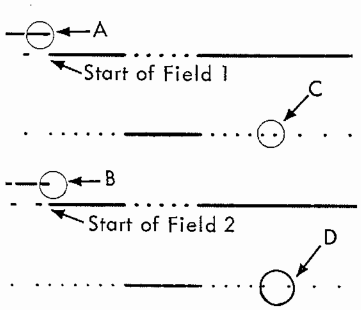


Figure 2. Waveform display showing that Field One is preceded by a full line of video (A) and Field Two by a ½ line of video (B). (C) and (D) indicate the equalizer pulses in the vertical blanking interval that determine correct instrument triggering.

Notice in the display shown in Figure 2, that Field One is preceded by a full line of video and Field Two by ½ line of video. (A and B in photo).

The Type RM529 actually uses the position of the first sync pulse after the last equalizer in the vertical blanking interval to determine correct instrument triggering. (See C and D in photo). The FIELD SHIFT (FIELD) switch selects and indicates the field which will initiate the sweep in all modes of operation. Hence, with the switch set to ONE, the vertical sync group seen at mid screen is the start of Field Two. Note the ½ line of video that precedes this group.

TYPE 544, TYPE 546 AND TYPE 547 OSCILLOSCOPES—USING THE AMPLITUDE CALIBRATOR WITH A TYPE 1S1 SAMPLING PLUG-IN UNIT

Amplitude Calibrator circuits in Tektronix instruments prior to the Type 544, Type 546 and Type 547 Oscilloscopes, were not intended to be loaded with anything less than 1 megohm. Consequently no effort was made to design the calibrator circuits to have a constant impedance. For the Type 544, Type 546 and Type 547 Oscilloscopes, however, we designed an Amplitude Calibrator circuit that, within the 0.2 millivolt to 0.2 volt range, delivers voltages having a constant 50 ohm source impedance. The development of the Type 1S1 Sampling Plug-In Unit which has a 50 ohm input impedance made such a calibrator desirable.

Here is a word of explanation for those using a Type 1S1 in a Type 544, Type 546 or Type 547 Oscilloscope and looking at the calibrator with the AMPLITUDE CALIBRATOR control set to one of the 0.2 millivolt to 0.2 volt (50 Ω constant source impedance) positions.

If you are checking the gain of the Type 1S1 (remember, it has a 50 Ω input impedance) you will find that the gain of the Type 1S1 appears to be 50% low. This is normal—the calibrator voltage indicated by the AMPLITUDE CALIBRATOR control will be twice the voltage available at the input of the Type 1S1. In other words, given a voltage with a 50 Ω source impedance and a 50 Ω load, the voltage across the load will be one-half the voltage of the generator.

One can look at it as shown in Figure 3, with the Amplitude Calibrator acting as

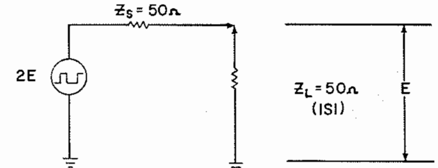


Figure 3. Simplified equivalent circuit representing the Amplitude Calibrator of a Type 544, Type 546, or Type 547 Oscilloscope and a Type 1S1 Sampling Unit.

the generator with a source impedance of 50 Ω and the Type 1S1 with an input impedance of 50 Ω acting as the load. If the Amplitude Calibrator open circuit voltage is 2E, then the voltage across the load will be E. So, if the Amplitude Calibrator is set for 0.2 volts one should read 100 millivolts on the Type 1S1.

We might mention here that when using the Amplitude Calibrator of a Type 544, Type 546 or Type 547 Oscilloscope in conjunction with a plug-in unit or other device having a high input impedance, the voltage delivered at the input of the plug-in or device will agree with the value indicated by the AMPLITUDE CALIBRATOR control setting.

TYPE 125 POWER SUPPLY—EXCESSIVE RIPPLE IN +135 V SUPPLY

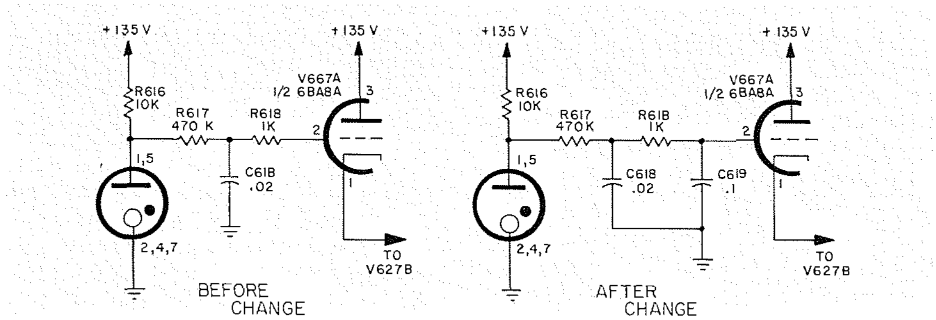


Figure 4. Before and After schematics showing installation of 0.1 discap in the +135 V supply of the Type 125.

In some Type 125 Power Supplies, ripple on the +135 V supply may exceed specifications (3 mV max). This is generally due to stray pick-up at the grid of V667A, one half of a Type 6BA8A tube that forms half a comparator circuit (V6278 and its circuitry form the other half). The solution to the problem is the addition of an 0.1 mFd, 200 V discap (Tektronix part number 283-0057-00) from the grid, pin 2, of V667A to the ground lug of the V667 tube socket. See Figure 4.

Designate the new capacitor C619 and add it to the parts list and schematic in your Type 125 Instruction Manual.

This modification is applicable to Type 125 Power Supplies, serial numbers 101-2169.

TYPE 1A2 DUAL-TRACE PLUG-IN UNIT—NEW SHAFT COUPLER IMPROVES VARIABLE VOLTS/CM POTENTIOMETER RELIABILITY

If you should have occasion to replace the Variable Volts/CM potentiometer in your Type 1A2 Dual-Trace Plug-In Unit, we suggest you also replace the control shaft and coupler. We now have a new style flexible shaft-coupler that secures with set screws and a new control rod to connect the potentiometer with the front panel control. Tektronix part numbers for the new parts are:

Coupler	376-0054-00
Control Rod	384-0276-00

The nylon pot-coupler formerly used requires a hard push to force the coupler sleeve onto the potentiometer shaft. The exercise of too much force here can cause damage to the potentiometer. The new type coupler and control shaft eliminate this hazard.

This information applies to Type 1A2 instruments with serial numbers below 1160.

TYPE 2B67 TIME-BASE UNIT — STABILITY ADJUSTMENT RANGE MADE LESS CRITICAL

In the early 2B67 Time-Base Units (below sn 10630), it was sometimes hard to find a compromise Stability Adjustment setting for both the NORMAL and SINGLE SWEEP operating modes. Changing resistor R126 from 220 k to a 680 k, ½ W, 10% resistor (Tektronix part number 302-0684-00) usually solves the problem. The original value of the resistor was chosen to compensate for the "spec" leakage in the transistor Q124, but few if any of the transistors ever develop this much leakage, resulting in overcompensation.

R126 is located in the front notches of the pair of ceramic strips that bracket the sweep-length potentiometer R176. After converting R126 to the new (680 k) value, be sure to note the new value in the schematic and parts list of your Type 2B67 Instruction Manual.

All Type 2B67 Time-Base Units, sn's 10630 and up have the modification installed at the factory.

TEST SET UP CHARTS

We would like to bring our readers up to date on the Test Set Up Charts now available.

As you may recall, the charts offer a ready means of recording instrument control settings for any given test or production set-up. For the laboratory this means that in so far as the oscilloscope is concerned, one need no longer rely on memory if the need to repeat the test should occur at a later date. Once the experiment or test has been performed, the oscilloscope control settings can be recorded on the test set up chart, a facsimile of the waveform resulting from the test drawn on the chart graticule (or a photograph of the waveform attached to the chart) and pertinent data recorded on the chart.

For production testing, an engineer generally devises the test procedure required to attain the desired result. He then designates the control settings on the chart and draws a picture of the display on the chart graticule, outlining the limits for acceptance or rejection. The production-test facility takes over at this point and performs the test with speed and accuracy. Often a non-technical person can handle this phase and release a highly trained person for more important work.

We know of several instances where girls from the production test line who had little or no experience with an oscilloscope, set up the oscilloscope and successfully performed the test required. These girls were able to do this using a previously prepared Test Set Up Chart and they required only a minimum of additional instruction.

Listed below are the oscilloscopes for which we now have Test Set Up Charts:

OSCILLOSCOPE	TEKTRONIX PART NUMBER
Type 262	070-0491-00
Type 422	070-0513-00
Type 453	070-0529-00
Type 502	070-0482-00
Type 502A	070-0488-00
Type 503	070-0483-00
Type 531	070-0492-00
Type 532	070-0493-00
Type 541	070-0494-00
Type 545A/CA	070-0481-00
Type 545A/R	070-0485-00
Type 545A/Z	070-0486-00
Type 547/1A1	070-0479-00
Type 561A/2A60/2B67	070-0540-00
Type 567	070-0487-00
Type 567/262	070-0490-00
Type 570	070-0484-00
Type 575	070-0480-00
Type 575 (MOD122C)	070-0489-00

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. The Test Set Up Charts come in pads of 100.

TYPE 545B AND TYPE RM545B OSCILLOSCOPES — TIMING ERROR AT SLOW SWEEP RATES

In some Type 545B and Type RM545B instruments, a timing error may occur in the Time Base B Generator. The error, when it occurs, affects only the slow sweep rates. It is caused by shield-to-cathode current leakage in V252, the dual-triode 12AL5 tube that serves as the disconnect diodes in the Time Base B Generator.

To cure the problem, disconnect, at ground, the #22 bare wire strap that runs from pin 6 of V252 to ground and reconnect it to pin 7 of V252.

This information applies to Type 545B instruments with serial numbers below 2021 and to Type RM545B instruments with serial numbers below 410.

TYPE 525 WAVEFORM MONITOR — PROTECTION FOR THE HIGH VOLTAGE TRANSFORMER

High line voltage or excessive line transients can cause failure of the High Voltage Transformer (T940) in the Type 525 Waveform Monitor. As protection against this hazard, we suggest the installation of a 390 Ω, 2 W, 10% resistor (Tektronix part number 306-0391-00). Install the resistor between the primary center tap of T940 and the +unregulated dc (360 V) supply.

This information applies to Type 525 instruments, all serial numbers.

TYPE RM561A OSCILLOSCOPE — HIGH VOLTAGE RIPPLE IN THE +125 V SUPPLY

Should you be troubled with high voltage ripple in the +125 V supply of a Type RM561A Oscilloscope, check C642 (A, B), a 160 μFd x 10 μFd, EMC capacitor in the power supply of the Type RM561A. Be sure that the twist tabs on this capacitor have a good low-resistance contact with the capacitor flange—*and that they are securely soldered to the flange.*

Failure of these twist tabs to make a good low-resistance contact with the flange may cause the Type RM561A to develop excessive high-frequency (HV oscillator) ripple in the +125 V supply. Amplitude of the ripple may measure up to 20 or 30 millivolts as against one or two millivolts normally. Actual ripple values and the effects on the display will vary considerably among instruments, with time and various plug-in type.

Because of a temporary change in assembly procedure, Type RM561A Oscilloscopes within the serial number range of 7800-8020 are more prone to the problem described here than other Type RM561A instruments.

TYPE 567 AND TYPE RM567 DIGITAL READOUT OSCILLOSCOPES—INSTALLATION OF IMPROVED CALIBRATOR MOD KIT

The calibration procedure for the Improved Calibrator Modification Kit (Tektronix part number 040-0380-00. See Service Scope #32, June, 1965) calls out a procedure to check the ground side of the square wave. This should be within 0.001 V of ground. Measuring this with a Fluke voltmeter you will find this tolerance cannot be met. The reading will typically be 50-100 mV or higher. The cause appears to be a pulse that is coupled through, even with Q925 removed, which affects the reading of the Fluke voltmeter.

Measuring the base line with a Type W High-Gain Differential Comparator Unit you will find the base line within 0.5 mV with a pulse riding on it of some 4.5 V amplitude and a microsecond or so wide at the 50% point. You will need to either make this measurement with the Type W Unit or to remove Q914 as well as Q925. This eliminates the pulse and allows the Fluke voltmeter to give an accurate reading.

NEW FIELD MODIFICATION KITS

TYPE 67, TYPE 2B67, TYPE 3B1, TYPE 3B3 AND TYPE 3B4 TIME BASE UNITS — SAWTOOTH DRIVE FOR TYPE 3L10 SPECTRUM ANALYZERS

This modification provides a sawtooth signal at pin 18 of the interconnecting plug of the above time-base units. This sawtooth signal is required by the Type 3L10 Spectrum Analyzer Plug-In Units to drive the analyzer's Swept Oscillator.

The sawtooth signal is a standardized *current* ramp of 66 μA/cm (nominal) fed from the sawtooth cathode follower of the time-base unit via a standardizing resistor to pin 18 of the time base interconnecting plug.

The current signal will drive a low-impedance circuit, such as the minus input of an operational amplifier or the emitter of a transistor, with a positive-going linear ramp of current. It will not drive two circuits (e.g. 3L10 and sawtooth out) at the same time, nor will it successfully serve as a "voltage" signal source—especially at faster sweep rates. The high source impedances of this signal prevent excessive cross-talk of the sweep signal into *vertical* plug-ins in which pin 18 of the interconnecting plug is open.

The sawtooth is provided by adding the standardizing resistor to the ceramic strips above the time base Sawtooth Cathode Follower. The standardizing resistor is connected between the cathode of the Sawtooth Cathode Follower and a length of coaxial cable. The other end of the coaxial cable is connected to pins 18 and 19 of the time-base interconnecting plug.

This modification is applicable to the following time base units:

Type	SN
67	101-5000
2B67	5001-15179
3B1	101-4039
3B3	100-4269
3B4	100-739

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. Specify Tektronix Part Number 040-0413-00.

CRADLE MOUNT — FOR LISTED OSCILLOSCOPES

This modification kit supplies a cradle-mount assembly that allows the instruments listed below to be rackmounted in a standard 19-inch relay rack. A vertical front panel space of 17½ inches is required.

The modification kit is applicable to the following Tektronix Oscilloscopes: Type 524AD, 531, 532, 535, 541, 545 and 570; serial numbers 5001 and up. Also, to Type 531A, 533, 533A, 535A, 536, 541A, 543, 543A, 543B, 544, 545A, 545B, 546, 547, 575, 581, 581A, 585, 585A and 661, all serial numbers.

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. Specify Tektronix Part Number 040-0281-00.

TYPE 180 TIME-MARK GENERATOR SILICON RECTIFIER

This modification kit replaces the selenium rectifier SR401 in the Type 180 with a silicon rectifier. Silicon rectifiers offer more reliability and longer life.

The modification kit also adds a series resistor to compensate for the lower voltage loss through the new silicon rectifier.

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. Specify Tektronix Part Number 040-0213-00.

DC FAN MOTOR — FOR LISTED OSCILLOSCOPES

This modification installs a DC fan motor assembly, a transformer and rectifier assembly, and a neon bulb assembly to allow the oscilloscope to operate on a 50-400 cycle power line supply. It is applicable to the following instruments:

TYPE	PART NUMBER
531A	22074-up
RM31A	1508-up
533A	3001-up
RM33A	1001-up
535A	24350-up
RM35A	1851-up
541A	21455-up
RM41A	1190-up
543A	3001-up
RM43A	1001-up
545A	27703-up
RM45A	1893-up

It is also applicable to instruments which have the DC Relay Field Modification Kit (Tektronix Part Number 040-258) installed.

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. Specify Tektronix Part Number 040-0233-00.

TYPE 1A1 DUAL-TRACE PLUG-IN UNIT — ETCHED CIRCUIT CARDS IMPROVEMENT

This modification involves the Etched Circuit cards (Channel 1 Input Amplifier, Channel 2 Input Amplifier and the Output Amplifier) and the 14 wires that connect these boards with other parts of the Type 1A1.

Original equipment employed a jack-type connector on the etched circuit board and a pin-type connector on the associated interconnecting wire. This modification reverses the procedure. It installs interconnecting wires employing an improved jack-type connector on the etched-circuit-board end of the wire and installs pin-type connectors at the associated locations on the etched circuit board. Four of these locations use 45°-angle pin-type connectors. This is to prevent the bending or breaking of the connector in the event the etched circuit board is removed without disconnecting these connectors. The other ten locations use a straight pin-type connector.

The improved jack-type connectors reduce the failures caused by faulty contact in the old connectors. The new connectors also realize a reduction in noise caused by intermittent contact between pin and jack in the old connector.

This modification is applicable to Type 1A1 instruments with serial numbers 101 through 3179 that have the following etched circuit cards installed:

Channel 1 Input Amplifier — Models 1 & 2

Channel 2 Input Amplifier — Models 1 & 2

Output Amplifier — Models 1 through 7.

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. Specify Tektronix part number 040-0402-00.

TYPE 531, TYPE 535, TYPE 541, TYPE 545 OSCILLOSCOPES — CHOPPING-TRANSIENT BLANKING

This modification provides a means of eliminating switching transients from the crt display by applying a blanking voltage to the crt cathode. Switching transients occur when a multiple-trace plug-in unit is operated in the chopped mode. The blanking voltage is applied by means of a crt CATHODE SELECTOR switch installed on the rear panel of the oscilloscope.

A 6DJ8 tube replaces the 6AU6 tube in the V78 position of the multi-trace unit's Sync-Amplifier circuit. One half of the new tube is used as the Sync Amplifier; the other half is used to generate the blanking pulse.

Installation of the modification involves replacing the old 7-pin socket for V78 with a 9-pin socket to accommodate the new 6DJ8 tube. Also, the addition of a crt CATHODE-SELECTOR switch to rear panel of the oscilloscope plus other minor circuit changes. The instructions divide the modification into several parts to facilitate the installation in the specific instrument at hand.

This modifiction is applicable to the Type 531, 535, 541 and 545 Oscilloscopes with serial numbers 101 through 19999 and Type RM31, RM35, RM41, and RM45 Oscilloscopes with serial numbers 101 through 999.

Order through your local Tektronix Field Office, Field Engineer, Representative or Distributor. Specify Tektronix Part Number 040-0403-00.

TYPE 180A TIME-MARK GENERATOR — SILICON RECTIFIERS

This modification kit replaces the selenium rectifiers in the Type 180A Time-mark generator with silicon rectifiers which offer more reliability and longer life. It is applicable to Type 180A instruments, sn's 5001-6385 with the exception of sn's 6380 and 6381. These two instruments were modified at the factory.

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. Specify Tektronix part number 040-0214-00.

TYPE 531, TYPE 535, TYPE 541 AND TYPE 545 OSCILLOSCOPES—TRIGGER IMPROVEMENTS

This modification installs the PRESET STABILITY and fully automatic TRIGGER MODE capabilities in the following oscilloscopes:

Type	SN
531	608-6019
535	1075-6044
541	101-5414
545	101-5945

Setting the STABILITY control to the PRESET position establishes an optimum setting for correct triggering in most applications. Normally the control will require no further adjustment.

In the Improved AC AUTO Trigger Mode, the STABILITY and TRIGGERING LEVEL controls do not function and triggering becomes fully automatic.

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. Specify Tektronix Part Number 040-0152-00.

TYPE 515, TYPE 515A, AND TYPE RM15 OSCILLOSCOPE — SILICON RECTIFIERS

This modification replaces the selenium rectifiers in the Type 515, Type 515A and Type RM15 Oscilloscopes with silicon rectifiers. The new rectifiers offer better reliability and longer life.

The installation consists of removing the original selenium rectifiers and installing a new silicon-rectifier bracket assembly and three additional resistors. The three resistors compensate for the lower voltage loss occasioned by the new rectifiers.

Order through your local Tektronix Field Office, Field Engineer, Representative, or Distributor. Specify for:

Type	Serial Number	Tektronix Part Number
RM15	101-1000	040-0205-00
515	1001-4029	040-0205-00
515A	101- 755	040-0208-00

TYPE 315D OSCILLOSCOPES — SILICON RECTIFIERS

This modification kit replaces the selenium rectifiers in the Type 315D Oscilloscope with silicon rectifiers which offer more reliability and longer life. It is applicable to Type 315D Oscilloscopes, all serial numbers.

Order through your local Tektronix Field Office, Field Engineer, Field Representative or Distributor. Specify Tektronix part number 040-0220-00.

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 causes loss of accuracy and often, severe instability.

The problems reported seem to fall into three main catagories: (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. Here are some suggested solutions to these problems:

(1) Many Tektronix oscilloscopes are supplied with multi-tap transformers. These transformers allow selection of a tap with a voltage rating close to that of the available power line supply. Each selectable tap will operate at line voltages within ±10% of its design center.

Other Tektronix oscilloscopes have transformers with either 115 (117) volt or 230 (234) volt taps and no additional taps to allow selection. In either case, it may be necessary to provide some type of external step-down transformer to supply the necessary operating voltage to the oscilloscope.

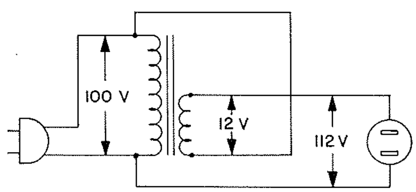


Fig. A. Low-cost line voltage boost or drop circuit, using a filament transformer. Connect as shown for 12 V boost; reverse secondary connections for 12 V drop. Filament winding must have a minimum rating sufficient to carry the oscilloscope load.

A variable autotransformer of the "Variac" or "Powerstat" type is particularly useful in accommodating 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. The filament transformer should be procured locally; they are not available from Tektronix. For an oscilloscope whose normal operating range is 105 to 125 volts, a 12-volt filament transformer will allow it to have an operating range of from 93 to 113 volts, thus making it compatible with 100 volt power line systems. Reconnected as shown in Figure A, the transformer's secondary voltage is added to or subtracted from the incoming line voltage to bring it within range. Be sure to check the oscilloscope specifications and then select a filament transformer with a current rating adequate to carry the oscilloscope load. For example: a Type 321 Oscilloscope, drawing 20 W will require a filament transformer rated to handle only ¼ amp, while a Type 517(A) Oscilloscope (drawing 1250 W) will require a filament transformer rated to handle 15 amps.

(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 pp (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 pp 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. An increase of the pp voltage is not a solution in this case because this would increase the rms voltage also. While these regulated power supplies are dependent upon pp, the tube filaments are dependent upon rms. The power-line waveform must retain a sinusoidal form. 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 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, an adapter such as that illustrated in Figure B can be used with a voltmeter to obtain pp measurement of the line waveform at moderate construction cost. An oscilloscope equipped for accurate differential voltage measurements in the 300-350 volt range can, through the use of a pair of P6023 probes, be used to make the pp 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 pp. If the pp line voltage is less than 295 volts for an rms reading of 105 volts, but the scope power supplies do regulate correctly at 295 pp volts, then the trouble is mostly in the power-line waveform, and power-supply waveform; and, power-supply components are probably in good condition.

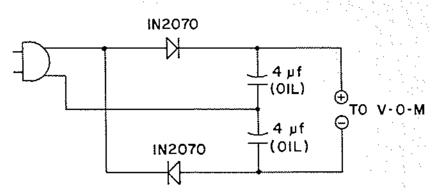


Figure B. Peak-ta-peak reading adapter for 20,000 ohm/volt V-O-M. The use of silicon diodes and oil-filled (or Mylar, or paper) capacitors assures accurate voltage output.

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

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 is adequate for oscilloscope operation.

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 pp voltage of a seriously flattened power-line waveform is increased sufficiently to obtain good power-supply regulation, the unregulated filament lines in the oscilloscope will rise to excessive levels, causing premature tube failures from increased dissipation, gas, leakage, and filament burn-outs.

Service Scope

USEFUL INFORMATION FOR

USERS OF TEKTRONIX INSTRUMENTS

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